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Junos® OS Ethernet Interfaces Feature Guide for Routing Devices
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Table of Contents

About the Documentation .......................................................... li
Documentation and Release Notes ............................................. li
Using the Examples in This Manual ........................................... li
   Merging a Full Example ....................................................... lii
   Merging a Snippet .............................................................. lii
Documentation Conventions ...................................................... liii
Documentation Feedback ........................................................ lv
Requesting Technical Support ................................................... lv
   Self-Help Online Tools and Resources .................................... lvi
Creating a Service Request with JTAC ....................................... lvi

Part 1 Ethernet Interfaces

Chapter 1 Ethernet Interfaces Overview ..................................... 3
   Ethernet Interfaces Overview .............................................. 3
   MX Series Router Interface Identifiers ................................... 4

Chapter 2 Performing Initial Configuration for Ethernet Interfaces ....... 5
   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 ....................................... 11
   Understanding Flow Control ............................................... 11
      IEEE 802.3X Ethernet PAUSE ........................................... 11
      Symmetric Flow Control ............................................... 12
   Configuring Flow Control ................................................... 12
   Configuring the Link Characteristics on Ethernet Interfaces ......... 13
   Configuring MAC Address Filtering for Ethernet Interfaces ......... 14
      Enabling Source Address Filtering .................................... 14
   Configuring MAC Address Filtering on PTX Series Packet Transport Routers .................................................... 16
   MAC Address Accounting for Dynamically Learned Addresses on Aggregated Ethernet Interfaces Overview .............................. 18
      Configuring Ethernet Loopback Capability ............................ 19
      Ignoring Layer 3 Incomplete Errors .................................... 20
      Configuring Gratuitous ARP ............................................. 20
      Adjusting the ARP Aging Timer ........................................ 21
      Configuring Weighted Random Early Detection ...................... 22
      Configuring Multicast Statistics Collection on Ethernet Interfaces .................................................... 22
   Displaying Internal Ethernet Interfaces for a Routing Matrix with a TX Matrix Plus Router .................................................... 23
Chapter 3  Configuring the Management Ethernet Interface ...................... 27
Management Ethernet Interface Overview .................................. 27
Configuring a Consistent Management IP Address .................. 28
Configuring the MAC Address on the Management Ethernet Interface ...... 29

Chapter 4  Enabling Passive Monitoring on Ethernet Interfaces ............... 31
Passive Monitoring on Ethernet Interfaces Overview .................. 31
Enabling Passive Monitoring on Ethernet Interfaces ................ 33

Chapter 5  Configuring IEEE 802.1x Port-Based Network Access Control ........ 35
IEEE 802.1x Port-Based Network Access Control Overview .......... 35
Understanding the Administrative State of the Authenticator Port .... 36
Understanding the Administrative Mode of the Authenticator Port .... 36
Configuring the Authenticator ............................................. 37
Viewing the dot1x Configuration ......................................... 37

Chapter 6  Configuring IEEE 802.1x Port-Based Network Access Control in Enhanced LAN Mode ................................................. 39
802.1X for MX Series Routers in Enhanced LAN Mode Overview .......... 41
   How 802.1X Authentication Works ...................................... 41
   802.1X Features Overview ............................................... 42
   Supported Features Related to 802.1X Authentication ................. 43
Understanding 802.1X and LLDP and LLDP-MED on MX Series Routers in Enhanced LAN Mode .................................................. 43
Understanding 802.1X and RADIUS Accounting on MX Series Routers in Enhanced LAN Mode .................................................. 46
Understanding 802.1X and VoIP on MX Series Routers in Enhanced LAN Mode ................................................................. 47
Understanding Guest VLANs for 802.1X on MX Series Routers in Enhanced LAN Mode ......................................................... 47
Understanding Dynamic VLANs for 802.1X on MX Series Routers in Enhanced LAN Mode ......................................................... 50
Understanding Server Fail Failback and Authentication on MX Series Routers in Enhanced LAN Mode ............................................. 51
Configuring 802.1X RADIUS Accounting on MX Series Routers in Enhanced LAN Mode ......................................................... 52
Configuring 802.1X Interface Settings on MX Series Routers in Enhanced LAN Mode ............................................................... 54
Configuring LLDP-MED on MX Series Routers in Enhanced LAN Mode . . 55
   Enabling LLDP-MED on Interfaces ....................................... 56
   Configuring Location Information Advertised by the Router ........ 56
   Configuring for Fast Start .................................................. 56
Configuring LLDP on MX Series Routers in Enhanced LAN Mode .......... 57
   Enabling LLDP on Interfaces ............................................. 57
   Adjusting LLDP Advertisement Settings .................................. 58
   Adjusting SNMP Notification Settings of LLDP Changes ............ 59
   Specifying a Management Address for the LLDP Management TLV .... 59
Configuring Server Fail Failback on MX Series Routers in Enhanced LAN Mode ................................................................. 61
Understanding Mixed Rates and Mixed Modes on Aggregated Ethernet

Bundles .......................................................... 120

Aggregated Ethernet Bundle with Mixed Rates and Mixed Modes on T Series

Routers .......................................................... 120

Understanding Mixed Rates and Mixed Modes .................................. 120

Platform Support Matrix for Mixed Aggregated Ethernet Bundles ...... 121

Guidelines to Follow When Configuring Aggregated Ethernet Bundles

with Mixed Rates and Mixed Modes .................................. 122

Aggregated Ethernet Bundles with Mixed Rates on MX Series Routers

PTX Series Routers .............................................. 123

Understanding Mixed Rates ........................................ 123

Platform Support Matrix for Mixed Aggregated Ethernet Bundles on

MX Series Routers .............................................. 124

Supported Features ............................................. 125

Configuring Mixed Rates and Mixed Modes on Aggregated Ethernet

Bundles on T Series Routers ..................................... 128

Configuring Mixed Rates on Aggregated Ethernet Bundles on MX Series

Routers .......................................................... 130

Example: Configuring Aggregated Ethernet Interfaces .................... 131

Configuring Junos OS for Supporting Aggregated Devices ............. 133

Configuring Virtual Links for Aggregated Devices ....................... 133

Configuring LACP Link Protection at the Chassis Level .................. 134

Enabling LACP Link Protection .................................... 134

Configuring System Priority ....................................... 135

Configuring the Maximum Links Limit .................................. 135

Configuring PPM on Junos Fusion ................................... 136

Configuring the Number of Aggregated Ethernet Interfaces on the Device .......... 137

Configuring Aggregated Ethernet Link Speed ......................... 138

Configuring Aggregated Ethernet Minimum Links ...................... 141

Configuring Tagged Aggregated Ethernet Interfaces .................. 142

Configuring Untagged Aggregated Ethernet Interfaces ................. 142

Configuring LACP for Aggregated Ethernet Interfaces ................. 143

Configuring the LACP Interval .................................... 145

Configuring LACP Link Protection .................................. 146

Enabling LACP Link Protection .................................... 147

Configuring LACP System Priority .................................. 148

Configuring LACP System Identifier .................................. 148

Configuring LACP administrative Key ................................ 149

Configuring LACP Port Priority .................................... 149

Configuring LACP Hold-Up Timer to Prevent Link Flapping on LAG

Interfaces ....................................................... 149

Tracing LACP Operations ........................................ 150

Sample Configuration for Configuring Aggregated Ethernet LACP on Tagged

and Untagged Interfaces .......................................... 151
Configuring Multicast Statistics Collection on Aggregated Ethernet Interfaces ........................................... 208
Deleting an Aggregated Ethernet Interface ................................................................. 209
Periodic Packet Management .................................................................................. 210
Understanding Periodic Packet Management on MX Series Routers ................. 210
Configuring Periodic Packet Management on MX Series Routers .................... 211
Identifying Periodic Packet Management Mode .................................................... 211
Enabling Centralized Periodic Packet Management ............................................. 212
ITU-T Y.1731 ETH-LM, ETH-SLM, and ETH-DM on Aggregated Ethernet Interfaces
Overview .............................................................................................................. 213
Guidelines for Configuring Performance Monitoring Functionalities on Aggregated Ethernet Interfaces ................................................................. 216
Targeted Distribution of Static Logical Interfaces Across Aggregated Ethernet
Member Links ........................................................................................................ 217
Targeted Distribution of Static Logical Interfaces Across Aggregated Ethernet
Member Links Overview ...................................................................................... 217
Example: Configuring Targeted Distribution for Accurate Policy Enforcement
on Logical Interfaces Across Aggregated Ethernet Member Links .................. 218

Chapter 8 Configuring Ethernet Automatic Protection Switching for High Availability .................................................. 229
Ethernet Automatic Protection Switching Overview ........................................... 229
Unidirectional and Bidirectional Switching ......................................................... 230
Selective and Merging Selectors ........................................................................ 230
Revertive and Nonrevertive Switching ............................................................... 230
Protection Switching Between VPWS Pseudowires ........................................ 230
CLI Configuration Statements ......................................................................... 231
Mapping of CCM Defects to APS Events ........................................................... 232
Example: Configuring Protection Switching Between Pseudowires ................ 233

Chapter 9 Configuring Ethernet Ring Protection Switching for High Availability ...................................................... 237
Ethernet Ring Protection Switching Overview ................................................. 237
Understanding Ethernet Ring Protection Switching Functionality .................. 238
Acronyms .......................................................................................................... 239
Ring Nodes ........................................................................................................ 239
Ring Node States ............................................................................................... 239
Default Logging of Basic State Transitions on EX Series Switches .............. 240
Logical Ring ....................................................................................................... 240
FDB Flush .......................................................................................................... 240
Traffic Blocking and Forwarding ................................................................... 241
RPL Neighbor Node .......................................................................................... 241
RAPS Message Blocking and Forwarding ....................................................... 241
Dedicated Signaling Control Channel .............................................................. 243
RAPS Message Termination ............................................................................ 243
Revertive and Non-revertive Modes ................................................................. 243
Multiple Rings .................................................................................................. 243
Node ID ............................................................................................................. 243
Ring ID ............................................................................................................... 244
Bridge Domains with the Ring Port (MX Series Routers Only) ..................... 244
Wait-to-Block Timer .......................................................................................... 244
Chapter 12 Configuring Private VLANs ........................................293
Understanding Private VLANs .............................................293
   Benefits of PVLANs .....................................................294
   Typical Structure and Primary Application of PVLANs .................295
   Typical Structure and Primary Application of PVLANs on MX Series
      Routers ..............................................................298
   Typical Structure and Primary Application of PVLANs on EX Series
      Switches ............................................................299
   Routing Between Isolated and Community VLANs .......................301
   PVLANs Use 802.1Q Tags to Identify Packets ..............................301
   PVLANs Use IP Addresses Efficiently ..................................301
   PVLAN Port Types and Forwarding Rules ................................302
   Creating a PVLAN ......................................................305
   Limitations of Private VLANs ..........................................306
   Bridge Domains Setup in PVLANs on MX Series Routers ..........307
   Bridging Functions With PVLANs ...................................309
Flow of Frames on PVLAN Ports Overview ................................311
   Ingress Traffic on Isolated Ports ....................................311
   Ingress Traffic on Community ports ................................312
   Ingress Traffic on Promiscuous Ports ................................312
   Ingress Traffic on Interswitch Links ................................312
   Packet Forwarding in PVLANs .......................................312
Guidelines for Configuring PVLANs on MX Series Routers ............313
Configuring PVLANs on MX Series Routers in Enhanced LAN Mode ....314
Example: Configuring PVLANs with Secondary VLAN Trunk Ports and
   Promiscuous Access Ports on a QFX Series Switch ....................316
   IRB Interfaces in Private VLANs on MX Series Routers ..........329
Guidelines for Configuring IRB Interfaces in PVLANs on MX Series Routers ...330
Forwarding of Packets Using IRB Interfaces in PVLANs .................331
   Incoming ARP Requests on PVLAN Ports ...........................331
   Outgoing ARP Responses on PVLAN Ports ..........................332
   Outgoing ARP Requests on PVLAN Ports ...........................332
   Incoming ARP Responses on PVLAN Ports ..........................332
Part 2  Gigabit Ethernet Interfaces

Chapter 22 Configuring 10-Gigabit Ethernet LAN/WAN PICs  ......................... 413
10-port 10-Gigabit Ethernet LAN/WAN PIC Overview  .................... 413
12-port 10-Gigabit Ethernet LAN/WAN PIC on Type 5 FPC Overview  ........ 417
24-port 10-Gigabit Ethernet LAN/WAN PIC on Type 5 FPC Overview  ........ 420
Modes of Operation of 10-Gigabit Ethernet PICs  ............................... 421
Configuring Line-Rate Mode on 10-Gigabit Ethernet LAN/WAN PICs Supporting
Oversubscription  .................................. 422
Configuring Control Queue Disable on a 10-port 10-Gigabit Ethernet LAN/WAN
PIC ........................................... 423
Example: Handling Oversubscription on a 10-Gigabit Ethernet LAN/WAN PIC  . 426
Configuring Mixed-Rate Mode Operation ........................................... 427
P2-10G-40G-QSFPP PIC Overview ................................................. 428
Understanding Dual Configuration on P2-10G-40G-QSFPP PIC ............. 428
Understanding Port Group .......................................................... 429
Port Group in 10-Gigabit Ethernet Mode ........................................ 430
Port Group in 40-Gigabit Ethernet Mode ........................................ 430
Port Number Mapping When Port Groups Are Configured .................. 430
Port Numbering on P2-10G-40G-QSFPP PIC When Port Groups Are Not
Configured ................................................................. 433
10-Gigabit Ethernet Mode .......................................................... 435
Framing Mode Overview .......................................................... 435
Supported Features on LAN PHY and WAN PHY Framing Mode .......... 436
40-Gigabit Ethernet Mode .......................................................... 436
Configuring the P2-10G-40G-QSFPP PIC ......................................... 437
Configuring the PIC in 10-Gigabit Ethernet Mode or in 40-Gigabit Ethernet
Mode ................................................................. 437
Configuring the PIC in 10-Gigabit Ethernet Mode to Operate in 40-Gigabit
Ethernet Mode ................................................................. 437
Configuring the PIC in 40-Gigabit Ethernet Mode to Operate in 10-Gigabit
Ethernet Mode ................................................................. 438
Configuring the PIC at Port Group Level .......................................... 439
Configuring Framing Mode on P2-10G-40G-QSFPP PIC ....................... 439
Configuring LAN PHY or WAN PHY Framing Mode in 10-Gigabit Ethernet
Mode ................................................................. 439
Configuring LAN PHY Framing Mode in 40-Gigabit Ethernet Mode ...... 440
Example: Configuring the P2-10G-40G-QSFPP PIC ............................. 440

Chapter 23  Configuring 10-Gigabit Ethernet Framing  ......................... 445
10-Gigabit Ethernet Framing Overview ............................................. 445
Understanding WAN Framing for 10-Gigabit Ethernet Trio Interfaces ........ 446
Configuring 10-Gigabit Ethernet Framing ......................................... 447

Chapter 24  Configuring 10-Gigabit Ethernet Notification of Link Down Alarm .... 449
Gigabit Ethernet Notification of Link Down Alarm Overview ................ 449
10-Gigabit Ethernet Notification of Link Down for Optics Options Overview . 449
Configuring Gigabit Ethernet Notification of Link Down Alarm .............. 450
Configuring 10-Gigabit Ethernet Link Down Notification for Optics Options Alarm
or Warning ................................................................. 450
## Chapter 25 Configuring 40-Gigabit Ethernet PICs ........................................451
- 40-Gigabit Ethernet PIC Overview ..................................................451
- Configuring 40-Gigabit Ethernet PICs .............................................453

## Chapter 26 Configuring 100-Gigabit Ethernet PICs/MICs ..................455
- 100-Gigabit Ethernet Interfaces Overview .....................................455
- MX Series 100-Gigabit Ethernet Interfaces .....................................455
- PTX Series 100-Gigabit Ethernet Interfaces .....................................456
- T Series 100-Gigabit Ethernet Interfaces .........................................457
- MPC3E MIC Overview ...................................................................458
- 100-Gigabit Ethernet Type 4 PIC with CFP Overview .......................459
- Configuring 100-Gigabit Ethernet Type 4 PIC with CFP ....................462
- Configuring VLAN Steering Mode for 100-Gigabit Ethernet Type 4 PIC with CFP ..........................................................466
- 100-Gigabit Ethernet Type 5 PIC with CFP Overview .......................468
- 100-Gigabit Ethernet Interfaces Interoperability .........................471
  - Interoperability of the MIC-3D-1X100GE-CFP MIC with PICs on Other Routers ..............................................................471
  - Interoperability of the MPC4E-3D-2CGE-8XGE MPC with PICs on Other Routers ..............................................................471
  - Interoperability of the P1-PTX-2-100GE-CFP PIC with PICs on Other Routers ..............................................................471
  - Interoperability of the PD-ICE-CFP-FPC4 PIC with PICs or MICs on Other Routers ..............................................................472
- Interoperability Between the 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and PF-1CGE-CFP ..........................................................473
- Interoperability Between the 100-Gigabit Ethernet PICs PD-1ICE-CFP-FPC4 and P1-PTX-2-100GE-CFP ..........................................................474
- Configuring the Interoperability Between the 100-Gigabit Ethernet PICs PF-1CGE-CFP and PD-1ICE-CFP-FPC4 ..........................................................475
- Configuring SA Multicast Bit Steering Mode on the 100-Gigabit Ethernet PIC PD-1ICE-CFP-FPC4 ..........................................................475
- Configuring Two 50-Gigabit Ethernet Physical Interfaces on the 100-Gigabit Ethernet PIC PD-1ICE-CFP-FPC4 as One Aggregated Ethernet Interface ..........................................................476
- Configuring the Interoperability Between the 100-Gigabit Ethernet PICs P1-PTX-2-100GE-CFP and PD-1ICE-CFP-FPC4 ..........................................................478
- Configuring SA Multicast Bit Steering Mode on 100-Gigabit Ethernet PIC P1-PTX-2-100GE-CFP ..........................................................478
- Configuring Two 50-Gigabit Ethernet Physical Interfaces on the 100-Gigabit Ethernet PIC PD-1ICE-CFP-FPC4 as One Aggregated Ethernet Interface ..........................................................479

## Chapter 27 Configuring Rate Selectability ......................................481
- Understanding Rate Selectability .....................................................482
- Rate Selectability on MPC7E-MRATE .................................................483
- Rate Selectability on MIC-MRATE .....................................................483
- Rate Selectability on JNP10K-LC2101 .................................................484
- Rate Selectability on MIC-MACSEC-20GE .........................................484
Understanding the PTX-5-100G-WDM PIC ................................. 627
  Interface Features .................................................. 628
  Layer 2 and Layer 3 Features ..................................... 629
  OTN Alarms and Defects ........................................... 629
Configuring OTN Interfaces on PTX-5-100G-WDM PIC ............... 631
Understanding the PTX10K-LC1104 Line Card .......................... 636
  Software Features .................................................. 636
  OTN Alarms and Defects ........................................... 637
Interface Mapping and Modulation format for PTX10K-LC1104 Line Card .... 638
Supported OTN Options on PTX10008 and PTX10016 Series Routers .... 639
Supported Optics Options on PTX10008 and PTX10016 Series Routers .... 645
Configuring OTN Interface Options on PTX10K-LC1104 ............... 650
Understanding ODU Path Delay Measurement on OTN Networks for Performance Monitoring ................................. 654
  Guidelines for Configuring Delay Measurement ................. 655
Enabling ODU Path Delay Measurement on OTN Networks for Performance Monitoring ................................. 656
Disabling ODU Path Delay Measurement on OTN Networks for Performance Monitoring ................................. 658

Chapter 29 Configuring Gigabit Ethernet Accounting and Policing ........... 661
Capabilities of Gigabit Ethernet IQ PICs and Gigabit Ethernet PICs with SFPs . 661
Configuring MAC Address Accounting .................................. 663
MAC Address Accounting for Dynamically Learned Addresses on Aggregated Ethernet Interfaces Overview ............................ 664
Accounting of the Layer 2 Overhead Attribute in Interface Statistics ........... 665
  Guidelines for Configuring the Computation of Layer 2 Overhead in Interface Statistics .............................................. 667
Configuring Layer 2 Overhead Accounting in Interface Statistics .......... 668
  Enabling the Accounting of Layer 2 Overhead in Interface Statistics at the PIC Level ......................................................... 668
  Verifying the Accounting of Layer 2 Overhead in Interface Statistics ........ 669
Configuring Gigabit Ethernet Policers .................................. 671
  Overview ............................................................. 672
  Configuring a Policer ............................................... 672
  Specifying an Input Priority Map .................................. 673
  Specifying an Output Priority Map ................................ 674
  Applying a Policer ................................................. 674
  Configuring MAC Address Filtering .................................. 676
  Example: Configuring Gigabit Ethernet Policers ....................... 676
Configuring Gigabit Ethernet Two-Color and Tricolor Policers .......... 678
  Overview ............................................................. 678
  Configuring a Policer ............................................... 680
  Applying a Policer ................................................. 680
  Example: Configuring and Applying a Policer ........................ 681
### Chapter 30 Configuring Gigabit Ethernet Autonegotiation

- Configuring Gigabit Ethernet Autonegotiation Overview
- Configuring Gigabit Ethernet Autonegotiation
- Configuring Gigabit Ethernet Autonegotiation with Remote Fault
- Configuring Flow Control
- Configuring Autonegotiation Speed on MX Series Routers
- Displaying Autonegotiation Status

### Chapter 31 Stacking and Rewriting Gigabit Ethernet VLAN Tags

- Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview
- Stacking and Rewriting Gigabit Ethernet VLAN Tags
- Configuring Frames with Particular TPIDs to Be Processed as Tagged Frames
- Configuring Tag Protocol IDs (TPIDs) on PTX Series Packet Transport Routers
- Configuring Stacked VLAN Tagging
- Configuring Dual VLAN Tags
- Configuring Inner and Outer TPIDs and VLAN IDs
- Stacking a VLAN Tag
- Stacking Two VLAN Tags
- Removing a VLAN Tag
- Removing the Outer and Inner VLAN Tags
- Removing the Outer VLAN Tag and Rewriting the Inner VLAN Tag
- Rewriting the VLAN Tag on Tagged Frames
- Rewriting a VLAN Tag on Untagged Frames
- Overview
- Example: push and pop with Ethernet CCC Encapsulation
- Example: push-push and pop-pop with Ethernet CCC Encapsulation
- Example: push and pop with Ethernet VPLS Encapsulation
- Example: push-push and pop-pop with Ethernet VPLS Encapsulation
- Rewriting a VLAN Tag and Adding a New Tag
- Rewriting the Inner and Outer VLAN Tags
- Examples: Stacking and Rewriting Gigabit Ethernet IQ VLAN Tags
- Understanding Transparent Tag Operations and IEEE 802.1p Inheritance
- Understanding swap-by-pop and push
- Configuring IEEE 802.1p Inheritance push and swap from the Transparent Tag

### Part 3 Operation, Administration, and Management (OAM) for Ethernet Interfaces

### Chapter 32 Configuring IEEE 802.1ag OAM Connectivity-Fault Management

- Ethernet Operations, Administration, and Maintenance
- Ethernet OAM Connectivity Fault Management
- IEEE 802.1ag OAM Connectivity Fault Management Overview
- Connectivity Fault Management Key Elements
- Best Practices for Configuring 802.1ag Ethernet OAM for VPLS
- Junos OSS Support for Performance Monitoring Compliant with Technical Specification MEF 36
Chapter 33 Configuring IEEE 802.3ah OAM Link-Fault Management 

IEEE 802.3ah OAM Link-Fault Management Overview ........................................... 818
Understanding Ethernet OAM Link Fault Management for ACX Series Routers .................. 819
Configuring IEEE 802.3ah OAM Link-Fault Management ........................................ 821
Configuring Ethernet 802.3ah OAM on PTX Series Packet Transport Routers .................. 822
Enabling IEEE 802.3ah OAM Support ................................................................. 823
Configuring Link Discovery ....................................................................................... 824
Configuring the OAM PDU Interval ........................................................................ 825
Configuring the OAM PDU Threshold .................................................................... 826
Configuring Threshold Values for Local Fault Events on an Interface ......................... 827
Disabling the Sending of Link Event TLVs ............................................................. 828
Detecting Remote Faults .......................................................................................... 828
Enabling Dying Gasp Functionality .......................................................................... 829
Configuring an OAM Action Profile ........................................................................ 830
Specifying the Actions to Be Taken for Link-Fault Management Events ..................... 832
Monitoring the Loss of Link Adjacency .................................................................... 833
Monitoring Protocol Status ...................................................................................... 834
Configuring Threshold Values for Fault Events in an Action Profile ....................... 835
Applying an Action Profile ...................................................................................... 836
Setting a Remote Interface into Loopback Mode ..................................................... 837
Enabling Remote Loopback Support on the Local Interface .................................... 838
Enabling Nonstop Routing for Ethernet Link Fault Management on Backup Routers ................................................................. 839
Example: Configuring IEEE 802.3ah OAM Support on an Interface ........... 842
Example: Configuring IEEE 802.3ah OAM Support for an Interface on ACX Series ............................................................... 844
Example: Configuring Ethernet LFM Between Provider Edge and Customer Edge ................................................................. 846
Example: Configuring Ethernet LFM for CCC ................................................. 847
Example: Configuring Ethernet LFM for Aggregated Ethernet ................... 849
Example: Configuring Ethernet LFM with Loopback Support....................... 851

Chapter 34 Configuring ITU-T Y.1731 Ethernet Service OAM ...................... 853
Ethernet Frame Delay Measurements Overview ........................................ 854
ITU-T Y.1731 Frame Delay Measurement Feature ..................................... 855
Ethernet CFM ................................................................. 855
Ethernet Frame Delay Measurement ...................................................... 856
One-Way Ethernet Frame Delay Measurement ......................................... 857
1DM Transmission ............................................................. 857
1DM Reception ............................................................... 857
One-Way ETH-DM Statistics ....................................................... 857
One-Way ETH-DM Frame Counts ..................................................... 857
Synchronization of System Clocks ......................................................... 857
Two-Way Ethernet Frame Delay Measurement ........................................ 858
DMM Transmission ............................................................. 858
DMR Transmission ............................................................. 858
DMR Reception ............................................................... 858
Two-Way ETH-DM Statistics ....................................................... 859
Two-Way ETH-DM Frame Counts ..................................................... 859
Choosing Between One-Way and Two-Way ETH-DM ......................... 859
Restrictions for Ethernet Frame Delay Measurement ................................. 859
Ethernet Frame Loss Measurement Overview ........................................ 860
Service-Level Agreement Measurement ............................................. 863
On-Demand Mode for SLA Measurement ............................................. 864
Proactive Mode for SLA Measurement .............................................. 865
Ethernet Delay Measurements and Loss Measurement by Proactive Mode ................................. 866
Ethernet Failure Notification Protocol Overview .................................... 866
Ethernet Synthetic Loss Measurement Overview ..................................... 867
Scenarios for Configuration of ETH-SLM ........................................... 869
Upstream MEP in MPLS Tunnels ..................................................... 869
Downstream MEP in Ethernet Networks .............................................. 869
Format of ETH-SLM Messages ..................................................... 870
SLM PDU Format ............................................................. 870
SLR PDU Format ............................................................... 871
Data Iterator TLV Format ......................................................... 871
Transmission of ETH-SLM Messages .................................................. 872
Initiation and Transmission of SLM Requests ....................................... 872
Reception of SLMs and Transmission of SLRs ..................................... 873
Reception of SLRs ............................................................... 873
<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computation of Frame Loss</td>
<td>873</td>
</tr>
<tr>
<td>Guidelines for Configuring ETH-SLM</td>
<td>874</td>
</tr>
<tr>
<td>Starting a Proactive ETH-SLM Session</td>
<td>875</td>
</tr>
<tr>
<td>Configuring MEP Interfaces</td>
<td>876</td>
</tr>
<tr>
<td>Configuring an Iterator Profile for ETH-SLM</td>
<td>877</td>
</tr>
<tr>
<td>Associating the Iterator Profile with MEPs for ETH-SLM</td>
<td>878</td>
</tr>
<tr>
<td>Starting an On-Demand ETH-SLM Session</td>
<td>880</td>
</tr>
<tr>
<td>Managing ETH-SLM Statistics and ETH-SLM Frame Counts</td>
<td>880</td>
</tr>
<tr>
<td>Displaying ETH-SLM Statistics Only</td>
<td>881</td>
</tr>
<tr>
<td>Displaying ETH-SLM Statistics and Frame Counts</td>
<td>881</td>
</tr>
<tr>
<td>Displaying ETH-SLM Frame Counts for MEPs by Enclosing CFM Entity</td>
<td>882</td>
</tr>
<tr>
<td>Displaying ETH-SLM Frame Counts for MEPs by Interface or Domain</td>
<td>883</td>
</tr>
<tr>
<td>Clearing ETH-SLM Statistics and Frame Counts</td>
<td>884</td>
</tr>
<tr>
<td>Clearing Iterator Statistics</td>
<td>884</td>
</tr>
<tr>
<td>Troubleshooting Failures with ETH-SLM</td>
<td>885</td>
</tr>
<tr>
<td>Configuring an Iterator Profile</td>
<td>886</td>
</tr>
<tr>
<td>Verifying the Configuration of an Iterator Profile</td>
<td>889</td>
</tr>
<tr>
<td>Displaying the Configuration of an Iterator Profile for Two-way Delay Measurement</td>
<td>889</td>
</tr>
<tr>
<td>Displaying the Configuration of an Iterator Profile for Loss Measurement</td>
<td>890</td>
</tr>
<tr>
<td>Displaying the Configuration of a Remote MEP with an Iterator Profile</td>
<td>890</td>
</tr>
<tr>
<td>Disabling an Iterator Profile</td>
<td>891</td>
</tr>
<tr>
<td>Managing Iterator Statistics</td>
<td>892</td>
</tr>
<tr>
<td>Displaying Iterator Statistics</td>
<td>892</td>
</tr>
<tr>
<td>Clearing Iterator Statistics</td>
<td>896</td>
</tr>
<tr>
<td>Configuring a Remote MEP with an Iterator Profile</td>
<td>897</td>
</tr>
<tr>
<td>Damping CFM performance Monitoring Traps and Notifications to Prevent Congestion of The NMS</td>
<td>899</td>
</tr>
<tr>
<td>Configuring Statistical Frame Loss Measurement for VPLS Connections</td>
<td>899</td>
</tr>
<tr>
<td>Guidelines for Configuring Routers to Support an ETH-DM Session</td>
<td>900</td>
</tr>
<tr>
<td>Configuration Requirements for ETH-DM</td>
<td>900</td>
</tr>
<tr>
<td>Configuration Options for ETH-DM</td>
<td>901</td>
</tr>
<tr>
<td>Guidelines for Starting an ETH-DM Session</td>
<td>901</td>
</tr>
<tr>
<td>ETH-DM Session Prerequisites</td>
<td>901</td>
</tr>
<tr>
<td>ETH-DM Session Parameters</td>
<td>902</td>
</tr>
<tr>
<td>Restrictions for an ETH-DM Session</td>
<td>903</td>
</tr>
<tr>
<td>Guidelines for Managing ETH-DM Statistics and ETH-DM Frame Counts</td>
<td>903</td>
</tr>
<tr>
<td>ETH-DM Statistics</td>
<td>904</td>
</tr>
<tr>
<td>ETH-DM Statistics Retrieval</td>
<td>905</td>
</tr>
<tr>
<td>ETH-DM Frame Counts</td>
<td>906</td>
</tr>
<tr>
<td>ETH-DM Frame Count Retrieval has</td>
<td>906</td>
</tr>
<tr>
<td>Frame Counts Stored in CFM Databases</td>
<td>906</td>
</tr>
<tr>
<td>One-Way ETH-DM Frame Counts</td>
<td>907</td>
</tr>
<tr>
<td>Two-Way ETH-DM Frame Counts</td>
<td>907</td>
</tr>
<tr>
<td>Configuring Routers to Support an ETH-DM Session</td>
<td>907</td>
</tr>
<tr>
<td>Configuring MEP Interfaces</td>
<td>908</td>
</tr>
<tr>
<td>Ensuring That Distributed ppm Is Not Disabled</td>
<td>909</td>
</tr>
<tr>
<td>Enabling the Hardware-Assisted Timestamping Option</td>
<td>911</td>
</tr>
</tbody>
</table>
Configuring the Server-Side Processing Option ........................................... 911
Starting an ETH-DM Session ................................................................. 912
Using the monitor ethernet delay-measurement Command ....................... 912
Starting a One-Way ETH-DM Session .................................................... 913
Starting a Two-Way ETH-DM Session .................................................... 914
Starting a One-Way ETH-DM Session .................................................... 915
Starting a Two-Way ETH-DM Session .................................................... 915
Managing ETH-DM Statistics and ETH-DM Frame Counts ...................... 916
Displaying ETH-DM Statistics Only ...................................................... 916
Displaying ETH-DM Statistics and Frame Counts .................................. 917
Displaying ETH-DM Frame Counts for MEPs by Enclosing CFM Entity .... 917
Displaying ETH-DM Frame Counts for MEPs by Interface or Domain Level .......................................................... 918
Clearing ETH-DM Statistics and Frame Counts .................................... 919
Displaying ETH-DM Statistics Only ...................................................... 919
Displaying ETH-DM Statistics and Frame Counts .................................. 920
Displaying ETH-DM Frame Counts for MEPs by Enclosing CFM Entity .... 920
Displaying ETH-DM Frame Counts for MEPs by Interface or Domain Level .......................................................... 921
Clearing ETH-DM Statistics and Frame Counts .................................... 922
Configuring MEP Interfaces ................................................................. 922
Ensuring That Distributed ppm Is Not Disabled .................................... 924
Enabling the Hardware-Assisted Timestamping Option .......................... 926
Enabling Inline Transmission of Continuity Check Messages for Maximum Scaling .......................................................... 927
Enabling Inline Mode Of Performance Monitoring To Achieve Maximum Scaling .......................................................... 928
Supported Inline CCM and Inline PM Scaling Values ............................ 930
Configuring Connectivity Fault Management for Interoperability During Unified In-Service Software Upgrades ................................. 932
Using the monitor ethernet delay-measurement Command ....................... 933
Managing ETH-LM Statistics ............................................................... 934
Displaying ETH-LM Statistics .............................................................. 934
Clearing ETH-LM Statistics ................................................................. 935
Managing Continuity Measurement Statistics ...................................... 936
Displaying Continuity Measurement Statistics ..................................... 936
Clearing Continuity Measurement Statistics ........................................ 936
Configuring the Failure Notification Protocol ...................................... 937
Ethernet Alarm Indication Signal (ETH-AIS) Function Overview ............. 938
Understanding ETH-AIS in a Maintenance Domain ............................... 938
Fault Detection in a Maintenance Domain .......................................... 939
Terms Defined .......................................................... 940
Ethernet Alarm Indication Signal Overview ........................................ 942
Configuring ETH-AIS on a CFM MEP ................................................. 943
Configuring an Action Profile .............................................................. 944
Configuring an Action to Be Taken When an AIS Alarm Is Detected ....... 945
Attaching the Action Profile to a CFM MEP ........................................ 946
Chapter 35 Configuring Ethernet Ring Protection ........................................... 989

Ethernet Ring Protection .............................................................. 989
Ethernet Ring Protection Using Ring Instances for Load Balancing .............. 991
Example: Configuring Ethernet Ring Protection for MX Series Routers ......... 992

Example Topology .............................................................. 992
Router 1 (RPL Owner) Configuration ............................................ 993
Router 2 Configuration ............................................................ 995
Router 3 Configuration ............................................................ 997
Example: Configuring Load Balancing Within Ethernet Ring Protection for MX
Series Routers ........................................................................ 999
Example: Viewing Ethernet Ring Protection Status—Normal Ring Operation . 1017
Example: Viewing Ethernet Ring Protection Status—Ring Failure Condition ... 1019

Chapter 36 CFM Action Profile to Bring Down a Group of Logical Interfaces ...... 1023

CFM Action Profile to Bring Down a Group of Logical Interfaces Overview .... 1023
Benefits of Creating CFM Action Profile to Bring Down a Group of Logical Interfaces ................................................................. 1024
Configuring a CFM Action Profile to Bring Down a Group of Logical Interfaces . 1024

Part 4 Troubleshooting Information

Chapter 37 Monitoring and Troubleshooting Ethernet Interfaces ..................... 1031

Configuring Interface Diagnostics Tools to Test the Physical Layer

Connections ........................................................................... 1031
Configuring Loopback Testing ................................................. 1031
Configuring BERT Testing ......................................................... 1033
Starting and Stopping a BERT Test ............................................. 1037
Checklist for Monitoring Fast Ethernet and Gigabit Ethernet Interfaces ........ 1037
Monitoring Fast Ethernet and Gigabit Ethernet Interfaces ....................... 1038
Checklist for Monitoring Fast Ethernet and Gigabit Ethernet Interfaces ... 1038
Monitor Fast Ethernet and Gigabit Ethernet Interfaces .......................... 1038

Display the Status of Fast Ethernet Interfaces ................................... 1039
Display the Status of Gigabit Ethernet Interfaces ................................ 1041
Display the Status of a Specific Fast Ethernet or Gigabit Ethernet Interface ................................................................. 1042
Display Extensive Status Information for a Specific Fast Ethernet or Gigabit Ethernet Interface .................................................... 1043
Chapter 39 Configuration Statements (OAM-CFM) ........................................... 1129

odu-signal-degrade .......................................................... 1101
odu-signal-degrade-monitor-enable ..................................... 1102
odu-ttim-action-enable ..................................................... 1103
odu-ttim-action-enable ..................................................... 1104
odu4 ............................................................................. 1105
pass-through .............................................................. 1106
prbs ................................................................. 1107
preemptive-fast-reroute .................................................. 1108
rate ................................................................. 1109
remote-loop-enable ...................................................... 1110
signal-degrade .......................................................... 1111
signal-degrade-monitor-enable .......................................... 1112
start-measurement ........................................................ 1113
tca ................................................................. 1114
transport-monitoring ..................................................... 1116
trigger ................................................................. 1117
tti ................................................................. 1118
tx-power ............................................................. 1122
warning ............................................................... 1123
wavelength ............................................................. 1124

action-profile (Applying to CFM) ........................................ 1131
action-profile (Defining for CFM) ...................................... 1132
action-profile (MEP) ...................................................... 1133
ais-trigger-condition .................................................... 1134
all-defects ............................................................... 1135
auto-discovery .......................................................... 1135
avg-fd-twoway-threshold .............................................. 1136
avg-ifdv-twoway-threshold ........................................... 1137
avg-flr-forward-threshold ............................................ 1138
avg-flr-backward-threshold .......................................... 1139
calculation-weight ...................................................... 1140
clear-action (CFM) ....................................................... 1141
continuity-check ......................................................... 1142
convey-loss-threshold ................................................ 1143
cross-connect-ccm ...................................................... 1143
cycle-time ............................................................. 1144
data-tlv-size .......................................................... 1145
default-actions .......................................................... 1146
delay ................................................................. 1147
delegate-server-processing ............................................ 1148
delay-variation ......................................................... 1149
detect-loc ............................................................. 1150
direction ............................................................... 1151
enhanced-cfm-mode .................................................... 1152
erroneous-ccm .......................................................... 1153
event (CFM) ............................................................. 1154
flap-trap-monitor ........................................................ 1155
adaptive ................................................................. 1212
address ............................................................. 1213
adjacency-loss ..................................................... 1215
advertisement-interval ......................................... 1216
age ................................................................. 1217
agent-specifier .................................................... 1218
aggregate (Gigabit Ethernet CoS Policer) .................... 1219
aggregated-devices ............................................... 1220
aggregated-ether-options ....................................... 1222
alarms ............................................................. 1223
allow-remote-loopback ......................................... 1224
apply-action-profile ............................................ 1224
arp (Interfaces) ................................................... 1225
asynchronous-notification ..................................... 1229
authentication-access-control (MX Series in Enhanced LAN Mode) 1230
authentication-profile-name .................................. 1231
authenticator ...................................................... 1232
auto-negotiation ................................................ 1233
auto-reconnect ................................................... 1235
bandwidth-limit (Policer for Gigabit Ethernet Interfaces) 1236
bridge-domain ................................................... 1237
bridge-domains .................................................. 1238
bfd-liveness-detection (LAG) .................................. 1240
burst-size-limit (Policer for Gigabit Ethernet Interfaces) 1242
cak (MX Series) .................................................... 1243
captive-portal (MX Series in Enhanced LAN Mode) .......... 1244
captive-portal-custom-options (MX Series in Enhanced LAN Mode) 1245
centralized ......................................................... 1247
cipher-suite (MACsec) .......................................... 1248
ckn (MX Series) .................................................... 1250
classifier .......................................................... 1251
clear .............................................................. 1251
client ............................................................. 1252
community-vlans (MX Series) ................................ 1253
compatibility-version ........................................... 1254
connectivity-association (MACsec Interfaces for MX Series) 1255
connectivity-association (MX Series) ......................... 1256
connectivity-fault-management ............................... 1258
control-channel .................................................. 1260
data-channel ..................................................... 1261
delay (PPPoE Service Name Tables) .......................... 1262
destination (IPCP) ............................................... 1263
device-count ...................................................... 1264
direction (MX Series) .......................................... 1265
disable ............................................................ 1266
disable (Link Protection) ....................................... 1267
disable (802.1X for MX Series in Enhanced LAN Mode) .... 1267
distribution-list ................................................... 1268
dot1p-priority .................................................... 1269
dot1x  ................................................................. 1270
  dot1x (MX Series in Enhanced LAN Mode) ................................ 1271
domain-id  ................................................................... 1272
drop (PPPoE Service Name Tables) .............................................. 1273
dynamic-profile (PPPoE Service Name Tables) .............................. 1274
east-interface  ............................................................. 1275
egress-policer-overhead ............................................................ 1276
encapsulation (Logical Interface) .................................................. 1277
encapsulation  ................................................................. 1281
encryption (MACsec for MX Series) ............................................. 1289
enhanced-convergence .............................................................. 1290
er -options  ........................................................................ 1291
ethernet (Chassis)  ............................................................ 1292
ethernet (Protocols OAM) ........................................................ 1293
ethernet-policer-profile ........................................................... 1299
ethernet-ring  ..................................................................... 1301
ethernet-switch-profile ............................................................ 1302
evcs  ................................................................................. 1304
evc-protocol cfm ................................................................... 1305
event (LFM)  ........................................................................ 1306
event-thresholds  ................................................................. 1307
exclude-protocol (MX Series) .................................................... 1308
exercise  ............................................................................ 1309
failover-delay  ................................................................. 1309
family  .............................................................................. 1310
fast-aps-switch  ................................................................. 1315
fastether-options  .................................................................. 1316
flexible-vlan-tagging ............................................................... 1317
flow-control  ....................................................................... 1318
fnp  ............................................................................... 1319
force switch  ....................................................................... 1320
force-up  ............................................................................ 1320
forwarding-class (Gigabit Ethernet IQ Classifier) ....................... 1321
forwarding-mode (100-Gigabit Ethernet) ................................... 1322
forwarding-mode (PTX Series Packet Transport Routers) ........... 1323
frame-error  ................................................................. 1324
frame-period  ................................................................. 1325
frame-period-summary ........................................................... 1326
framing (10-Gigabit Ethernet Interfaces) ..................................... 1327
gigether-options  ............................................................... 1329
gratuitous-arp-reply .............................................................. 1330
guest-vlan (MX Series in Enhanced LAN Mode) ......................... 1331
guard-interval  ................................................................. 1332
hold-interval (Protection Group) ................................................ 1333
hold-multiplier  ................................................................. 1334
hold-time up  ................................................................. 1335
iccp  ................................................................................. 1336
id (MACsec for MX Series) .................................................... 1337
ieee802.1p  ....................................................................... 1338
Ethernet Interfaces Feature Guide for Routing Devices

igmp-snooping ......................................................... 1339
ignore-l3-incompletes ........................................... 1343
include-sci (MACsec for MX Series) .......................... 1343
ingress-policer ..................................................... 1344
ingress-rate-limit .................................................. 1346
inner-tag-protocol-id .............................................. 1347
inner-vlan-id ....................................................... 1348
inline ................................................................. 1349
input-policer ....................................................... 1350
input-priority-map ................................................ 1351
input-three-color ................................................ 1352
input-vlan-map (Aggregated Ethernet) ......................... 1353
input-vlan-map ..................................................... 1354
interface ........................................................... 1355
interface (IEEE 802.1x) ........................................ 1356
interface (OAM Link-Fault Management) ..................... 1358
interface (Static MAC Bypass) .................................. 1359
interfaces (MACsec for MX Series) ......................... 1360
interface-group .................................................... 1361
interface-group-down ............................................ 1362
interface-none ..................................................... 1362
isolated-vlan (MX Series) ........................................ 1363
key (MACsec for MX Series) ..................................... 1364
key-server-priority (MACsec for MX Series) .................. 1365
lacp (802.3ad) ...................................................... 1366
lacp (Aggregated Ethernet) ..................................... 1367
layer2-policer ...................................................... 1369
link-adjacency-loss .............................................. 1370
link-discovery ..................................................... 1370
link-degrade-monitor ............................................ 1371
link-down .......................................................... 1372
link-event-rate .................................................... 1372
link-fault-management ......................................... 1373
link-mode .......................................................... 1375
link-protection .................................................... 1377
link-protection (non-LACP) ..................................... 1378
link-speed (Aggregated Ethernet) ............................... 1379
link-speed (Aggregated SONET/SDH) .......................... 1381
lldp ................................................................. 1382
lldp-configuration-notification-interval ...................... 1383
trap-notification .................................................. 1384
lmi (Ethernet OAM) ................................................. 1385
load-balance ....................................................... 1386
load-balance-stateful (Aggregated Ethernet Interfaces) ...... 1387
load-type (Aggregated Ethernet Interfaces) .................. 1388
lockout ............................................................. 1389
logical-interface-policer ........................................ 1390
loopback (Aggregated Ethernet, Fast Ethernet, and Gigabit Ethernet) 1392
loopback (Local and Remote) .................................... 1393
loopback-tracking .................................................. 1394
loss-priority .......................................................... 1394
mac ................................................................. 1395
mac (IRB) .............................................................. 1396
mac-address (Accept Source Mac) ................................. 1397
mac-address (MACsec) ............................................... 1398
mac-learn-enable .................................................... 1399
mac-radius (MX Series in Enhanced LAN Mode) ................. 1400
mac-validate ........................................................ 1401
macsec (MX Series) ............................................... 1402
major-ring-name ................................................... 1403
manual switch ....................................................... 1403
master-only ........................................................ 1404
max-sessions (PPPoE Service Name Tables) ....................... 1405
max-sessions-vsa-ignore (Static and Dynamic Subscribers) .... 1406
maximum-links .................................................... 1407
maximum-requests ................................................ 1408
maximum-requests (MX Series in Enhanced LAN Mode) ....... 1409
mc-ae ............................................................... 1410
minimum-bandwidth (aggregated Ethernet) ......................... 1413
minimum-links ..................................................... 1414
mixed-rate-mode ................................................... 1415
mka (MX Series) .................................................... 1416
must-secure (MX Series) .......................................... 1417
mtu ................................................................. 1418
multicast-router-interface (IGMP Snooping) ....................... 1422
multi-chassis-protection ......................................... 1423
negotiate-address .................................................. 1424
negotiation-options ............................................... 1425
no-adaptive ........................................................ 1425
no-allow-link-events .............................................. 1426
no-encryption (MACsec for MX Series) ............................ 1427
no-auto-mdix ....................................................... 1428
no-gratuitous-arp-request ....................................... 1429
no-keepalives ..................................................... 1430
no-mac-table-binding (802.1X for MX Series in Enhanced LAN Mode) ................................. 1431
no-native-vlan-insert .............................................. 1432
no-pre-classifier .................................................. 1433
no-reauthentication (MX Series in Enhanced LAN Mode) ....... 1434
no-send-pads-ac-info ............................................. 1435
no-send-pads-error ............................................... 1436
non-revertive (Interfaces) ....................................... 1436
non-revertive ..................................................... 1437
non-vc-mode ....................................................... 1437
node-id ............................................................ 1438
offset (MX Series) ............................................... 1439
oam ............................................................... 1441
optics-options ..................................................... 1444
otn-options ........................................................ 1445
<table>
<thead>
<tr>
<th>Feature</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>output-policer</td>
<td>1447</td>
</tr>
<tr>
<td>output-priority-map</td>
<td>1448</td>
</tr>
<tr>
<td>output-three-color</td>
<td>1449</td>
</tr>
<tr>
<td>output-vlan-map (Aggregated Ethernet)</td>
<td>1450</td>
</tr>
<tr>
<td>output-vlan-map</td>
<td>1451</td>
</tr>
<tr>
<td>pado-advertise</td>
<td>1452</td>
</tr>
<tr>
<td>passive-monitor-mode</td>
<td>1453</td>
</tr>
<tr>
<td>pdu-interval</td>
<td>1454</td>
</tr>
<tr>
<td>pdu-threshold</td>
<td>1455</td>
</tr>
<tr>
<td>per-flow (Aggregated Ethernet Interfaces)</td>
<td>1456</td>
</tr>
<tr>
<td>peer</td>
<td>1457</td>
</tr>
<tr>
<td>periodic</td>
<td>1458</td>
</tr>
<tr>
<td>policer (CFM Firewall)</td>
<td>1459</td>
</tr>
<tr>
<td>policer (CoS)</td>
<td>1460</td>
</tr>
<tr>
<td>policer (MAC)</td>
<td>1461</td>
</tr>
<tr>
<td>pop</td>
<td>1462</td>
</tr>
<tr>
<td>pop-pop</td>
<td>1463</td>
</tr>
<tr>
<td>pop-swap</td>
<td>1464</td>
</tr>
<tr>
<td>port-description-type</td>
<td>1465</td>
</tr>
<tr>
<td>port-id (MACsec for MX Series)</td>
<td>1466</td>
</tr>
<tr>
<td>port-priority</td>
<td>1467</td>
</tr>
<tr>
<td>port-id-subtype</td>
<td>1468</td>
</tr>
<tr>
<td>pp0 (Dynamic PPPoE)</td>
<td>1470</td>
</tr>
<tr>
<td>ppm (Ethernet Switching)</td>
<td>1472</td>
</tr>
<tr>
<td>pppoe-options</td>
<td>1473</td>
</tr>
<tr>
<td>pppoe-underlying-options (Static and Dynamic Subscribers)</td>
<td>1474</td>
</tr>
<tr>
<td>preferred-source-address</td>
<td>1475</td>
</tr>
<tr>
<td>pre-shared-key (MX Series)</td>
<td>1476</td>
</tr>
<tr>
<td>premium (Output Priority Map)</td>
<td>1477</td>
</tr>
<tr>
<td>premium (Policer)</td>
<td>1478</td>
</tr>
<tr>
<td>propagate-tc</td>
<td>1479</td>
</tr>
<tr>
<td>protection-group</td>
<td>1480</td>
</tr>
<tr>
<td>protocols</td>
<td>1481</td>
</tr>
<tr>
<td>protocol-down</td>
<td>1482</td>
</tr>
<tr>
<td>ptopo-configuration-maximum-hold-time</td>
<td>1482</td>
</tr>
<tr>
<td>ptopo-configuration-trap-interval</td>
<td>1483</td>
</tr>
<tr>
<td>push</td>
<td>1484</td>
</tr>
<tr>
<td>push-push</td>
<td>1485</td>
</tr>
<tr>
<td>premium (Output Priority Map)</td>
<td>1486</td>
</tr>
<tr>
<td>premium (Policer)</td>
<td>1487</td>
</tr>
<tr>
<td>proxy</td>
<td>1488</td>
</tr>
<tr>
<td>proxy-arp</td>
<td>1489</td>
</tr>
<tr>
<td>push</td>
<td>1490</td>
</tr>
<tr>
<td>push-push</td>
<td>1491</td>
</tr>
<tr>
<td>quiet-period</td>
<td>1492</td>
</tr>
<tr>
<td>quiet-period (MX Series in Enhanced LAN Mode)</td>
<td>1493</td>
</tr>
<tr>
<td>reauthentication</td>
<td>1494</td>
</tr>
<tr>
<td>reauthentication (MX Series in Enhanced LAN Mode)</td>
<td>1495</td>
</tr>
<tr>
<td>rebalance (Aggregated Ethernet Interfaces)</td>
<td>1495</td>
</tr>
<tr>
<td>Topic</td>
<td>Page</td>
</tr>
<tr>
<td>------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>receive-options-packets</td>
<td>1496</td>
</tr>
<tr>
<td>receive-ttl-exceeded</td>
<td>1496</td>
</tr>
<tr>
<td>recovery</td>
<td>1497</td>
</tr>
<tr>
<td>remote</td>
<td>1498</td>
</tr>
<tr>
<td>remote-loopback</td>
<td>1499</td>
</tr>
<tr>
<td>replay-window-size (MX Series)</td>
<td>1500</td>
</tr>
<tr>
<td>replay-protect (MX Series)</td>
<td>1501</td>
</tr>
<tr>
<td>restore-interval</td>
<td>1502</td>
</tr>
<tr>
<td>retries</td>
<td>1503</td>
</tr>
<tr>
<td>retries (MX Series in Enhanced LAN Mode)</td>
<td>1504</td>
</tr>
<tr>
<td>revertive</td>
<td>1505</td>
</tr>
<tr>
<td>ring-id</td>
<td>1506</td>
</tr>
<tr>
<td>ring-protection-link-end</td>
<td>1507</td>
</tr>
<tr>
<td>ring-protection-link-owner</td>
<td>1508</td>
</tr>
<tr>
<td>routing-instance</td>
<td>1509</td>
</tr>
<tr>
<td>routing-instance (PPPoE Service Name Tables)</td>
<td>1510</td>
</tr>
<tr>
<td>rx-enable</td>
<td>1511</td>
</tr>
<tr>
<td>rx-max-duration</td>
<td>1512</td>
</tr>
<tr>
<td>sa-multicast (100-Gigabit Ethernet)</td>
<td>1513</td>
</tr>
<tr>
<td>sa-multicast (PTX Series Packet Transport Routers)</td>
<td>1514</td>
</tr>
<tr>
<td>secure-authentication (MX Series in Enhanced LAN Mode)</td>
<td>1515</td>
</tr>
<tr>
<td>secure-channel</td>
<td>1516</td>
</tr>
<tr>
<td>security-association</td>
<td>1517</td>
</tr>
<tr>
<td>send-critical-event</td>
<td>1518</td>
</tr>
<tr>
<td>server</td>
<td>1518</td>
</tr>
<tr>
<td>server-fail</td>
<td>1519</td>
</tr>
<tr>
<td>server-reject-vlan (MX Series in Enhanced LAN Mode)</td>
<td>1520</td>
</tr>
<tr>
<td>server-timeout</td>
<td>1521</td>
</tr>
<tr>
<td>server-timeout (MX Series in Enhanced LAN Mode)</td>
<td>1522</td>
</tr>
<tr>
<td>service (PPPoE)</td>
<td>1523</td>
</tr>
<tr>
<td>service-name</td>
<td>1524</td>
</tr>
<tr>
<td>service-name-table</td>
<td>1525</td>
</tr>
<tr>
<td>service-name-tables</td>
<td>1526</td>
</tr>
<tr>
<td>session-expiry (MX Series in Enhanced LAN Mode)</td>
<td>1527</td>
</tr>
<tr>
<td>source-address-filter</td>
<td>1528</td>
</tr>
<tr>
<td>source-filtering</td>
<td>1529</td>
</tr>
<tr>
<td>speed (Ethernet)</td>
<td>1530</td>
</tr>
<tr>
<td>speed (MX Series DPC)</td>
<td>1530</td>
</tr>
<tr>
<td>stacked-vlan-tagging</td>
<td>1536</td>
</tr>
<tr>
<td>static (Protocols 802.1X)</td>
<td>1537</td>
</tr>
<tr>
<td>static-interface</td>
<td>1538</td>
</tr>
<tr>
<td>static</td>
<td>1539</td>
</tr>
<tr>
<td>supplicant</td>
<td>1540</td>
</tr>
<tr>
<td>supplicant (MX Series in Enhanced LAN Mode)</td>
<td>1541</td>
</tr>
<tr>
<td>supplicant-timeout</td>
<td>1542</td>
</tr>
<tr>
<td>supplicant-timeout (MX Series in Enhanced LAN Mode)</td>
<td>1543</td>
</tr>
<tr>
<td>swap</td>
<td>1544</td>
</tr>
<tr>
<td>swap-by-poppush</td>
<td>1545</td>
</tr>
<tr>
<td>swap-push</td>
<td>1545</td>
</tr>
<tr>
<td>swap-swap</td>
<td>1546</td>
</tr>
</tbody>
</table>
Chapter 41 Operational Commands .........................................1629

clear interfaces interface-set statistics ..............................1632
clear interfaces interval ...............................................1633
clear interfaces aX forwarding-options load-balance state ......1636
clear interfaces aggregate forwarding-options load-balance state 1637
clear interfaces transport pm ......................................1638
clear llidp neighbors ..............................................1639
clear llidp statistics ...............................................1640

clear oam ethernet connectivity-fault-management
    continuity-measurement .......................................1641
clear oam ethernet connectivity-fault-management linktrace
    path-database ...............................................1642
clear oam ethernet connectivity-fault-management loss-statistics 1643
clear oam ethernet connectivity-fault-management policer ..........1644
clear oam ethernet connectivity-fault-management statistics .....1645

clear oam ethernet connectivity-fault-management
    synthetic-loss-measurement ..................................1647

clear oam ethernet link-fault-management state ..................1648

clear oam ethernet link-fault-management statistics ..............1649

clear protection-group ethernet-ring statistics ..................1650

clear security mka statistics (MX Series) .........................1651

clear security mka statistics (MX Series) .........................1652

monitor ethernet delay-measurement ............................1653

monitor ethernet loss-measurement .............................1658

monitor ethernet synthetic-loss-measurement ....................1663

monitor ethernet synthetic-loss-measurement ....................1667

request interface link-degrade-recover ..........................1671

request interface mc-aeswitchover (Multichassis Link Aggregation) 1674

request interface (revert | switchover) (Aggregated Ethernet Link Protection) 1676

request lacp link-switchover ..................................1677

show chassis hardware .........................................1678

show chassis pic ..................................................1945

show ethernet-switching redundancy-groups .....................1973

show interfaces (Adaptive Services) .............................1977

show interfaces (Aggregated Ethernet) ..........................1985

show interfaces demux0 (Demux Interfaces) ....................1996

show interfaces diagnostics optics (Gigabit Ethernet, 10-Gigabit Ethernet,
    40-Gigabit Ethernet, 100-Gigabit Ethernet, and Virtual Chassis Port) 2006

show interfaces (far-end-interval) .............................2041

show interfaces (Fast Ethernet) ..................................2043

show interfaces .................................................2060

show interfaces (M Series, MX Series, T Series Routers, and PTX Series
    Management and Internal Ethernet) .........................2140

show interfaces (PPPoE) ........................................2157

show interfaces interface-set (Ethernet Interface Set) ..........2167
show interfaces interface-set queue .......................... 2172
show interfaces interval ......................................... 2180
show interfaces irb .................................................. 2184
show interfaces mac-database .................................. 2191
show interfaces mc-ae ............................................. 2197
show interfaces transport pm .................................. 2201
show l2-learning instance ....................................... 2207
show l2-learning redundancy-groups ......................... 2209
show lacp interfaces ............................................. 2214
show lldp .......................................................... 2219
show lldp local-information .................................... 2222
show lldp neighbors .............................................. 2225
show lldp remote-global-statistics ......................... 2231
show lldp statistics .............................................. 2233
show oam ethernet connectivity-fault-management delay-statistics ......................... 2236
show oam ethernet connectivity-fault-management forwarding-state .............. 2240
show oam ethernet connectivity-fault-management interfaces .................. 2244
show oam ethernet connectivity-fault-management linktrace path-database ......................... 2255
show oam ethernet connectivity-fault-management loss-statistics ............. 2258
show oam ethernet connectivity-fault-management mep-database .............. 2262
show oam ethernet connectivity-fault-management mep-statistics ............. 2274
show oam ethernet connectivity-fault-management path-database ............. 2286
show oam ethernet connectivity-fault-management policer ................... 2288
show oam ethernet connectivity-fault-management sla-iterator-statistics ........ 2291
show oam ethernet connectivity-fault-management synthetic-loss-statistics .......................................................... 2301
show oam ethernet evc ........................................... 2304
show oam ethernet fnp interface ................................ 2306
show oam ethernet fnp messages ................................ 2308
show oam ethernet fnp status .................................. 2310
show oam ethernet link-fault-management .......................................................... 2312
show oam ethernet lmi ............................................ 2320
show oam ethernet lmi statistics ................................ 2322
show pppoe interfaces ........................................... 2324
show pppoe service-name-tables ................................ 2328
show pppoe sessions ............................................. 2331
show pppoe statistics ............................................ 2333
show pppoe underlying-interfaces ................................ 2335
show pppoe version ............................................... 2342
show protection-group ethernet-ring aps .................... 2344
show protection-group ethernet-ring configuration .................. 2348
show protection-group ethernet-ring data-channel .................. 2355
show protection-group ethernet-ring flush-info .................... 2358
show protection-group ethernet-ring interface .................. 2360
show protection-group ethernet-ring node-state .................. 2364
show protection-group ethernet-ring statistics .................. 2369
show protection-group ethernet-ring vlan .......................... 2375
show security macsec connections (MX Series) .................. 2380
<table>
<thead>
<tr>
<th>Command</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>show security macsec statistics (MX Series)</td>
<td>2383</td>
</tr>
<tr>
<td>show security mka sessions (MX Series)</td>
<td>2388</td>
</tr>
<tr>
<td>show security mka statistics (MX Series)</td>
<td>2391</td>
</tr>
<tr>
<td>show vrrp</td>
<td>2394</td>
</tr>
<tr>
<td>traceroute ethernet</td>
<td>2405</td>
</tr>
</tbody>
</table>
# List of Figures

## Part 1 Ethernet Interfaces

### Chapter 6 Configuring IEEE 802.1x Port-Based Network Access Control in Enhanced LAN Mode
- Figure 1: VoIP Multiple Supplicant Topology ..................................................... 48
- Figure 2: VoIP Single Supplicant Topology .......................................................... 49
- Figure 3: Authentication Process Flow for an MX Series Router ......................... 66
- Figure 4: Example of a Captive Portal Login Page ............................................. 71
- Figure 5: Conceptual Model: Dynamic Filter Updated for Each New User ........... 98
- Figure 6: Multiple Supplicants on an 802.1X-Enabled Interface Connecting to a File Server .......................................................... 99

### Chapter 7 Configuring Aggregated Ethernet Interfaces for Increased Throughput and Link Redundancy
- Figure 7: Symmetric Load Balancing on an 802.3ad LAG on MX Series Routers ................................................. 157
- Figure 8: Traffic Polarization on Cascaded Routers When Symmetrical Load Balancing in Enabled on Trio-based MPCs ......................................................... 161
- Figure 9: Aggregated Ethernet Load Balancing .................................................. 176
- Figure 10: Configuring an Independent Micro BFD Session for LAG ................. 198

### Chapter 8 Configuring Ethernet Automatic Protection Switching for High Availability
- Figure 11: Connections Terminating on Single PE ............................................. 230
- Figure 12: Connections Terminating on a Different PE ....................................... 231
- Figure 13: Understanding APS Events ................................................................. 232
- Figure 14: Topology of a Network Using VPWS Psuedowires ............................. 233

### Chapter 9 Configuring Ethernet Ring Protection Switching for High Availability
- Figure 15: Protocol Packets from the Network to the Router ................................ 241
- Figure 16: Protocol Packets from the Router or Switch to the Network ............... 241
- Figure 17: Example of a Three-Node Ring Topology ......................................... 247

### Chapter 12 Configuring Private VLANs
- Figure 18: Subdomains in a PVLAN ................................................................. 296
- Figure 19: PVLAN Spanning Multiple Switches .................................................. 297
- Figure 20: Subdomains in a PVLAN With One Router ....................................... 298
- Figure 21: Private VLAN on a Single EX Switch ................................................ 299
- Figure 22: PVLAN Spanning Multiple EX Series Switches ................................. 300
- Figure 23: Configuring a PVLAN on a Single Switch ....................................... 305
- Figure 24: PVLAN Topology with Secondary VLAN Trunk Ports and Promiscuous Access Port ................................................................. 318

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### Chapter 13  Configuring Layer 2 Bridging Interfaces
- **Figure 25:** Configuring the MAC Address of an IRB Interface

### Chapter 16  Configuring Point-to-Point Protocol over Ethernet
- **Figure 26:** PPPoE Session on an Ethernet Loop

### Chapter 17  Configuring Restricted and Unrestricted Proxy ARP
- **Figure 27:** Edge Device Case for Unrestricted Proxy ARP
- **Figure 28:** Core Device Case for Unrestricted Proxy ARP

### Chapter 19  Configuring TCC and Layer 2.5 Switching
- **Figure 29:** Sample Translation Cross-Connect Topology
- **Figure 30:** Sample Topology of Layer 2.5 Translational Cross-Connect

### Part 2  Gigabit Ethernet Interfaces

#### Chapter 22  Configuring 10-Gigabit Ethernet LAN/WAN PICs
- **Figure 31:** Control Queue Rate Limiter Scenario

#### Chapter 28  Configuring Gigabit Ethernet OTN Options
- **Figure 32:** Pre-FEC BER Monitoring

#### Chapter 31  Stacking and Rewriting Gigabit Ethernet VLAN Tags
- **Figure 33:** swap-push (transparent tag)
- **Figure 34:** swap-push (no transparent tag)
- **Figure 35:** push (transparent tag)
- **Figure 36:** push-push (transparent tag)

### Part 3  Operation, Administration, and Management (OAM) for Ethernet Interfaces

#### Chapter 32  Configuring IEEE 802.1ag OAM Connectivity-Fault Management
- **Figure 37:** Relationship Among MEPs, MIPs, and Maintenance Domain Levels
- **Figure 38:** Relationship Among Bridges, Maintenance Domains, Maintenance Associations, and MEPs
- **Figure 39:** Scope of the E-LMI Protocol
- **Figure 40:** E-LMI Configuration for a Point-to-Point EVC (SVLAN) Monitored by CFM
- **Figure 41:** CET inter-op Dual Homed Topology
- **Figure 42:** CET inter-op Dual Attached Topology
- **Figure 43:** Topology of CET network
- **Figure 44:** Layer 2 VPN Topology
- **Figure 45:** Ethernet CFM on Physical Interfaces
- **Figure 46:** Ethernet CFM over a Bridge Network
- **Figure 47:** Ethernet OAM with VPLS

#### Chapter 33  Configuring IEEE 802.3ah OAM Link-Fault Management
- **Figure 48:** Ethernet LFM Between Provider Edge and Customer Edge
- **Figure 49:** Ethernet LFM for CCC
- **Figure 50:** Ethernet LFM for Aggregated Ethernet
- **Figure 51:** Ethernet LFM with Loopback Support
Chapter 34 Configuring ITU-T Y.1731 Ethernet Service OAM ...................... 853
Figure 52: Relationship of MEPs, MIPs, and Maintenance Domain Levels ...... 856
Figure 53: VPWS Service Configured Between Two MX Series Routers ....... 960
Figure 54: VPWS Service Configured Between Two MX Series Routers ...... 973

Chapter 35 Configuring Ethernet Ring Protection .............................. 989
Figure 55: Ethernet Ring Protection Example Nodes ............................... 992
Figure 56: ERP with Multiple Protection Instances Configured on Three MX Series Routers ......................................................... 1000

Chapter 36 CFM Action Profile to Bring Down a Group of Logical Interfaces ..... 1023
Figure 57: Topology of Multiple VLAN Services Sharing a Single Port on PE Router Destined to Multiple CE Routers ................................. 1024

Part 4 Troubleshooting Information

Chapter 37 Monitoring and Troubleshooting Ethernet Interfaces .................. 1031
Figure 58: RJ-45 Ethernet Loopback Plug .............................................. 1051
List of Tables

About the Documentation .................................................. li
Table 1: Notice Icons .......................................................... liii
Table 2: Text and Syntax Conventions ..................................... liv

Part 1 Ethernet Interfaces

Chapter 6 Configuring IEEE 802.1x Port-Based Network Access Control in Enhanced LAN Mode ............................................. 39

Table 3: Configurable Elements of a Captive Portal Login Page .......... 71
Table 4: Components of the MAC RADIUS Authentication Configuration
  Topology ........................................................................ 78
Table 5: Components of the Topology ...................................... 88
Table 6: Components of the Topology ...................................... 91
Table 7: Components of the Static MAC Authentication Configuration
  Topology ........................................................................ 95

Chapter 7 Configuring Aggregated Ethernet Interfaces for Increased Throughput and Link Redundancy ............................................. 103

Table 8: Platform Support Matrix for Mixed Aggregated Ethernet Bundles ................................................................. 106
Table 9: Hashing Behavior for Pseudowire (Layer 2 Circuit) and Bridging Services ............................................................ 117
Table 10: Hashing Behavior for IP Services .................................. 118
Table 11: Platform Support Matrix for Mixed Aggregated Ethernet Bundles ................................................................. 121
Table 12: Platform Support Matrix for Mixed Aggregated Ethernet Bundles on MX Series Routers ................................................... 124
Table 13: Untagged Aggregated Ethernet and LACP Support by PIC and Platform ................................................................. 143

Chapter 11 Configuring 802.1Q VLANs .............................................. 259

Table 14: VLAN ID Range by Interface Type .................................. 261
Table 15: Configuration Statements Used to Bind VLAN IDs to Logical Interfaces ................................................................. 270
Table 16: Configuration Statements Used to Associate VLAN IDs to VLAN Demux Interfaces ................................................................. 274
Table 17: Encapsulation Inside Circuits CCC-Connected by VLAN-Bundled Logical Interfaces ................................................................. 290

Chapter 12 Configuring Private VLANs ............................................. 293

Table 18: When VLANs in a PVLAN Need 802.1Q Tags ...................... 301
Table 19: PVLAN Ports and Layer 2 Forwarding on EX Series switches that support ELS ................................................................. 303
Table 20: PVLAN Ports and Layer 2 Connectivity ................................ 303
Table 21: PVLAN Ports and Layer 2 Connectivity on EX Series Switches without ELS Support ........................................ 304
Table 22: Components of the Topology for Configuring a Secondary VLAN Trunk on Switch 1 ........................................ 318
Table 23: Components of the Topology for Configuring a Secondary VLAN Trunk on Switch 2 ........................................ 319
Chapter 14 Configuring Link Layer Discovery Protocol .................. 355
Table 24: LLDP Operational Mode Commands ................................ 361
Chapter 20 Configuring Link Degrade Monitoring ......................... 399
Table 25: Line Cards that Support Link Degrade Monitoring ............. 400
Chapter 21 Configuring Power-over-Ethernet on ACX Series ........... 401
Table 26: PoE Specifications for the ACX2000 Routers ...................... 402
Table 27: ACX2000 Universal Metro Router PoE Specifications .......... 402
Table 28: PoE Configuration Options and Default Settings ................ 403
Table 29: Components of the PoE Configuration ............................ 404
Table 30: Troubleshooting a PoE Interface ................................... 409
Part 2 Gigabit Ethernet Interfaces
Chapter 22 Configuring 10-Gigabit Ethernet LAN/WAN PICs ........... 413
Table 31: Capabilities of 10-Gigabit Ethernet LAN/WAN PICs ............ 416
Table 32: Handling Oversubscription on 10-Gigabit Ethernet LAN/WAN PICs .. 426
Table 33: Port Number Mapping When Port Groups Are Configured .......... 431
Table 34: Port Number Mapping When Port Groups Are Not Configured ...... 433
Chapter 26 Configuring 100-Gigabit Ethernet PICs/MICs ............... 455
Table 35: MX Series 100-Gigabit Ethernet Interfaces ...................... 456
Table 36: PTX Series 100-Gigabit Ethernet Interfaces ..................... 456
Table 37: T Series 100-Gigabit Ethernet Interfaces .......................... 457
Table 38: Capabilities of 100-Gigabit Ethernet Type 5 PIC with CFP .......... 470
Table 39: 100-Gigabit Ethernet MIC with CFP (MIC3-3D-1X100GE-CFP) Interoperability ........................................ 471
Table 40: MPC4E Interoperability ............................................. 471
Table 41: 100-Gigabit Ethernet PIC with CFP (Type 5) (P1-PTX-2-100GE-CFP) Interoperability ........................................ 472
Table 42: 100-Gigabit Ethernet PIC with CFP (Type 4) PD-1CE-CFP-FPC4 Interoperability ........................................ 472
Chapter 27 Configuring Rate Selectability ................................. 481
Table 43: Interface Naming Convention for MPC7E-MRATE .............. 488
Table 44: Interface Naming Convention for MIC-MRATE Installed on Slot 0 of MPC8E and MPC9E ........................................ 490
Table 45: Interface Naming Convention for MIC-MRATE Installed on Slot 1 of MPC8E and MPC9E ........................................ 490
Table 46: Interface Naming Convention for MIC-MRATE Installed on Slot 0 of Mx10003MPC ........................................ 491
Table 47: Interface Naming Convention for the Fixed-Port PIC Installed in Slot 1 of MX10003 MPC ........................................ 492
Table 48: Interface Naming Convention for Modular MIC Installed in Slot 1 of MX10003 MPC .................................................. 493
Table 49: Interface Naming Convention for JNP10K-LC2101 MPC .................. 494
Table 50: Interface Naming Convention for MPC10E-15C-MRATE .................. 496
Table 51: Active Physical Ports on MPC7E-MRATE MPC for Configuring Rate Selectability at PIC Level .......................... 498
Table 52: Active Physical Ports on MIC-MRATE on MPC8E MPC for Configuring Rate Selectability at MIC Level ...................... 499
Table 53: Active Physical Ports on MIC-MRATE on MPC9E MPC and MPC8E MPC in 1.6T Mode for Configuring Rate Selectability at MIC Level .......... 499
Table 54: Active Physical Ports on the MX10003 MPC for configuring rate selectability at the PIC level .................................. 501
Table 55: Active Physical Ports on MX10003 MPC for configuring rate selectability at the PIC level .................................. 501
Table 56: Active Physical Ports on the MX204 Router for Configuring Rate Selectability at PIC level .................................. 503
Table 57: Without number-of-ports But with Rate Selectability at PIC Level for MX204 Router .......................................................... 504
Table 58: With number-of-ports Rate Selectability at PIC level for MX204 Router ........................................................................ 504
Table 59: Active Ports with number-of-ports and without rate-selectability ... 505
Table 60: Active Ports without number-of-ports and with speed configured at PIC level ................................................................. 505
Table 61: Active Ports with number-of-ports and rate selectability at PIC level ............................................................................. 506
Table 62: Active Physical Ports on MPC7E-MRATE MPC Based on the number-of-ports Configuration ........................................... 512
Table 63: Rate Selectability of MX10003 MPC .................................................. 517
Table 64: PFE Based Port Mode Configuration .................................................. 519
Table 65: PIC Mode Configuration ................................................................. 519
Table 66: Rate Selectability of MX204 Routers ................................................. 523
Table 67: Configurable Rate Selectability of MX204 Router ....................... 525
Table 68: Maximum number of 10/40/100 Gigabit Ethernet ports Configurable at PIC and Port Level ............................................. 526
Table 69: Port Configuration at PIC Level in MX204 Routers ....................... 526
Table 70: Rate Selectability of MPC10E-15C-MRATE ........................................ 529
Table 71: Port speed capability of MPC10E-15C-MRATE ................................. 530
Table 72: Interface Naming Convention for MIC-MACSEC-20GE ................. 545
Table 73: MIC/PIC Mapping for MPC1E and MPC1E-Q ................................. 551
Table 74: MIC/PIC Mapping for MPC2E, MPC2E-Q, and MPC2E-EQ ............ 556

Chapter 28 Configuring Gigabit Ethernet OTN Options .......................... 561
Table 75: Wavelength-to-Frequency Conversion Matrix ................................. 564
Table 76: Statements Supported on ACX6360 Routers ................................. 580
Table 77: Example—Signal Degrade and Clear Threshold Values at 1 dBQ ...... 585
Table 78: Example—Signal Degrade and Clear Thresholds After Configuration ................................................................. 585
Table 79: FEC modes Supported on MX Series Routers ............................... 586
Table 80: FEC Modes Supported on PTX Series Routers ............................... 587
Table 81: FEC modes Supported on ACX6360 Routers.......................... 588
Table 82: Statements Supported on 100-Gigabit Ethernet PICs on PTX Series Routers ................................................................. 591
Table 83: Statements Supported on 100-Gigabit Ethernet MICs on MX Series Routers ................................................................. 599
Table 84: Statements Supported on ACX6360 Routers .......................... 606
Table 85: Statements Supported on PTX10K-LC1104 line cards ............... 640
Table 86: Statements Supported on PTX10008 and PTX10016 Series Routers .................................................................................. 646

Chapter 29 Configuring Gigabit Ethernet Accounting and Policing .............. 661
Table 87: Capabilities of Gigabit Ethernet IQ and Gigabit Ethernet with SFPs . 662
Table 88: Adjustment Bytes for Logical Interfaces over Ethernet Interfaces . 666
Table 89: Default Forwarding Classes .................................................. 674

Chapter 30 Configuring Gigabit Ethernet Autonegotiation .......................... 683
Table 90: Mode and Autonegotiation Status (Local) ................................. 685
Table 91: Mode and Autonegotiation Status (Remote) ............................... 687

Chapter 31 Stacking and Rewriting Gigabit Ethernet VLAN Tags ................. 691
Table 92: Rewrite Operations on Untagged, Single-Tagged, and Dual-Tagged Frames ................................................................. 694
Table 93: Applying Rewrite Operations to VLAN Maps .......................... 695
Table 94: Rewrite Operations and Statement Usage for Input VLAN Maps . 699
Table 95: Rewrite Operations and Statement Usage for Output VLAN Maps .. 700
Table 96: Input VLAN Map Statements Allowed for ethernet-ccc and ethernet-vpls Encapsulations ........................................... 707
Table 97: Output VLAN Map Statements Allowed for ethernet-ccc and ethernet-vpls Encapsulations ........................................... 707
Table 98: Rules for Applying Rewrite Operations to VLAN Maps ............... 708
Table 99: VLAN Map Operation and IEEE 802.1p Inheritance .................. 718

Part 3 Operation, Administration, and Management (OAM) for Ethernet Interfaces

Chapter 32 Configuring IEEE 802.1ag OAM Connectivity-Fault Management .... 725
Table 100: Service Protection Options ............................................... 752
Table 101: Format of TLVs ................................................................ 768
Table 102: Type Field Values for Various TLVs for CFM PDUs .................. 768
Table 103: Port Status TLV Format .................................................... 771
Table 104: Port Status TLV Values ..................................................... 771
Table 105: Interface Status TLV Format ............................................. 773
Table 106: Interface Status TLV Values ............................................. 774
Table 107: Loss Threshold TLV Format .............................................. 790

Chapter 34 Configuring ITU-T Y.1731 Ethernet Service OAM .................... 853
Table 108: Displaying Iterator Statistics for Ethernet Delay Measurement Output Fields .............................................................. 893
Table 109: Displaying Iterator Statistics for Ethernet Loss Measurement Output Fields .............................................................. 895
Table 110: ETH-DM Statistics ............................................................. 904
Table 111: ETH-DM Frame Counts ............................................. 906
Table 112: Scaling Values for CFM and PM (CCM Interval: 1 sec and PM Interval: 
1 sec) .............................................................. 930
Table 113: Scaling Values for CFM and PM (CCM Interval: 1 sec and PM interval: 
100 ms) ............................................................ 931
Table 114: Scaling Values for CFM and PM (CCM Interval: 100 ms and PM interval: 
1 sec) ............................................................. 931
Table 115: Scaling Values for CFM and PM (CCM Interval: 100 ms and PM interval: 
100 ms) .......................................................... 931
Table 116: Operational Mode Commands .................................. 939
Table 117: AIS Transmission Periodicity .................................. 941
Table 118: Monitor Ethernet Delay Command Parameters .................. 985
Table 119: Show Ethernet Delay Command Parameters ..................... 986

Chapter 35 Configuring Ethernet Ring Protection .......................... 989
Table 120: Components of the Network Topology ........................... 1000

Part 4 Troubleshooting Information
Chapter 37 Monitoring and Troubleshooting Ethernet Interfaces .......... 1031
Table 121: Loopback Modes by Interface Type ............................... 1032
Table 122: BERT Capabilities by Interface Type .............................. 1036
Table 123: Checklist for Monitoring Fast Ethernet and Gigabit Ethernet 
Interfaces ....................................................... 1038
Table 124: Checklist for Monitoring Fast Ethernet and Gigabit Ethernet 
Interfaces ...................................................... 1038
Table 125: Status of Fast Ethernet Interfaces .................................. 1040
Table 126: Status of Gigabit Ethernet Interfaces ............................. 1041
Table 127: Errors to Look For .................................................. 1044
Table 128: MAC Statistics Errors .............................................. 1045
Table 129: Autonegotiation Information ....................................... 1045
Table 130: Fiber-Optic Ethernet Interface Specifications ..................... 1047
Table 131: Checklist for Using Loopback Testing for Fast Ethernet and Gigabit 
Ethernet Interfaces ............................................. 1049
Table 132: Problems and Solutions for a Physical Link That Is Down ...... 1056
Table 133: Checklist for Locating Fast Ethernet and Gigabit Ethernet Alarms and 
Counters ......................................................... 1064
Table 134: Major Fast Ethernet and Gigabit Ethernet Counters ............. 1066

Part 5 Configuration Statements and Operational Commands
Chapter 38 Configuration Statements (OTN) ................................. 1073
Table 135: Default Clear Threshold Values ................................... 1078
Table 136: Default Signal Degrade Threshold Values ......................... 1081
Chapter 40 Configuration Statements ......................................... 1195
Table 137: Options for speed .................................................. 1534
Table 138: Options for traceoptions ........................................... 1569
Chapter 41 Operational Commands ........................................... 1629
Table 139: monitor ethernet delay-measurement one-way Output Fields ... 1655
<table>
<thead>
<tr>
<th>Table Number</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>140</td>
<td>monitor ethernet delay-measurement two-way Output Fields</td>
<td>1656</td>
</tr>
<tr>
<td>141</td>
<td>monitor ethernet loss-measurement output fields</td>
<td>1660</td>
</tr>
<tr>
<td>142</td>
<td>monitor ethernet synthetic-loss-measurement Output Fields</td>
<td>1665</td>
</tr>
<tr>
<td>143</td>
<td>monitor ethernet synthetic-loss-measurement Output Fields</td>
<td>1669</td>
</tr>
<tr>
<td>144</td>
<td>Routing Engines Displaying DIMM Information</td>
<td>1681</td>
</tr>
<tr>
<td>145</td>
<td>show chassis hardware Output Fields</td>
<td>1687</td>
</tr>
<tr>
<td>146</td>
<td>show chassis pic Output Fields</td>
<td>1950</td>
</tr>
<tr>
<td>147</td>
<td>show ethernet-switching redundancy-groups arp-statistics Output Fields</td>
<td>1973</td>
</tr>
<tr>
<td>148</td>
<td>show ethernet-switching redundancy-groups nd-statistics Output Fields</td>
<td>1974</td>
</tr>
<tr>
<td>149</td>
<td>show ethernet-switching redundancy-groups remote-macs Output Fields</td>
<td>1974</td>
</tr>
<tr>
<td>150</td>
<td>Adaptive Services and Redundant Adaptive Services show interfaces Output Fields</td>
<td>1977</td>
</tr>
<tr>
<td>151</td>
<td>Aggregated Ethernet show interfaces Output Fields</td>
<td>1986</td>
</tr>
<tr>
<td>152</td>
<td>show interfaces demux0 (Demux Interfaces) Output Fields</td>
<td>1996</td>
</tr>
<tr>
<td>153</td>
<td>show interfaces diagnostics optics Output Fields for 10-Gigabit Ethernet DWDM and DWDM OTN PICs</td>
<td>2007</td>
</tr>
<tr>
<td>154</td>
<td>show interfaces diagnostics optics Output Fields for Gigabit Ethernet Bidirectional SFP Optics</td>
<td>2008</td>
</tr>
<tr>
<td>155</td>
<td>show interfaces diagnostics Output Fields for Gigabit Ethernet SFP Transceivers</td>
<td>2012</td>
</tr>
<tr>
<td>156</td>
<td>show interfaces diagnostics optics Output Fields for 10-Gigabit Ethernet Transceivers</td>
<td>2014</td>
</tr>
<tr>
<td>157</td>
<td>show interfaces diagnostics optics Output Fields for 10-Gigabit Ethernet XFP Transceivers</td>
<td>2017</td>
</tr>
<tr>
<td>158</td>
<td>show interfaces diagnostics optics Output for Virtual Chassis Ports</td>
<td>2019</td>
</tr>
<tr>
<td>159</td>
<td>show interfaces far-end-interval Output Fields</td>
<td>2041</td>
</tr>
<tr>
<td>160</td>
<td>show interfaces Fast Ethernet Output Fields</td>
<td>2043</td>
</tr>
<tr>
<td>161</td>
<td>show interfaces (Gigabit Ethernet) Output Fields</td>
<td>2065</td>
</tr>
<tr>
<td>162</td>
<td>Gigabit and 10 Gigabit Ethernet IQ PIC Traffic and MAC Statistics by Interface Type</td>
<td>2092</td>
</tr>
<tr>
<td>163</td>
<td>show interfaces Output Fields</td>
<td>2093</td>
</tr>
<tr>
<td>164</td>
<td>show interfaces Output Fields for M Series, MX Series, T Series, and PTX Series Routers Management Ethernet Interface</td>
<td>2141</td>
</tr>
<tr>
<td>165</td>
<td>show interfaces (PPPoE) Output Fields</td>
<td>2157</td>
</tr>
<tr>
<td>166</td>
<td>Ethernet show interfaces interface-set Output Fields</td>
<td>2167</td>
</tr>
<tr>
<td>167</td>
<td>Ethernet show interfaces interface-set queue Output Fields</td>
<td>2172</td>
</tr>
<tr>
<td>168</td>
<td>show interfaces interval Output Fields</td>
<td>2180</td>
</tr>
<tr>
<td>169</td>
<td>show interfaces irb Output Fields</td>
<td>2184</td>
</tr>
<tr>
<td>170</td>
<td>show interfaces mac-database Output Fields</td>
<td>2192</td>
</tr>
<tr>
<td>171</td>
<td>show interfaces mc-ae Output Fields</td>
<td>2197</td>
</tr>
<tr>
<td>172</td>
<td>show interfaces transport pm Output Fields</td>
<td>2202</td>
</tr>
<tr>
<td>173</td>
<td>show l2-learning instance Output Fields</td>
<td>2207</td>
</tr>
<tr>
<td>174</td>
<td>show l2-learning redundancy-groups arp-statistics Output Fields</td>
<td>2210</td>
</tr>
<tr>
<td>175</td>
<td>show l2-learning redundancy-groups nd-statistics Output Fields</td>
<td>2210</td>
</tr>
<tr>
<td>176</td>
<td>show l2-learning redundancy-groups remote-macs Output Fields</td>
<td>2211</td>
</tr>
</tbody>
</table>
Table 177: show lACP interfaces Output Fields ........................................... 2215
Table 178: show lldp Output Fields .......................................................... 2219
Table 179: show lldp local-information Output Fields ............................. 2222
Table 180: show lldp neighbors Output Fields .......................................... 2225
Table 181: show lldp remote-global-statistics Output Fields ...................... 2231
Table 182: show lldp statistics Output Fields ........................................... 2233
Table 183: show oam ethernet connectivity-fault-management delay-statistics
and mep-statistics Output Fields ........................................................... 2237
Table 184: show oam ethernet connectivity-fault-management forwarding-state
Output Fields ......................................................................................... 2240
Table 185: show oam ethernet connectivity-fault-management interfaces Output
Fields .................................................................................................... 2245
Table 186: show oam ethernet connectivity-fault-management linktrace
path-database Output Fields ................................................................. 2255
Table 187: show oam ethernet connectivity-fault-management loss-statistics
Output Fields ......................................................................................... 2258
Table 188: show oam ethernet connectivity-fault-management mep-database
Output Fields ......................................................................................... 2263
Table 189: show oam ethernet connectivity-fault-management delay-statistics
and mep-statistics Output Fields ........................................................... 2275
Table 190: show oam ethernet connectivity-fault-management path-database
Output Fields ......................................................................................... 2286
Table 191: show oam ethernet connectivity-fault-management policer Output
Fields ..................................................................................................... 2288
Table 192: show oam ethernet connectivity-fault-management
sla-iterator-statistics Output Fields ......................................................... 2292
Table 193: show oam ethernet connectivity-fault-management
synthetic-loss-statistics Output Fields .................................................... 2302
Table 194: show oam evc Output Fields ...................................................... 2304
Table 195: show oam fnp interface Output Fields ....................................... 2306
Table 196: show oam fnp messages Output Fields ...................................... 2308
Table 197: show oam fnp status Output Fields ........................................... 2310
Table 198: show oam link-fault-management Output Fields ...................... 2312
Table 199: show oam lmi Output Fields ....................................................... 2320
Table 200: show oam lmi statistics Output Fields ........................................ 2322
Table 201: show pppoe interfaces Output Fields ........................................ 2324
Table 202: show pppoe service-name-tables Output Fields ......................... 2328
Table 203: show pppoe sessions Output Fields .......................................... 2331
Table 204: show pppoe statistics Output Fields ........................................... 2333
Table 205: show pppoe underlying-interfaces Output Fields ........................ 2336
Table 206: show pppoe version Output Fields ............................................ 2342
Table 207: show protection-group ethernet-ring aps Output Fields ............ 2345
Table 208: show protection-group ethernet-ring configuration Output Fields 2348
Table 209: show protection-group ethernet-ring data-channel Output Fields 2355
Table 210: show protection-group ethernet-ring flush-info Output Fields 2358
Table 211: MX Series Routers show protection-group ethernet-ring interface
Output Fields ......................................................................................... 2361
Table 212: show protection-group ethernet-ring node-state Output Fields .... 2365
Table 213: show protection-group ethernet-ring statistics Output Fields 2370
Table 214: show protection-group ethernet-ring statistics detail Output Fields (for MX Series Routers) ............................................. 2371
Table 215: show protection-group ethernet-ring vlan Output Fields .......... 2375
Table 216: show security macsec connections Output Fields ................. 2380
Table 217: show security macsec statistics Output Fields ..................... 2383
Table 218: show security mka sessions Output Fields .......................... 2388
Table 219: show security mka statistics Output Fields ......................... 2391
Table 220: show vrrp Output Fields ........................................... 2395
Table 221: traceroute ethernet Output Fields ................................. 2406
About the Documentation

- Documentation and Release Notes on page li
- Using the Examples in This Manual on page li
- Documentation Conventions on page liii
- Documentation Feedback on page lv
- Requesting Technical Support on page lv

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 https://www.juniper.net/documentation/.

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 https://www.juniper.net/books.

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.

   ```xml
   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.xsl; 
   }
   ```
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 CLI Explorer.

**Documentation Conventions**

**Table 1: Notice Icons**

<table>
<thead>
<tr>
<th>Icon</th>
<th>Meaning</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>📚</td>
<td>Informational note</td>
<td>Indicates important features or instructions.</td>
</tr>
<tr>
<td>🚨</td>
<td>Caution</td>
<td>Indicates a situation that might result in loss of data or hardware damage.</td>
</tr>
<tr>
<td>⚠️</td>
<td>Warning</td>
<td>Alerts you to the risk of personal injury or death.</td>
</tr>
<tr>
<td>🌡️</td>
<td>Laser warning</td>
<td>Alerts you to the risk of personal injury from a laser.</td>
</tr>
<tr>
<td>💡</td>
<td>Tip</td>
<td>Indicates helpful information.</td>
</tr>
<tr>
<td>🏆</td>
<td>Best practice</td>
<td>Alerts you to a recommended use or implementation.</td>
</tr>
</tbody>
</table>

**Table 2 on page liv** defines the text and syntax conventions used in this guide.
Table 2: Text and Syntax Conventions

<table>
<thead>
<tr>
<th>Convention</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bold text like this</strong></td>
<td>Represents text that you type.</td>
<td>To enter configuration mode, type the configure command: user@host&gt; configure</td>
</tr>
<tr>
<td><strong>Fixed-width text like this</strong></td>
<td>Represents output that appears on the terminal screen.</td>
<td>user@host&gt; show chassis alarms No alarms currently active</td>
</tr>
<tr>
<td><strong>Italic text like this</strong></td>
<td>• Introduces or emphasizes important new terms. • Identifies guide names. • Identifies RFC and internet draft titles.</td>
<td>• A policy term is a named structure that defines conditions and actions. • Junos OS CLI User Guide • RFC 1997, BGP Communities Attribute</td>
</tr>
<tr>
<td><strong>Italic text like this</strong></td>
<td>Represents variables (options for which you substitute a value) in commands or configuration statements.</td>
<td>Configure the machine's domain name: [edit] root@# set system domain-name domain-name</td>
</tr>
<tr>
<td><strong>Text like this</strong></td>
<td>Represents names of configuration statements, commands, files, and directories; configuration hierarchy levels; or labels on routing platform components.</td>
<td>To configure a stub area, include the stub statement at the [edit protocols ospf area area-id] hierarchy level. • The console port is labeled CONSOLE.</td>
</tr>
<tr>
<td>&lt; &gt; (angle brackets)</td>
<td>Encloses optional keywords or variables.</td>
<td>stub &lt;default-metric metric&gt;;</td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td>broadcast</td>
</tr>
<tr>
<td></td>
<td>Indicates a comment specified on the same line as the configuration statement to which it applies.</td>
<td>rsvp { # Required for dynamic MPLS only</td>
</tr>
<tr>
<td></td>
<td>Encloses a variable for which you can substitute one or more values.</td>
<td>community name members [community-ids]</td>
</tr>
<tr>
<td></td>
<td>Identifies a level in the configuration hierarchy.</td>
<td>[edit] routing-options { static { route default { nexthop address; retain; } } }</td>
</tr>
<tr>
<td>: (semicolon)</td>
<td>Identifies a leaf statement at a configuration hierarchy level.</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Convention</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
</table>
| **Bold text like this**       | Represents graphical user interface (GUI) items you click or select. | • In the Logical Interfaces box, select All Interfaces.  
                               |                                                                       | • To cancel the configuration, click Cancel.               |
| > (bold right angle bracket) | Separates levels in a hierarchy of menu selections.  | In the configuration editor hierarchy, select Protocols>Ospf.            |

Documentation Feedback

We encourage you to provide feedback so that we can improve our documentation. You can use either of the following methods:

- Online feedback system—Click TechLibrary Feedback, on the lower right of any page on the Juniper Networks TechLibrary site, and do one of the following:
  
  - Click the thumbs-up icon if the information on the page was helpful to you.
  - Click the thumbs-down icon if the information on the page was not helpful to you or if you have suggestions for improvement, and use the pop-up form to provide feedback.
  - E-mail—Send your comments to techpubs-comments@juniper.net. Include the document or topic name, URL or page number, and software version (if applicable).

Requesting Technical Support

Technical product support is available through the Juniper Networks Technical Assistance Center (JTAC). If you are a customer with an active Juniper Care or Partner Support Services 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.

- Product warranties—For product warranty information, visit https://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: https://www.juniper.net/customers/support/
- Search for known bugs: https://prsearch.juniper.net/
- Find product documentation: https://www.juniper.net/documentation/
- Find solutions and answer questions using our Knowledge Base: https://kb.juniper.net/
- Download the latest versions of software and review release notes: https://www.juniper.net/customers/csc/software/
- Search technical bulletins for relevant hardware and software notifications: https://kb.juniper.net/InfoCenter/
- Join and participate in the Juniper Networks Community Forum: https://www.juniper.net/company/communities/
- Create a service request online: https://myjuniper.juniper.net

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

Creating a Service Request with JTAC

You can create a service request with JTAC on the Web or by telephone.

- Visit https://myjuniper.juniper.net.
- 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 https://support.juniper.net/support/requesting-support/.
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 27
- Enabling Passive Monitoring on Ethernet Interfaces on page 31
- Configuring IEEE 802.1x Port-Based Network Access Control on page 35
- Configuring IEEE 802.1x Port-Based Network Access Control in Enhanced LAN Mode on page 39
- Configuring Aggregated Ethernet Interfaces for Increased Throughput and Link Redundancy on page 103
- Configuring Ethernet Automatic Protection Switching for High Availability on page 229
- Configuring Ethernet Ring Protection Switching for High Availability on page 237
- Configuring MAC Address Validation on Static Ethernet Interfaces on page 255
- Configuring 802.1Q VLANs on page 259
- Configuring Private VLANs on page 293
- Configuring Layer 2 Bridging Interfaces on page 343
- Configuring Link Layer Discovery Protocol on page 355
- Configuring VRRP and VRRP for IPv6 on page 363
- Configuring Point-to-Point Protocol over Ethernet on page 367
- Configuring Restricted and Unrestricted Proxy ARP on page 385
- Configuring Static ARP Table Entries on page 389
- Configuring TCC and Layer 2.5 Switching on page 393
- Configuring Link Degrade Monitoring on page 399
- Configuring Power-over-Ethernet on ACX Series on page 401
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 14
- Configuring Ethernet Loopback Capability on page 19
- Configuring Flow Control on page 12
- Ignoring Layer 3 Incomplete Errors on page 20
- Configuring the Link Characteristics on Ethernet Interfaces on page 13
- Configuring Gratuitous ARP on page 20
- Adjusting the ARP Aging Timer on page 21
- Configuring the Interface Speed on Ethernet Interfaces on page 8
- Configuring the Ingress Rate Limit on page 11
- Configuring Multicast Statistics Collection on Ethernet Interfaces on page 22
- Configuring Weighted Random Early Detection on page 22
- Ethernet Interfaces Feature Guide for Routing Devices
- Junos OS Network Interfaces Library for Routing Devices

MX Series Router Interface Identifiers

Juniper Networks MX Series 5G Universal Routing Platforms 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 11
- Understanding Flow Control on page 11
- Configuring Flow Control on page 12
- Configuring the Link Characteristics on Ethernet Interfaces on page 13
- Configuring MAC Address Filtering for Ethernet Interfaces on page 14
- Configuring MAC Address Filtering on PTX Series Packet Transport Routers on page 16
- MAC Address Accounting for Dynamically Learned Addresses on Aggregated Ethernet Interfaces Overview on page 18
- Configuring Ethernet Loopback Capability on page 19
- Ignoring Layer 3 Incomplete Errors on page 20
- Configuring Gratuitous ARP on page 20
- Adjusting the ARP Aging Timer on page 21
- Configuring Weighted Random Early Detection on page 22
- Configuring Multicast Statistics Collection on Ethernet Interfaces on page 22
- Displaying Internal Ethernet Interfaces for a Routing Matrix with a TX Matrix Plus Router on page 23

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
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.

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:
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 \(\text{gigether-options}\) 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 \(\text{optics-options}\) 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 \(\text{gigether-options}\) 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).
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 xe-fpc/pic/port]
user@host# set gigether-options {
```

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 445
- 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.
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 | auto | auto-10m-100m);
```
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.

- Starting with Junos OS Release 14.2 the auto-10m-100m option allows the fixed tri-speed port to auto negotiate with ports limited by 100m or 10m maximum speed. This option must be enabled only for Tri-rate MPC port, that is, 3D 40x 1GE (LAN) RJ45 MIC on MX platform. This option does not support other MICs on MX platform.

- 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.

- Starting with Junos OS Release 11.4, 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.

### Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.2</td>
<td>Starting with Junos OS Release 14.2 the <strong>auto-10m-100m</strong> option allows the fixed tri-speed port to auto negotiate with ports limited by <strong>100m</strong> or <strong>10m</strong> maximum speed. This option must be enabled only for Tri-rate MPC port, that is, 3D 40x 1GE (LAN) RJ45 MIC on MX platform. This option does not support other MICs on MX platform.</td>
</tr>
<tr>
<td>11.4</td>
<td>Starting with Junos OS Release 11.4, half-duplex mode is not supported on Tri-Rate Ethernet copper interfaces. When you include the <strong>speed</strong> statement, you must include the <strong>link-mode full-duplex</strong> statement at the same hierarchy level.</td>
</tr>
</tbody>
</table>

### Related Documentation

- speed on page 1530
- Ethernet Interfaces Overview on page 3
### 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.

### 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 enabled. 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 11

### 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
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.)

**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:

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

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

```plaintext
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 1318
• Ethernet Interfaces Overview on page 3
• 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.
When you configure the Tri-Rate Ethernet copper interface to operate at 1 Gbps, autonegotiation must be enabled.

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.

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);
```

Starting with Junos OS release 17.4R1 and later, the `link-mode` configuration is not supported for 10-Gigabit Ethernet interfaces.

Related Documentation
- link-mode on page 1375
- 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 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]
```
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 `nnnn:nnnn:nnnn` 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 MAC Address Filtering" on page 676.

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 143.
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-SFP and MPC4E-3D-2CGE-8XGE); instead, include the accept-source-mac statement. For more information, see “Configuring MAC Address Filtering” on page 676.

Related Documentation

- source-address-filter on page 1528
- Configuring MAC Address Filtering on page 676
- Configuring LACP for Aggregated Ethernet Interfaces on page 143
- 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` 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 2191
MAC Address Accounting for Dynamically Learned Addresses on Aggregated Ethernet Interfaces Overview

Junos OS supports 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 ae 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.

### Release History Table

<table>
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</tr>
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<tr>
<td>15.1</td>
<td>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.</td>
</tr>
</tbody>
</table>

### Related Documentation
- [mac-learn-enable on page 1399](#)

## 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:

```plaintext
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:

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

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

```plaintext
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 gigether-options]`
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 gigether-options]`

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

```yaml
[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:

```yaml
[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.

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

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

```yaml
[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:

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

**Related Documentation**

- `gratuitous-arp-reply` on page 1330
- `no-gratuitous-arp-request` on page 1429
- Ethernet Interfaces Overview on page 3
- *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:

```conf
[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*.

### 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).

For information on configuring WRED, see the *Class of Service Feature Guide (Routers and EX9200 Switches)*.

### 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 208
- 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:

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

Interface       Admin Link Proto    Local                 Remote
em0             up    up    inet     192.168.35.95/24
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    inet     10.34.0.4/8
ixgbe0.0        up    up    inet     10.34.0.4/8
inet6           162.0.0.4/2
inet6           fe80::200:ff:fe22:4/64
inet6           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    inet     10.34.0.4/8
ixgbe1.0        up    up    inet     10.34.0.4/8
inet6           162.0.0.4/2
inet6           fe80::200:ff:fe22:4/64
inet6           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 hostname `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.

```bash
user@host-sfc-0> request routing-engine login lcc 2
```
```
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
<table>
<thead>
<tr>
<th>Interface</th>
<th>Admin</th>
<th>Link</th>
<th>Proto</th>
<th>Local</th>
<th>Remote</th>
</tr>
</thead>
<tbody>
<tr>
<td>em0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>em0.0</td>
<td>up</td>
<td>up</td>
<td>inet</td>
<td>192.168.35.117/24</td>
<td></td>
</tr>
</tbody>
</table>

user@host-sfc-0-lcc-2> show interfaces bcm0 terse
<table>
<thead>
<tr>
<th>Interface</th>
<th>Admin</th>
<th>Link</th>
<th>Proto</th>
<th>Local</th>
<th>Remote</th>
</tr>
</thead>
<tbody>
<tr>
<td>bcm0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bcm0.0</td>
<td>up</td>
<td>up</td>
<td>inet</td>
<td>10.1.0.5/8</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>129.0.0.5/2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>inet6</td>
<td>fe80::201:ff:fe01:5/64</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>fec0:a:1:0:5/64</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>tnp</td>
<td>0x1000005</td>
<td></td>
</tr>
</tbody>
</table>

user@host-sfc-0-lcc-2> show interfaces em1 terse
<table>
<thead>
<tr>
<th>Interface</th>
<th>Admin</th>
<th>Link</th>
<th>Proto</th>
<th>Local</th>
<th>Remote</th>
</tr>
</thead>
<tbody>
<tr>
<td>em1</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>em1.0</td>
<td>up</td>
<td>up</td>
<td>inet</td>
<td>10.1.0.5/8</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>129.0.0.5/2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>inet6</td>
<td>fe80::201:ff:fe01:5/64</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>fec0:a:1:0:5/64</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>tnp</td>
<td>0x1000005</td>
<td></td>
</tr>
</tbody>
</table>

Related Documentation

- Understanding Internal Ethernet Interfaces
CHAPTER 3

Configuring the Management Ethernet Interface

- Management Ethernet Interface Overview on page 27
- Configuring a Consistent Management IP Address on page 28
- Configuring the MAC Address on the Management Ethernet Interface on page 29

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 28
- Configuring the MAC Address on the Management Ethernet Interface on page 29
- Configuring MAC Address Filtering on PTX Series Packet Transport Routers on page 16
- 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.

```plaintext
[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;
        }
    }
}```
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 27
- Configuring the MAC Address on the Management Ethernet Interface on page 29
- 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, `00:11:22:33:44:55`) or `nn:nn:nn:nn:nn:nn` (for example,
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 27
- Configuring a Consistent Management IP Address on page 28
- Configuring MAC Address Filtering on PTX Series Packet Transport Routers on page 16
- Ethernet Interfaces Feature Guide for Routing Devices
Enabling Passive Monitoring on Ethernet Interfaces

• Passive Monitoring on Ethernet Interfaces Overview on page 31
• Enabling Passive Monitoring on Ethernet Interfaces on page 33

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: Starting with Junos OS Release 9.5, I2.0 based M120 routers and I3.0 based M320 routers with the PICs in the preceding list support passive monitoring. 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.
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 31. 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 31](#)
- [Configuring Multiservice Physical Interface Properties](#)
- [Junos OS Services Interfaces Library for Routing Devices](#)
- [Ethernet Interfaces Feature Guide for Routing Devices](#)
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.

**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.

**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.
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;
  }
}
```

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 35
- Understanding the Administrative State of the Authenticator Port on page 36
- Understanding the Administrative Mode of the Authenticator Port on page 36
- Configuring the Authenticator on page 37
- *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 41
- Understanding 802.1X and LLDP and LLDP-MED on MX Series Routers in Enhanced LAN Mode on page 43
- Understanding 802.1X and RADIUS Accounting on MX Series Routers in Enhanced LAN Mode on page 46
- Understanding 802.1X and VoIP on MX Series Routers in Enhanced LAN Mode on page 47
- Understanding Guest VLANs for 802.1X on MX Series Routers in Enhanced LAN Mode on page 50
- Understanding Dynamic VLANs for 802.1X on MX Series Routers in Enhanced LAN Mode on page 50
- Understanding Server Fail Fallback and Authentication on MX Series Routers in Enhanced LAN Mode on page 51
- Configuring 802.1X RADIUS Accounting on MX Series Routers in Enhanced LAN Mode on page 52
- Configuring 802.1X Interface Settings on MX Series Routers in Enhanced LAN Mode on page 54
- Configuring LLDP-MED on MX Series Routers in Enhanced LAN Mode on page 55
- Configuring LLDP on MX Series Routers in Enhanced LAN Mode on page 57
- Configuring Server Fail Fallback on MX Series Routers in Enhanced LAN Mode on page 61
- Understanding Captive Portal Authentication on the MX Series Routers on page 62
- Understanding Authentication Session Timeout on MX Series Routers on page 64
- Authentication Process Flow for MX Series Routers in Enhanced LAN Mode on page 65
- Specifying RADIUS Server Connections on an MX Series Router in Enhanced LAN Mode on page 67
- Configuring Captive Portal Authentication on MX Series Routers in Enhanced LAN Mode on page 68
- Designing a Captive Portal Authentication Login Page on an MX Series Router on page 70
- Configuring Static MAC Bypass of Authentication on MX Series Routers in Enhanced LAN Mode on page 73
- Controlling Authentication Session Timeouts on an MX Series Router in Enhanced LAN Mode on page 74
- Configuring MAC RADIUS Authentication on MX Series Routers in Enhanced LAN Mode on page 76
- Example: Configuring MAC RADIUS Authentication on an MX Series Router on page 77
- Example: Setting Up Captive Portal Authentication on an MX Series Router on page 82
- Example: Connecting a RADIUS Server for 802.1X to an MX Series Router on page 87
- Example: Setting Up 802.1X in Conference Rooms to Provide Internet Access to Corporate Visitors on an MX Series Router on page 90
- Example: Configuring Static MAC Bypass of Authentication on an MX Series Router on page 94
- Example: Applying Firewall Filters to Multiple Supplicants on Interfaces Enabled for 802.1X or MAC RADIUS Authentication on MX Series Routers on page 97
802.1X for MX Series Routers in Enhanced LAN Mode Overview

Starting with Junos OS Release 14.2, 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.

**Release History Table**

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<tr>
<td>14.2</td>
<td>Starting with Junos os Release 14.2, 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.</td>
</tr>
</tbody>
</table>

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

Starting with Junos OS Release 14.2, 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.
Starting with Junos OS Release 14.2, 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.

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**. Starting with Junos OS Release 14.2, you can configure RADIUS accounting on an MX Series router which enables 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.

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**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. Starting with Junos OS Release 14.2, 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 48.
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-suppliant mode. In single-suppliant 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 49.
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.

Figure 2: VoIP Single Supplicant Topology
Starting with Junos OS Release 14.2, 802.1X authentication provides network edge security, protecting Ethernet LANs from unauthorized user access.

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

Starting with Junos OS Release 14.2, 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

Starting with Junos OS Release 14.2, 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.

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

Starting with Junos OS Release 14.2, 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.
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### Configuring 802.1X RADIUS Accounting on MX Series Routers in Enhanced LAN Mode

Starting with Junos OS Release 14.2, 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
   ```
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
```

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<td>Starting with Junos OS Release 14.2, RADIUS accounting permits statistical data about users logging onto or off a LAN to be collected and sent to a RADIUS accounting server.</td>
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### Related Documentation
Configuring 802.1X Interface Settings on MX Series Routers in Enhanced LAN Mode

Starting with Junos OS Release 14.2, 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-0/0/5/0 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:
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 transmit-period 60

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 dot1x maximum-requests 5
   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.

---

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### 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. Starting with Junos OS Release 14.2, 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 56
- Configuring Location Information Advertised by the Router on page 56
- Configuring for Fast Start on page 56
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
country
  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.
Starting with Junos OS Release 14.2, the router uses LLDP-MED to support device discovery of VoIP telephones and to create location databases for these telephone locations.

14.2

Related Documentation

Configuring LLDP on MX Series Routers in Enhanced LAN Mode

Starting with Junos OS Release 14.2, 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 57
- Adjusting LLDP Advertisement Settings on page 58
- Adjusting SNMP Notification Settings of LLDP Changes on page 59
- Specifying a Management Address for the LLDP Management TLV on page 59

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 interface em0` 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.
### Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.2</td>
<td>Starting with Junos OS Release 14.2, 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.</td>
</tr>
</tbody>
</table>

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

Starting with Junos OS Release 14.2, 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.

---

**Release History Table**

<table>
<thead>
<tr>
<th>Release</th>
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</tr>
</thead>
<tbody>
<tr>
<td>14.2</td>
<td>Starting with Junos OS Release 14.2, 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.</td>
</tr>
</tbody>
</table>
Starting with Junos OS Release 14.2, 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` command 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.
Starting with Junos OS Release 14.2, 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.

Understanding Authentication Session Timeout on MX Series Routers

Starting with Junos OS Release 14.2, 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.
### Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.2</td>
<td>Starting with Junos OS Release 14.2, you can specify authentication session timeout values for captive portal authentication sessions and 802.1X and MAC RADIUS authentication sessions.</td>
</tr>
</tbody>
</table>

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

Starting with Junos OS Release 14.2, 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 66 illustrates the authentication process:
Figure 3: Authentication Process Flow for an MX Series Router
Starting with Junos OS Release 14.2, 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.

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.

Starting with Junos OS Release 14.2, 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.

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.2</td>
<td>Starting with Junos OS Release 14.2, 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.</td>
</tr>
</tbody>
</table>

**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.

Starting with Junos OS Release 14.2, 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 69
- Enabling an Interface for Captive Portal on page 69
- Configuring Bypass of Captive Portal Authentication on page 69

### 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.

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
</table>
| 14.2    | Starting with Junos OS Release 14.2, 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.

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

Starting with Junos OS Release 14.2, 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 71 shows an example of a captive portal login page:
**Table 3 on page 71** summarizes the configurable elements of a captive portal login page.

### Table 3: Configurable Elements of a Captive Portal Login Page

<table>
<thead>
<tr>
<th>Element</th>
<th>CLI Statement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Footer background color</td>
<td>footer-bgccolor hex-color</td>
<td>The HTML hexadecimal code for the background color of the captive portal login page footer.</td>
</tr>
</tbody>
</table>
| Footer message               | footer-message text-string | 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 Copyright ©2010, Juniper Networks Inc.  |
| Footer text color            | footer-text-color-color | Color of the text in the footer. The default color is white.                                                                                                                                                |
| Form header background color | form-header-bgccolor hex-color | 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          | form-header-message text-string | Text displayed in the header of the captive portal login page. The default text is Captive Portal User Authentication.                                                                                      |
| Form header text color       | form-header-text-color-color | Color of the text in the form header. The default color is black.                                                                                                                                            |
| Form reset button label      | form-reset-label label-name | Using the Reset button, the user can clear the username and password fields on the form.                                                                                                                    |
| Form submit button label     | form-submit-label label-name | Using the Login button, the user can submit the login information.                                                                                                                                          |
Table 3: Configurable Elements of a Captive Portal Login Page (continued)

<table>
<thead>
<tr>
<th>Element</th>
<th>CLI Statement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Header background color</td>
<td>header-bgcolor hex-color</td>
<td>The HTML hexadecimal code for the background color of the captive portal login page header.</td>
</tr>
<tr>
<td>Header logo</td>
<td>header-logo filename</td>
<td>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.</td>
</tr>
<tr>
<td>Header message</td>
<td>header-message text-string</td>
<td>Text displayed in the page header. The default text is User Authentication.</td>
</tr>
<tr>
<td>Header text color</td>
<td>header-text-color color</td>
<td>Color of the text in the header. The default color is white.</td>
</tr>
<tr>
<td>Post-authentication URL</td>
<td>post-authentication-url url</td>
<td>URL to which the users are directed on successful authentication. By default, users are directed to the page they had originally requested.</td>
</tr>
</tbody>
</table>

To design the captive portal login page:

1. (Optional) Upload your logo image file to the switch:
   
   user@router> file copy ftp://username:prompt@ftp.hostname.net/var/tmp/my-logo.jpeg

2. 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

Starting with Junos OS Release 14.2, 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**

Starting with Junos OS Release 14.2, 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;
```

### Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.2</td>
<td>Starting with Junos OS Release 14.2, for 802.1X and MAC RADIUS authentication sessions, you can specify authentication session timeout values using the <code>reauthentication</code> statement.</td>
</tr>
</tbody>
</table>

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

Starting with Junos OS Release 14.2, 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"
0004aeccd235f Auth-type:=Local, User-Password = "0004aeccd235f"
```

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</tr>
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<tbody>
<tr>
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<td>Starting with Junos OS Release 14.2, 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.</td>
</tr>
</tbody>
</table>

### Related Documentation

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

Starting with Junos OS Release 14.2 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 78
- Overview and Topology on page 78
- Configuration on page 79
- Verification on page 80
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 \texttt{mac-radius restrict} option, and thus avoid the delay that occurs while the router determines that the device is 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 78 shows the components in the example for MAC RADIUS authentication.

<table>
<thead>
<tr>
<th>Property</th>
<th>Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router hardware</td>
<td>Ports (ge-0/0/0 through ge-0/0/23)</td>
</tr>
<tr>
<td>VLAN name</td>
<td>sales</td>
</tr>
</tbody>
</table>
Table 4: Components of the MAC RADIUS Authentication Configuration Topology (continued)

<table>
<thead>
<tr>
<th>Property</th>
<th>Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connections to printers</td>
<td>ge-0/0/19, MAC address 00040ffdacfe</td>
</tr>
<tr>
<td></td>
<td>ge-0/0/20, MAC address 0004aecd235f</td>
</tr>
<tr>
<td>RADIUS server</td>
<td>Connected to the router on interface ge-0/0/10</td>
</tr>
</tbody>
</table>

The printer with the MAC address 00040ffdacfe is connected to access interface ge-0/0/19. A second printer with the MAC address 0004aecd235f 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 0004aecd235f as usernames and passwords:

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

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 80

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.

### Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.2</td>
<td>Starting with Junos OS Release 14.2 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.</td>
</tr>
</tbody>
</table>

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

Starting with Junos OS Release 14.2, 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 82
- Overview and Topology on page 82
- Configuration on page 83
- Verification on page 85
- Troubleshooting on page 86

### 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]
user@router# set system services web-management http
user@router# set system services web-management https local-certificate my-signed-cert
user@router# set protocols captive-portal-custom-options secure-authentication https
user@router# set protocols authentication-access-control interface ge-0/0/10 supplicant multiple
user@router# set protocols authentication-access-control static 00:10:12:e0:28:22
user@router# 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:
4. (Optional) Allow specific clients to bypass captive portal:

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

**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 routering 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 {
```

---

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"-----BEGIN RSA PRIVATE KEY-----
MIICXwIBAAKBgQDk8sUggnXdDUmr7TvLv63yJq/LRpsDASf1Z3z92De1Kfk5C9\n
...Pt5YmvWDo0m5joIliH08qYdh9YGqv3T2IEuffISTQHEOShSOgWDFH\nnYo0b1O/vQIjk20X9NVQgJHBwidssY9eR5p\n-----END CERTIFICATE-----"

## SECRET-DATA

```json

declarations {

}

}

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 85**
- **Verify That Captive Portal Is Working Correctly on page 86**

#### 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 86

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
```

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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. Starting with Junos OS Release 14.2, 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 87
- Overview and Topology on page 87
- Configuration on page 88
- Verification on page 89

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 and Junos OS Release 14.2R3 for all other routers.
- 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**

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

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 "$9$qPT3ApBSrv69rvWLb.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 89

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**

Starting with Junos OS Release 14.2, 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 90
- Overview and Topology on page 90
- Configuration of a Guest VLAN That Includes 802.1X Authentication on page 91
- Verification on page 92

**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

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

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 bridge-domain-name vlan-id 300
set protocols dot1x authenticator interface all guest-bridge-domain bridge-domain-name
```

**Step-by-Step Procedure**

To configure a guest VLAN that includes 802.1X authentication on MX Series routers:

1. Configure the VLAN ID for the guest VLAN:

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

2. Configure the guest VLAN under dot1x protocols:

```
[edit]
user@switch# set protocols dot1x authenticator interface all guest-bridge-domain bridge-domain-name
```

**Results**

Check the results of the configuration:

```
user@switch> show configuration protocols {
  dot1x {
    authenticator {
      interface {
        all {
```

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Verification

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

- **Verifying That the Guest VLAN is Configured** on page 92

**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
```

<table>
<thead>
<tr>
<th>Instance</th>
<th>Bridging Domain</th>
<th>Type</th>
<th>Active</th>
</tr>
</thead>
<tbody>
<tr>
<td>vs1 0</td>
<td>bridge.0</td>
<td>guest</td>
<td>2</td>
</tr>
<tr>
<td>vs1 0</td>
<td>bridge.0</td>
<td>guest-vlan</td>
<td>0</td>
</tr>
<tr>
<td>vs1 0</td>
<td>bridge.0</td>
<td>vlan_dyn</td>
<td>0</td>
</tr>
</tbody>
</table>

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

ge-0/0/1.0  
Role: Authenticator  
Administrative state: Auto  
Suppliant 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  
Suppliant 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: v011  
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 `bridge-domain-name` 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 bridge domain name, indicating that a supplicant at this interface failed 802.1X authentication and was passed through to the bridge-domain-name.
### Example: Configuring Static MAC Bypass of Authentication on an MX Series Router

Starting with Junos OS Release 14.2, 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 94
- **Overview and Topology** on page 94
- **Configuration** on page 95
- **Verification** on page 96

### 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 95 will be configured for static MAC authentication.

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

<table>
<thead>
<tr>
<th>Property</th>
<th>Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router hardware</td>
<td>MX Series router</td>
</tr>
<tr>
<td>VLAN name</td>
<td>default</td>
</tr>
</tbody>
</table>
| 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:

```bash
[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 authenticaton-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:

   ```bash
   [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:

   ```bash
   [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:

   ```bash
   [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 96

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

<table>
<thead>
<tr>
<th>MAC address</th>
<th>VLAN-Assignment</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:04:0f:fd:ac:fe</td>
<td>default</td>
<td>ge-0/0/19.0</td>
</tr>
<tr>
<td>00:04:ae:cd:23:5f</td>
<td>default</td>
<td>ge-0/0/20.0</td>
</tr>
</tbody>
</table>

**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.

**Release History Table**

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.2</td>
<td>Starting with Junos OS Release 14.2, 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.</td>
</tr>
</tbody>
</table>

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

Starting with Junos OS Release 14.2, 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 97
- **Overview and Topology** on page 98
- **Configuration** on page 99
- **Verification** on page 101

**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 98, 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 99 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 99

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
```
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;
         }
      }
   }
}
```
Verification

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

• Verifying Firewall Filters on Interfaces with Multiple Supplicants on page 101

**Verifying Firewall Filters on Interfaces with Multiple Supplicants**

**Purpose**
Verify that firewall filters are functioning on the interface with multiple supplicants.

**Action**
1. Check the results with one user authenticated on the interface. In this case, the user is authenticated on **ge-0/0/2**:

   ```
   user@router> show dot1x firewall
   Filter: dot1x_ge-0/0/2
   Counters
   counter1_dot1x_ge-0/0/2_user1 100
   
   2. When a second user, User2, is authenticated on the same interface, **ge-0/0/2**, you can verify that the filter includes the results for both of the users authenticated on the interface:

   ```
   user@router> show dot1x firewall
   Filter: dot1x-filter-ge-0/0/2
   Counters
   counter1_dot1x_ge-0/0/2_user1 100
   counter1_dot1x_ge-0/0/2_user2 400
   ```

**Meaning**
The results displayed by the `show dot1x firewall` 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.
Starting with Junos OS Release 14.2, 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.
CHAPTER 7

Configuring Aggregated Ethernet Interfaces for Increased Throughput and Link Redundancy

- Aggregated Ethernet Interfaces Overview on page 104
- Configuring an Aggregated Ethernet Interface on page 110
- Understanding Ethernet Link Aggregation on ACX Series Routers on page 112
- Configuring Aggregated Ethernet Interfaces on PTX Series Packet Transport Routers on page 118
- Understanding Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles on page 120
- Configuring Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles on page 127
- Example: Configuring Aggregated Ethernet Interfaces on page 131
- Configuring Junos OS for Supporting Aggregated Devices on page 133
- Configuring the Number of Aggregated Ethernet Interfaces on the Device on page 137
- Configuring Aggregated Ethernet Link Speed on page 138
- Configuring Aggregated Ethernet Minimum Links on page 141
- Configuring Tagged Aggregated Ethernet Interfaces on page 142
- Configuring Untagged Aggregated Ethernet Interfaces on page 142
- Configuring LACP for Aggregated Ethernet Interfaces on page 143
- Configuring Aggregated Ethernet Link Protection on page 152
- Example: Configuring Aggregated Ethernet Link Protection on page 154
- Configuring Shared Scheduling on Aggregated Ethernet Interfaces on page 155
- Configuring Scheduler on Aggregated Ethernet Interfaces Without Link Protection on page 155
- Configuring Symmetrical Load Balancing on an 802.3ad Link Aggregation Group on MX Series Routers on page 156
- Configuring PIC-Level Symmetrical Hashing for Load Balancing on 802.3ad LAGs for MX Series Routers on page 162
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 120.

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-ICE-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 8 on page 106 lists the platforms and corresponding hardware components that support mixed aggregated Ethernet bundles.
Table 8: Platform Support Matrix for Mixed Aggregated Ethernet Bundles

<table>
<thead>
<tr>
<th>Rate and Mode</th>
<th>Supported Platform</th>
<th>Supported FPCs</th>
<th>Supported PICs</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-Gigabit Ethernet and WAN (WAN rate: OC192)</td>
<td>T640, T1600, T4000, and TX Matrix Plus routers</td>
<td>• T4000 FPC5 (T4000-FPC5-3D)                                                   • 10-Gigabit Ethernet LAN/WAN PIC with Oversubscription and SFP+ (PF-24XGE-SFP)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Enhanced Scaling FPC3 (T640-FPC3-ES)                                         • 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PD-12XGE-SFP)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Enhanced Scaling FPC4 (T640-FPC4-ES)                                         • 10-Gigabit Ethernet LAN/WAN PIC with XENPAK (PC-1XGE-XENPAK)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Enhanced Scaling FPC4-1P (T640-FPC4-1P-ES)                                  • 10-Gigabit Ethernet LAN/WAN PIC with XFP (PD-4XGE-XFP)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• T1600 Enhanced Scaling FPC4 (T1600-FPC4-ES)</td>
<td></td>
</tr>
<tr>
<td>40-Gigabit Ethernet, 100-Gigabit Ethernet</td>
<td>T4000 and TX Matrix Plus routers</td>
<td>• T4000 FPC5 (T4000-FPC5-3D)                                                   • 100-Gigabit Ethernet PIC with CFP (PF-1CGE-CFP)</td>
<td></td>
</tr>
<tr>
<td>T640, T1600, T4000, and TX Matrix Plus routers</td>
<td></td>
<td>• Enhanced Scaling FPC4 (T640-FPC4-ES)                                         • 100-Gigabit Ethernet PIC with CFP (PD-1ICE-CFP-FPC4)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Enhanced Scaling FPC4-1P (T640-FPC4-1P-ES)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• T1600 Enhanced Scaling FPC4 (T1600-FPC4-ES)</td>
<td><strong>NOTE:</strong> This PIC is available packaged only in an assembly with the T1600-FPC4-ES FPC.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Enhanced LAG Support on MX Series Routers

Starting in Junos OS Release 14.2, you can configure an enhanced link aggregation group (LAG) on MX Series routers. When you associate a physical interface with an aggregated Ethernet interface, the physical child links are also associated with the parent aggregated Ethernet interface to form a LAG.

In the absence of enhanced LAG support, one child next hop is created for each member link of an aggregated Ethernet interface for each VLAN interface. For example, an aggregate next hop for an aggregated Ethernet interface with 16 member links leads to the installation of 17 next hops per VLAN created. Thus the number of next hops supported on the routers with aggregated Ethernet interfaces is significantly reduced.

With the enhanced LAG support, when the `[edit chassis network-services enhanced-ip]` statement is configured, child next hops are not created for member links and, as a result, a higher number of next hops can be supported.
Note that the enhanced LAG feature is only supported when the router’s network services is set to operate in the enhanced-ip mode. This feature is not supported when the router’s network services is set to operate in the enhanced-ethernet mode.

**Enhanced LAG Support on PTX Series Routers**

Starting in Junos OS Release 18.1, Junos OS supports removal of child next hop usage for aggregated Ethernet Interfaces and clients on PTX Series routers with FPC3-PTX-U2 and FPC3-PTX-U3. Removal of child next hop usage helps reduce the memory and CPU resources required to support aggregated Ethernet Interfaces and improves the overall system performance and scaling numbers. This feature is enabled by default if the network services mode on the router is configured to enhanced-mode. You can disable this feature by using the `set chassis aggregated-devices disable-lag-enhanced`. You must reboot the router for the configuration to take effect.

Previously, each unicast next hop over aggregated Ethernet Interfaces resulted in creation of a number of children next hops as well. For an aggregated Ethernet Interface with 16 member links, addition of one unicast next hop over the aggregated Ethernet Interface results in installing total of 17 next hops. As a result, with aggregated Ethernet configuration, the number of next hops supported decreases in proportion to the number of aggregated Ethernet links.

**NOTE:** Child next hop optimizations are supported for aggregated Ethernet Interfaces, Interfaces that make use of aggregated Ethernet Interfaces, and for both unicast and multicast scenarios.

**Configuration Guidelines for Aggregated Ethernet Interfaces**

- Aggregated Ethernet interfaces can use interfaces from different FPCs, DPCs, PICs, or MPCs.
- 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.
- 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 (Routers and EX9200 Switches)*.

- 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
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 8 on page 106 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 ae x 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-ICE-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 ae x` 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.
Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.1</td>
<td>Starting in Junos OS Release 18.1, Junos OS supports removal of child next hop usage for aggregated Ethernet Interfaces and clients on PTX Series routers with FPC3-PTX-U2 and FPC3-PTX-U3.</td>
</tr>
<tr>
<td>14.2</td>
<td>Starting in Junos OS Release 14.2, you can configure an enhanced link aggregation group (LAG) on MX Series routers.</td>
</tr>
<tr>
<td>13.2</td>
<td>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.</td>
</tr>
</tbody>
</table>

Related Documentation

- inner-tag-protocol-id on page 1347
- inner-vlan-id on page 1348
- pop-pop on page 1463
- pop-swap on page 1464
- push-push on page 1485
- swap-push on page 1545
- swap-swap on page 1546
- Configuring Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles on page 127
- Capabilities of Gigabit Ethernet IQ PICs and Gigabit Ethernet PICs with SFPs on page 661
- Ethernet Interfaces Feature Guide for Routing Devices
- Understanding Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles on page 120

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.
2. Configure the aggregated Ethernet interface.

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

[edit interfaces interface-name]
user@host# set (fastether-options | gigether-options) 802.3 adae
```

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 `ae x` 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 131.

**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 137
- Deleting an Aggregated Ethernet Interface on page 209
- Aggregated Ethernet Interfaces Overview on page 104
Understanding Ethernet Link Aggregation on ACX Series Routers

Ethernet link aggregation is a mechanism for increasing the bandwidth linearly and improving the resiliency of Ethernet links by bundling or combining multiple full-duplex same-speed point-to-point Ethernet links into a single virtual link. The virtual link interface is referred to as a link aggregation group (LAG) or aggregated Ethernet (AE) interface. The LAG 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.

**NOTE:** ACX Series routers support connectivity fault management (CFM) on aggregated Ethernet interfaces with a continuity check interval of 100 milliseconds or higher.

**NOTE:** ACX5048 and ACX5096 routers support connectivity fault management (CFM) on aggregated Ethernet interfaces with a continuity check interval of 1 second or higher.

**NOTE:** The Ethernet options configurations for ACX5048 and ACX5096 routers differ compared to other ACX Series routers. For more information, see [Layer 2 Next Generation Mode for ACX Series](Layer 2 Next Generation Mode for ACX Series).

On ACX Series routers, up to 128 AE interfaces can be created with each AE interface having up to 8 physical interfaces. AE interfaces can be created across PICs and fixed-ports on the chassis.

**NOTE:** On ACX5048 and ACX5096 routers, up to 64 AE interfaces can be created with each AE interface having up to 16 physical interfaces.

ACX Series routers do not support statistics for aggregated Ethernet interfaces. However, statistics can be retrieved for member interfaces.
To configure aggregated Ethernet interface:

1. Specify the number of aggregated Ethernet interfaces to be created:

   [edit chassis]
   user@host# set aggregated-devices ethernet device-count number

2. Specify the minimum number of links for the aggregated Ethernet interface (aex), that is, the defined bundle, to be labeled “up”:

   NOTE: By default only one link must be up for the bundle to be labeled “up”.

   [edit interfaces]
   user@host# set ae0 aggregated-ether-options minimum-links number (1 — 8)

3. Specify the link speed for the aggregated Ethernet bundle:

   [edit interfaces]
   user@host# set ae0 aggregated-ether-options link-speed speed (10g | 1g | 100m)

4. Specify the members to be included within the aggregated Ethernet bundle:

   [edit interfaces]
   user@host# set ge-1/0/0 gigether-options 802.3ad ae0
   user@host# set ge-1/0/1 gigether-options 802.3ad ae0

5. Specify an interface family for the aggregated Ethernet bundle:

   [edit interfaces]
   user@host# set ae0 unit 0 family inet address ip-address

The above procedure creates an AE interface and they would be up and ready for running the services defined on AE logical interfaces.

AE interfaces can be VLAN-tagged or untagged. You can configure flexible-vlan-tagging, native-vlan-id, and dual-tagging on AE interfaces.

NOTE: Whenever there is a configuration change (AE interface to Gigabit Ethernet interfaces or vice versa), you need to remove the existing configuration, perform a commit, then add the new configuration and again commit the configuration.

To delete an aggregated Ethernet interface:

1. Delete the aggregated Ethernet configuration.
   This step changes the interface state to down and removes the configuration statements related to aex.

   [edit]
2. Delete the interface from the device count.

   \[\text{[edit]}\]
   \[
   \text{user@host#delete chassis aggregated-devices ethernet device-count}
   \]

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.

### Load Balancing

JUNOS load-balances traffic across member links in an AE bundle based on the Layer 3 information in the packet. You can globally configure what fields are used for load-balancing for inet and MPLS.

On ACX Series Routers, the inet family knobs are available at PIC level. You can configure inet family Layer 3 and Layer 4 fields to be used for load-balancing. For bridge family, Layer 2, layer 3 and Layer 4 fields to be used for load-balancing.

ACX Series routers also support load balancing across the member links using Layer 2 source MAC addresses, destination MAC addresses, or both. This can be configured at the [edit forwarding-options hash-key family multiservice] hierarchy level. Layer 2 source MAC addresses and destination MAC addresses are used as hash-keys for load balancing.

```
[edit]
forwarding-options {
    hash-key {
        family multiservice {
            destination-mac;
            source-mac;
        }
    }
}
```

**NOTE:**
- For IP Layer 2 packets, only IP fields are used for load balancing across member links. Source MAC address and destination MAC address are not be used for load balancing.
- For non-IP Layer 2 packets, either Source MAC address or destination MAC address is used as hash-keys for load balancing.
- If you want to hash based on layer 2 fields, then you need to configure multiservice.
- If you want to hash based on layer 3 and layer 4 fields, then you need to configure family (inet | inet6)
LACP Monitoring

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 is 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.

LACP monitoring can be either distributed or centralized. The default is distributed and it can be overridden by configuring the centralized knob under LACP protocols. 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.

By default, LACP does not initiate a LACP PDU exchange. LACP packets can be configured to exchange LACP PDUs at a rate of 1 packet per second, or a slower rate of 1 packet for 30 seconds.

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.

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.

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 {
}
```
Link Protection

Link protection can be configured on AE interfaces to provide 1:1 link resiliency using LACP. Primary and backup links can be configured within an AE bundle. The primary link is used for all transit traffic and host generated traffic. The backup link is used when the primary link fails.

Link protection is supported only when the AE bundles have no more than 2 member links, one primary and another backup. LACP works in revertive link-protection mode by default and can be configured to work in non-revertive mode.

NOTE: Link protection without LACP (static link protection on AE interfaces) is not supported on all ACX Series routers. Link protection works as expected with LACP configured on the AE bundle.

- Configuring Link Protection for Aggregated Ethernet Interfaces on page 116
- Disabling Link Protection for Aggregated Ethernet Interfaces on page 116

Configuring Link Protection for Aggregated Ethernet Interfaces

Aggregated Ethernet interfaces support link protection to ensure QoS on the interface. To configure link protection:

1. Configure the options for an aggregated Ethernet interface.

   ```
   user@host# edit interfaces ae
   user@host# aggregated-ether-options
   ```

2. Configure the link protection mode.

   ```
   [edit interfaces ae aggregated-ether-options]
   user@host# set link-protection
   ```

Disabling Link Protection for Aggregated Ethernet Interfaces

To disable link protection, issue the `delete interface revert ae` configuration command.

```
user@host# delete interfaces ae aggregated-ether-options link-protection
```
The hashing algorithm makes hashing decisions based on values in various packet fields, as well as on some internal values like source port ID and source device ID. You can configure some of the fields that are used by the hashing algorithm.

The hashing algorithm is used to make traffic-forwarding decisions for traffic entering a LAG bundle.

For LAG bundles, the hashing algorithm determines how traffic entering a LAG bundle is placed onto the bundle's member links. The hashing algorithm tries to manage bandwidth by evenly load-balancing all incoming traffic across the member links in the bundle.

The hashing algorithm makes hashing decisions based on values in various packet fields, as well as on some internal values like source port ID and source device ID. The packet fields used by the hashing algorithm varies by the packet's EtherType and, in some instances, by the configuration on the router. The hashing algorithm recognizes the following EtherTypes:

- IPv4
- MPLS

Traffic that is not recognized as belonging to any of these EtherTypes is hashed based on the Layer 2 header. IP and MPLS traffic are also hashed based on the Layer 2 header when a user configures the hash mode as Layer 2 header.

You can configure some fields that are used by the hashing algorithm to make traffic forwarding decisions. You cannot, however, configure how certain values within a header are used by the hashing algorithm.

Note the following points regarding the hashing algorithm:

- The fields selected for hashing are based on the packet type only. The fields are not based on any other parameters, including forwarding decision (bridged or routed) or egress LAG bundle configuration (Layer 2 or Layer 3).
- The same fields are used for hashing unicast and multicast packets. Unicast and multicast packets are, however, hashed differently.

Table 9 on page 117 describes the fields used for hashing by Layer 2 services. The table explains the default behavior and the configurable fields based on the type of traffic received on the Layer 2 service.

Table 9: Hashing Behavior for Pseudowire (Layer 2 Circuit) and Bridging Services

<table>
<thead>
<tr>
<th>Traffic Type</th>
<th>Default Hash Fields</th>
<th>Configurable Fields (Hash keys)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layer 2</td>
<td>None</td>
<td>Source MAC Address</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Destination MAC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Source MAC and Destination MAC</td>
</tr>
</tbody>
</table>
Table 9: Hashing Behavior for Pseudowire (Layer 2 Circuit) and Bridging Services (continued)

<table>
<thead>
<tr>
<th>Traffic Type</th>
<th>Default Hash Fields</th>
<th>Configurable Fields (Hash keys)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP</td>
<td>Source IP and Destination IP</td>
<td>Source MAC Address</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Destination MAC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Source MAC and Destination MAC</td>
</tr>
<tr>
<td>MPLS</td>
<td>MPLS label 1 and MPLS label 2</td>
<td>Source MAC Address</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Destination MAC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Source MAC and Destination MAC</td>
</tr>
</tbody>
</table>

Table 10 on page 118 describes the fields used for hashing by Layer 3 services. The table explains the default behavior and the configurable fields based on the type of traffic received on the Layer 3 service.

Table 10: Hashing Behavior for IP Services

<table>
<thead>
<tr>
<th>Traffic Type</th>
<th>Default Hash Fields</th>
<th>Configurable Fields (Hash keys)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP</td>
<td>Source IP and Destination IP</td>
<td>Layer 3 (Source IP and/or destination IP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Layer 4 (UDP/TCP source port and UDP/TCP destination port)</td>
</tr>
</tbody>
</table>

Related Documentation

- CoS on ACX Series Universal Metro Routers Features Overview
- Controlling Network Access Using Traffic Policing Overview
- Firewall Filter Match Conditions and Actions on ACX Series Routers Overview

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 104
• Configuring Junos OS for Supporting Aggregated Devices on page 133
• Configuring Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles on page 127
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. For information on the first Junos OS release that supports aggregated Ethernet bundles on the various Juniper Networks routers, see Feature Explorer.

The following sections provide an overview about mixed rates and mixed modes on various platforms:

• Aggregated Ethernet Bundle with Mixed Rates and Mixed Modes on T Series Routers on page 120
• Aggregated Ethernet Bundles with Mixed Rates on MX Series Routers and PTX Series Routers on page 123

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 120
• Platform Support Matrix for Mixed Aggregated Ethernet Bundles on page 121
• Guidelines to Follow When Configuring Aggregated Ethernet Bundles with Mixed Rates and Mixed Modes on page 122

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 8 on page 106 lists the platforms and corresponding hardware components that support mixed aggregated Ethernet bundles.

**Table 1:** Platform Support Matrix for Mixed Aggregated Ethernet Bundles

<table>
<thead>
<tr>
<th>Rate and Mode</th>
<th>Supported Platform</th>
<th>Supported FPCs</th>
<th>Supported PICs</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-Gigabit Ethernet LAN and WAN (WAN rate: OC192)</td>
<td>T640, T1600, T4000, and TX Matrix Plus routers</td>
<td>T4000 FPC5 (T4000-FPC5-3D)</td>
<td>10-Gigabit Ethernet LAN/WAN PIC with Oversubscription and SFP+ (PF-24XGE-SFPP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PF-12XGE-SFPP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Enhanced Scaling FPC3 (T640-FPC3-ES)</td>
<td>10-Gigabit Ethernet PIC with XENPAK (PC-1XGE-XENPAK)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Enhanced Scaling FPC4 (T640-FPC4-ES)</td>
<td>10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PD-5-10XGE-SFPP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Enhanced Scaling FPC4-1P (T640-FPC4-1P-ES)</td>
<td>10-Gigabit Ethernet LAN/WAN PIC with XFP (PD-4XGE-XFP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• T1600 Enhanced Scaling FPC4 (T1600-FPC4-ES)</td>
<td></td>
</tr>
</tbody>
</table>
### Table 11: Platform Support Matrix for Mixed Aggregated Ethernet Bundles (continued)

<table>
<thead>
<tr>
<th>Rate and Mode</th>
<th>Supported Platform</th>
<th>Supported FPCs</th>
<th>Supported PICs</th>
</tr>
</thead>
<tbody>
<tr>
<td>40-Gigabit Ethernet, 100-Gigabit Ethernet</td>
<td>T4000 and TX Matrix Plus routers</td>
<td>• T4000 FPC5 (T4000-FPC5-3D)</td>
<td>• 100-Gigabit Ethernet PIC with CFP (PF-1CGE-CFP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 100-Gigabit Ethernet PIC with CFP (PD-1XLE-CFP)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Enhanced Scaling FPC4 (T640-FPC4-ES)</td>
<td>• 100-Gigabit Ethernet PIC with CFP (PD-ICE-CFP-FPC4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Enhanced Scaling FPC4-1P (T640-FPC4-1P-ES)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• T1600 Enhanced Scaling FPC4 (T1600-FPC4-ES)</td>
<td></td>
</tr>
</tbody>
</table>

**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 104, 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-ICE-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 8 on page 106 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-ICE-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 and PTX Series Routers

The following sections explain mixed rates on aggregated Ethernet bundles:

- Understanding Mixed Rates on page 123
- Platform Support Matrix for Mixed Aggregated Ethernet Bundles on MX Series Routers on page 124
- Supported Features on page 125

### 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
gress 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
gress 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.

**Platform Support Matrix for Mixed Aggregated Ethernet Bundles on MX Series
Routers**

Table 12 on page 124 lists the platforms and corresponding MPCs that support mixed
aggregated Ethernet bundles on MX Series routers.

**Table 12: Platform Support Matrix for Mixed Aggregated Ethernet Bundles on MX Series
Routers**

<table>
<thead>
<tr>
<th>Supported MPCs</th>
<th>Supported Platform</th>
<th>Initial Release</th>
</tr>
</thead>
<tbody>
<tr>
<td>16x10GE (MPC-3D-16XGE-SFPP)</td>
<td>MX240, MX480, MX960, MX2010, and MX2020</td>
<td>14.2R1</td>
</tr>
<tr>
<td>MPC1E (MX-MPC1-3D; MX-MPC1E-3D; MX-MPC1-1-3D-Q; MX-MPC1E-3D-Q)</td>
<td>MX240, MX480, MX960, MX2010, and MX2020</td>
<td>14.2R1</td>
</tr>
<tr>
<td>MPC2E (MX-MPC2-3D; MX-MPC2E-3D; MX-MPC2-3D-Q; MX-MPC2E-3D-Q; MX-MPC2-3D-EQ; MX-MPC2E-3D-EQ; MX-MPC2-3D-P)</td>
<td>MX240, MX480, MX960, MX2010, and MX2020</td>
<td>14.2R1</td>
</tr>
<tr>
<td>MPC3E (MX-MPC3E-3D)</td>
<td>MX240, MX480, MX960, MX2010, and MX2020</td>
<td>14.2R1</td>
</tr>
<tr>
<td>MPC4E (MPC4E-3D-32XGE-SFPP and MPC4E-3D-2CGE-8XGE)</td>
<td>MX240, MX480, MX960, MX2010, and MX2020</td>
<td>14.2R1</td>
</tr>
<tr>
<td>MPC5E (6x40GE+24x10GE;6x40GE+24x10GEQ;2x100GE+4x10GE; 2x100GE+4x10GEQ)</td>
<td>MX240, MX480, MX960, MX2010, and MX2020</td>
<td>14.2R1</td>
</tr>
</tbody>
</table>
Table 12: Platform Support Matrix for Mixed Aggregated Ethernet Bundles on MX Series Routers (continued)

<table>
<thead>
<tr>
<th>Supported MPCs</th>
<th>Supported Platform</th>
<th>Initial Release</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPC6E (MX2K-MPC6E)</td>
<td>MX2010 and MX2020</td>
<td>14.2R1</td>
</tr>
<tr>
<td>MPC7E (Multi-Rate) (MPC7E-MRATE)</td>
<td>MX240, MX480, MX960, MX2010, and MX2020</td>
<td>15.1F4</td>
</tr>
<tr>
<td>MPC7E 10G (MPC7E-10G)</td>
<td>MX240, MX480, MX960, MX2010, and MX2020</td>
<td>15.1F5</td>
</tr>
<tr>
<td>MPC8E (MX2K-MPC8E)</td>
<td>MX2010 and MX2020</td>
<td>15.1F5</td>
</tr>
<tr>
<td>MPC9E (MX2K-MPC9E)</td>
<td>MX2010 and MX2020</td>
<td>15.1F5</td>
</tr>
</tbody>
</table>

**Supported Features**

The following features are supported on mixed-rate aggregated Ethernet bundles on MX Series routers and PTX 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 155.
- 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 and PTX 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.
## Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.2</td>
<td>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.</td>
</tr>
<tr>
<td>13.2</td>
<td>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.</td>
</tr>
</tbody>
</table>

## Related Documentation
- Aggregated Ethernet Interfaces Overview on page 104
- Configuring Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles on page 127
- Minimum-bandwidth on page 1413
- P2-10G-40G-QSFP PIC Overview on page 428
- Understanding the P2-100GE-OTN PIC on page 611

---

### 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 128
- Configuring Mixed Rates on Aggregated Ethernet Bundles on MX Series Routers on page 130
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 mixed rates and mixed modes on T640, T1600, T4000, and TX Matrix Plus routers. Following mixed rates and mixed modes are supported:

- 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 802.3adae 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. You can now 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 ae x 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 ae x
   ```

6. Configure an interface family for the aggregated Ethernet bundle as inet, inet6, or mpls:
   
   ```
   [edit interfaces]
   user@host# set ae x 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

Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.1R1</td>
<td>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.</td>
</tr>
<tr>
<td>13.2</td>
<td>Starting with Junos OS Release 13.2, aggregated Ethernet supports mixed rates and mixed modes on T640, T1600, T4000, and TX Matrix Plus routers.</td>
</tr>
<tr>
<td>13.2</td>
<td>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.</td>
</tr>
</tbody>
</table>

Related Documentation

- Aggregated Ethernet Interfaces Overview on page 104
- Configuring Aggregated Ethernet Link Speed on page 138
- Configuring Aggregated Ethernet Interfaces on PTX Series Packet Transport Routers on page 118
- link-speed on page 1379
- minimum-bandwidth on page 1413
- Understanding Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles on page 120

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 10.0.0.1/24;
   }
}
unit 1 {
   vlan-id 1024;
   family inet {
      address 10.0.0.2/24;
   }
}
unit 2 {
   vlan-id 1025;
   family inet {
      address 10.0.0.3/24;
   }
}
unit 3 {
   vlan-id 4094;
   family inet {
      address 10.0.0.4/24;
   }
}
}
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 133
- Configuring LACP Link Protection at the Chassis Level on page 134
- Enabling LACP Link Protection on page 134
- Configuring System Priority on page 135
- Configuring the Maximum Links Limit on page 135
- Configuring PPM on Junos Fusion on page 136

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;
    }
}
```

The aggregated interfaces are numbered from ae0 through ae4091. The maximum number of aggregated interfaces supported by different routers is listed below:

- For PTX Series routers, you can configure a maximum of 128 aggregated interfaces.
- For M Series and T Series routers, you can configure a maximum of 128 aggregated interfaces (LAG bundles).
- In Junos release 14.2R2 and earlier, you can configure a maximum of 480 aggregated interfaces on MX Series routers.
- In Junos release 14.2R3 and later, you can configure a maximum of 1000 aggregated interfaces on MX240, MX480, and MX960 routers.
- In Junos release 14.2R3 and later, you can configure a maximum of 800 aggregated interfaces on MX2010 and MX2020 routers.
In Junos OS 15.1F5 and 15.1F6 releases, you can configure a maximum of 480 aggregated interfaces on MX240, MX480, and MX960 routers.

In Junos OS 15.1F5 and 15.1F6 releases, you can configure a maximum of 800 aggregated interfaces on MX2010 and MX2020 routers.

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).

See Also

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:
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.

**BEST PRACTICE:** (MX Series) In a highly scaled configuration over aggregated Ethernet, we recommend that you prevent the router from performing such a switch by including the `non-revertive` statement. Failure to do so may result in some traffic loss if a MIC on which a member interface is located reboots. Using the `non-revertive` statement for this purpose is not effective if both the primary and secondary interfaces are on the MIC that reboots.

**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;
```

Starting in Junos OS Release 14.2R4, the timer values that ensure proper link aggregation and STP functions are configured by default if you use Junos Fusion with Junos OS.

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.1F5</td>
<td>In Junos OS 15.1F5 and 15.1F6 releases, you can configure a maximum of 480 aggregated interfaces on MX240, MX480, and MX960 routers.</td>
</tr>
<tr>
<td>15.1F5</td>
<td>In Junos OS 15.1F5 and 15.1F6 releases, you can configure a maximum of 800 aggregated interfaces on MX2010 and MX2020 routers.</td>
</tr>
<tr>
<td>14.2R4</td>
<td>Starting in Junos OS Release 14.2R4, the timer values that ensure proper link aggregation and STP functions are configured by default if you use Junos Fusion with Junos OS.</td>
</tr>
<tr>
<td>14.2R3</td>
<td>In Junos release 14.2R3 and later, you can configure a maximum of 1000 aggregated interfaces on MX240, MX480, and MX960 routers.</td>
</tr>
<tr>
<td>14.2R3</td>
<td>In Junos release 14.2R3 and later, you can configure a maximum of 800 aggregated interfaces on MX2010 and MX2020 routers.</td>
</tr>
<tr>
<td>14.2R3</td>
<td>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.</td>
</tr>
<tr>
<td>14.2R2</td>
<td>In Junos release 14.2R2 and earlier, you can configure a maximum of 480 aggregated interfaces on MX Series routers.</td>
</tr>
<tr>
<td>13.2</td>
<td>For SONET/SDH, starting with Junos OS Release 13.2, the maximum number of logical interfaces is 64, numbered from as0 through as63.</td>
</tr>
</tbody>
</table>

Related Documentation
- Configuring an Aggregated Ethernet Interface on page 110
- Ethernet Interfaces Feature Guide for Routing Devices
- Configuring Aggregated Ethernet Interfaces on PTX Series Packet Transport Routers on page 118
- 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.
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.

For SONET/SDH, starting with Junos OS Release 13.2, the maximum number of logical interfaces is 16, numbered from as0 through as15.

### 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, there are exceptions.

Starting with Junos OS Release 13.2, aggregated Ethernet supports mixed rates and mixed modes on T640, T1600, T4000, and TX Matrix Plus routers. For example, these mixes are supported:

- 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 14.1R1 and 14.2, support for mixed rates on aggregated Ethernet bundles is extended to MX240, MX480, MX960, MX2010, and MX2020 routers.

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, MX Series, PTX Series routers, and QFX5100, QFX10002, QFX10008, and QFX10016 switches 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.

### Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.2</td>
<td>Starting with Junos OS Release 14.2, aggregated Ethernet supports mixed link speeds on PTX Series Packet Transport Routers.</td>
</tr>
<tr>
<td>14.1</td>
<td>Starting with Junos OS Release 14.1 R1 and 14.2, support for mixed rates on aggregated Ethernet bundles is extended to MX240, MX480, MX960, MX2010, and MX2020 routers.</td>
</tr>
<tr>
<td>13.2</td>
<td>Starting with Junos OS Release 13.2, aggregated Ethernet supports mixed rates and mixed modes on T640, T1600, T4000, and TX Matrix Plus routers.</td>
</tr>
<tr>
<td>13.2</td>
<td>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.</td>
</tr>
</tbody>
</table>

### Related Documentation
- [aggregated-ether-options on page 1222](#)
- Configuring Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles on page 127
- [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 1222
- `minimum-links` on page 1414
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 260.

Related Documentation

- `vlan-id` on page 1605
- `vlan-tagging` on page 1618

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 13 on page 143 lists untagged aggregated Ethernet and LACP support by PIC and router.

### Table 13: Untagged Aggregated Ethernet and LACP Support by PIC and Platform

<table>
<thead>
<tr>
<th>PIC Type</th>
<th>M Series</th>
<th>LACP</th>
<th>T Series</th>
<th>LACP</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-port Fast Ethernet PIC Type 1</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>1-port Gigabit Ethernet PIC Type 1</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>2-port Gigabit Ethernet PIC Type 2</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>4-port Gigabit Ethernet PIC Type 2</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>1-port 10-Gigabit Ethernet M160</td>
<td>Yes</td>
<td>Yes</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>10-port Gigabit Ethernet PIC Type 3</td>
<td>Yes (M120, M320)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>1-port 10-Gigabit Ethernet PIC Type 3</td>
<td>N/A</td>
<td>NA</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>8-port Gigabit Ethernet PIC Type 3</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

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.

### 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 145
- Configuring LACP Link Protection on page 146
- Configuring LACP Hold-Up Timer to Prevent Link Flapping on LAG Interfaces on page 149
- Tracing LACP Operations on page 150
- Sample Configuration for Configuring Aggregated Ethernet LACP on Tagged and Untagged Interfaces on page 151

**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:
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:** Starting with Junos OS Release 11.4, 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 14.

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*.

Generally, LACP is supported on all untagged aggregated Ethernet interfaces. For more information, see “Configuring Untagged Aggregated Ethernet Interfaces” on page 142.

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 147
- Configuring LACP System Priority on page 148
- Configuring LACP System Identifier on page 148
- Configuring LACP administrative Key on page 149
- Configuring LACP Port Priority on page 149

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:

```sh
[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.


### 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 ae X aggregated-ether-options lacp]` hierarchy level:

```
[edit interfaces ae X 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 ae X aggregated-ether-options lacp]` hierarchy level:

```
[edit interfaces ae X aggregated-ether-options lacp]
system-id system-id;
```

Starting with Junos OS Release 13.3, you must not configure the LACP system identifier by using the `system-id` statement at the `[edit interfaces ae X 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 ae x 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 ae x lacp]` or `[edit interfaces interface-name fastether-options 802.3ad ae x lacp]` hierarchy levels:

```
[edit interfaces interface-name gigether-options 802.3ad ae x 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: Starting with Junos OS Release 9.3, 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:

```plaintext
[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 {
      address 10.1.1.2/24 {
        vrrp-group 0 {
          virtual-address 10.1.1.4;
          priority 200;
        }
      }
    }
  }
}

LACP with Untagged Aggregated Ethernet

[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;
        }
      }
    }
  }
}
```
Starting with Junos OS Release 14.1, you can configure aggregated Ethernet interfaces with LACP on logical systems within an MX Series router.

Starting with Junos OS Release 13.3, 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).

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.

Starting with Junos OS Release 11.4, source address filtering does not work when LACP is enabled.

Starting with Junos OS Release 9.3, port aggregation selection (discussed previously) is performed for the active link when LACP link protection is enabled.

### Related Documentation
- Junos OS Administration Library
- 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.
Chapter 7: Configuring Aggregated Ethernet Interfaces for Increased Throughput and Link Redundancy

- Reverting Traffic to a Primary Link When Traffic is Passing Through a Backup Link on page 153
- Disabling Link Protection for Aggregated Ethernet Interfaces on page 154

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
   ```

See Also
- Example: Configuring Aggregated Ethernet Link Protection on page 154
- Ethernet Interfaces Feature Guide for Routing Devices

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 | gigether-options) 802.3ad aex primary
   ```

2. Configure the backup logical interface.
   ```
   [edit interfaces interface-name]
   user@host# set (fastether-options | gigether-options) 802.3ad aex backup
   ```

See Also
- 802.3ad on page 1205
- Ethernet Interfaces Feature Guide for Routing Devices

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
```

See Also • *Ethernet Interfaces Feature Guide for Routing Devices*

**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
```

See Also • *Ethernet Interfaces Feature Guide for Routing Devices*

**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 ae x aggregated-ether-options
   ```

2. Configure the link protection mode.

   ```
   [edit interfaces ae x aggregated-ether-options]
   user@host# set link-protection
   ```

3. Configure shared scheduling.

   ```
   [edit interfaces ae x aggregated-ether-options]
   user@host# top
   [edit]
   user@host# edit interfaces ae x shared-scheduler
   ```

Related Documentation

- Configuring Aggregated Ethernet Link Protection on page 152

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 ae x]` hierarchy level:
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`.

**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 (Routers and EX9200 Switches).

### 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 156
- Configuring Symmetric Load Balancing on an 802.3ad LAG on MX Series Routers on page 157
- Configuring Symmetrical Load Balancing on Trio-Based MPCs on page 160
- Example Configurations on page 161

### 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 157.

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 $f$, post hash computation is from Router A to Router B through $i_2$. The reverse traffic for the same flow $f$ is from Router B to Router A through the same $i_2$ 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.

**Example Configuration Statements**

To configure 802.3ad LAG parameters at the bundle level:

```plaintext
[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:

```plaintext
[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;]
          }
        }
      }
    }
    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 161, 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.

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 161
- Example Configurations of Per–Packet-Forwarding-Engine Settings on page 162

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.

Configuring PIC-Level Symmetrical Hashing for Load Balancing on 802.3ad LAGs for MX Series Routers

Symmetrical hashing for load balancing on an 802.3ad Link Aggregation Group (LAG) is useful when two MX Series routers (for example, Router A and Router B) are connected transparently through Deep Packet Inspection (DPI) devices over a LAG bundle. The DPI devices keep track of traffic flows in both the forward and reverse directions.

If symmetrical hashing is configured, the reverse flow of traffic is also directed through the same child link on the LAG and is bound to flow through the same DPI device. This enables proper accounting on the DPI of the traffic in both the forward and reverse flows.

If symmetrical hashing is not configured, a different child link on the LAG might be chosen for the reverse flow of traffic through a different DPI device. This results in incomplete information about the forward and reverse flows of traffic on the DPI device leading to incomplete accounting of the traffic by the DPI device.
Symmetrical hashing is computed based on fields like source address and destination address. You can configure symmetrical hashing both at the chassis level and the PIC level for load balancing based on Layer 2, Layer 3, and Layer 4 data unit fields for family inet (IPv4 protocol family) and multiservice (switch or bridge) traffic. Symmetrical hashing configured at the chassis level is applicable to the entire router, and is inherited by all its PICs and Packet Forwarding Engines. Configuring PIC-level symmetrical hashing provides you more granularity at the Packet Forwarding Engine level.

For the two routers connected through the DPI devices over a LAG bundle, you can configure `symmetric-hash` on one router and `symmetric-hash complement` on the remote-end router or vice-versa.

To configure symmetrical hashing at the chassis level, include the `symmetric-hash` or the `symmetric-hash complement` statements at the `[edit forwarding-options hash-key family]` hierarchy level. For information about configuring symmetrical hashing at the chassis level and configuring the link index, see the Junos OS Network Interfaces Library for Routing Devices and the Junos OS VPNs Library for Routing Devices.

NOTE: On MX Series DPCs, configuring symmetrical hashing at the PIC level refers to configuring symmetrical hashing at the Packet Forwarding Engine level.

To configure symmetrical hashing at the PIC level on the inbound traffic interface (where traffic enters the router), include the `symmetric-hash` or `symmetric-hash complement` statement at the `[edit chassis fpc slot-number pic pic-number hash-key]` hierarchy level:

```plaintext
[edit chassis fpc slot-number pic pic-number hash-key]
family multiservice {
    source-mac;
    destination-mac;
    payload {
        ip {
            layer-3 (source-ip-only | destination-ip-only);
            layer-4;
        }
    }
    symmetric-hash {
        complement;
    }
}

family inet {
    layer-3;
    layer-4;
    symmetric-hash {
        complement;
    }
}
```
NOTE:

- PIC-level symmetrical hashing overrides the chassis-level symmetrical hashing configured at the [edit chassis forwarding-options hash-key] hierarchy level.
- Symmetrical hashing for load balancing on 802.3ad Link Aggregation Groups is currently supported for the VPLS, INET and bridged traffic only.
- Hash key configuration on a PIC or Packet Forwarding Engine can be either in the “symmetric hash” or the “symmetric hash complement” mode, but not both at the same time.

Related Documentation

Examples: Configuring PIC-Level Symmetrical Hashing for Load Balancing on 802.3ad LAGs on MX Series Routers on page 164

- family
- hash-key
- inet
- multiservice
- payload
- symmetric-hash

Examples: Configuring PIC- Level Symmetrical Hashing for Load Balancing on 802.3ad LAGs on MX Series Routers

NOTE: These examples are applicable only to the DPCs Supported on MX240, MX480, and MX960 Routers. For the list of DPCs supported, see DPCs Supported on MX240, MX480, and MX960 Routers in the Related Documentation section.

The following examples show how to configure symmetrical hashing at the PIC level for load balancing on MX Series routers:

- Configuring Symmetrical Hashing for family multiservice on Both Routers on page 164
- Configuring Symmetrical Hashing for family inet on Both Routers on page 165
- Configuring Symmetrical Hashing for family inet and family multiservice on the Two Routers on page 166

Configuring Symmetrical Hashing for family multiservice on Both Routers

On the inbound traffic interface where traffic enters Router A, include the symmetric-hash statement at the [edit chassis fpc slot-number pic pic-number hash-key family multiservice] hierarchy level:
On the inbound traffic interface where traffic enters Router B, include the `symmetric-hash complement` statement at the `[edit chassis fpc slot-number pic pic-number hash-key family multiservice]` hierarchy level:

```plaintext
[edit chassis fpc 0 pic 3 hash-key]
family multiservice {
  source-mac;
  destination-mac;
  payload {
    ip {
      layer-3;
      layer-4;
    }
  }
  symmetric-hash {
    complement;
  }
}
```

Configuring Symmetrical Hashing for family inet on Both Routers

On the inbound traffic interface where traffic enters Router A, include the `symmetric-hash` statement at the `[edit chassis fpc slot-number pic pic-number hash-key family inet]` hierarchy level:

```plaintext
[edit chassis fpc 0 pic 1 hash-key]
family inet {
  layer-3;
  layer-4;
  symmetric-hash;
}
```

On the inbound traffic interface where traffic enters Router B, include the `symmetric-hash complement` statement at the `[edit chassis fpc slot-number pic pic-number hash-key family inet]` hierarchy level:

```plaintext
[edit chassis fpc 1 pic 2 hash-key]
family inet {
  layer-3;
}
Configuring Symmetrical Hashing for family inet and family multiservice on the Two Routers

On the inbound traffic interface where traffic enters Router A, include the `symmetric-hash` statement at the [edit chassis fpc slot-number pic pic-number hash-key family multiservice] hierarchy level:

```plaintext
[edit chassis fpc 1 pic 0 hash-key]
family multiservice {
  payload {
    ip {
      layer-3;
      layer-4;
    }
    symmetric-hash;
  }
}
```

On the inbound traffic interface where traffic enters Router B, include the `symmetric-hash complement` statement at the [edit chassis fpc slot-number pic pic-number hash-key family inet] hierarchy level:

```plaintext
[edit chassis fpc 0 pic 3 hash-key]
family inet {
  layer-3;
  layer-4;
  symmetric-hash {
    complement;
  }
}
```

Related Documentation
- Configuring PIC-Level Symmetrical Hashing for Load Balancing on 802.3ad LAGs for MX Series Routers on page 162
- DPCs Supported on MX240, MX480, and MX960 Routers

Configuring ECMP Next Hops for RSVP and LDP LSPs for Load Balancing

The Junos OS supports configurations of 16, 32, or 64 equal-cost multipath (ECMP) next hops for RSVP and LDP LSPs on M10i routers with an Enhanced CFEB, M320, M120, MX Series, and T Series routers, and routing devices. For networks with high-volume traffic, this provides more flexibility to load-balance the traffic over as many as 64 LSPs.

To configure the maximum limit for ECMP next hops, include the `maximum-ecmp next-hops` statement at the [edit chassis] hierarchy level:
You can configure a maximum ECMP next-hop limit of 16, 32, or 64 using this statement. The default limit is 16.

NOTE: MX Series routers with one or more Modular Port Concentrator (MPC) cards and with Junos OS 11.4 or earlier installed, support the configuration of the `maximum-ecmp` statement with only 16 next hops. You should not configure the `maximum-ecmp` statement with 32 or 64 next hops. When you commit the configuration with 32 or 64 next hops, the following warning message appears:

Error: Number of members in Unilist NH exceeds the maximum supported 16 on Trio.

The following types of routes support the ECMP maximum next-hop configuration for as many as 64 ECMP gateways:

- Static IPv4 and IPv6 routes with direct and indirect next-hop ECMPs
- LDP ingress and transit routes learned through associated IGP routes
- RSVP ECMP next hops created for LSPs
- OSPF IPv4 and IPv6 route ECMPs
- ISIS IPv4 and IPv6 route ECMPs
- EIGP IPv4 and IPv6 route ECMPs
- IBGP (resolving over IGP routes) IPv4 and IPv6 route ECMPs

The enhanced ECMP limit of up to 64 ECMP next hops is also applicable for Layer 3 VPNs, Layer 2 VPNs, Layer 2 circuits, and VPLS services that resolve over an MPLS route, because the available ECMP paths in the MPLS route can also be used by such traffic.
NOTE:
The following FPCs on M320, T640, and T1600 routers only support 16 ECMP next hops:

- (M320, T640, and T1600 routers only) Enhanced II FPC1
- (M320, T640, and T1600 routers only) Enhanced II FPC2
- (M320 and T640 routers only) Enhanced II FPC3
- (T640 and T1600 routers only) FPC2
- (T640 and T1600 routers only) FPC3

If a maximum ECMP next-hop limit of 32 or 64 is configured on an M320, T640, or T1600 router with any of these FPCs installed, the Packet Forwarding Engines on these FPCs use only the first 16 ECMP next hops. For Packet Forwarding Engines on FPCs that support only 16 ECMP next hops, the Junos OS generates a system log message if a maximum ECMP next-hop limit of 32 or 64 is configured. However, for Packet Forwarding Engines on other FPCs installed on the router, a maximum configured ECMP limit of 32 or 64 ECMP next hops is applicable.

NOTE: If RSVP LSPs are configured with bandwidth allocation, for ECMP next hops with more than 16 LSPs, traffic is not distributed optimally based on bandwidths configured. Some LSPs with smaller allocated bandwidths receive more traffic than the ones configured with higher bandwidths. Traffic distribution does not strictly comply with the configured bandwidth allocation. This caveat is applicable to the following routers:

- T1600 and T640 routers with Enhanced Scaling FPC1, Enhanced Scaling FPC2, Enhanced Scaling FPC3, Enhanced Scaling FPC 4, and all Type 4 FPCs
- M320 routers with Enhanced III FPC1, Enhanced III FPC2, and Enhanced III FPC3
- MX Series routers with all types of FPCs and DPCs, excluding MPCs. This caveat is not applicable to MX Series routers with line cards based on the Junos Trio chipset.
- M120 routers with Type 1, Type 2, and Type 3 FPCs
- M10i routers with Enhanced CFEB

Next-hop cloning and permutations are disabled on T Series routers with Enhanced Scaling FPCs (Enhanced Scaling FPC1, Enhanced Scaling FPC2, Enhanced Scaling FPC3, and Enhanced Scaling FPC 4) that support enhanced load-balancing capability. As a result, memory utilization is reduced for a highly scaled system with a high number of
next hops on ECMP or aggregated interfaces. Next-hop cloning and permutations are also disabled on T Series routers with Type-4 FPCs.

To view the details of the ECMP next hops, issue the show route command. The show route summary command also shows the current configuration for the maximum ECMP limit. To view details of the ECMP LDP paths, issue the traceroute mpls ldp command.

Related Documentation

- maximum-ecmp

**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 173

### Example: Configuring Aggregated Ethernet Load Balancing

- Understanding Aggregated Ethernet Load Balancing on page 171
- Example: Configuring Aggregated Ethernet Load Balancing on page 173

### 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 ae x 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 ae x 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 ae x 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.

**See Also**

- Example: Configuring Aggregated Ethernet Load Balancing on page 173

**Example: Configuring Aggregated Ethernet Load Balancing**

This example shows how to configure aggregated Ethernet load balancing.

- Requirements on page 173
- Overview on page 174
- Configuration on page 176
- Verification on page 186

**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 ae x 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 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 ae x 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 ae x 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**

**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.

```plaintext
R1
    set chassis aggregated-devices ethernet device-count 12
    set interfaces xe-0/0/0 unit 0 family inet address 120.168.1.1/30
    set interfaces xe-0/0/0 unit 0 family iso
    set interfaces xe-0/0/0 unit 0 family mpls
    set interfaces xe-0/0/1 unit 0 family inet address 120.168.2.1/30
    set interfaces xe-0/0/1 unit 0 family iso
    set interfaces xe-0/0/1 unit 0 family mpls
    set interfaces ge-1/0/0 unit 0 family inet address 120.168.100.2/30
    set interfaces ge-1/0/0 unit 0 family iso
    set interfaces ge-1/0/0 unit 0 family mpls
    set interfaces ge-1/0/1 unit 0 family inet address 120.168.101.2/30
    set interfaces ge-1/0/1 unit 0 family iso
    set interfaces ge-1/0/1 unit 0 family mpls
    set interfaces lo0 unit 0 family inet address 120.168.0.2/32
    set interfaces lo0 unit 0 family iso address 49.0001.1201.6800.0002.00
    set routing-options router-id 120.168.0.2
    set routing-options autonomous-system 55
    set protocols rsvp interface ge-1/0/0.0
    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-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-0/0/0.0
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 ael aggregated-ether-options load-balance adaptive tolerance 10
set interfaces ael aggregated-ether-options link-speed 1g
set interfaces ael aggregated-ether-options lacp active
set interfaces ael unit 0 family inet address 120.168.105.1/30
set interfaces ael unit 0 family iso
set interfaces ael 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 ael.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 ael.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 ael.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-5/3/1 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
**Configuring Adaptive Load Balancing**

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.

### 1. Specify the number of aggregated Ethernet interfaces to be created.

```plaintext
[edit chassis]
user@R2# set aggregated-devices ethernet device-count 5
```

### 2. Configure the Gigabit Ethernet interface link connecting R2 to R1.

```plaintext
[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
```
3. Configure the five member links of the ae0 aggregated Ethernet bundle.

```plaintext
[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.

```plaintext
[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.

```plaintext
[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.

```plaintext
[edit interfaces]
user@R2# set ae0 aggregated-ether-options link-speed 1g
```

7. Configure LACP on the ae0 aggregated Ethernet bundle.

```plaintext
[edit interfaces]
user@R2# set ae0 aggregated-ether-options lACP active
```

8. Configure the interface parameters for the ae0 aggregated Ethernet bundle.

```plaintext
[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.
<table>
<thead>
<tr>
<th></th>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.</td>
<td><code>set ae1 aggregated-ether-options load-balance adaptive tolerance 10</code></td>
<td>Configure the link speed for the ae1 aggregated Ethernet bundle.</td>
</tr>
<tr>
<td>11.</td>
<td><code>set ae1 aggregated-ether-options link-speed 1g</code></td>
<td>Configure LACP on the ae1 aggregated Ethernet bundle.</td>
</tr>
<tr>
<td>12.</td>
<td><code>set ae1 aggregated-ether-options lacp active</code></td>
<td>Configure the interface parameters for the ae1 aggregated Ethernet bundle.</td>
</tr>
<tr>
<td>14.</td>
<td><code>set rsvp interface ge-1/2/0.0</code></td>
<td>Configure RSVP on all the interfaces of R2 and on the AE bundles.</td>
</tr>
<tr>
<td>15.</td>
<td><code>set mpls interface ge-1/2/0.0</code></td>
<td>Configure MPLS on all the interfaces of R2 and on the AE bundles.</td>
</tr>
<tr>
<td>16.</td>
<td><code>set isis traffic-engineering family inet shortcuts</code></td>
<td>Configure IS-IS on all the interfaces of R2 and on the AE bundles.</td>
</tr>
</tbody>
</table>
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 {
    gigether-options {
        802.3ad ae1;
    }
}
ge-2/2/7 {
    gigether-options {
        802.3ad ae1;
    }
}
ge-2/2/8 {
    gigether-options {
        802.3ad ae1;
    }
}
ae0 {
    aggregated-ether-options {
        load-balance {
            adaptive tolerance 10;
        }
    }
}
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 {
 Verification

Confirm that the configuration is working properly.

- Verifying Adaptive Load Balancing on ae0 on page 186

**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: 32248375409 | 705446 | 2540695966732 | 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: 32245875402 | 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.

See Also  • Understanding Aggregated Ethernet Load Balancing on page 169

### Load Balancing and Ethernet Link Aggregation Overview

You can create a link aggregation group (LAG) for a group of Ethernet ports. Layer 2 bridging traffic is load balanced across the member links of this group, making the configuration attractive for congestion concerns as well as for redundancy. You can configure up to 128 LAG bundles on M Series, and T Series routers, and 480 LAG bundles on MX Series routers and EX9200 switches. Each LAG bundle contains up to 16 links. (Platform support depends on the Junos OS release in your installation.)

By default, the hash key mechanism to load-balance frames across LAG interfaces is based on Layer 2 fields (such as frame source and destination address) as well as the input logical interface (unit). The default LAG algorithm is optimized for Layer 2 switching. Starting with Junos OS Release 10.1, you can also configure the load balancing hash key for Layer 2 traffic to use fields in the Layer 3 and Layer 4 headers using the `payload`
statement. However, note that the load-balancing behavior is platform-specific and based on appropriate hash-key configurations.

For more information, see “Configuring Load Balancing on a LAG Link” on page 188. In a Layer 2 switch, one link is overutilized and other links are underutilized.

**Release History Table**

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.1</td>
<td>Starting with Junos OS Release 10.1, you can also configure the load balancing hash key for Layer 2 traffic to use fields in the Layer 3 and Layer 4 headers using the <code>payload</code> statement.</td>
</tr>
</tbody>
</table>

**Related Documentation**

- `payload`

**Example: Configuring Load Balancing on a LAG Link**

This example configures the load-balancing hash key to use the source Layer 3 IP address option and Layer 4 header fields as well as the source and destination MAC addresses for load balancing on a link aggregation group (LAG) link:

```
[edit]
forwarding-options {
    hash-key {
        family multiservice {
            source-mac;
            destination-mac;
            payload {
                ip {
                    layer-3 {
                        source-ip-only;
                    }
                    layer-4;
                }
            }
        }
    }
}
```

**NOTE:** Any change in the hash key configuration requires a reboot of the FPC for the changes to take effect.

**Configuring Load Balancing on a LAG Link**

You can configure the load balancing hash key for Layer 2 traffic to use fields in the Layer 3 and Layer 4 headers inside the frame payload for load-balancing purposes using the `payload` statement. You can configure the statement to look at `layer-3` (and `source-ip-only`
or destination-ip-only packet header fields) or layer-4 fields. You configure this statement at the [edit forwarding-options hash-key family multiservice] hierarchy level.

You can configure Layer 3 or Layer 4 options, or both. The source-ip-only or destination-ip-only options are mutually exclusive. The layer-3-only statement is not available on MX Series routers.

By default, Junos 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.

For more information about link aggregation group (LAG) configuration, see the Junos OS Network Interfaces Library for Routing Devices.

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 ECM 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 ae bundle.

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 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 ae X 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.

### Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.2R1</td>
<td>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.</td>
</tr>
</tbody>
</table>

### Related Documentation
- Configuring Stateful Load Balancing on Aggregated Ethernet Interfaces on page 192

### 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 189

**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
   ```

   **NOTE:** To configure adaptive load balancing on aggregated Ethernet bundles with mixed link speeds, use the following statement:

   ```
   user@router# set interfaces ae0 aggregated-ether-options link-speed mixed load-balance 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 169
- Example: Configuring Aggregated Ethernet Load Balancing on page 173
- adaptive on page 1212
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 14.2 and later

**TIP:** See PTX Series PIC/FPC Compatibility for a list of PICs that are supported on each PTX Series FPC.

**NOTE:** Micro-BFD configuration with interface addresses is not supported on PTX routers on FPC3 and QFX10000 line of switches.

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 member link 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:**

- Starting with Junos OS Release 13.3, 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.
- In Junos OS, MicroBFD control packets are always untagged by default. For L2 aggregated interfaces, the configuration must include vlan-tagging or flexible-vlan-tagging in the Aggregated Ethernet with BFD. Otherwise, the system will throw error while committing the configuration.

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.
- Starting with Junos OS Release 14.1, specify the neighbor in a BFD session. In releases prior to Junos OS Release 16.1, you must configure the loopback address of the remote destination as the neighbor address. Beginning with Junos OS Release 16.1, you can also configure this feature with aggregated Ethernet interface address of the remote destination as the neighbor address.
CAUTION: Deactivate bfd-liveness-detection at the [edit interfaces aex aggregated-ether-options] hierarchy level or deactivate the aggregated Ethernet interface before changing the neighbor address from loopback IP address to aggregated Ethernet interface IP address. Modifying the local and neighbor address without deactivating bfd-liveness-detection or the aggregated Ethernet interface first might cause micro BFD sessions failure.

NOTE: Beginning with Release 16.1R2, Junos OS checks and validates the configured micro BFD local-address against the interface or loopback IP address before the configuration commit. Junos OS performs this check on both IPv4 and IPv6 micro BFD address configurations, and if they do not match, the commit fails.

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.

For the IPv6 address family, disable duplicate address detection before configuring this feature with AE interface addresses. To disable duplicate address detection, include the dad-disable statement at the [edit interface aex unit y family inet6] hierarchy level.

<table>
<thead>
<tr>
<th>Release</th>
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</tr>
</thead>
<tbody>
<tr>
<td>16.1</td>
<td>Beginning with Junos OS Release 16.1, you can also configure this feature with aggregated Ethernet interface address of the remote destination as the neighbor address.</td>
</tr>
<tr>
<td>16.1</td>
<td>Beginning with Release 16.1R2, Junos OS checks and validates the configured micro BFD local-address against the interface or loopback IP address before the configuration commit.</td>
</tr>
<tr>
<td>14.1</td>
<td>Starting with Junos OS Release 14.1, specify the neighbor in a BFD session. In releases prior to Junos OS Release 16.1, you must configure the loopback address of the remote destination as the neighbor address.</td>
</tr>
<tr>
<td>13.3</td>
<td>Starting with Junos OS Release 13.3, IANA has allocated 01-00-5E-90-00-01 as the dedicated MAC address for micro BFD.</td>
</tr>
</tbody>
</table>

Related Documentation
- authentication
- bfd-liveness-detection on page 1240
- detection-time
- transmit-interval
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 198
- Overview on page 198
- Configuration on page 199
- Verification on page 204

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

BFD for LAG is supported on the following PIC types on T-Series:

- 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
- PTX Series routers with 24X10GE (LAN/WAN) SFPP
- 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 for IPv4 connectivity and AE1 for IPv6 connectivity. Configure micro BFD session on the AE0 bundle using IPv4 addresses as local and neighbor endpoints on both routers. Configure micro BFD session on the AE1 bundle using IPv6 addresses as local and neighbor endpoints on both routers. This example verifies that independent micro BFD sessions are active in the output.

Topology

Figure 10 on page 198 shows the sample topology.
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::1:1/126`
- `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 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 aggregated-ether-options lacp active`
- `set interfaces ae1 unit 0 family inet6 address 5555::1/126`
- `set interface ae1 unit 0 family inet6 dad-disable`
- `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::1/126 next-hop 5555::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 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::1/126`
- `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 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 multiplier 3
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 aggregated-ether-options minimum-links 1
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 aggregated-ether-options lacp passive
set interfaces ae1 unit 0 family inet6 address 5555::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::1:1/126 next-hop 5555::1

Configuring a 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 a 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-4/1/0 gigether-options 802.3ad ae0
   user@R0# set xe-4/0/1 gigether-options 802.3ad ae1
   user@R0# set xe-4/1/0 gigether-options 802.3ad ae1

2. Configure the loopback interface.
3. Configure an IP address 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
```

4. Set the routing option, create a static route, and set the next-hop address.

```
[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 5555::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 multiplier 3
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 an IP address 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 5555::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
```

**NOTE:** Beginning with Junos OS Release 16.1, you can also configure this feature with the AE interface address as the local address in a micro BFD session.

Beginning with Release 16.1R2, Junos OS checks and validates the configured micro BFD local-address against the interface or loopback IP address before the configuration commit. Junos OS performs this check on both IPv4 and IPv6 micro BFD address configurations, and if they do not match, the commit fails.

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 20.20.20.30/30;
    }
    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;
    }
  }
  unit 0 {
    family inet {
      address 10.255.106.107/32;
    }
    family inet6 {
      address 201:DB8:251::aa:aa:1/128;
    }
  }
  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;
    }
  }
}
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 inet6 {
      address 5555::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 5555::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 205
- Viewing Detailed BFD Events on page 207
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
```

<table>
<thead>
<tr>
<th>Address</th>
<th>State</th>
<th>Interface</th>
<th>Detect Time</th>
<th>Transmit Interval</th>
<th>Multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.255.106.102</td>
<td>Up</td>
<td>xe-4/0/0</td>
<td>9.000</td>
<td>3.000</td>
<td>3</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Address</th>
<th>State</th>
<th>Interface</th>
<th>Detect Time</th>
<th>Transmit Interval</th>
<th>Multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.255.106.102</td>
<td>Up</td>
<td>xe-4/0/1</td>
<td>9.000</td>
<td>3.000</td>
<td>3</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Address</th>
<th>State</th>
<th>Interface</th>
<th>Detect Time</th>
<th>Transmit Interval</th>
<th>Multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>201:DB8:251::bb:bb:1</td>
<td>Up</td>
<td>xe-4/1/1</td>
<td>9.000</td>
<td>3.000</td>
<td>3</td>
</tr>
</tbody>
</table>

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
### 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 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
```
**Meaning**

BFD messages are being written to the specified trace file.

**Related Documentation**

- [authentication](#)
- [bfd-liveness-detection on page 1240](#)
- [detection-time](#)
- [Configuring Independent Micro BFD Sessions for LAG](#)
- [Understanding Independent Micro BFD Sessions for LAG on page 195](#)

## 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 22
- `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`.
   
   ```plaintext
   [edit]
   user@host# delete interfaces aex
   ```

2. Delete the interface from the device count.
   
   ```plaintext
   [edit]
   user@host# delete chassis aggregated-devices ethernet device-count
   ```

**Related Documentation**
- Configuring an Aggregated Ethernet Interface on page 110
- Configuring the Number of Aggregated Ethernet Interfaces on the Device on page 137
- Aggregated Ethernet Interfaces Overview on page 104
- `Ethernet Interfaces Feature Guide for Routing Devices`
Periodic Packet Management

Periodic packet management (PPM) is responsible for processing a variety of time-sensitive periodic tasks for particular processes so that other processes on the router can more optimally direct their resources.

- Understanding Periodic Packet Management on MX Series Routers on page 210
- Configuring Periodic Packet Management on MX Series Routers on page 211

Understanding Periodic Packet Management on MX Series Routers

Periodic packet management (PPM) for MX Series routers is responsible for processing a variety of time-sensitive periodic tasks for particular processes so that other processes on the router can more optimally direct their resources. PPM is responsible for the periodic transmission of packets on behalf of its various client processes, which include the processes that control the Link Aggregation Control Protocol (LACP) and Bidirectional Forwarding Detection (BFD) protocols, and also for receiving packets on behalf of these client processes. To enable PPM to send and receive packets on their behalf, the clients establish adjacencies with PPM. When packets are not received from the client, the adjacency is marked as down and the client is informed.

PPM operates in two modes:

- **Centralized**—When PPM is operating in centralized mode, it runs on the Routing Engine only.

- **Distributed**—When PPM is operating in distributed mode, it runs on the Packet Forwarding Engine. Currently, Bidirectional Forwarding Detection (BFD), Link Aggregation Control Protocol (LACP), Link Fault Management (LFM), Connectivity Fault Management (CFM), and Virtual Router Redundancy Protocol (VRRP) operate in distributed mode, by default.

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 LACP packets only.

**BEST PRACTICE:** We recommend that, generally, 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.
Configuring Periodic Packet Management on MX Series Routers

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.

This topic describes:

- Identifying Periodic Packet Management Mode on page 211
- Enabling Centralized Periodic Packet Management on page 212

Identifying Periodic Packet Management Mode

Before you configure periodic packet management, you must identify the mode of periodic packet management.

To identify the mode of periodic packet management:

1. From operational mode, enter the `show ppm adjacencies detail` command.

   ```
   user@host> show ppm adjacencies detail
   Protocol: OSPF2, Hold time: 40000, IFL-index: 359
   Distributed: FALSE
   OSPF source key: 88.1.1.2, OSPF area ID: 0.0.0.0
   ```

   In the above example, the distributed field is false. So, the periodic packet management mode for the OSPF protocol is centralized or running on the Routing Engine only.

   OR

   From configuration mode, enter the `run show ppm adjacencies detail` command.

   ```
   user@host# run show ppm adjacencies detail
   Protocol: BFD, Hold time: 900, IFL-index: 359
   Distributed: TRUE
   BFD discriminator: 16, BFD routing table index: 0
   ```

   In the above example, the distributed field is true. So, the periodic packet management mode for the BFD protocol is distributed to PFE.

2. From configuration mode, enter the `run show ppm adjacencies protocol protocol-name detail` command.

   ```
   user@host# show ppm adjacencies protocol lacp detail
   Protocol: LACP, Hold time: 3000, IFL-index: 361
   Distributed: TRUE
   Distribution handle: 30, Distribution address: fpc1
   Adjacencies: 1, Remote adjacencies: 1
   ```

   In the above example, the distributed field is true. So, the periodic packet management mode for the LACP protocol is distributed to PFE.
NOTE: You can also run the `show ppm adjacencies` command from the PFE shell. When you run the command from the PFE shell, the command displays all the process that are running in distributed mode.

**Enabling Centralized Periodic Packet Management**

After you identify the periodic packet management mode, you can enable centralized periodic packet management. When you enable centralized periodic packet management, the `ppm` process runs on the routing engine only. When you enable centralized periodic packet management, you have disabled distributed PPM. You can enable centralized periodic packet management for troubleshooting to identify if the protocol is having issues while running on distributed mode. If you do not face the issue while the protocol is running on centralized mode, you can narrow down the issue and identify if the issue is because of PFE failure.

**BEST PRACTICE:** We recommend that, generally, 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.

To enable centralized periodic packet management:

1. From configuration mode, enable centralized periodic packet management by specifying the `no-delegate-processing` statement at the `[edit]` hierarchy level.

   ```
   [edit]
   user@host# set routing-options ppm no-delegate-processing
   ```

2. Commit the configuration by using the `commit` statement.

   ```
   [edit]
   user@host# commit
   ```

3. Clear the current active protocol session on the device by using the `clear protocol-name session` command. For example, to clear the BFD session, use the following command.

   ```
   [edit]
   user@host# run clear bfd session
   ```

4. Verify the periodic packet management mode by using the `run show ppm adjacencies detail` command.

   ```
   user@host# run show ppm adjacencies detail
   ```
Starting with Junos OS Release 16.1R1, you can configure ITU-T Y.1731 standard-compliant Ethernet loss measurement (ETH-LM), Ethernet synthetic loss measurement (ETH-SLM), and Ethernet delay measurement (ETH-DM) capabilities on aggregated Ethernet (ae) interfaces. These ITU-T Y.1731 OAM services or performance monitoring techniques can be measured by on-demand mode (triggered through the CLI) or by proactive mode (triggered by the iterator application). These performance monitoring functionalities are supported on the following platforms:

- MX Series routers with 16-port 10-Gigabit Ethernet MPCs and Trio-based FPCs (MPCs), where the same level of support for the Ethernet services OAM mechanisms on non-aggregated Ethernet interfaces is available on AE interfaces
- MX2020 routers
- ETH-DM is supported on MPC3E and MPC4E modules with only software timestamping
- ETH-SLM is supported on MPC3E and MPC4E modules.

Also, connectivity fault management (CFM) sessions established on the AE interfaces can be distributed to the Packet Forwarding Engine, apart from being handled on the Routing engine. This capability to distribute CFM sessions is useful in both scaled topologies and graceful Routing Engine switchover (GRES) for CFM sessions.

Connectivity fault management (CFM) sessions operate in centralized mode over AE interfaces by default. Y.1731 performance monitoring (PM) is supported on centralized CFM sessions over AE interfaces. Also, distribution of CFM session over AE interfaces to line cards is supported from Junos OS Release 13.3. To enable the distribution of CFM sessions and to operate in centralized mode, include the ppm delegate-processing statement at the [edit routing-options ppm] hierarchy level. The mechanism that enables distribution of CFM sessions over AE interfaces provides the underlying infrastructure to support PM over AE interfaces. In addition, periodic packet management (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 performance monitoring processes on the Packet Forwarding Engine.

In the output, the distributed field is false and so ppm is centralized.

Related Documentation

- Ensuring That Distributed ppm Is Not Disabled on page 909
- Configuring Distributed Periodic Packet Management on an EX Series Switch (CLI Procedure)
- ppm on page 1472

ITU-T Y.1731 ETH-LM, ETH-SLM, and ETH-DM on Aggregated Ethernet Interfaces

Overview
For Ethernet delay measurement, hardware-assisted timestamping is supported on AE interfaces, similar to the support that exists on non-AE interfaces. Only hardware-based timestamping is supported because it is performed in the received path of the protocol data unit (PDU) packets, whereas software-based timestamping needs to be performed on the transmitted path and is not supported. For software timestamping, ETH-DM PDUs need to be transmitted and received on the same line card (same member of the AE interface). All the received ETH-DM PDUs are always redirected to the anchor Packet Forwarding Engine. In the transmission path, if the interface on the anchor Packet Forwarding Engine goes down, then the OAM pdus are redirected to one of the subordinate or member FPCs. Therefore, the processing of ETH-DM PDUs always occurs at the CPU of the line card or module that hosts the anchor Packet Forwarding Engine. ETH-DM is supported on AE interfaces with CCC, bridge, virtual private LAN service (VPLS), and inet address families. ETH-DM is supported for both active-active and active-standby modes of AE interfaces. For one-way delay measurement (IDM), the system clocks of the initiator MEP that transmits a request frame and the responder MEP that receives a reply frame need to be synchronized.

For Ethernet loss measurement on AE interfaces, with the active-standby mode of the interfaces, transmission and reception of PDUs is always through the Packet Forwarding Engine that hosts the active link. For the active-standby mode of the AE interfaces, you can configure a maximum of only two member links. ETH-LM is supported only when all the active member or child links are on the same Packet Forwarding Engine. For the downstream maintenance endpoints (MEPs), ETH-LM is supported for CCC, VPLS, and bridge address families, and for upward MEPs, ETH-LM is supported only for CCC address families. For Ethernet synthetic loss measurement (SLM), processing of SLM PDUs for requests and responses is similar to other protocols from the line card CPU is implemented. All other computation and data are software-based. ETH-SLM is supported on AE interfaces for CCC, bridge, VPLS, and inet families.
NOTE: Starting with Junos OS Release 16.1, Ethernet loss measurement over an aggregated Ethernet (ae) interface is not supported when the enhanced LAG functionality is enabled on a router. The enhanced LAG capability is enabled by default when you configure enhanced IP services mode by including the `network-services enhanced-ip` statement at the [edit chassis] hierarchy level. For Ethernet loss measurement to work properly, you must disable the enhanced LAG functionality by entering the set chassis `aggregated-devices disable-lag-enhanced` statement. Also, CFM is not supported when enhanced LAG is enabled.

Starting with Junos OS Release 16.1, 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.

Before you can start an ETH-DM, ETH-LM, or ETH-SLM measurement sessions across an aggregated Ethernet service, you must configure two MX Series routers to support these measurement sessions. On each router, configure two physical or logical AE interfaces connected by a VLAN by including the `interface ae-fpc/pic/port unit logical-unit-number vlan-id vlan-id` statement at the [edit interfaces] hierarchy level and on each router, attach the peer MEPS to the interfaces by including the `mep mep-id interface interface-name (protect | working)` statement at the [edit protocols oam ethernet connectivity-fault-management maintenance-domain md-name maintenance-association ma-name] hierarchy level.

### Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.1R1</td>
<td>Starting with Junos OS Release 16.1R1, you can configure ITU-T Y.1731 standard-compliant Ethernet loss measurement (ETH-LM), Ethernet synthetic loss measurement (ETH-SLM), and Ethernet delay measurement (ETH-DM) capabilities on aggregated Ethernet (ae) interfaces.</td>
</tr>
<tr>
<td>16.1</td>
<td>Starting with Junos OS Release 16.1, Ethernet loss measurement over an aggregated Ethernet (ae) interface is not supported when the enhanced LAG functionality is enabled on a router.</td>
</tr>
<tr>
<td>16.1</td>
<td>Starting with Junos OS Release 16.1, performance monitoring for connectivity fault management (by including the <code>performance-monitoring</code> 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.</td>
</tr>
</tbody>
</table>

### Related Documentation
Guidelines for Configuring Performance Monitoring Functionalities on Aggregated Ethernet Interfaces

Keep the following points in mind while you configure ETH-LM, ETH-SLM, and ETH-DM capabilities on aggregated Ethernet (ae-) interfaces:

- The scaling limits and performance considerations for distributed periodic packet management (PPM) sessions. The scaling limits for distributed PPM sessions over aggregated Ethernet (AE) interfaces are identical to the maximum supported numbers for continuity check messages (CCM) over AE interfaces.
- SLA iterators always coexist with CCM sessions. Therefore, while configuring a scaled environment, you must account for CCM sessions should be accounted along with SLA iterators. The following table describes the maximum number of distributed PM sessions you can configure for different CCM intervals per line card and per router (system-wide value).
- A mixed operation of distributed and centralized modes for performance monitoring (PM) sessions is not supported on AE interfaces, if the interfaces that form the aggregated Ethernet bundle are in mixed mode.
- The limitations for performance monitoring (PM) capabilities for non-AE interfaces apply equally well for AE interfaces. For example, flapping of sessions resets the PM statistics.
- The limitations that exist with distributed PPM sessions are valid for performance monitoring capabilities over AE interfaces because measurements are always performed on CCM sessions.
- For ETH-LM over AE interfaces in an active-standby setup, if active and standby line cards are swapped, then the measurements during this window are ignored.
- For ETH-DM over AE interfaces, the additional time that is taken for packet transmission (packets are redirected to anchor in the received [Rx] direction and to the active child FPC in the transmitted [Tx] direction) is computed in the delay measurement.
- For ETH-LM over AE interfaces, in an active-standby setup, whenever the link failover from the active interface to the standby interface happens, the counters are reset.
Targeted Distribution of Static Logical interfaces Across Aggregated Ethernet Member Links

This document provides an overview of targeted distribution of static logical interfaces across aggregated Ethernet member links, and an example for configuring targeted distribution.

- Targeted Distribution of Static Logical interfaces Across Aggregated Ethernet Member Links Overview on page 217
- Example: Configuring Targeted Distribution for Accurate Policy Enforcement on Logical Interfaces Across Aggregated Ethernet Member Links on page 218

Targeted Distribution of Static Logical interfaces Across Aggregated Ethernet Member Links Overview

Targeted distribution provides a mechanism to direct traffic through specified links for an aggregated Ethernet bundle, and also assigns roles to member links to handle link failure scenarios.

The targeted distribution of static logical interfaces is also used to accurately enforce egress class-of-service (CoS) profiles. Without this feature, the enforcement of egress class-of-service profiles is distributed among the individual member interface schedulers, shapers, or policers instantiated in each Packet Forwarding Engine that hosts a member link. In the absence of targeted distribution of aggregated Ethernet bundles, traffic destined through a logical interface of a bundle can exit through any of the members based on the hashing algorithm. As a result, it is not possible to determine which link is used to forward traffic. Distributed egress policy enforcement relies on traffic load balancing, which might not be accurate all the time. With targeted distribution, logical interface traffic is directed to a certain member link or a number of member links. Targeted distribution ensures an accurate policy enforcement that is no longer distributed for a given logical interface.

NOTE: Irrespective of the family configured for the logical interface, the targeted distribution feature is applicable to both Layer 3 and Layer 2 interfaces.

You can form distribution lists consisting of member links of the aggregated Ethernet bundle and you can assign roles to these lists, such as primary, backup, and standby. A distribution list specified as primary ensures that traffic is load-balanced among all the links in the primary list. If all links within the primary list are up, traffic is forwarded on those links. If some of the links within a primary list fail, the remaining links carry traffic. If all links within the primary list go down, only then the links in the backup list start carrying traffic. If some of links within the backup list fail, the remaining links in the backup list carry traffic. If all the links within the primary list and the backup list go down, only then the links in the standby list start carrying traffic. When the primary member links come back online, they continue to carry traffic.
You can configure distribution lists for primary links and backup links. The remaining links are added to a defined standby list. You can make changes to the distribution lists and their roles by configuring them again. When targeted distribution lists are deleted, all links carry traffic. When you commit the configuration, the member links are assigned the specified roles irrespective of whether the links are up or down.

**NOTE:** The feature is supported only on MX Series routers with MPCs, and with the enhanced-ip configuration enabled.

The outbound traffic of a Layer 3 host is distributed among all the member links of an aggregated Ethernet bundle. Targeted distribution is implemented only for the transit traffic.

---

**Example: Configuring Targeted Distribution for Accurate Policy Enforcement on Logical Interfaces Across Aggregated Ethernet Member Links**

This example shows how to configure targeted distribution lists for aggregated Ethernet member links as primary, or backup. Member links are assigned membership to the distribution lists. Logical interfaces of the aggregated Ethernet are then assigned membership to the primary list and the backup list.

- Requirements on page 218
- Overview on page 218
- Configuration on page 219
- Verification on page 222

**Requirements**

This example uses the following software and hardware components:

- Junos OS Release 16.1 and later releases
- One MX Series 5G Universal Routing Platform

**Overview**

Targeted distribution provides a mechanism to direct traffic through specified links of an aggregated Ethernet bundle, and also assigns roles to member links to handle link failure scenarios.

You can configure targeted distribution to load-balance the traffic between the aggregated Ethernet bundle member links. You can map a logical interface to a single link only for the outgoing traffic.

This example uses the `apply-groups` configuration for specifying the distribution lists for the logical interfaces of the aggregated Ethernet member links. You can use the `apply-groups` statement to inherit the Junos OS configuration statements from a configuration group. The `apply-groups` configuration statement in the example shows...
the odd numbered member links of the aggregated Ethernet bundle being assigned the primary list dl2 and even numbered member links being assigned primary list dl1.

The aggregated Ethernet interface used in this example is ae10 with units 101, 102, 103, and 104. The Gigabit Ethernet interface, ge-0/0/3 is specified as distribution list dl1 and ge-0/0/4 as dl2. The logical interface unit numbers of the aggregated Ethernet bundle ending in an odd number are assigned to the distribution list dl1 as the primary list, and those ending in an even number are assigned the distribution list dl2 as the primary list.

To configure targeted distribution you must:

1. Create a global apply group.
2. Assign each member of the aggregated Ethernet interface to a different distribution list.
3. Attach the apply group to the aggregated Ethernet interface.
4. Create the logical interfaces. The apply group automatically assigns the distribution lists to each member of the aggregated Ethernet bundle as required.

**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, copy and paste the commands into the CLI at the [edit] hierarchy level, and then enter commit from configuration mode.

```
[edit groups GR-AE-ACCESS-DISTRIBUTION]
user@host# set interfaces <ae*> unit <*[1 3 5 7 9]> description "matched-odd" targeted-distribution primary-list dl2
user@host# set interfaces <ae*> unit <*[1 3 5 7 9]> description "matched-odd" targeted-distribution backup-list dl1
user@host# set interfaces <ae*> unit <*[0 2 4 6 8]> description "matched-even" targeted-distribution primary-list dl1
user@host# set interfaces <ae*> unit <*[0 2 4 6 8]> description "matched-even" targeted-distribution backup-list dl2
user@host# set interfaces ge-0/0/3 apply-groups-except INTF gigether-options 802.3ad ae10 distribution-list dl1
user@host# set interfaces ge-0/0/4 apply-groups-except INTF gigether-options 802.3ad ae10 distribution-list dl2
user@host# set interfaces <ae*> apply-groups GR-AE-ACCESS-DISTRIBUTION
user@host# set interfaces <ae*> flexible-vlan-tagging encapsulation flexible-ethernet-services unit 101 vlan-id 101 family inet address 10.1.0.1/16
user@host# set interfaces <ae*> flexible-vlan-tagging encapsulation flexible-ethernet-services unit 102 vlan-id 102 family inet address 10.2.0.1/16
user@host# set interfaces <ae*> flexible-vlan-tagging encapsulation flexible-ethernet-services unit 103 vlan-id 103 family inet address 10.3.0.1/16
user@host# set interfaces <ae*> flexible-vlan-tagging encapsulation flexible-ethernet-services unit 104 vlan-id 104 family inet address 10.4.0.1/16
```

To configure targeted distribution:

1. Create a global apply group and specify the primary list and the backup list.
2. Assign each member of the aggregated Ethernet bundle to a different distribution list.

```bash
[edit]
user@host# set interfaces ge-0/0/3 apply-groups-except INTF gigether-options 802.3adae10 distribution-list dl1
[edit]
user@host# set interfaces ge-0/0/4 apply-groups-except INTF gigether-options 802.3adae10 distribution-list dl2
```

3. Attach the defined apply group to the aggregated Ethernet interface.

```bash
[edit]
user@host# set interfaces ae10 apply-groups GR-AE-ACCESS-DISTRIBUTION
```

4. Create the logical interfaces and configure its provisions.

```bash
[edit]
user@host# set interfaces ae10 apply-groups GR-AE-ACCESS-DISTRIBUTION
user@host# set interfaces ae10 flexible-vlan-tagging encapsulation flexible-ethernet-services set unit 101 vlan-id 101 family inet address 10.1.0.1/16
user@host# set interfaces ae10 flexible-vlan-tagging encapsulation flexible-ethernet-services unit 102 vlan-id 102 family inet address 10.2.0.1/16
user@host# set interfaces ae10 flexible-vlan-tagging encapsulation flexible-ethernet-services unit 103 vlan-id 103 family inet address 10.3.0.1/16
user@host# set interfaces ae10 flexible-vlan-tagging encapsulation flexible-ethernet-services unit 104 vlan-id 104 family inet address 10.4.0.1/16
```

**Results**

From configuration mode, confirm your configuration by using the `show` command. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```bash
user@host# show groups GR-AE-ACCESS-DISTRIBUTION
interfaces {
  <ae*> {
    unit "<*[1 3 5 7 9]>" {
      description "matched odd";
      targeted-distribution {
        primary-list dl2;
      }
    }
  }
}
```
backup-list dl1;
}
}
unit "<*[0 2 4 6 8]>" {
    description "matched even";
    targeted-distribution {
        primary-list dl1;
        backup-list dl2;
    }
}
}
}

user@host# show interfaces ge-0/0/3
apply-groups-except INTF;
gigether-options {
    802.3ad {
        ae10;
        distribution-list dl1;
    }
}

user@host# show interfaces ge-0/0/4
apply-groups-except INTF;
gigether-options {
    802.3ad {
        ae10;
        distribution-list dl2;
    }
}

user@host# show interfaces ae10 apply-groups
apply-groups GR-AE-ACCESS-DISTRIBUTION;

user@host# show interfaces ae10
apply-groups GR-AE-ACCESS-DISTRIBUTION;
flexible-vlan-tagging; encapsulation flexible-ethernet-services;
unit 101 {
    vlan-id 101;
    family inet {
        address 10.1.0.1/16 {
        }
    }
}
unit 102 {
    vlan-id 102;
    family inet {
        address 10.2.0.1/16 {
        }
    }
}
unit 103 {
    vlan-id 103;
Verification

Verifying Targeted Distribution of Logical Interfaces

Purpose
Verify that the logical interfaces are assigned to the distribution lists.

Action
To verify that the logical interfaces are assigned to the distribution lists, enter the `show interfaces detail` or `extensive` command.

The `show interfaces detail` or `extensive` command output shows the logical interfaces ending in an odd number being assigned to the distribution list, `dl1 (ge-0/0/3)` and those ending in an even number being assigned distribution list, `dl2 (ge-0/0/4)` by default. If there is a failure of either of those interfaces, the logical interfaces switch to the interfaces in the backup list or continue to use the active member interface. For example, on the aggregated Ethernet bundle, `ae10.101`, the primary interface shown is `ge-0/0/4` and on the aggregated Ethernet bundle `ae10.102`, the primary interface is `ge-0/0/3` and similarly for the other logical interfaces.

```
user@host# run show interfaces extensive ae10
```

Physical interface: ae10, Enabled, Physical link is Up
Interface index: 129, SNMP ifIndex: 612, Generation: 132
Link-level type: Flexible-Ethernet, MTU: 9000, Speed: 2Gbps, BPDU Error: None, MAC-REWRITE Error: None,
Loopback: Disabled, Source filtering: Disabled, Flow control: Disabled
Pad to minimum frame size: Disabled
Minimum links needed: 1, Minimum bandwidth needed: 1bps
Device flags : Present Running
Interface flags: SNMP-Traps Internal: 0x4000
Current address: 00:05:86:1e:70:c1, Hardware address: 00:05:86:1e:70:c1
Last flapped : 2016-08-30 16:15:28 PDT (00:43:15 ago)
Statistics last cleared: Never
Traffic statistics:
Input bytes : 0 0 bps
Output bytes : 77194 200 bps
Input packets: 0 0 pps
Output packets: 300 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, 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: 8 supported, 4 in use
Queue counters:    Queued packets  Transmitted packets  Dropped packets
  0                    0                    0                    0
  1                    0                    0                    0
  2                    0                    0                    0
  3                    0                    0                    0

Egress queues: 8 supported, 4 in use
Queue counters:    Queued packets  Transmitted packets  Dropped packets
  0                    0                    0                    0
  1                    0                    0                    0
  2                    0                    0                    0
  3                    0                    0                    0

Queue number: Mapped forwarding classes
  0                   best-effort
  1               expedited-forwarding
  2               assured-forwarding
  3            network-control

Logical interface ae10.101 (Index 345) (SNMP ifIndex 617) (Generation 154)
Description: matched odd
Flags: Up SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.101 ] Encapsulation: ENET2

Statistics

Bundle:
Input: 0 0 0 0
Output: 2 0 92 0

Adaptive Statistics:
Adaptive Adjusts: 0
Adaptive Scans: 0
Adaptive Updates: 0

Link:
ge-0/0/3.101
Input: 0 0 0 0
Output: 2 0 92 0
ge-0/0/4.101
Input: 0 0 0 0
Output: 0 0 0 0
Aggregate member links: 2

<table>
<thead>
<tr>
<th>Marker Statistics:</th>
<th>Marker Rx</th>
<th>Resp Tx</th>
<th>Unknown Rx</th>
<th>Illegal Rx</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-0/0/3.101</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>ge-0/0/4.101</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>List-Type</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>Active</td>
</tr>
<tr>
<td>Interfaces:</td>
<td>ge-0/0/4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>List-Type</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backup</td>
<td>Waiting</td>
</tr>
<tr>
<td>Interfaces:</td>
<td>ge-0/0/3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>List-Type</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standby</td>
<td>Down</td>
</tr>
</tbody>
</table>

Protocol inet, MTU: 8978, Generation: 198, Route table: 0
Flags: Sendbcast-pkt-to-re
Addresses, Flags: Is-Preferred Is-Primary
Destination: 10.1.0.1/15, Local: 10.1.0.2, Broadcast: 10.1.0.3, Generation: 154

Protocol multiservice, MTU: Unlimited, Generation: 199, Route table: 0
Policer: Input: __default_arp_policer__

Logical interface ae10.102 (Index 344) (SNMP ifIndex 615) (Generation 153)
Description: matched even
Flags: Up SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.102 ] Encapsulation: ENET2
Statistics Packets pps Bytes bps
Bundle: 0 0 0 0
Input: 0 0 0 0
Output: 4 0 296 0
Adaptive Statistics:
Adaptive Adjusts: 0
Adaptive Scans : 0
Adaptive Updates: 0
Link:
ge-0/0/3.102
Input: 0 0 0 0
Output: 4 0 296 0
ge-0/0/4.102
Input: 0 0 0 0
Output: 0 0 0 0
Marker Statistics: Marker Rx Resp Tx Unknown Rx Illegal Rx
ge-0/0/3.102 0 0 0 0
ge-0/0/4.102 0 0 0 0

<table>
<thead>
<tr>
<th>List-Type</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>Active</td>
</tr>
<tr>
<td>Interfaces:</td>
<td>ge-0/0/3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>List-Type</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backup</td>
<td>Waiting</td>
</tr>
<tr>
<td>Interfaces:</td>
<td>ge-0/0/4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>List-Type</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standby</td>
<td>Down</td>
</tr>
</tbody>
</table>

Protocol inet, MTU: 8978, Generation: 196, Route table: 0
Chapter 7: Configuring Aggregated Ethernet Interfaces for Increased Throughput and Link Redundancy

Flags: Sendbcast-pkt-to-re
Addresses, Flags: Is-Preferred Is-Primary
Destination: 10.2.0.1, Local: 10.2.0.1, Broadcast: 10.2.0.3, Generation: 152
Protocol multiservice, MTU: Unlimited, Generation: 197, Route table: 0
Policer: Input: __default_arp_policer__

Logical interface ae10.103 (Index 343) (SNMP ifIndex 614) (Generation 152)
Description: matched odd
Flags: Up SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.103 ] Encapsulation: ENET2
Statistics

<table>
<thead>
<tr>
<th>Bundle:</th>
<th>Packets</th>
<th>pps</th>
<th>Bytes</th>
<th>bps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Output</td>
<td>3</td>
<td>0</td>
<td>194</td>
<td>0</td>
</tr>
</tbody>
</table>

Adaptive Statistics:
Adaptive Adjusts: 0
Adaptive Scans: 0
Adaptive Updates: 0

Link:
ge-0/0/3.103
Input: 0 0 0 0
Output: 3 0 194 0
ge-0/0/4.103
Input: 0 0 0 0
Output: 0 0 0 0

Marker Statistics:
Marker Rx Resp Tx Unknown Rx Illegal Rx
ge-0/0/3.103 0 0 0 0
ge-0/0/4.103 0 0 0 0

List-Type Status
Primary Active Interfaces:
ge-0/0/4 Up
List-Type Status
Backup Waiting Interfaces:
ge-0/0/3 Up
List-Type Status
Standby Down

Protocol inet, MTU: 8978, Generation: 194, Route table: 0
Flags: Sendbcast-pkt-to-re
Addresses, Flags: Is-Preferred Is-Primary
Destination: 10.3.0.0/15, Local: 10.3.0.1, Broadcast: 10.3.0.3, Generation: 150
Protocol multiservice, MTU: Unlimited, Generation: 195, Route table: 0
Policer: Input: __default_arp_policer__

Logical interface ae10.104 (Index 342) (SNMP ifIndex 616) (Generation 151)
Description: matched even
Flags: Up SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.104 ] Encapsulation: ENET2
Statistics

<table>
<thead>
<tr>
<th>Bundle:</th>
<th>Packets</th>
<th>pps</th>
<th>Bytes</th>
<th>bps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Output</td>
<td>2</td>
<td>0</td>
<td>92</td>
<td>0</td>
</tr>
</tbody>
</table>

Adaptive Statistics:
Adaptive Adjusts: 0
Adaptive Scans: 0
Adaptive Updates: 0

Link:
<table>
<thead>
<tr>
<th>Interface</th>
<th>List-Type</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-0/0/3.104</td>
<td>Primary</td>
<td>Active</td>
</tr>
<tr>
<td>ge-0/0/4.104</td>
<td>Backup</td>
<td>Waiting</td>
</tr>
<tr>
<td>ge-0/0/3.104</td>
<td>Standby</td>
<td>Down</td>
</tr>
<tr>
<td>ge-0/0/4.104</td>
<td>Standby</td>
<td>Down</td>
</tr>
</tbody>
</table>

Protocol inet, MTU: 8978, Generation: 192, Route table: 0
Flags: Sendbcast-pkt-to-re
Addresses, Flags: Is-Preferred Is-Primary
Destination: 10.4.0.0/16, Local: 10.4.0.1, Broadcast: 10.4.0.3, Generation: 148

Protocol multiservice, MTU: Unlimited, Generation: 193, Route table: 0
Policer: Input: __default_arp_policer__

Logical interface ae10.32767 (Index 341) (SNMP ifIndex 613) (Generation 150)
Flags: Up SNMP-Traps 0x4004000 VLAN-Tag [ 0x0000.0 ] Encapsulation: ENET2
Statistics | Packets | pps | Bytes | bps |
---|---|---|---|---|
Bundle: | | | | |
| Input: | 0 | 0 | 0 | 0 |
| Output: | 0 | 0 | 0 | 0 |
Adaptive Statistics:
| Adaptive Adjusts: | 0 |
| Adaptive Scans : | 0 |
| Adaptive Updates: | 0 |
Link:
ge-0/0/3.32767
Input: | 0 | 0 | 0 | 0 |
Output: | 95 | 0 | 38039 | 0 |
ge-0/0/4.32767
Input: | 0 | 0 | 0 | 0 |
Output: | 95 | 0 | 38039 | 0 |
Marker Statistics: | Marker Rx | Resp Tx | Unknown Rx | Illegal Rx |
ge-0/0/3.32767 | 0 | 0 | 0 | 0 |
ge-0/0/4.32767 | 0 | 0 | 0 | 0 |

Protocol multiservice, MTU: Unlimited, Generation: 191, Route table: 0
Flags: None
Policer: Input: __default_arp_policer__

See Also
- distribution-list on page 1268
- targeted-distribution on page 1558
• targeted-options on page 1559
CHAPTER 8

Configuring Ethernet Automatic Protection Switching for High Availability

- Ethernet Automatic Protection Switching Overview on page 229
- Mapping of CCM Defects to APS Events on page 232
- Example: Configuring Protection Switching Between Psuedowires on page 233

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

In the scenario diagramed in Figure 11 on page 230, 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 231*, 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 232
- Example: Configuring Protection Switching Between Psuedowires on page 233

### 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 shown in Figure 13 on page 232, 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
Example: Configuring Protection Switching Between Psuedowires

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 233.

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 233.

- 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 229
- Mapping of CCM Defects to APS Events on page 232
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.

NOTE: ERPS on AE interfaces is not supported on ACX Series routers except on ACX5000 Series routers.

The following standards provide detailed information on Ethernet ring protection switching:

NOTE: EX2300 and EX3400 switches support G.8032v1 only.

- 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 238
- Configuring Ethernet Ring Protection Switching on page 245
- Example: Ethernet Ring Protection Switching Configuration on MX Routers on page 246
- 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 239
- Ring Nodes on page 239
- Ring Node States on page 239
- Default Logging of Basic State Transitions on EX Series Switches on page 240
- Logical Ring on page 240
- FDB Flush on page 240
- Traffic Blocking and Forwarding on page 241
- RPL Neighbor Node on page 241
- RAPS Message Blocking and Forwarding on page 241
- Dedicated Signaling Control Channel on page 243
- RAPS Message Termination on page 243
- Revertive and Non-revertive Modes on page 243
- Multiple Rings on page 243
- Node ID on page 243
- Ring ID on page 244
- Bridge Domains with the Ring Port (MX Series Routers Only) on page 244
- Wait-to-Block Timer on page 244
- Adding and Removing a Node on page 245
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. Note that WTB is always disabled on EX2300 and EX3400 switches because it is not supported in ERPSv1. Any configuration you make to the WTB setting on EX2300 and EX3400 switches has no effect. The output from the CLI command 'show protection-group ethernet-ring node-state detail' lists a WTB setting but that setting has no effect on EX2300 and EX3400 switches.
- WTR—Wait to restore. Note that on EX2300 and EX3400 switches only, the WTR configuration must be 5-12 minutes.
- 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.

NOTE: EX2300 and EX3400 switches do not support force switch.

• 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.

NOTE: EX2300 and EX3400 switches do not support manual switch.

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

Starting with Junos OS Release 14.1X53-D15, EX Series switches automatically log basic state transitions for the ERPS protocol. Starting with Junos OS Release 18.2R1, EX2300 and EX3400 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.

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.
NOTE: Optimized flushing is not supported on EX2300 and EX3400 switches.

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.

NOTE: RPL neighbor node is not supported on EX2300 and EX3400 switches.

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 241, the system also sends 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 241. 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.

NOTE: Non-revertive mode is not supported on EX2300 and EX3400 switches.

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.

NOTE: Interconnection of multiple rings is not supported on EX2300 and EX3400 switches.

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.

NOTE: The Wait To Block Timer (WTB) is always disabled on EX2300 and EX3400 switches because it is not supported in ERPSv1. Any configuration you make to the WTB setting has no effect. The output from the CLI command 'show protection-group ethernet-ring node-state detail' lists a WTB setting but that setting has no effect.
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.

**NOTE:** EX2300 and EX3400 switches do not support force switch.

### Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.2R1</td>
<td>Starting with Junos OS Release 18.2R1, EX2300 and EX3400 switches automatically log basic state transitions for the ERPS protocol.</td>
</tr>
<tr>
<td>14.2</td>
<td>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.</td>
</tr>
<tr>
<td>14.2</td>
<td>Starting with Junos OS Release 14.2, ring protection link neighbor nodes are supported.</td>
</tr>
<tr>
<td>14.2</td>
<td>Starting with Junos OS Release 14.2, you can add or remove a node between two nodes in an Ethernet ring.</td>
</tr>
<tr>
<td>14.1X53-D15</td>
<td>Starting with Junos OS Release 14.1X53-D15, EX Series switches automatically log basic state transitions for the ERPS protocol.</td>
</tr>
</tbody>
</table>

### Related Documentation

- Ethernet Ring Protection Switching Overview on page 237
- Configuring Ethernet Ring Protection Switching on page 245
- Example: Ethernet Ring Protection Switching Configuration on MX Routers on page 246
- Example: Configuring Ethernet Ring Protection Switching on EX Series Switches
- Configuring Ethernet Ring Protection Switching on Switches (CLI Procedure)

### Configuring Ethernet Ring Protection Switching

The inheritance model follows:

```conf
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 {
        ...
      }
    }
  }
}
```
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 237
- Understanding Ethernet Ring Protection Switching Functionality on page 238
- Example: Ethernet Ring Protection Switching Configuration on MX Routers on page 246
- 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 246
- Ethernet Ring Overview and Topology on page 246
- Configuring a Three-Node Ring on page 247

### 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 247.
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 247

**Configuring Ethernet Ring Protection Switching on a Three-Node Ring**

Step-by-Step Procedure

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;
     }
   }
}

2. bridge-domains {
   bd1 {
     domain-type bridge;
     interface ge-1/2/4.1;
     interface ge-1/0/1.1;
   }
}

3. 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;
       }
     }
   }
}

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```plaintext

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. 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;
            }
        }
    }
    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. 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 {
                    
                }
            }
        }
    }
}
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 246. 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

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

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  Quad 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  Quad Timer  Operation state
disabled  disabled  operational

user@node2> 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
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  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                    : 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
```
show protection-group ethernet-ring node-state

show protection-group ethernet-ring statistics group-name pg102

Related Documentation

- Ethernet Ring Protection Switching Overview on page 237
- Understanding Ethernet Ring Protection Switching Functionality on page 238
- Configuring Ethernet Ring Protection Switching on page 245
- Ethernet Interfaces Feature Guide for Routing Devices
CHAPTER 10

Configuring MAC Address Validation on Static Ethernet Interfaces

MAC Address Validation on Static Ethernet Interfaces Overview on page 255
Configuring MAC Address Validation on Static Ethernet Interfaces on page 256
Disabling MAC Address Learning of Neighbors Through ARP or Neighbor Discovery for IPv4 and IPv6 Neighbors on page 257

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 256
- Disabling MAC Address Learning of Neighbors Through ARP or Neighbor Discovery for IPv4 and IPv6 Neighbors on page 257
- 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 `nnnn:nnnn:nnnn` 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
   user@host# set arp ip-address mac mac-address
   ```

Related Documentation:
- [family](#) on page 1310
- [mac-validate](#) on page 1401
- MAC Address Validation on Static Ethernet Interfaces Overview on page 255
- 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:

```plaintext
[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:

```plaintext
[edit interfaces interface-name unit interface-unit-number family inet6]
no-neighbor-learn;
```

Related Documentation

- `no-neighbor-learn`
- *Configuring Junos OS ARP Learning and Aging Options for Mapping IPv4 Network Addresses to MAC Addresses*
- *Ethernet Interfaces Feature Guide for Routing Devices*
CHAPTER 11

Configuring 802.1Q VLANs

- 802.1Q VLANs Overview on page 260
- 802.1Q VLAN IDs and Ethernet Interface Types on page 261
- Configuring Dynamic 802.1Q VLANs on page 262
- Enabling VLAN Tagging on page 263
- Configuring Tagged Interface with multiple tagged vlans and native vlan on page 265
- Sending Untagged Traffic Without VLAN ID to Remote End on page 266
- Configuring Flexible VLAN Tagging on PTX Series Packet Transport Routers on page 267
- Configuring VLAN tagging on Routers on page 268
- Binding VLAN IDs to Logical Interfaces on page 270
- Associating VLAN IDs to VLAN Demux Interfaces on page 274
- Configuring VLAN and Extended VLAN Encapsulation on page 275
- Configuring a Layer 2 VPN Routing Instance on a VLAN-Bundled Logical Interface on page 276
- Example: Configuring a Layer 2 VPN Routing Instance on a VLAN-Bundled Logical Interface on page 278
- Specifying the Interface Over Which VPN Traffic Travels to the CE Router on page 280
- Configuring Access Mode on a Logical Interface on page 280
- Configuring a Logical Interface for Trunk Mode on page 281
- Configuring the VLAN ID List for a Trunk Interface on page 281
- Configuring a Trunk Interface on a Bridge Network on page 282
- Configuring a VLAN-Bundled Logical Interface to Support a Layer 2 VPN Routing Instance on page 285
- Configuring a VLAN-Bundled Logical Interface to Support a Layer 2 VPN Routing Instance on page 285
- Configuring a Layer 2 Circuit on a VLAN-Bundled Logical Interface on page 286
- Example: Configuring a Layer 2 Circuit on a VLAN-Bundled Logical Interface on page 288
- Guidelines for Configuring VLAN ID List-Bundled Logical Interfaces That Connect CCCs on page 289
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 262
- 802.1Q VLAN IDs and Ethernet Interface Types on page 261
- Enabling VLAN Tagging on page 263
- Binding VLAN IDs to Logical Interfaces on page 270
- Guidelines for Configuring VLAN ID List-Bundled Logical Interfaces That Connect CCCs on page 289
- Configuring a Layer 2 VPN Routing Instance on a VLAN-Bundled Logical Interface on page 276
- Configuring a VLAN-Bundled Logical Interface to Support a Layer 2 VPN Routing Instance on page 276
- Specifying the Interface Over Which VPN Traffic Travels to the CE Router on page 277
- Specifying the Interface to Handle Traffic for a CCC on page 277
- Configuring a Layer 2 Circuit on a VLAN-Bundled Logical Interface on page 286
- Configuring a VLAN-Bundled Logical Interface to Support a Layer 2 VPN Routing Instance on page 285
- Specifying the Interface to Handle Traffic for a CCC Connected to the Layer 2 Circuit on page 287
- Example: Configuring a Layer 2 VPN Routing Instance on a VLAN-Bundled Logical Interface on page 278
- Example: Configuring a Layer 2 Circuit on a VLAN-Bundled Logical Interface on page 288
- Configuring Access Mode on a Logical Interface on page 280
- Configuring a Logical Interface for Trunk Mode on page 281
- Configuring the VLAN ID List for a Trunk Interface on page 281
- Configuring a Trunk Interface on a Bridge Network on page 282
- Ethernet Interfaces Feature Guide for Routing Devices
802.1Q VLAN IDs and Ethernet Interface Types

A VLAN (virtual LAN) abstracts the idea of the local area network (LAN) by providing data link connectivity for a subnet. VLANs make it easy for network administrators to partition a single switched network to match the functional and security requirements of their systems without having to run new cables or make major changes in their current network infrastructure. Each VLAN can be uniquely identified by VLAN ID, which is transmitted & received as IEEE 802.1Q tag in an Ethernet frame.

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 14 on page 261 lists VLAN ID range by interface type.

Table 14: VLAN ID Range by Interface Type

<table>
<thead>
<tr>
<th>Interface Type</th>
<th>VLAN ID Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregated Ethernet for Fast Ethernet</td>
<td>1 through 1023</td>
</tr>
<tr>
<td>Aggregate Ethernet for Gigabit Ethernet</td>
<td>1 through 4094</td>
</tr>
<tr>
<td>4-port, 8-port, and 12-port Fast Ethernet</td>
<td>1 through 1023</td>
</tr>
<tr>
<td>48-port Fast Ethernet</td>
<td>1 through 4094</td>
</tr>
<tr>
<td>Tri-Rate Ethernet copper</td>
<td>1 through 4094</td>
</tr>
<tr>
<td>Gigabit Ethernet</td>
<td>1 through 4094</td>
</tr>
<tr>
<td>Gigabit Ethernet IQ</td>
<td>1 through 4094</td>
</tr>
<tr>
<td>10-Gigabit Ethernet</td>
<td>1 through 4094</td>
</tr>
<tr>
<td>100-Gigabit Ethernet</td>
<td>1 through 4094</td>
</tr>
<tr>
<td>Management and internal Ethernet interfaces</td>
<td>1 through 1023</td>
</tr>
</tbody>
</table>
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.

Related Documentation
- 802.1Q VLANs Overview on page 260
- 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 260
- 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, 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 router 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 router Gigabit and 10-Gigabit Ethernet interfaces on MX Series routers, and for aggregated Ethernet interfaces with member links in IQ2 and IQ2-E PICs or in MX Series DPCs. Mixed tagging enables to 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;
   ```
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:

```plaintext
[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:** If you configure the physical interface MTU for mixed tagging, then 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:

```plaintext
[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.

5.

Related Documentation
- 802.1Q VLANs Overview on page 260
- Configuring VLAN and Extended VLAN Encapsulation on page 275
- Stacking a VLAN Tag on page 701
- Ethernet Interfaces Feature Guide for Routing Devices
- Sending Untagged Traffic Without VLAN ID to Remote End on page 266

Configuring Tagged Interface with multiple tagged vlans and native vlan

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.

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. 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;

   For encapsulation type flexible-ethernet-services, all VLAN IDs are valid.

3. 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]
   user@host# flexible-vlan-tagging;
   native-vlan-id number;

   The range for native-vlan-id is 0 to 4094.

   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.
4. Configure the `vlan-id range` providing the range 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 range number;
   ```

5. Configure the `vlan-tags` statement with `inner` and `outer` options or the `vlan-id range` 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 range number;
   user@host# vlan-tags outer tpid:vlan-id inner tpid:vlan-id;
   ```

   The range for `inner` and `outer` option 32 to 4094.

To verify the configuration execute the `show` command.

```
user@host> show configuration
```

```text
set interfaces ge-1/0/3 flexible-vlan-tagging
set interfaces ge-1/0/3 native-vlan-id 1010
set interfaces ge-1/0/3 unit 1 vlan-id-range 100-200
set interfaces ge-1/0/3 unit 2 vlan-tags outer 300
set interfaces ge-1/0/3 unit 2 vlan-tags inner 123
set interfaces ge-1/0/3 unit 3 vlan-tags outer 400
set interfaces ge-1/0/3 unit 3 vlan-tags inner 323
```

**Related Documentation**
- 802.1Q VLANs Overview on page 260
- Configuring VLAN and Extended VLAN Encapsulation on page 275
- Stacking a VLAN Tag on page 701
- Ethernet Interfaces Feature Guide for Routing Devices
- Sending Untagged Traffic Without VLAN ID to Remote End on page 266

**Sending Untagged Traffic Without VLAN ID to Remote End**

Send traffic without the native VLAN ID (`native-vlan-id`) to the remote end of the network if untagged traffic is received.

If this option is not configured, then `native-vlan-id` is added to untagged traffic. But if this option is configured, then `native-vlan-id` is not added to untagged traffic.
NOTE:

- This feature works only on MX series routers with MPCs/MICs. Configuring this option with DPC results in no behavior change. But, if this option is configured with Aggregated Ethernet (AE) in which the sub interfaces reside across MPCs/MICs and DPC, MPCs/MICs and DPC will show a different behavior.

- In the egress direction, this feature is disrupted by VLAN normalization. Because of normalization, the egress interface cannot distinguish between untagged traffic and tagged traffic. And untagged traffic is sent out with `native-vlan-id`. Consider this while configuring both VLAN normalization and new `native-vlan-id` option.

  There will be a problem with ingress firewall filter if filter term includes `native-vlan-id`. With no-native-vlan-insert option configured, `native-vlan-id` will not be inserted to untagged traffic. So, firewall filter term will not match with untagged traffic. But if incoming traffic have VLAN ID which is equal to `native-vlan-id`, then firewall filter term will match and firewall will work.

- When this feature is used with AE, all sub-interfaces of AE should be in same type of FPC.

### Related Documentation

- Configuring Interface Encapsulation on Physical Interfaces
- 802.1Q VLANs Overview on page 260
- Configuring VPLS Interface Encapsulation
- `native-vlan-id`
- no-native-vlan-insert on page 1432
- Enabling VLAN Tagging on page 263

### 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:

```plaintext
[edit interfaces et-fpc/pic/port]
flexible-vlan-tagging;
unit logical-unit-number {
```
Related Documentation

• Enabling VLAN Tagging on page 263

Configuring VLAN tagging on Routers

This example shows how to configure a VLANs.

• Requirements on page 268
• Overview on page 268
• Configuration on page 268
• Verification on page 269

Requirements

This example uses the following hardware and software components:

• An MX240 router.
• Junos OS Release .

Before you begin:

• Determine which interfaces to use and verify that they are in routing mode.
• Determine what ports to use on the device and how to segment your network.

Overview

In this example, you create a new VLAN and then configure its attributes.

Configuration

To configure [item], perform these tasks:

• [xref target has no title]
• Results on page 269

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, and then enter commit from configuration mode.

```set interfaces xe-1/2/1 native-vlan-id 200 unit 0 family bridge interface-mode trunk vlan-id-list 100-200```
set interfaces ge-3/0/1 flexible-vlan-tagging
set interfaces ge-3/0/1 unit 1 vlan-tags outer 1
set interfaces ge-3/0/1 unit 1 vlan-tags inner 1
set interfaces ge-3/0/1 unit 1 family inet address 65.0.0.1/24

set interfaces ge-3/1/1 flexible-vlan-tagging
set interfaces ge-3/1/1 unit 16000 vlan-tags outer 4
set interfaces ge-3/1/1 unit 16000 vlan-tags inner 4000
set interfaces ge-3/1/1 unit 16000 family inet address 98.15.159.1/24

Step-by-Step Procedure

The following steps require you to 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.

To configure VLANs:

1.
2.

Results

From configuration mode, confirm your configuration by entering the show vlans command. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

Verification

• Verifying VLANs on page 269

Verifying VLANs

Purpose Verify that VLANs are configured and assigned to the interfaces.

Action From operational mode, enter the show vlans command.

Meaning The output shows the VLAN is configured and assigned to the interface.

Related Documentation •
## 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 15 on page 270 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 15: Configuration Statements Used to Bind VLAN IDs to Logical Interfaces

<table>
<thead>
<tr>
<th>Scope of VLAN ID Matching</th>
<th>Type of VLAN Framing Supported on the Logical Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLAN ID</td>
<td>Single-Tag Framing</td>
</tr>
<tr>
<td></td>
<td>vlan-id vlan-id;</td>
</tr>
<tr>
<td></td>
<td>vlan-tags outer tpid. vlan-id;</td>
</tr>
<tr>
<td></td>
<td>vlan-id-range vlan-id–vlan-id;</td>
</tr>
<tr>
<td>VLAN ID Range</td>
<td>vlan-id-range vlan-id–vlan-id;</td>
</tr>
<tr>
<td></td>
<td>vlan-id-list [vlan-id vlan-id];</td>
</tr>
<tr>
<td>VLAN ID List</td>
<td>vlan-id-list [vlan-id vlan-id];</td>
</tr>
</tbody>
</table>

### 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]
   ```
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.

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.

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 {
        vlan-id-list [110 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 260
- 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 274
- Associating a VLAN ID to a VLAN Demux Interface on page 274

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 16 on page 274 shows the configuration statements you use to associate VLAN IDs to VLAN demux interfaces, depending on the VLAN tag framing you use:

<table>
<thead>
<tr>
<th>Statement Format</th>
<th>Single-Tag Framing</th>
<th>Dual-Tag Framing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>vlan-id vlan-id;</td>
<td>vlan-tags outer tpid.&lt;vlan-id&gt; inner tpidvlan-id;</td>
</tr>
</tbody>
</table>

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 274
2. Associating a VLAN ID to a Dual-Tag VLAN Demux Interface on page 275

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.

See Also
- Configuring a VLAN Demultiplexing Interface
**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.

**See Also**
- 802.1Q VLANs Overview on page 260
- Configuring a VLAN Demultiplexing Interface
- Ethernet Interfaces Feature Guide for Routing Devices

**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:

- Starting with Junos OS Release 8.1, 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.
- Starting with Junos OS Release 9.5, 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.

### Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.5</td>
<td>Starting with Junos OS Release 9.5, aggregated Ethernet interfaces configured for VPLS can use <code>flexible-ethernet-services, vlan-ccc</code>, or <code>vlan-vpls</code>.</td>
</tr>
<tr>
<td>8.1</td>
<td>Starting with Junos OS Release 8.1, 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 <code>flexible-ethernet-services, vlan-ccc</code>, or <code>vlan-vpls</code> encapsulation.</td>
</tr>
</tbody>
</table>

### Related Documentation

- Configuring Interface Encapsulation on Physical Interfaces
- 802.1Q VLANs Overview on page 260
- 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 276
- Specifying the Interface Over Which VPN Traffic Travels to the CE Router on page 277
- Specifying the Interface to Handle Traffic for a CCC on page 277

### 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:

```plaintext
interfaces {
    ethernet-interface-name {
        vlan-tagging; # Support single- or dual-tag logical interfaces
    }
}
```
flexible-vlan-tagging; # Support mixed tagging
en 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]

**See Also**
- 802.1Q VLANs Overview on page 260
- 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]

**See Also**
- 802.1Q VLANs Overview on page 260
- Ethernet Interfaces Feature Guide for Routing Devices

### 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 ...]
    }
  }
}
```

---

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Chapter 11: Configuring 802.1Q VLANs
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.

---

See Also

- 802.1Q VLANs Overview on page 260
- Example: Configuring a Layer 2 VPN Routing Instance on a VLAN-Bundled Logical Interface on page 278
- Ethernet Interfaces Feature Guide for Routing Devices

---

**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 bundles a list of VLAN IDs, and the logical interface ge-1/1/1.0 supports IPv4 traffic using IP address 10.30.1.30 and can participate in an MPLS path.

```plaintext
[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 10.30.1.30;
        }
    }
}
```
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 260
- 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 260
- 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:

```plaintext
[edit interfaces ge-1/2/0]
unit 0 {
    family bridge {
        interface-mode access;
        vlan-id 20;
    }
}
```

### 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:

```plaintext
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]`

### 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.

\[
\text{vlan-id-list [number number-number]};
\]

You can include this statement at the following hierarchy levels:

- \[\text{[edit interfaces interface-name unit logical-unit-number family bridge interface-mode trunk]}\]
- \[\text{[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number family bridge interface-mode trunk]}\]

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
\textit{Junos Routing Protocols Configuration Guide}.

### Related Documentation

- 802.1Q VLANs Overview on page 260
- \textit{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:

```sh
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 {
```
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
```
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 260
- 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:

```plaintext
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 260
- 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:

```plaintext
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 260
- Specifying the Interface to Handle Traffic for a CCC Connected to the Layer 2 Circuit on page 287
- *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 286
- Specifying the Interface to Handle Traffic for a CCC Connected to the Layer 2 Circuit on page 287

#### 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.

See Also

- 802.1Q VLANs Overview on page 260
- Specifying the Interface to Handle Traffic for a CCC Connected to the Layer 2 Circuit on page 287
- 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:

```plaintext
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.

See Also

- 802.1Q VLANs Overview on page 260
- Example: Configuring a Layer 2 Circuit on a VLAN-Bundled Logical Interface on page 288
- Configuring a VLAN-Bundled Logical Interface to Support a Layer 2 VPN Routing Instance on page 285
- Ethernet Interfaces Feature Guide for Routing Devices
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 10.30.1.30 and can participate in an MPLS path.

```plaintext
[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 10.30.1.30/30;
        }
        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:

```plaintext
[edit protocols]
rsvp {
    interface all;
    interface lo0.0;
}
mls {
    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
    }
```
Related Documentation

- 802.1Q VLANs Overview on page 260
- 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 289
- Guidelines for Configuring Logical Link-Layer Encapsulation to Support CCCs on page 290

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 17 on page 290 describes the logical link-layer encapsulation types used within circuits connected using VLAN-bundled logical interfaces of the same type.

<table>
<thead>
<tr>
<th>Encapsulation Inside the Circuit</th>
<th>Layer 2 Circuit Joined by Configuring an Interface-to-Interface CCC Connection</th>
<th>Layer 2 VPN Routing Instance</th>
<th>Layer 2 Circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>encapsulation-type (ethernet</td>
<td>ethernet-vlan);</td>
<td>encapsulation vlan-ccc;</td>
</tr>
<tr>
<td>Hierarchy Level</td>
<td>[edit routing-instances routing-instance-name protocols l2vpn],</td>
<td>[edit interfaces ethernet-interface-name unit logical-unit-number],</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[edit logical-systems logical-system-name routing-instances routing-instance-name protocols l2vpn]</td>
<td>[edit logical-systems logical-system-name interfaces ethernet-interface-name unit logical-unit-number]</td>
<td></td>
</tr>
<tr>
<td>Usage Guidelines</td>
<td>See the Junos OS VPNs Library for Routing Devices.</td>
<td>See Configuring Interface Encapsulation on Logical Interfaces, Circuit and Translational Cross-Connects Overview, and Defining the Encapsulation for Switching Cross-Connects.</td>
<td></td>
</tr>
</tbody>
</table>

For a Single-Tag Logical Interface

The MX Series router automatically uses ethernet 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.

**NOTE:** 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.

Configure the MX Series router to use vlan-ccc as the logical link-layer encapsulation type.

For a Dual-Tag Logical Interface

Configure the MX Series router to use ethernet-vlan as the Layer 2 protocol to encapsulate incoming traffic.

With ethernet-vlan 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 show interfaces command output.

The MX Series router automatically uses vlan-ccc as the logical link-layer encapsulation type, regardless of the value configured.

**Related Documentation**

- 802.1Q VLANs Overview on page 260
- Binding VLAN IDs to Logical Interfaces on page 270
- 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:

```plaintext
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 260
- Example: Configuring a Layer 2 VPN Routing Instance on a VLAN-Bundled Logical Interface on page 278
- 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 260
- Example: Configuring a Layer 2 Circuit on a VLAN-Bundled Logical Interface on page 288
- Configuring a VLAN-Bundled Logical Interface to Support a Layer 2 VPN Routing Instance on page 285
- Ethernet Interfaces Feature Guide for Routing Devices
CHAPTER 12

Configuring Private VLANs

- Understanding Private VLANs on page 293
- Bridge Domains Setup in PVLANs on MX Series Routers on page 307
- Bridging Functions With PVLANs on page 309
- Flow of Frames on PVLAN Ports Overview on page 311
- Guidelines for Configuring PVLANs on MX Series Routers on page 313
- Configuring PVLANs on MX Series Routers in Enhanced LAN Mode on page 314
- Example: Configuring PVLANs with Secondary VLAN Trunk Ports and Promiscuous Access Ports on a QFX Series Switch on page 316
- IRB Interfaces in Private VLANs on MX Series Routers on page 329
- Guidelines for Configuring IRB Interfaces in PVLANs on MX Series Routers on page 330
- Forwarding of Packets Using IRB Interfaces in PVLANs on page 331
- Configuring IRB Interfaces in PVLAN Bridge Domains on MX Series Routers in Enhanced LAN Mode on page 333
- Example: Configuring an IRB Interface in a Private VLAN on a Single MX Series Router on page 335

Understanding Private VLANs

VLANs limit broadcasts to specified users. Private VLANs (PVLANs) take this concept a step further by limiting communication within a VLAN. PVLANs accomplish this 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. The uplink trunk port or link aggregation group (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 port, thereby preventing the ports from communicating with each other.

PVLANs provide Layer 2 isolation between ports within a VLAN, splitting a broadcast domain into multiple discrete broadcast subdomains by creating secondary VLANs (community VLANs and an isolated VLAN) inside a primary VLAN. Ports within the same community VLAN can communicate with each other. Ports within an isolated VLAN can communicate only with a single uplink port.
Just like regular VLANs, PVLANs are isolated on Layer 2 and require one of the following options to route Layer 3 traffic among the secondary VLANs:

- A promiscuous port connection with a router
- A routed VLAN interface (RVI)

**NOTE:** To route Layer 3 traffic among secondary VLANs, a PVLAN needs only one of the options mentioned above. If you use an RVI, you can still implement a promiscuous port connection to a router with the promiscuous port set up to handle only traffic that enters and exits the PVLAN.

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.

**NOTE:** You can configure a PVLAN to span switches that support PVLANs.

This topic explains the following concepts regarding PVLANs on EX Series switches:

- Benefits of PVLANs on page 294
- Typical Structure and Primary Application of PVLANs on page 295
- Typical Structure and Primary Application of PVLANs on MX Series Routers on page 298
- Typical Structure and Primary Application of PVLANs on EX Series Switches on page 299
- Routing Between Isolated and Community VLANs on page 301
- PVLANs Use 802.1Q Tags to Identify Packets on page 301
- PVLANs Use IP Addresses Efficiently on page 301
- PVLAN Port Types and Forwarding Rules on page 302
- Creating a PVLAN on page 305
- Limitations of Private VLANs on page 306

**Benefits of PVLANs**

The need to segregate a single VLAN is particularly useful in the following deployment scenarios:

- Server farms—A typical Internet service provider uses a server farm to provide Web hosting for numerous customers. Locating the various servers within a single server farm provides ease of management. Security concerns arise if all servers are in the same VLAN because Layer 2 broadcasts go to all servers in the VLAN.
- Metropolitan Ethernet networks—A metro service provider offers Layer 2 Ethernet access to assorted homes, rental communities, and businesses. The traditional solution of deploying one VLAN per customer is not scalable and is difficult to manage, leading
to potential waste of IP addresses. PVLANs provide a more secure and more efficient solution.

**Typical Structure and Primary Application of PVLANs**

A PVLAN can be configured on a single switch or can be configured to span multiple switches. The types of domains and ports are:

- **Primary VLAN**—The primary VLAN of the PVLAN is defined with an 802.1Q tag (VLAN ID) for the complete PVLAN. The primary PVLAN can contain multiple secondary VLANs (one isolated VLAN and multiple community VLANs).

- **Isolated VLAN/isolated port**—A primary VLAN can contain only one isolated VLAN. An interface within an isolated VLAN can forward packets only to a promiscuous port or the Inter-Switch Link (ISL) port. An isolated interface cannot forward packets to another isolated interface; and an isolated interface cannot receive packets from another isolated interface. If a customer device needs to have access only to a gateway router, the device must be attached to an isolated trunk port.

- **Community VLAN/community port**—You can configure multiple community VLANs within a single PVLAN. An interface within a specific community VLAN can establish Layer 2 communications with any other interface that belongs to the same community VLAN. An interface within a community VLAN can also communicate with a promiscuous port or the ISL port. If you have, for example, two customer devices that you need to isolate from other customer devices but that must be able to communicate with one another, use community ports.

- **Promiscuous port**—A promiscuous port has Layer 2 communications with all interfaces in the PVLAN, regardless of whether an interface belongs to an isolated VLAN or a community VLAN. A promiscuous port is a member of the primary VLAN but is not included within any secondary subdomain. Layer 3 gateways, DHCP servers, and other trusted devices that need to communicate with endpoint devices are typically connected to a promiscuous port.

- **Inter-Switch Link (ISL)**—An ISL is a trunk port that connects multiple switches in a PVLAN and contains two or more VLANs. It is required only when a PVLAN spans multiple switches.

The configured PVLAN is the primary domain (primary VLAN). Within the PVLAN, you configure secondary VLANs, which become subdomains nested within the primary domain. A PVLAN can be configured on a single switch or can be configured to span multiple switches. The PVLAN shown in Figure 18 on page 296 includes two switches, with a primary PVLAN domain and various subdomains.
As shown in Figure 20 on page 298, a PVLAN has only one primary domain and multiple secondary domains. The types of domains are:

- **Primary VLAN**—VLAN used to forward frames downstream to isolated and community VLANs. The primary VLAN of the PVLAN is defined with an 802.1Q tag (VLAN ID) for the complete PVLAN. The primary PVLAN can contain multiple secondary VLANs (one isolated VLAN and multiple community VLANs).

- **Secondary isolated VLAN**—VLAN that receives packets only from the primary VLAN and forwards frames upstream to the primary VLAN. The isolated VLAN is a secondary VLAN nested within the primary VLAN. A primary VLAN can contain only one isolated VLAN. An interface within an isolated VLAN (isolated interface) can forward packets only to a promiscuous port or the PVLAN trunk port. An isolated interface cannot forward packets to another isolated interface; nor can an isolated interface receive packets from another isolated interface. If a customer device needs to have access only to a router, the device must be attached to an isolated trunk port.
• Secondary interswitch isolated VLAN—VLAN used to forward isolated VLAN traffic from one switch to another through PVLAN trunk ports. 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. An interswitch isolated VLAN is a secondary VLAN nested within the primary VLAN.

• Secondary community VLAN—VLAN used to transport frames among members of a community (a subset of users within the VLAN) and to forward frames upstream to the primary VLAN. A community VLAN is a secondary VLAN nested within the primary VLAN. You can configure multiple community VLANs within a single PVLAN. An interface within a specific community VLAN can establish Layer 2 communications with any other interface that belongs to the same community VLAN. An interface within a community VLAN can also communicate with a promiscuous port or the PVLAN trunk port.

Figure 19 on page 297 shows a PVLAN spanning multiple switches, where the primary VLAN (100) contains two community domains (300 and 400) and one interswitch isolated domain.

Figure 19: PVLAN Spanning Multiple Switches

NOTE: Primary and secondary VLANs count against the limit of 4089 VLANs supported on the QFX Series. For example, each VLAN in Figure 19 on page 297 counts against this limit.
Typical Structure and Primary Application of PVLANs on MX Series Routers

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 20 on page 298 includes one router, with one primary PVLAN domain and multiple secondary subdomains.

*Figure 20: 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.
NOTE: 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.

Typical Structure and Primary Application of PVLANs on EX Series Switches

NOTE: The primary VLAN of the PVLAN is defined with an 802.1Q tag (VLAN ID) for the complete PVLAN. On EX9200 switches, each secondary VLAN must also be defined with its own separate VLAN ID.

Figure 21 on page 299 shows a PVLAN on a single switch, where the primary VLAN (VLAN 100) contains two community VLANs (VLAN 300 and VLAN 400) and one isolated VLAN (VLAN 50).

Figure 21: Private VLAN on a Single EX Switch

Figure 22 on page 300 shows a PVLAN spanning multiple switches, where the primary VLAN (VLAN 100) contains two community VLANs (VLAN 300 and VLAN 400) and one
isolated VLAN (VLAN 200). It also shows that Switches 1 and 2 are connected through an interswitch link (PVLAN trunk link).

*Figure 22: PVLAN Spanning Multiple EX Series Switches*

Also, the PVLANs shown in Figure 21 on page 299 and Figure 22 on page 300 use a promiscuous port connected to a router as the means to route Layer 3 traffic among the community and isolated VLANs. Instead of using the promiscuous port connected to a router, you can configure an RVI on the switch in Figure 21 on page 299 or one of the switches shown in Figure 22 on page 300 (on some EX switches).
To route Layer 3 traffic between isolated and community VLANs, you must either connect a router to a promiscuous port, as shown in Figure 21 on page 299 and Figure 22 on page 300, or configure an RVI.

If you choose the RVI option, you must configure one RVI for the primary VLAN in the PVLAN domain. This RVI serves the entire PVLAN domain regardless of whether the domain includes one or more switches. After you configure the RVI, Layer 3 packets received by the secondary VLAN interfaces are mapped to and routed by the RVI.

When setting up the RVI, you must also enable proxy Address Resolution Protocol (ARP) so that the RVI can handle ARP requests received by the secondary VLAN interfaces.

For information about configuring PVLANs on a single switch and on multiple switches, see Creating a Private VLAN on a Single EX Series Switch (CLI Procedure). For information about configuring an RVI, see Configuring a Routed VLAN Interface in a Private VLAN on an EX Series Switch.

Routing Between Isolated and Community VLANs

To route Layer 3 traffic between isolated and community VLANs, you must connect an external router or switch to a trunk port of the primary VLAN. The trunk port of the primary VLAN is a promiscuous port; therefore, it can communicate with all the ports in the PVLAN.

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 switch or router in the network. Sometimes, 802.1Q tags are needed within PVLANs to keep track of packets from different subdomains. Table 18 on page 301 indicates when a VLAN 802.1Q tag is needed on the primary VLAN or on secondary VLANs.

Table 18: When VLANs in a PVLAN Need 802.1Q Tags

<table>
<thead>
<tr>
<th></th>
<th>On a Single Switch</th>
<th>On Multiple Switches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary VLAN</td>
<td>Specify an 802.1Q tag by setting a VLAN ID.</td>
<td>Specify an 802.1Q tag by setting a VLAN ID.</td>
</tr>
<tr>
<td>Secondary VLAN</td>
<td>No tag needed on VLANs.</td>
<td>VLANs need 802.1Q tags:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Specify an 802.1Q tag for each community VLAN by setting a VLAN ID.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Specify the 802.1Q tag for an isolation VLAN ID by setting an isolation ID.</td>
</tr>
</tbody>
</table>

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. However, each secondary VLAN is a separate broadcast domain.

**PVLAN Port Types and Forwarding Rules**

PVLANs can use up to six different port types. The network depicted in Figure 19 on page 297 uses a promiscuous port to transport information to the router, community ports to connect the finance and HR communities to their respective switches, isolated ports to connect the servers, and a PVLAN trunk port to connect the two switches. PVLAN ports have different restrictions:

- **Promiscuous trunk port**—A promiscuous port has Layer 2 communications with all the interfaces that are in the PVLAN, regardless of whether the interface belongs to an isolated VLAN or a community VLAN. A promiscuous port is a member of the primary VLAN, but is not included within one of the secondary subdomains. Layer 3 gateways, DHCP servers, and other trusted devices that need to communicate with endpoint devices are typically connected to a promiscuous port.

- **PVLAN trunk link**—The PVLAN trunk link, which is also known as the interswitch link, is required only when a PVLAN is configured to span multiple switches. The PVLAN trunk link connects the multiple switches that compose the PVLAN.

- **PVLAN trunk port**—A PVLAN trunk port is required in multiswitch PVLAN configurations to span the switches. The PVLAN trunk port is a member of all VLANs within the PVLAN (that is, the primary VLAN, the community VLANs, and the interswitch isolated VLAN), and it carries traffic from the primary VLAN and all secondary VLANs. It can communicate with all ports other than the isolated ports.

  Communication between a PVLAN trunk port and an isolated port is usually unidirectional. A PVLAN trunk port’s membership in the interswitch isolated VLAN is egress-only, meaning that an isolated port can forward packets to a PVLAN trunk port, but a PVLAN trunk port does not forward packets to an isolated port (unless the packets ingress on a promiscuous access port and are therefore being forwarded to all the secondary VLANs in the same primary VLAN as the promiscuous port).

- **Secondary VLAN trunk port**—Secondary 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 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.

- **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 access 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.

- Promiscuous access port (not shown)—These ports carry untagged traffic. Traffic that ingresses on a promiscuous access port is forwarded to all secondary VLAN ports on the device. If traffic ingresses into the device on a VLAN-enabled 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.

- 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 303 summarizes whether Layer 2 connectivity exists between the different types of ports.

Table 19 on page 303 summarizes Layer 2 connectivity between the different types of ports within a PVLAN on EX Series switches that support ELS.

**Table 19: PVLAN Ports and Layer 2 Forwarding on EX Series switches that support ELS**

<table>
<thead>
<tr>
<th>From Port Type</th>
<th>To Isolated Ports?</th>
<th>To Promiscuous Ports?</th>
<th>To Community Ports?</th>
<th>To Inter-Switch Link Port?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolated</td>
<td>Deny</td>
<td>Permit</td>
<td>Deny</td>
<td>Permit</td>
</tr>
<tr>
<td>Promiscuous</td>
<td>Permit</td>
<td>Permit</td>
<td>Permit</td>
<td>Permit</td>
</tr>
<tr>
<td>Community 1</td>
<td>Deny</td>
<td>Permit</td>
<td>Permit</td>
<td>Permit</td>
</tr>
</tbody>
</table>

**Table 20: PVLAN Ports and Layer 2 Connectivity**

<table>
<thead>
<tr>
<th>Port Type</th>
<th>Promiscuous Trunk</th>
<th>PVLAN Trunk</th>
<th>Secondary Trunk</th>
<th>Community</th>
<th>Isolated Access</th>
<th>Promiscuous access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Promiscuous trunk</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>PVLAN trunk</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes—same community only</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Secondary Trunk</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Community</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes—same community only</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Isolated access</td>
<td>Yes</td>
<td>Yes—unidirectional only</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Table 20: PVLAN Ports and Layer 2 Connectivity (continued)

<table>
<thead>
<tr>
<th>Port Type</th>
<th>Promiscuous</th>
<th>Trunk</th>
<th>PVLAN Trunk</th>
<th>Secondary Trunk</th>
<th>Community</th>
<th>Isolated Access</th>
<th>Promiscuous access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Promiscuous</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

Table 21 on page 304 summarizes whether or not Layer 2 connectivity exists between the different types of ports within a PVLAN.

Table 21: PVLAN Ports and Layer 2 Connectivity on EX Series Switches without ELS Support

<table>
<thead>
<tr>
<th>Port Type</th>
<th>To: →</th>
<th>Promiscuous</th>
<th>Community</th>
<th>Isolated</th>
<th>PVLAN Trunk</th>
<th>RVI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Promiscuous</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Community</td>
<td>Yes</td>
<td>Yes—same community only</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Isolated</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>PVLAN trunk</td>
<td>Yes</td>
<td>Yes—same community only</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

NOTE: This communication is unidirectional.

As noted in Table 21 on page 304, Layer 2 communication between an isolated port and a PVLAN trunk port is unidirectional. That is, an isolated port can only send packets to a PVLAN trunk port, and a PVLAN trunk port can only receive packets from an isolated port. Conversely, a PVLAN trunk port cannot send packets to an isolated port, and an isolated port cannot receive packets from a PVLAN trunk port.

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 23 on page 305 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 23 on page 305.

*Figure 23: 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.

**Limitations of Private VLANs**

The following constraints apply to private VLAN configurations:

- An access interface can belong to only one PVLAN domain, that is, it cannot participate in two different primary VLANs.
- A trunk interface can be a member of two secondary VLANs as long as the secondary VLANs are in two different primary VLANs. A trunk interface cannot be a member of two secondary VLANs that are in the same primary VLAN.
- A single region of Multiple Spanning Tree Protocol (MSTP) must be configured on all VLANs that are included within the PVLAN.
- VLAN Spanning Tree Protocol (VSTP) is not supported.
- IGMP snooping is not supported with private VLANs.
- Routed VLAN interfaces are not supported on private VLANs.
- Routing between secondary VLANs in the same primary VLAN is not supported.
- Some configuration statements cannot be specified on a secondary VLAN. You can configure the following statements at the `[edit vlans vlan-name switch-options]` hierarchy level only on the primary VLAN.
- If you want to change a primary VLAN to be a secondary VLAN, you must first change it to a normal VLAN and commit the change. For example, you would follow this procedure:
  1. Change the primary VLAN to be a normal VLAN.
  2. Commit the configuration.
  3. Change the normal VLAN to be a secondary VLAN.
  4. Commit the configuration.
Follow the same sequence of commits if you want to change a secondary VLAN to be a primary VLAN. That is, make the secondary VLAN a normal VLAN and commit that change and then change the normal VLAN to be a primary VLAN.

The following features are not supported on PVLANs on Junos switches with support for the ELS configuration style:

- DHCP security features (DHCP snooping, dynamic ARP inspection, IP source guard)
- Egress VLAN firewall filters
- Ethernet ring protection (ERP)
- Flexible VLAN tagging
- \textit{global-mac-statistics}
- Integrated routing and bridging (IRB) interface
- Multicast snooping or IGMP snooping
- Multichassis link aggregation groups (MC-LAGs)
- Port mirroring
- Q-in-Q tunneling
- VLAN Spanning Tree Protocol (VSTP)
- Voice over IP (VoIP)

You can configure the following statements at the \texttt{[edit vlans vlan-name switch-options]} hierarchy level only on the primary PVLAN:

- \texttt{mac-table-size}
- \texttt{no-mac-learning}
- \texttt{mac-statistics}
- \texttt{interface-mac-limit}

### 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:

<table>
<thead>
<tr>
<th>Steps</th>
<th>Source</th>
<th>Destination</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>0</td>
<td>{*}</td>
<td>Permit</td>
</tr>
<tr>
<td>Step 2</td>
<td>{*}</td>
<td>0</td>
<td>Permit</td>
</tr>
<tr>
<td>Step 3</td>
<td>1</td>
<td>1</td>
<td>Drop</td>
</tr>
<tr>
<td>Step 4</td>
<td>X &lt;-&gt; Y (X &gt; 1 and Y &gt; 1 and X ≠ Y)</td>
<td>Drop</td>
<td></td>
</tr>
</tbody>
</table>
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 f 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:

<table>
<thead>
<tr>
<th>Port Type</th>
<th>From: ↓</th>
<th>Isolated</th>
<th>Community</th>
<th>Promiscuous</th>
<th>Inter-switch Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolated</td>
<td>Dropped</td>
<td>Dropped</td>
<td>Primary VLAN tag to Isolation VLAN tag.</td>
<td>If received with the primary VLAN tag, translate to the isolation VLAN Tag; else dropped</td>
<td></td>
</tr>
<tr>
<td>Promiscuous</td>
<td>Dropped</td>
<td>No translation if it is the same community; else dropped.</td>
<td>Primary VLAN tag to Community VLAN tag.</td>
<td>If received with primary VLAN tag, translate to community VLAN tag; else no translation if received with same community vlan else dropped.</td>
<td></td>
</tr>
<tr>
<td>Community</td>
<td>Isolated VLAN tag to Primary VLAN tag</td>
<td>Community VLAN tag to Primary VLAN tag</td>
<td>No translation</td>
<td>If received with isolation or community VLAN tag, translate to Primary VLAN tag; else no translation</td>
<td></td>
</tr>
<tr>
<td>Interswitch Link</td>
<td>No translation</td>
<td>No translation</td>
<td>No translation</td>
<td>No translation</td>
<td></td>
</tr>
</tbody>
</table>

**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 275 and “Enabling VLAN Tagging” on page 263.

• 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.
5. Create a virtual switch instance with a bridge domain and associate the logical interfaces.

```
[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
```

6. Specify the primary, isolated, and community VLAN IDs, and associate the VLANs with the bridge domain.

```
[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
```

Related Documentation

Example: Configuring PVLANs with Secondary VLAN Trunk Ports and Promiscuous Access Ports on a QFX Series Switch

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 317
- Overview and Topology on page 317
- Configuring the PVLANs on Switch 1 on page 319
- Configuring the PVLANs on Switch 2 on page 324
- Verification on page 328

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 24 on page 318 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 24: PVLAN Topology with Secondary VLAN Trunk Ports and Promiscuous Access Port

Table 22 on page 318 and Table 23 on page 319 list the settings for the example topology on both switches.

Table 22: Components of the Topology for Configuring a Secondary VLAN Trunk on Switch 1

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pvlan100, ID 100</td>
<td>Primary VLAN</td>
</tr>
<tr>
<td>pvlan400, ID 400</td>
<td>Primary VLAN</td>
</tr>
<tr>
<td>comm300, ID 300</td>
<td>Community VLAN, member of pvlan100</td>
</tr>
<tr>
<td>comm600, ID 600</td>
<td>Community VLAN, member of pvlan400</td>
</tr>
<tr>
<td>isolation-vlan-id 200</td>
<td>VLAN ID for isolated VLAN, member of pvlan100</td>
</tr>
<tr>
<td>isolation–vlan-id 500</td>
<td>VLAN ID for isolated VLAN, member of pvlan400</td>
</tr>
<tr>
<td>xe-0/0/0.0</td>
<td>Secondary VLAN trunk port for primary VLANs pvlan100 and pvlan400</td>
</tr>
<tr>
<td>xe-0/0/1.0</td>
<td>PVLAN trunk port for primary VLANs pvlan100 and pvlan400</td>
</tr>
<tr>
<td>xe-0/0/2.0</td>
<td>Isolated access port for pvlan100</td>
</tr>
<tr>
<td>xe-0/0/3.0</td>
<td>Community access port for comm300</td>
</tr>
<tr>
<td>xe-0/0/5.0</td>
<td>Isolated access port for pvlan400</td>
</tr>
<tr>
<td>xe-0/0/6.0</td>
<td>Community trunk port for comm600</td>
</tr>
</tbody>
</table>
### Table 23: Components of the Topology for Configuring a Secondary VLAN Trunk on Switch 2

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pvlan100, ID 100</td>
<td>Primary VLAN</td>
</tr>
<tr>
<td>pvlan400, ID 400</td>
<td>Primary VLAN</td>
</tr>
<tr>
<td>comm300, ID 300</td>
<td>Community VLAN, member of pvlan100</td>
</tr>
<tr>
<td>comm600, ID 600</td>
<td>Community VLAN, member of pvlan400</td>
</tr>
<tr>
<td>isolation-vlan-id 200</td>
<td>VLAN ID for isolated VLAN, member of pvlan100</td>
</tr>
<tr>
<td>isolation-vlan-id 500</td>
<td>VLAN ID for isolated VLAN, member of pvlan400</td>
</tr>
<tr>
<td>xe-0/0/0.0</td>
<td>Promiscuous access port for primary VLANs pvlan100</td>
</tr>
<tr>
<td>xe-0/0/1.0</td>
<td>PVLAN trunk port for primary VLANs pvlan100 and pvlan400</td>
</tr>
<tr>
<td>xe-0/0/2.0</td>
<td>Secondary trunk port for isolated VLAN, member of pvlan100</td>
</tr>
<tr>
<td>xe-0/0/3.0</td>
<td>Community access port for comm300</td>
</tr>
<tr>
<td>xe-0/0/5.0</td>
<td>Isolated access port for pvlan400</td>
</tr>
<tr>
<td>xe-0/0/6.0</td>
<td>Community access port for comm600</td>
</tr>
</tbody>
</table>

### 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:

```plaintext
[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
```
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:
7. Configure the interface for comm300:

```
[edit vlans]
user@switch# set comm300 primary-vlan pvlan100
```

8. Create secondary VLAN comm600 with VLAN ID 600:

```
[edit vlans]
user@switch# set comm600 interface xe-0/0/3.0
```

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;
        }
    }
}
}
lans {
    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;
        }
    }
}
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 24 on page 318 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-0/0/0/0.0 on Switch 1 and carries tag 600 as it is forwarded through the secondary VLAN. When it egresses from xe-0/0/0/0.0 on Switch 2, it will be untagged if you configure xe-0/0/0/0.0 as a promiscuous access port as shown in this example. If you instead configure xe-0/0/0/0.0 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:

```plaintext
[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-0/0/0/1.0 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;
    }
  ]
}

vlans {
  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;
xz-0/0/2.0;
xz-0/0/3.0;
xz-0/0/1.0 {
    pvlan-trunk;
}
no-local-switching;
isolation-id 200;
}
pvlan400 {
    vlan-id 400;
    interface {
        xz-0/0/5.0;
xz-0/0/6.0;
xz-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 328
- Verifying The Ethernet Switching Table Entries on page 329

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
```

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Tag</th>
<th>Interfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>pvlan100</td>
<td>Primary</td>
<td>100</td>
<td>xe-0/0/0.0, xe-0/0/1.0, xe-0/0/2.0,</td>
</tr>
<tr>
<td><strong>iso_pvlan100</strong></td>
<td>Isolated</td>
<td>200</td>
<td>xe-0/0/2.0</td>
</tr>
<tr>
<td>comm300</td>
<td>Community</td>
<td>300</td>
<td>xe-0/0/3.0</td>
</tr>
<tr>
<td>pvlan400</td>
<td>Primary</td>
<td>400</td>
<td>xe-0/0/0.0, xe-0/0/1.0, xe-0/0/5.0,</td>
</tr>
<tr>
<td><strong>iso_pvlan400</strong></td>
<td>Isolated</td>
<td>500</td>
<td>xe-0/0/5.0</td>
</tr>
<tr>
<td>comm600</td>
<td>Community</td>
<td>600</td>
<td>xe-0/0/6.0</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>VLAN</th>
<th>Action</th>
<th>Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>pvlan100</td>
<td>Flood</td>
<td>xe-0/0/2.0</td>
</tr>
<tr>
<td>pvlan100</td>
<td>Learn</td>
<td>xe-0/0/2.0</td>
</tr>
<tr>
<td><strong>iso_pvlan100</strong></td>
<td>Flood</td>
<td>xe-0/0/2.0</td>
</tr>
<tr>
<td><strong>iso_pvlan100</strong></td>
<td>Replicated</td>
<td>xe-0/0/2.0</td>
</tr>
</tbody>
</table>

Related Documentation
• 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 across 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 an 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 an 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 275 and “Enabling VLAN Tagging” on page 263.
- 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.

```plaintext
[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]
```
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 335
- Overview and Topology on page 336
- Configuration on page 336
- Verification on page 340

**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 275 and “Enabling VLAN Tagging” on page 263.
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, l1, l2, c1x1, and c1x2. The port types of these configured ports are as follows:

- Promiscuous ports = p1, p2
- ISL ports = t1, t2
- Isolated ports = l1, l2
- Community VLAN = Cx
- Community ports = c1x1, c1x2

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, c1x1, c1x2)
Vi—BD_isolate_Vi (ports contained are p1, t1, *i1, *i2)
Vcx—BD_community_Vcx (ports contained are p1, t1, c1x1, c1x2)

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 vlan-id 100
set interfaces ge-0/0/10 unit 0 family bridge interface-mode trunk
set interfaces ge-0/0/11 unit 0 family bridge vlan-id 100
set interfaces ge-0/0/12 unit 0 family bridge interface-mode access
set interfaces ge-0/0/13 unit 0 family bridge vlan-id 10
set interfaces ge-0/0/14 unit 0 family bridge interface-mode access
set interfaces ge-0/0/15 unit 0 family bridge vlan-id 50
set interfaces ge-0/0/16 unit 0 family bridge interface-mode access
set interfaces ge-0/0/17 unit 0 family bridge vlan-id 50
set interfaces ge-0/0/18 unit 0 family bridge interface-mode access
set interfaces ge-0/0/19 unit 0 family bridge vlan-id 50
set interfaces ge-0/0/20 unit 0 family bridge interface-mode access
set interfaces ge-0/0/21 unit 0 family bridge vlan-id 60
set interfaces ge-0/0/22 unit 0 family bridge interface-mode access
set interfaces ge-0/0/23 unit 0 family bridge vlan-id 60

Configuring a Virtual Switch Instance With Bridge Domain Interfaces

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-0/0/5.0
set routing-instances vs-1 interface ge-0/0/6.0
set routing-instances vs-1 interface ge-0/0/7.0
set routing-instances vs-1 interface ge-0/0/8.0
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-0/0/11.0
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 interface ge-0/0/14.0
set routing-instances vs-1 bridge-domains bd1

Specify the IRB Interface and Primary, Isolated, and Community VLAN IDs in the Bridge Domain

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

Step-by-Step Procedure

To configure the interswitch link (ISL) for a PVLAN, the PVLAN port types, and secondary VLANs for the PVLAN:

1. Create an IRB interface.

   [edit interfaces]
   user@host# set interfaces irb unit 0 family inet address 22.22.22.1/24

2. Create a promiscuous port for the PVLAN.

   [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

3. Create the interswitch link (ISL) trunk port for the PVLAN.
4. Create the isolated ports for the PVLAN.

```
[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
```

5. Create the community ports for the PVLAN.

```
[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
```

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:

```conf
[edit]
[interfaces]
ge-0/0/9 {
  unit 0 {
    family bridge {
    interface-mode trunk;         Promiscuous port by vlan id
      vlan-id 100;                 
    }
  }
}
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;       isolated port by vlan ID
      vlan-id 10;                 
    }
  }
}
ge-0/0/12 {
  unit 0 {
    family bridge {
    interface-mode access;       isolated port by vlan ID
      vlan-id 10;                 
    }
  }
}
ge-0/0/1 {
  unit 0 {
    family bridge {
    interface-mode access;       community port by vlan ID
      vlan-id 50;                 
    }
  }
}
ge-0/0/2 {
  unit 0 {
    family bridge {
    interface-mode access;       community port by vlan ID
      vlan-id 50;                 
    }
  }
}
```
Verification

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

- Verifying That the Private VLAN and Secondary VLANs Were Created on page 341
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
```

<table>
<thead>
<tr>
<th>Routing instance</th>
<th>Bridge domain</th>
<th>VLAN ID</th>
<th>Interfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>default-switch</td>
<td>bd1-primary-100</td>
<td>100</td>
<td>ge-0/0/9.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ge-0/0/10.0</td>
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<td>ge-0/0/12.0</td>
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<td>ge-0/0/2.0</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>ge-0/0/3.0</td>
</tr>
<tr>
<td></td>
<td>bd1-isolation-10</td>
<td>10</td>
<td>ge-0/0/9.0</td>
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<td></td>
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<td></td>
<td>ge-0/0/10.0</td>
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<td>ge-0/0/12.0</td>
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<td>ge-0/0/13.0</td>
</tr>
<tr>
<td></td>
<td>bd1-comunity-50</td>
<td>50</td>
<td>ge-0/0/9.0</td>
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<td></td>
<td></td>
<td>ge-0/0/10.0</td>
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<td>ge-0/0/1.0</td>
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<td></td>
<td>ge-0/0/2.0</td>
</tr>
<tr>
<td></td>
<td>bd1-comunity-60</td>
<td>60</td>
<td>ge-0/0/9.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ge-0/0/10.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ge-0/0/13.0</td>
</tr>
</tbody>
</table>

Meaning
The output shows that the primary VLAN was created and identifies the interfaces and secondary VLANs associated with it.

Related Documentation
• Chapter 12: Configuring Private VLANs
CHAPTER 13

Configuring Layer 2 Bridging Interfaces

- Layer 2 Bridging Interfaces Overview on page 343
- Configuring Layer 2 Bridging Interfaces on page 344
- Example: Configuring the MAC Address of an IRB Interface on page 345

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 344
- Ethernet Interfaces Feature Guide for Routing Devices
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
   ```
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 345
- Overview on page 345
- Configuration on page 346
- Verification on page 351

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 25 on page 346 shows the sample topology.

**Figure 25: 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.

```
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 00:00:00:00:00:00:02
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 00:00:00:00:00:00:03
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 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 00:00:00:00:00:00:04
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;
}
mls {
    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;
}
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 351

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
Bandwidth: 1000mbps
Routing Instance: LS1/default Bridging Domain: lsbd1+10
Input packets : 55202
Output packets: 69286
Protocol inet, MTU: 1450
Flags: Sendbcast-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
Bandwidth: 1000mbps
Routing Instance: LS2/default Bridging Domain: lsbd2+10
Input packets : 66044
Output packets: 68464
Protocol inet, MTU: 1450
Flags: Sendbcast-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
Bandwidth: 1000mbps
Routing Instance: LS2/default Bridging Domain: lsbd3+40
Input packets : 26948
Output packets: 53605
Protocol inet, MTU: 1500
Flags: Sendbcast-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: Sendbcast-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 1396
  • Active-Active Bridging and VRRP over IRB Functionality Overview
CHAPTER 14

Configuring Link Layer Discovery Protocol

- LLDP Overview on page 355
- Configuring LLDP on page 356
- Example: Configuring LLDP on page 360
- LLDP Operational Mode Commands on page 361
- Tracing LLDP Operations on page 362

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

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.

### Related Documentation
- Configuring LLDP on page 356
- Tracing LLDP Operations on page 362
- Example: Configuring LLDP on page 360
- LLDP Operational Mode Commands on page 361

### 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:

```plaintext
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-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.

By default, LLDP is disabled, and user must configure it using `set protocols lldp interface (all | interface-name)` to use the LLDP services. If it is enabled for all interfaces, you can disable LLDP 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. To configure the management interfaces, include 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.

Starting with Junos OS Release 14.2, 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.

Starting in Junos OS Release 15.1R7, you can enable or disable the Link Layer Discovery Protocol (LLDP) and Physical Topology (PTOPO) MIB traps for a specific interface or for all interfaces on EX3300, EX4200, EX4500, EX4550, EX6200, and EX8200 switches.
by configuring the `trap-notification` statement at the `[edit protocols lldp interface interface-name]` 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. To do so, include 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:** Starting with Junos OS Release 12.3, 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.

### Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.1R7</td>
<td>Starting in Junos OS Release 15.1R7, you can enable or disable the Link Layer Discovery Protocol (LLDP) and Physical Topology (PTOPO) MIB traps for a specific interface or for all interfaces on EX3300, EX4200, EX4500, EX4550, EX6200, and EX8200 switches by configuring the <code>trap-notification</code> statement at the <code>[edit protocols lldp interface interface-name]</code> hierarchy level.</td>
</tr>
<tr>
<td>14.2</td>
<td>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.</td>
</tr>
<tr>
<td>14.2</td>
<td>Starting with Junos OS Release 14.2, LLDP is supported on extended ports in the Junos Fusion technology.</td>
</tr>
<tr>
<td>12.3</td>
<td>Starting with Junos OS Release 12.3R1, you can generate the interface name as the port ID TLV.</td>
</tr>
<tr>
<td>12.3</td>
<td>Starting with Junos OS Release 12.3, the value of the MIB variable <code>lldpLocPortId</code> depends on the SNMP MIB object entity that is used to generate the port ID TLV.</td>
</tr>
</tbody>
</table>

### Related Documentation

- LLDP Overview on page 355
- Tracing LLDP Operations on page 362
- Example: Configuring LLDP on page 360
- 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.

```plaintext
[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
```

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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 355
- Configuring LLDP on page 356
- Tracing LLDP Operations on page 362

LLDP Operational Mode Commands

Table 24 on page 361 summarizes the command-line interface (CLI) commands you can
use to monitor and troubleshoot the Link Layer Discovery Protocol (LLDP) protocol. Commands are listed in alphabetical order.

Table 24: LLDP Operational Mode Commands

<table>
<thead>
<tr>
<th>Task</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear LLDP neighbor information.</td>
<td>clear lldp neighbors</td>
</tr>
<tr>
<td>Clear LLDP statistics.</td>
<td>clear lldp statistics</td>
</tr>
<tr>
<td>Display basic LLDP information.</td>
<td>show lldp</td>
</tr>
<tr>
<td>Display LLDP local information.</td>
<td>show lldp local-information</td>
</tr>
<tr>
<td>Display LLDP neighbor information.</td>
<td>show lldp neighbors</td>
</tr>
<tr>
<td>Display LLDP remote global statistics.</td>
<td>show lldp remote-global-statistics</td>
</tr>
<tr>
<td>Display LLDP statistics.</td>
<td>show lldp statistics</td>
</tr>
</tbody>
</table>

Related Documentation
- LLDP Overview on page 355
- Configuring LLDP on page 356
- Tracing LLDP Operations on page 362
- Example: Configuring LLDP on page 360
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.

**Related Documentation**

- LLDP Overview on page 355
- Configuring LLDP on page 356
- Example: Configuring LLDP on page 360
CHAPTER 15

Configuring VRRP and VRRP for IPv6

- VRRP and VRRP for IPv6 Overview on page 363
- Configuring VRRP and VRRP for IPv6 on page 364

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 *High Availability Feature Guide*.

Related Documentation

- Configuring VRRP and VRRP for IPv6 on page 364
- 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:

```plaintext
(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:

```plaintext
[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 1309
- traceoptions on page 1566
- failover-delay on page 1309
- vrrp-group
- VRRP and VRRP for IPv6 Overview on page 363
- Ethernet Interfaces Feature Guide for Routing Devices
CHAPTER 16

Configuring Point-to-Point Protocol over Ethernet

• PPPoE Overview on page 368
• Configuring PPPoE on page 371
• Disabling the Sending of PPPoE Keepalive Messages on page 378
• Verifying a PPPoE Configuration on page 378
• Tracing PPPoE Operations on page 379
• Configuring the PPPoE Trace Log Filename on page 381
• Configuring the Number and Size of PPPoE Log Files on page 382
• Configuring Access to the PPPoE Log File on page 382
• Configuring a Regular Expression for PPPoE Lines to Be Logged on page 382
• Configuring the PPPoE Tracing Flags on page 383
• Configuring the Severity Level to Filter Which PPPoE Messages Are Logged on page 383
**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 `pp0` 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 368
- PPPoE Stages on page 369
- Optional CHAP Authentication on page 370

**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 26 on page 369 shows a typical PPPoE session between a Services Router and an access concentrator on the Ethernet loop.
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
- Evaluation Order for Matching Client Information in PPPoE Service Name Tables
- Benefits of Configuring PPPoE Service Name Tables
Configuring PPPoE on page 371
Disabling the Sending of PPPoE Keepalive Messages on page 378
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 379
Troubleshooting PPPoE Service Name Tables
Verifying a PPPoE Configuration on page 378
Ethernet Interfaces Feature Guide for Routing Devices

Configuring PPPoE

Overview on page 372
Setting the Appropriate Encapsulation on the PPPoE Interface on page 372
Configuring PPPoE Encapsulation on an Ethernet Interface on page 373
Configuring PPPoE Encapsulation on an ATM-over-ADSL Interface on page 373
Configuring the PPPoE Underlying Interface on page 374
Identifying the Access Concentrator on page 374
Configuring the PPPoE Automatic Reconnect Wait Timer on page 374
Configuring the PPPoE Service Name on page 375
Configuring the PPPoE Server Mode on page 375
Configuring the PPPoE Client Mode on page 375
Configuring the PPPoE Source and Destination Addresses on page 376
Deriving the PPPoE Source Address from a Specified Interface on page 376
Configuring the PPPoE IP Address by Negotiation on page 376
Overview

To configure PPPoE on an M120 or M320 Multiservice Edge Router or MX Series 5G Universal Routing Platform 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. Starting in Junos OS Release 10.0, optionally, configure one or more PPPoE service name tables and the action taken for each service in the tables.
9. Starting in Junos OS Release 12.3, optionally, disable the sending of PADS messages that contain certain error tags.

**NOTE:** Starting in Junos OS Release 10.4, 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 PPPoE encapsulation on an ethernet interface and on an ATM-over-ADSL interface, see “Configuring PPPoE Encapsulation on an Ethernet Interface” on page 373 and “Configuring PPPoE Encapsulation on an ATM-over-ADSL Interface” on page 373.

### 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:

```plaintext
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:

```plaintext
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 IPAddress 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:

```plaintext
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;
        }
    }
}
```
### Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.3</td>
<td>Starting in Junos OS Release 12.3, optionally, disable the sending of PADS messages that contain certain error tags.</td>
</tr>
<tr>
<td>10.4</td>
<td>Starting in Junos OS Release 10.4, when you configure a static PPPoE logical interface, you must include the <code>pppoe-options</code> subhierarchy at the <code>[edit interfaces pp0 unit logical-unit-number]</code> hierarchy level or at the <code>[edit logical-systems logical-system-name interfaces pp0 unit logical-unit-number]</code> hierarchy level.</td>
</tr>
<tr>
<td>10.0</td>
<td>Starting in Junos OS Release 10.0, optionally, configure one or more PPPoE service name tables and the action taken for each service in the tables.</td>
</tr>
</tbody>
</table>

### Related Documentation
- PPPoE Overview on page 368
- 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]`

### 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.

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 trace options operations are described in the following sections:

- Configuring the PPPoE Trace Log Filename on page 380
- Configuring the Number and Size of PPPoE Log Files on page 380
- Configuring Access to the PPPoE Log File on page 381
- Configuring a Regular Expression for PPPoE Lines to Be Logged on page 381
- Configuring the PPPoE Tracing Flags on page 381

**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.

**See Also**

- Tracing PPPoE Operations on page 379
- `traceoptions (PPPoE)` on page 1579

**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`.

**See Also**

- Tracing PPPoE Operations on page 379
- `traceoptions (PPPoE)` on page 1579
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.

See Also
- Tracing PPPoE Operations on page 379
- traceoptions (PPPoE) on page 1579

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.

See Also
- Tracing PPPoE Operations on page 379
- traceoptions (PPPoE) on page 1579

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
```

See Also
- Tracing PPPoE Operations on page 379

Related Documentation
- PPPoE Overview on page 368
- 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 379
- traceoptions (PPPoE) on page 1579
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 379
- traceoptions (PPPoE) on page 1579

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 379
- traceoptions (PPPoE) on page 1579

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 379
- traceoptions (PPPoE) on page 1579
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 379

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 379
- traceoptions (PPPoE) on page 1579
CHAPTER 17

Configuring Restricted and Unrestricted Proxy ARP

- Restricted and Unrestricted Proxy ARP Overview on page 385
- Configuring Restricted and Unrestricted Proxy ARP on page 387

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 27 on page 386 and Figure 28 on page 387 show examples of situations in which you might want to configure unrestricted proxy ARP.

In Figure 27 on page 386, 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 28 on page 387, 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 27: Edge Device Case for 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 20 for information about how to disable responses to gratuitous ARP requests.

Related Documentation

- Ethernet Interfaces Feature Guide for Routing Devices
Chapter 18

Configuring Static ARP Table Entries

- Static ARP Table Entries Overview on page 389
- Configuring Static ARP Table Entries For Mapping IP Addresses to MAC Addresses on page 390

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
- 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
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.

```
[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:** 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 1225
- Management Ethernet Interface Overview on page 27
- Applying Policers
- Configuring an Unnumbered Interface
- Ethernet Interfaces Feature Guide for Routing Devices
TCC and Layer 2.5 Switching Overview

Translational cross-connect (TCC) 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. Also, TCC can be used to create Layer 2.5 VPNs and Layer 2.5 circuits.

Consider a sample topology (Figure 29 on page 393) in which you can configure a full-duplex Layer 2.5 translational cross-connect between Router A and Router C, using a Juniper Networks router, Router B, as the TCC interface. In this topology, Router B strips all PPP encapsulation data from frames arriving from Router A and adds ATM encapsulation data before the frames are sent to Router C. All Layer 2 negotiations are terminated at the interconnecting router (Router B).

Figure 29: Sample Translation Cross-Connect Topology

TCC functionality is different from standard Layer 2 switching. TCC only swaps Layer 2 headers. No other processing, such as header checksums, time-to-live (TTL) decrementing, or protocol handling, is performed. Currently, TCC is supported in IPv4, ISO, and MPLS.

Ethernet TCC is supported on interfaces that carry IPv4 traffic only. For 8-port, 12-port, and 48-port Fast Ethernet PICs, TCC and extended VLAN CCC are not supported. For 4-port Gigabit Ethernet PICs, extended VLAN CCC and extended VLAN TCC are not supported.
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:
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 1281](#)
- [remote on page 1498](#)
- [proxy on page 1488](#)
- [TCC and Layer 2.5 Switching Overview on page 393](#)
- [Configuring Translation Cross-Connect Interface Switching on page 396](#)
- [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 30 on page 396 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 30: Sample Topology of Layer 2.5 Translational Cross-Connect](image)

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 1281
- remote on page 1498
- proxy on page 1488
- TCC and Layer 2.5 Switching Overview on page 393
- Configuring VLAN TCC Encapsulation on page 394
- Ethernet Interfaces Feature Guide for Routing Devices
CHAPTER 20

Configuring Link Degrade Monitoring

- Link Degrade Monitoring Overview on page 399

**Link Degrade Monitoring Overview**

Link degrade monitoring enables you to monitor the quality of physical links on Ethernet interfaces (10-Gigabit, 40-Gigabit, and 100-Gigabit) and take corrective action when the link quality degrades beyond a certain level. You can configure this feature by applying the `link-degrade-monitor` statement at the `[edit interfaces interface-name]` hierarchy level. When configured on your device, this feature continuously monitors bit error rate (BER) value of the link and initiates a corrective action (media-based) when the BER value breaches a user-configured threshold. The feature can detect a BER value as low as $10^{-13}$ through $10^{-5}$, helping you prevent or minimize packet drops in physical links.

You can configure autorecovery or manual recovery method for the degraded link. In the case of manual recovery, you need to use the `request interface link-degrade-recover interface-name` statement to recover the degraded link. If autorecovery is configured, automatic recovery of the degraded link is attempted at the user configured intervals, and when the link’s BER value is within the configured limit, the link is recovered.

**NOTE:** Layer 2 and Layer 3 protocols already support physical link monitoring. So do Ethernet links through the Link Fault Signaling (LFS) protocol. However, these existing mechanisms cannot detect BER ranges that are very low (for example, $10^{-13}$ through $10^{-5}$).

**Supported Platforms**

Table 25 on page 400 lists the platform series and line cards that support link degrade monitoring.
### Table 25: Line Cards that Support Link Degrade Monitoring

<table>
<thead>
<tr>
<th>Platform Series</th>
<th>MPC Line Cards Supported</th>
<th>DPC Line Cards Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>MX</td>
<td>• MPC4E-3D-2CGE-8XGE</td>
<td>• DPCE-R-Q-4XGE-XFP</td>
</tr>
<tr>
<td></td>
<td>• MPC4E-3D-32XGE-SFPPP</td>
<td>• DPCE-R-4XGE-XFP</td>
</tr>
<tr>
<td></td>
<td>• MPC-3D-16XGE-SFP</td>
<td>• DPCE-X-4XGE-XFP</td>
</tr>
<tr>
<td></td>
<td>• MPC3 with MIC3-3D-1X100GE-CFP</td>
<td>• DPCE-X-Q-4XGE-XFP</td>
</tr>
<tr>
<td></td>
<td>• MPC3 with MIC3-3D-2X40GE-QSFP</td>
<td>• DPCE-R-2XGE-XFP</td>
</tr>
<tr>
<td></td>
<td>• MPC3 with MIC-3D-2XGE-XFP</td>
<td>• DPCE-R-4XGE-XFP</td>
</tr>
<tr>
<td></td>
<td>• MPC3 with 2x10GE XFP MIC</td>
<td>• DPCE-X-4XGE-XFP</td>
</tr>
<tr>
<td></td>
<td>• MPC3 with 2x10GE XFP MIC</td>
<td>On 10-Gigabit Ethernet interfaces:</td>
</tr>
<tr>
<td></td>
<td>• MPC5 with following variants:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 2CGE + 4XGE</td>
<td>• DPCE-R-Q-20GE-2XGE</td>
</tr>
<tr>
<td></td>
<td>• 24XGE + 6XLGE</td>
<td>• DPCE-R-20GE-2XGE</td>
</tr>
<tr>
<td></td>
<td>• MPC6 with the following variants:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 2X100GE CFP2</td>
<td>• DPCE-X-20GE-2XGE</td>
</tr>
<tr>
<td></td>
<td>• 24X10GE SFPP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 24X10GE SFPP OTN</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 4x100GE CXP</td>
<td></td>
</tr>
</tbody>
</table>

**Related Documentation**
- Physical Interface Damping Overview
- Fast Reroute Overview
- link-degrade-monitor on page 1371
- thresholds on page 1561
- recovery on page 1497
- request interface link-degrade-recover on page 1671
CHAPTER 21

Configuring Power-over-Ethernet on ACX Series

- Understanding PoE on ACX Series Universal Metro Routers on page 401
- Example: Configuring PoE on ACX2000 Routers on page 403
- Example: Disabling a PoE Interface on ACX2000 Routers on page 408
- Troubleshooting PoE Interfaces on ACX2000 Universal Metro Routers on page 409

Understanding PoE on ACX Series Universal Metro Routers

Power over Ethernet (PoE) is the implementation of the IEEE 802.3af and IEEE 802.3at standards that allows both data and electrical power to pass over a copper Ethernet LAN cable.

Juniper Networks provides PoE on ACX2000 Universal Metro Routers that allows power delivery up to 65 W per PoE port. PoE ports transfer electrical power and data to remote devices over standard twisted-pair cables in an Ethernet network. Using the PoE ports, you can plug in devices that require both network connectivity and electrical power, such as voice over IP (VoIP) and wireless LAN access points.

You can configure the ACX2000 Universal Metro Router to act as a power sourcing equipment (PSE), supplying power to powered devices that are connected on designated ports.

This topic contains the following sections:

- ACX2000 PoE Specifications on page 401
- PoE Classes and Power Ratings on page 402
- PoE Options on page 403

ACX2000 PoE Specifications

Table 26 on page 402 lists the PoE specifications for the ACX2000 routers.
Table 26: PoE Specifications for the ACX2000 Routers

<table>
<thead>
<tr>
<th>Specifications</th>
<th>For ACX2000 Universal Metro Routers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supported standards</td>
<td>• IEEE 802.3 AF</td>
</tr>
<tr>
<td></td>
<td>• IEEE 802.3 AT (PoE+)</td>
</tr>
<tr>
<td></td>
<td>• Legacy (pre-standards)</td>
</tr>
<tr>
<td>Supported ports</td>
<td>Supported on only two Gigabit Ethernet ports (ge-0/1/3 and ge-0/1/7).</td>
</tr>
<tr>
<td>Total PoE power sourcing capacity</td>
<td>130 W</td>
</tr>
<tr>
<td>Default per port power limit</td>
<td>32 W</td>
</tr>
<tr>
<td>Maximum per port power limit</td>
<td>65 W</td>
</tr>
</tbody>
</table>

Power management modes

- class—Power allocated for each interface can be configured.
- static—Power allocated for interfaces is based on the class of powered device connected.
- high-power—Power allocated for interfaces up to 65 W per port.

PoE Classes and Power Ratings

A powered device is classified based on the maximum power that it draws across all input voltages and operational modes. When class-based power management mode is configured on the ACX2000 routers, power is allocated taking into account the maximum power ratings defined for the different classes of devices.

Table 27 on page 402 lists the classes and their power ratings as specified by the IEEE standards.

Table 27: ACX2000 Universal Metro Router PoE Specifications

<table>
<thead>
<tr>
<th>Class</th>
<th>Usage</th>
<th>Minimum Power Levels Output from PoE Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Default</td>
<td>15.4 W</td>
</tr>
<tr>
<td>1</td>
<td>Optional</td>
<td>4.0 W</td>
</tr>
<tr>
<td>2</td>
<td>Optional</td>
<td>7.0 W</td>
</tr>
<tr>
<td>3</td>
<td>Optional</td>
<td>15.4 W</td>
</tr>
<tr>
<td>4</td>
<td>Reserved</td>
<td>Class 4 power devices are eligible to receive power up to 30 W according to the IEEE standards.</td>
</tr>
</tbody>
</table>
PoE Options

For ACX2000 Universal Metro Routers that support PoE ports, the factory default configuration enables PoE on the PoE-capable ports, with default settings in effect. You might not have to do any additional configuration if the default settings work for you.

Table 28 on page 403 shows the PoE configuration options and their default settings for the PoE controller and for the PoE interfaces.

<table>
<thead>
<tr>
<th>Option</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PoE Controller Options</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>guard-band</strong></td>
<td>0 W</td>
<td>Reserves up to 19 W power from the PoE power budget to be used in the case of a spike in PoE power consumption.</td>
</tr>
<tr>
<td><strong>management</strong></td>
<td>static</td>
<td>Sets the PoE power management mode for the router. The power management mode determines how power to a PoE interface is allocated:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• <strong>class</strong>—Power allocated for each interface can be configured.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• <strong>static</strong>—Power allocated for interfaces is based on the class of powered device connected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• <strong>high-power</strong>—Power allocated for interfaces up to 65 W per port.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Interface Options</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>disable (Power over Ethernet)</strong></td>
</tr>
<tr>
<td><strong>priority (Power over Ethernet)</strong></td>
</tr>
<tr>
<td><strong>telemetries</strong></td>
</tr>
</tbody>
</table>

Related Documentation

- Example: Configuring PoE on ACX2000 Routers on page 403
- Example: Disabling a PoE Interface on ACX2000 Routers on page 408

**Example: Configuring PoE on ACX2000 Routers**

Power over Ethernet (PoE) ports supply electric power over the same ports that are used to connect network devices. These ports allow you to plug in devices that need both
network connectivity and electric power, such as voice over IP (VoIP) phones, wireless access points, and IP cameras.

This example shows how to configure PoE to deliver power up to 65 W on ACX2000 interfaces:

- Requirements on page 404
- Overview on page 404
- Configuration on page 405
- Verification on page 407

Requirements

This example uses the following software and hardware components:

- Junos OS Release 12.2 or later for ACX Series routers
- An ACX2000 router that supports PoE

Before you configure PoE, be sure you have:

- Performed the initial router configuration. See ACX Series Autoinstallation Overview, Verifying Autoinstallation on ACX Series Universal Metro Routers, and Boot Sequence on Devices with Routing Engines for details.

Overview

This example consists of a router that has eight ports. Only two ports—ge-0/1/3 and ge-0/1/7—support PoE, which means they provide both network connectivity and electric power for powered devices such as VoIP telephones, wireless access points, and IP security cameras that require power up to 65 W. The remaining six ports provide only network connectivity. You use the standard ports to connect devices that have their own power sources, such as desktop and laptop computers, printers, and servers.

Table 29 on page 404 details the topology used in this configuration example.

<table>
<thead>
<tr>
<th>Property</th>
<th>Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware</td>
<td>ACX2000 router with 8 Gigabit Ethernet ports: Two PoE interfaces (ge-0/1/3 and ge-0/1/7) and 6 non-PoE interfaces (ge-0/1/0, ge-0/1/1, ge-0/1/2, ge-0/1/4, ge-0/1/5, ge-0/1/6).</td>
</tr>
<tr>
<td>VLAN name</td>
<td>default</td>
</tr>
<tr>
<td>Connection to a wireless access point (requires PoE)</td>
<td>ge-0/1/7</td>
</tr>
<tr>
<td>Power port priority</td>
<td>high</td>
</tr>
<tr>
<td>Maximum power available to PoE port</td>
<td>65 W</td>
</tr>
</tbody>
</table>
Table 29: Components of the PoE Configuration (continued)

<table>
<thead>
<tr>
<th>Property</th>
<th>Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>PoE management mode</td>
<td>high-power</td>
</tr>
<tr>
<td>Direct connections to desktop PCs, file servers, integrated printer/fax/copier machines (no PoE required)</td>
<td>ge-0/1/0 through ge-0/1/2</td>
</tr>
<tr>
<td>Unused ports (for future expansion)</td>
<td>ge-0/1/4 through ge-0/1/6</td>
</tr>
</tbody>
</table>

Configuration

To configure PoE on an ACX2000 router:

**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.

```plaintext
set poe management high-power guard-band 19
set poe interface ge-0/1/3 priority high maximum-power 65 telemetries
```

**Step-by-Step Procedure**

The following example requires you to navigate various levels in the configuration hierarchy. For instructions on how to do that, see Using the CLI Editor in Configuration Mode in the CLI User Guide.

To configure PoE:

1. Set the PoE management mode to **high-power**.

   ```plaintext
   [edit]
   user@host# set poe management high-power
   ```

   **NOTE:**
   - Set the PoE management mode to high-power only when the power requirement is more than 32 W and up to 65 W. If the power requirement is less than or equal to 32 W, then you do not need to set the PoE management mode to high-power.
   - The default management mode is static. In this mode, the power sourcing equipment can deliver power up to 32 W.

2. Reserve power wattage in case of a spike in PoE consumption.

   ```plaintext
   [edit]
   user@host# set poe guard-band 19
   ```
3. Enable PoE.

```
[edit]
user@host# edit poe interface ge-0/1/3
```

4. Set the power port priority.

```
[edit poe interface ge-0/1/3]
user@host# set priority high
```

5. Set the maximum PoE power for a port.

```
[edit poe interface ge-0/1/3]
user@host# set maximum-power 65
```

**NOTE:** Set the maximum PoE power for a port only when the power requirement is more than 32 W and up to 65 W. If the power requirement is less than or equal to 32 W, then you do not need to configure the maximum PoE power.

6. Enable the logging of PoE power consumption.

```
[edit poe interface ge-0/1/3]
user@host# set telemetries
```

**Results**

In configuration mode, confirm your configuration by entering the `show poe interface ge-0/1/3` command. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
[edit]
user@host# show poe interface ge-0/1/3
priority high;
maximum-power 65;
telemetries;
```

If you are done configuring the device, enter `commit` in configuration mode.
Verification

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

- Verifying the Status of PoE Interfaces on page 407
- Verifying the Telemetry Data (History) for the Specified Interface on page 407
- Verifying PoE Global Parameters on page 408

Verifying the Status of PoE Interfaces

Purpose
Verify that the PoE interfaces are enabled and set to the desired priority settings.

Action
In operational mode, enter the `show poe interface ge-0/1/3` command.

```
user@host> show poe interface ge-0/1/3
```

<table>
<thead>
<tr>
<th>Interface status:</th>
<th>PoE interface</th>
<th>ge-0/1/3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative status</td>
<td>Enabled</td>
<td></td>
</tr>
<tr>
<td>Operational status</td>
<td>Powered-up</td>
<td></td>
</tr>
<tr>
<td>Power limit on the interface</td>
<td>65 W</td>
<td></td>
</tr>
<tr>
<td>Priority</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Power consumed</td>
<td>6.6 W</td>
<td></td>
</tr>
<tr>
<td>Class of power device</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Meaning
The `show poe interface ge-0/1/3` command lists PoE interfaces configured on the ACX2000 router, with their status, priority, power consumption, and class.

Verifying the Telemetry Data (History) for the Specified Interface

Purpose
Verify the PoE interface's power consumption over a specified period.

Action
In operational mode, enter the `show poe telemetries interface` command.

For all records:

```
user@host> show poe telemetries interface ge-0/1/3 all
```

<table>
<thead>
<tr>
<th>Interface</th>
<th>Sl No</th>
<th>Timestamp</th>
<th>Power</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>Mon May 14 00:45:05 2012</td>
<td>14.2 W</td>
<td>$3.9 V</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Mon May 14 00:44:04 2012</td>
<td>14.2 W</td>
<td>$3.9 V</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Mon May 14 00:43:03 2012</td>
<td>14.2 W</td>
<td>$3.9 V</td>
</tr>
</tbody>
</table>

For a specific number of records:

```
user@host> show poe telemetries interface ge-0/1/3 2
```

<table>
<thead>
<tr>
<th>Interface</th>
<th>Sl No</th>
<th>Timestamp</th>
<th>Power</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>Mon May 14 00:45:05 2012</td>
<td>14.2 W</td>
<td>$3.9 V</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Mon May 14 00:44:04 2012</td>
<td>14.2 W</td>
<td>$3.9 V</td>
</tr>
</tbody>
</table>
Meaning  The telemetry status displays the power consumption history for the specified interface, provided telemetry has been configured for that interface.

Verifying PoE Global Parameters

Purpose  Verify global parameters such as guard band, power limit, and power consumption.

Action  In operational mode, enter the `show poe controller` command.

```
user@host> show poe controller
Controller index  Maximum power  Power consumption  Guard band  Management  Status  Lldp Priority
                  W                           W          W          high-power  UP
0                   130.0 W             14.2 W     0 W
```

Meaning  The `show poe controller` command lists the global parameters configured on the router.

Related Documentation
- Understanding PoE on ACX Series Universal Metro Routers on page 401

Example: Disabling a PoE Interface on ACX2000 Routers

This example shows how to disable PoE on all interfaces or on a specific interface.

- Requirements on page 408
- Overview on page 408
- Configuration on page 409
- Verification on page 409

Requirements

Before you begin:

- Configure PoE on all interfaces. See “Example: Configuring PoE on ACX2000 Routers” on page 403.

Overview

In this example, you disable PoE on all interfaces and on a specific interface, which in this case is ge-0/1/3.
**Configuration**

**Step-by-Step Procedure**

- Disable PoE on all interfaces.
  
  ```bash
  [edit]
  user@host# set poe interface all disable
  ```

- Disable PoE on a specific interface.
  
  ```bash
  [edit]
  user@host# set poe interface ge-0/1/3 disable
  ```

**Verification**

To verify the configuration is working properly, enter the `show poe interface` command.

```
user@host> show poe interface
```

<table>
<thead>
<tr>
<th>Interface</th>
<th>Admin status</th>
<th>Oper status</th>
<th>Max power</th>
<th>Priority</th>
<th>Power consumption</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-0/1/3</td>
<td>Disabled</td>
<td>Disabled</td>
<td>32.0W</td>
<td>Low</td>
<td>0.0W</td>
<td>0</td>
</tr>
<tr>
<td>ge-0/1/7</td>
<td>Disabled</td>
<td>Disabled</td>
<td>32.0W</td>
<td>Low</td>
<td>0.0W</td>
<td>0</td>
</tr>
</tbody>
</table>

```
user@host> show poe interface ge-0/1/3
```

PoE interface status:
- PoE interface : ge-0/1/3
- Administrative status : Disabled
- Operational status : Disabled
- Power limit on the interface : 32.0 W
- Priority : Low
- Power consumed : 0.0 W
- Class of power device : 0

**Related Documentation**

- **Understanding PoE on ACX Series Universal Metro Routers** on page 401

**Troubleshooting PoE Interfaces on ACX2000 Universal Metro Routers**

**Problem**  **Description:** A Power over Ethernet (PoE) interface is not supplying power to the powered device.

**Solution**  
Check for the items shown in **Table 30 on page 409**.

<table>
<thead>
<tr>
<th>Table 30: Troubleshooting a PoE Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Items to Check</strong></td>
</tr>
<tr>
<td>Is interface PoE enabled?</td>
</tr>
</tbody>
</table>
### Table 30: Troubleshooting a PoE Interface (continued)

<table>
<thead>
<tr>
<th>Items to Check</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has PoE capability been disabled for that interface?</td>
<td>Use the <code>show poe interface</code> command to check PoE interface status.</td>
</tr>
<tr>
<td>Is the cable properly seated in the port socket?</td>
<td>Check the hardware.</td>
</tr>
<tr>
<td>Does the powered device require more power than is available on the interface?</td>
<td>Use the <code>show poe interface</code> command to check the maximum power provided by the interface.</td>
</tr>
<tr>
<td>If the <code>telemetries</code> option has been enabled for the interface, check the history of power consumption.</td>
<td>Use the <code>show poe telemetries</code> command to display the history of power consumption.</td>
</tr>
</tbody>
</table>

### Related Documentation

- Understanding PoE on ACX Series Universal Metro Routers on page 401
- Example: Configuring PoE on ACX2000 Routers on page 403
PART 2

Gigabit Ethernet Interfaces

- Configuring 10-Gigabit Ethernet LAN/WAN PICs on page 413
- Configuring 10-Gigabit Ethernet Framing on page 445
- Configuring 10-Gigabit Ethernet Notification of Link Down Alarm on page 449
- Configuring 40-Gigabit Ethernet PICs on page 451
- Configuring 100-Gigabit Ethernet PICs/MICs on page 455
- Configuring Rate Selectability on page 481
- Configuring Gigabit Ethernet OTN Options on page 561
- Configuring Gigabit Ethernet Accounting and Policing on page 661
- Configuring Gigabit Ethernet Autonegotiation on page 683
- Stacking and Rewriting Gigabit Ethernet VLAN Tags on page 691
CHAPTER 22

Configuring 10-Gigabit Ethernet LAN/WAN PICs

- 10-port 10-Gigabit Ethernet LAN/WAN PIC Overview on page 413
- 12-port 10-Gigabit Ethernet LAN/WAN PIC on Type 5 FPC Overview on page 417
- 24-port 10-Gigabit Ethernet LAN/WAN PIC on Type 5 FPC Overview on page 420
- Modes of Operation of 10-Gigabit Ethernet PICs on page 421
- Configuring Line-Rate Mode on 10-Gigabit Ethernet LAN/WAN PICs Supporting Oversubscription on page 422
- Configuring Control Queue Disable on a 10-port 10-Gigabit Ethernet LAN/WAN PIC on page 423
- Example: Handling Oversubscription on a 10-Gigabit Ethernet LAN/WAN PIC on page 426
- Configuring Mixed-Rate Mode Operation on page 427
- P2-10G-40G-QSFPP PIC Overview on page 428
- Configuring the P2-10G-40G-QSFPP PIC on page 437
- Example: Configuring the P2-10G-40G-QSFPP PIC on page 440

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 31 on page 416 10-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PD-5-10XGE-SFPP).

Table 31: Capabilities of 10-Gigabit Ethernet LAN/WAN PICs

<table>
<thead>
<tr>
<th>Capability</th>
<th>Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum VLANs per PIC</td>
<td>4065</td>
</tr>
<tr>
<td>Maximum VLANs per port</td>
<td>1022</td>
</tr>
</tbody>
</table>
Table 31: Capabilities of 10-Gigabit Ethernet LAN/WAN PICs (continued)

<table>
<thead>
<tr>
<th>Capability</th>
<th>Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAC learning per port</td>
<td>960</td>
</tr>
<tr>
<td>MAC accounting per port</td>
<td>960</td>
</tr>
<tr>
<td>MAC filtering per port</td>
<td>960 (64 filters per physical or logical interface)</td>
</tr>
<tr>
<td></td>
<td>960 filters across multiple logical interfaces</td>
</tr>
<tr>
<td>MAC policers</td>
<td>128 ingress Mac policers</td>
</tr>
<tr>
<td></td>
<td>128 egress Mac policers</td>
</tr>
<tr>
<td>Classifiers</td>
<td>Eight classifiers per PIC for each BA classifier type</td>
</tr>
</tbody>
</table>

Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.2</td>
<td>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).</td>
</tr>
<tr>
<td>12.1R2</td>
<td>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).</td>
</tr>
</tbody>
</table>

Related Documentation

- Configuring Line-Rate Mode on 10-Gigabit Ethernet LAN/WAN PICs Supporting Oversubscription on page 422
- Configuring Control Queue Disable on a 10-port 10-Gigabit Ethernet LAN/WAN PIC on page 423
- Example: Handling Oversubscription on a 10-Gigabit Ethernet LAN/WAN PIC on page 426
- IEEE 802.1ag OAM Connectivity Fault Management Overview on page 728
- IEEE 802.3ah OAM Link-Fault Management Overview on page 818
- 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

<table>
<thead>
<tr>
<th>Capability</th>
<th>Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum logical interfaces per PIC</td>
<td>32,000</td>
</tr>
<tr>
<td>Maximum logical interfaces per port</td>
<td>For IPv4 the limit is 4093.</td>
</tr>
<tr>
<td></td>
<td>For IPv6 the limit is 1022.</td>
</tr>
<tr>
<td>Classifiers</td>
<td>Eight classifiers per PIC for each BA classifier type</td>
</tr>
</tbody>
</table>
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 422.
- 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 417
- Configuring Line-Rate Mode on 10-Gigabit Ethernet LAN/WAN PICs Supporting Oversubscription on page 422

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.
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)
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 31 on page 423.

**Figure 31: 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 Layer 2 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).

```plaintext
[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 413](#)
- [Configuring Line-Rate Mode on 10-Gigabit Ethernet LAN/WAN PICs Supporting Oversubscription on page 422](#)
- [no-pre-classifier on page 1433](#)
Example: Handling Oversubscription on a 10-Gigabit Ethernet LAN/WAN PIC

Table 32 on page 426 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>
<thead>
<tr>
<th>Number of Port Groups with Two Active Ports (A)</th>
<th>Number of Port Groups with One Active Port (B)</th>
<th>Total Number of Ports Used on PIC (C = A x 2 + B)</th>
<th>Status of Oversubscription and Throughput</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>Oversubscription is not active. Each port will receive 10 Gbps throughput.</td>
</tr>
<tr>
<td>0</td>
<td>2</td>
<td>2</td>
<td>Oversubscription is not active. Each port will receive 10 Gbps throughput.</td>
</tr>
<tr>
<td>0</td>
<td>5</td>
<td>5</td>
<td>Oversubscription is not active. Each port will receive 10 Gbps throughput.</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>2</td>
<td>Oversubscription is active. Each port will receive 5 Gbps throughput (with default shaper configuration).</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>6</td>
<td>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.</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>6</td>
<td>Oversubscription is active. Each port will receive 5 Gbps throughput (with default shaper configuration).</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>10</td>
<td>Oversubscription is active on all 10 ports (5 port groups). Each port will receive 5 Gbps throughput (with default shaper configuration).</td>
</tr>
</tbody>
</table>

Related Documentation
- 10-port 10-Gigabit Ethernet LAN/WAN PIC Overview on page 413
- Configuring Line-Rate Mode on 10-Gigabit Ethernet LAN/WAN PICs Supporting Oversubscription on page 422
- Configuring Control Queue Disable on a 10-port 10-Gigabit Ethernet LAN/WAN PIC on page 423
- 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 421
- mixed-rate-mode on page 1415
P2-10G-40G-QSFPP PIC Overview

Starting with Junos OS Release 14.1R2 and 14.2R1, the PTX5000 Packet Transport Router 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 14.2R3 and 16.1R1, you can configure the ports on the PIC in 10-Gigabit Ethernet mode or 40-Gigabit Ethernet mode at the port group level.

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 428
- Understanding Port Group on page 429
- Port Numbering on P2-10G-40G-QSFPP PIC When Port Groups Are Not Configured on page 433
- 10-Gigabit Ethernet Mode on page 435
- 40-Gigabit Ethernet Mode on page 436

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.
  
  Note that the ports follow a 4-level interface-naming convention—et-fpc/pic/QSFP+ port:channel in this mode.

- 40-Gigabit Ethernet in LAN PHY framing mode.
  
  Note that the ports follow a 3-level interface-naming convention—et-fpc/pic/QSFP+ port in this mode.

**NOTE:** The P2-10G-40G-QSFPP PIC provides forty-eight 10-Gigabit Ethernet ports or twelve 40-Gigabit Ethernet ports. or .

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-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-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 diagnostics optics interface-name`.

**Understanding Port Group**

The FPC2-PTX-P1A FPC on PTX5000 routers can host two PICs and has eight Packet Forwarding Engines. The first four Packet Forwarding Engines on the FPC are associated with PIC 0 and the next four are associated with PIC 1.

All ports associated to one Packet Forwarding Engine compose a port group. Each PIC supports four Packet Forwarding Engines. Therefore, four port groups exist for each P2-10G-40G-QSFPP PIC.

Each Packet Forwarding Engine providesthroughput of 120 Gbps.

**Points to Remember**

Consider the following points when configuring the PIC at the port group level:

- You can configure the ports in 10-Gigabit Ethernet mode or in 40-Gigabit Ethernet mode at the port group level.

- You can configure the port speed only on the first port in the port group. That is, you must configure the port speed for the port group on the ports numbered 0, 3, 6, and 9—the first ports in the respective port groups. An error message is logged when you try to configure the speed on any other port in the port group and this configuration will not have any effect on the PIC.

- You can configure the port speed of a port group only when the value of the `pic-mode` statement at the `[edit chassis fpc fpc-slot pic-slot pic-mode]` is set to 10G or when the statement is not configured.
- You cannot configure different speeds for the ports in the same port group.
- You can configure different speeds for different port groups.

**Port Group in 10-Gigabit Ethernet Mode**

Each Packet Forwarding Engine supports twelve 10-Gigabit Ethernet ports in LAN PHY or in WAN PHY framing mode.

Note that when a port group is configured from 10-Gigabit Ethernet mode to 40-Gigabit Ethernet mode, the ports with 4-level interface-naming convention are deleted and three 40-Gigabit Ethernet mode ports with 3-level interface-naming convention are created.

Note that when the configuration of a port group is changed from 10-Gigabit Ethernet mode to 40-Gigabit Ethernet mode, the configuration of the twelve 10-Gigabit Ethernet ports is deleted and the 4-level interface-naming convention of the ports is also lost. Instead, three 40-Gigabit Ethernet ports are configured and these ports adhere to the 3-level interface-naming convention.

**Port Group in 40-Gigabit Ethernet Mode**

Each Packet Forwarding Engine supports three 40-Gigabit Ethernet ports in LAN PHY framing mode.

Note that when the configuration of a port group is changed from 40-Gigabit Ethernet mode to 10-Gigabit Ethernet mode, the configuration of the three 40-Gigabit Ethernet ports is deleted and the 3-level interface-naming convention of the ports is also lost. Instead, twelve 10-Gigabit Ethernet ports are configured and these ports adhere to the 4-level interface-naming convention.

**Port Number Mapping When Port Groups Are Configured**

Table 33 on page 431 shows the port numbering in 40-Gigabit Ethernet mode and in 10-Gigabit Ethernet mode at the port group level.
### Table 33: Port Number Mapping When Port Groups Are Configured

<table>
<thead>
<tr>
<th>QSFP+ Port Number</th>
<th>Port Numbering in 40-Gigabit Ethernet Mode</th>
<th>Port Numbering in 10-Gigabit Ethernet Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (0)</td>
<td>et-1/1/0</td>
<td>et-1/1/0:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/0:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/0:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/0:3</td>
</tr>
<tr>
<td>et-1/1/1</td>
<td>et-1/1/1:0</td>
<td>et-1/1/1:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/1:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/1:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/1:3</td>
</tr>
<tr>
<td>et-1/1/2</td>
<td>et-1/1/2:0</td>
<td>et-1/1/2:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/2:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/2:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/2:3</td>
</tr>
<tr>
<td>3(1)</td>
<td>et-1/1/3</td>
<td>et-1/1/3:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/3:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/3:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/3:3</td>
</tr>
<tr>
<td>et-1/1/4</td>
<td>et-1/1/4:0</td>
<td>et-1/1/4:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/4:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/4:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/4:3</td>
</tr>
<tr>
<td>et-1/1/5</td>
<td>et-1/1/5:0</td>
<td>et-1/1/5:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/5:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/5:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/5:3</td>
</tr>
</tbody>
</table>
Table 33: Port Number Mapping When Port Groups Are Configured (continued)

<table>
<thead>
<tr>
<th>QSFP+ Port Number</th>
<th>Port Numbering in 40-Gigabit Ethernet Mode</th>
<th>Port Numbering in 10-Gigabit Ethernet Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>6(2)</td>
<td>et-1/1/6</td>
<td>et-1/1/6:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/6:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/6:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/6:3</td>
</tr>
<tr>
<td>et-1/1/7</td>
<td></td>
<td>et-1/1/7:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/7:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/7:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/7:3</td>
</tr>
<tr>
<td>et-1/1/8</td>
<td></td>
<td>et-1/1/8:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/8:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/8:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/8:3</td>
</tr>
<tr>
<td>6(2)</td>
<td>et-1/1/6</td>
<td>et-1/1/6:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/6:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/6:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/6:3</td>
</tr>
<tr>
<td>et-1/1/7</td>
<td></td>
<td>et-1/1/7:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/7:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/7:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/7:3</td>
</tr>
<tr>
<td>et-1/1/8</td>
<td></td>
<td>et-1/1/8:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/8:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/8:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/8:3</td>
</tr>
</tbody>
</table>
### Table 33: Port Number Mapping When Port Groups Are Configured (continued)

<table>
<thead>
<tr>
<th>QSFP+ Port Number</th>
<th>Port Numbering in 40-Gigabit Ethernet Mode</th>
<th>Port Numbering in 10-Gigabit Ethernet Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>9(3)</td>
<td>et-1/1/9</td>
<td>et-1/1/9:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/9:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/9:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/9:3</td>
</tr>
<tr>
<td>et-1/1/10</td>
<td>et-1/1/10:0</td>
<td>et-1/1/10:1</td>
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<td>et-1/1/10:2</td>
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<tr>
<td></td>
<td></td>
<td>et-1/1/10:3</td>
</tr>
<tr>
<td>et-1/1/11</td>
<td>et-1/1/11:0</td>
<td>et-1/1/11:1</td>
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<tr>
<td></td>
<td></td>
<td>et-1/1/11:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/11:3</td>
</tr>
</tbody>
</table>

### Port Numbering on P2-10G-40G-QSFPP PIC When Port Groups Are Not Configured

Table 34 on page 433 shows the port numbering in 40-Gigabit Ethernet mode and in 10-Gigabit Ethernet mode when port groups are not configured on the P2-10G-40G-QSFPP PIC.

### Table 34: Port Number Mapping When Port Groups Are Not Configured

<table>
<thead>
<tr>
<th>QSFP+ Port Number</th>
<th>Port Numbering in 40-Gigabit Ethernet Mode</th>
<th>Port Numbering in 10-Gigabit Ethernet Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>et-1/1/0</td>
<td>et-1/1/0:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/0:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/0:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/0:3</td>
</tr>
<tr>
<td>1</td>
<td>et-1/1/1</td>
<td>et-1/1/1:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/1:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/1:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/1:3</td>
</tr>
<tr>
<td>QSFP+ Port Number</td>
<td>Port Numbering in 40-Gigabit Ethernet Mode</td>
<td>Port Numbering in 10-Gigabit Ethernet Mode</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>2</td>
<td>et-1/1/2</td>
<td>et-1/1/2:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/2:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/2:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/2:3</td>
</tr>
<tr>
<td>3</td>
<td>et-1/1/3</td>
<td>et-1/1/3:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/3:1</td>
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<tr>
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<td></td>
<td>et-1/1/3:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/3:3</td>
</tr>
<tr>
<td>4</td>
<td>et-1/1/4</td>
<td>et-1/1/4:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/4:1</td>
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<tr>
<td></td>
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<td>et-1/1/4:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/4:3</td>
</tr>
<tr>
<td>5</td>
<td>et-1/1/5</td>
<td>et-1/1/5:0</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
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<td>et-1/1/5:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/5:3</td>
</tr>
<tr>
<td>6</td>
<td>et-1/1/6</td>
<td>et-1/1/6:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/6:1</td>
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<td>et-1/1/6:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/6:3</td>
</tr>
<tr>
<td>7</td>
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<td>et-1/1/7:0</td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/7:3</td>
</tr>
<tr>
<td>8</td>
<td>et-1/1/8</td>
<td>et-1/1/8:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/8:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/8:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/8:3</td>
</tr>
</tbody>
</table>
Table 34: Port Number Mapping When Port Groups Are Not Configured (continued)

<table>
<thead>
<tr>
<th>QSFP+ Port Number</th>
<th>Port Numbering in 40-Gigabit Ethernet Mode</th>
<th>Port Numbering in 10-Gigabit Ethernet Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>et-1/1/9</td>
<td>et-1/1/9:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/9:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/9:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/9:3</td>
</tr>
<tr>
<td>10</td>
<td>et-1/1/10</td>
<td>et-1/1/10:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/10:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/10:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/10:3</td>
</tr>
<tr>
<td>11</td>
<td>et-1/1/11</td>
<td>et-1/1/11:0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/11:1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/11:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-1/1/11:3</td>
</tr>
</tbody>
</table>

**10-Gigabit Ethernet Mode**

A 10-Gigabit Ethernet interface can operate in 10-Gigabit Ethernet LAN PHY framing mode or in 10-Gigabit Ethernet WAN PHY framing mode.

You can configure a 10-Gigabit Ethernet interface at the [edit interface interface-name frning-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 4-level interface-naming convention—et-fpc/pic/QSFP+ port:channel, 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.

- Framing Mode Overview on page 435
- Supported Features on LAN PHY and WAN PHY Framing Mode on page 436

**Framing Mode Overview**

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. You can configure loopback at the [edit interfaces interface-name sonet-options loopback] hierarchy level.
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

Supported Features on LAN PHY and WAN PHY Framing Mode

The following features are supported in LAN PHY and WAN PHY framing mode when the PIC operates in 10-Gigabit Ethernet mode:

- The following are supported for WAN interface sublayer statistics, defects, and alarms when the PIC operates in WAN PHY framing mode:
  - GR 253 standard.
  - `show interfaces interfaces-name` operational mode command displays WAN interface sublayer statistics, defects and alarms.
  - Interrupt-driven notification for WAN interface sublayer defects.
  - Path trace and trigger options for WAN interface sublayer alarms.
  - Transmitting and receiving J1 (path trace) messages—J1 is a part of path overhead in a WAN interface sublayer frame.

- Line loopback and local loopback. Loopback is configured at the [edit interfaces interface-name sonet-options loopback] hierarchy level in WAN PHY framing mode.

- The defects PHY LOL (loss of light) and PHY PLL (loss of PLL lock) are detected and reported at the physical level in WAN PHY framing mode.

Fast reroute (FRR) in WAN PHY framing mode:

- Enable or disable preemptive fast reroute (FRR) options at the [edit interfaces interface-name otn-options preemptive-fast-reroute] hierarchy level.

- Configure thresholds and interval for the optical channel data unit (ODU) signal degradation (odu-signal-degrade) and the configurable pre-FEC bit error rate (BER) (ber-threshold-signal-degrade) at the [edit interfaces interface-name otn-options odu-signal-degrade] hierarchy level and the [edit interfaces interface-name otn-options signal-degrade] hierarchy level, respectively.

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 3-level interface-naming convention `et-fpc/pic/QSFP+ port`, where the value of the QSFP+ port variable ranges from 0 through 11.
Starting with Junos OS Release 14.1R2, PTX5000 supports the P2-10G-40G-QSFPP PIC on the FPC2-PTX-P1 AFPC. 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 437
- Configuring the PIC in 10-Gigabit Ethernet Mode to Operate in 40-Gigabit Ethernet Mode on page 437
- Configuring the PIC in 40-Gigabit Ethernet Mode to Operate in 10-Gigabit Ethernet Mode on page 438
- Configuring the PIC at Port Group Level on page 439
- Configuring Framing Mode on P2-10G-40G-QSFPP PIC on page 439

### 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.
2. Delete all the interfaces in the PIC, commit, and then move to the top of the hierarchy level.

```
[edit]
user@host# edit interfaces
```

```
[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 the PIC at Port Group Level

#### Before You Begin

Verify that the `pic-mode` statement at the `[edit chassis fpc fpc-slot pic pic-slot pic-mode]` is not configured or that its value is set to 10G.

To configure a port group in the P2-10G-40G-QSFPP PIC to operate in 10-Gigabit Ethernet mode or 40-Gigabit Ethernet mode:

1. In configuration mode, go to the `[edit chassis fpc fpc-slot pic pic-slot]` hierarchy level.

   ```
   [edit]
   user@host# edit chassis fpc fpc-slot pic pic-slot
   ```

2. Configure the port number as 0, 3, 6, or 9 and the speed as 10G or 40G. Note that you can configure the port speed only on the first port in the port group. That is, configure the port speed only on the ports numbered 0, 3, 6, and 9. An error message is displayed when you try to configure the speed on any other port in the port group.

   ```
   [edit chassis fpc fpc-slot pic pic-slot]
   user@host# set port port-number speed (10G | 40G)
   ```

   **NOTE:** A system log message is logged when you try to configure a different port speed on a port when the port group is operating at another speed.

### Configuring Framing Mode on P2-10G-40G-QSFPP PIC

You can configure LAN PHY, or WAN PHY framing mode when the PIC is operating in 10-Gigabit Ethernet mode. You can configure LAN PHY framing mode when the PIC is operating in 40-Gigabit Ethernet mode. The following tasks explain how to configure the various framing modes on the PIC:

- Configuring LAN PHY or WAN PHY Framing Mode in 10-Gigabit Ethernet Mode on page 439
- Configuring LAN PHY Framing Mode in 40-Gigabit Ethernet Mode on page 440

#### Configuring LAN PHY or WAN PHY Framing Mode in 10-Gigabit Ethernet 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.
2. Configure the framing mode as LAN PHY or WAN PHY and commit.

```bash
[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.

**Configuring LAN PHY Framing Mode in 40-Gigabit Ethernet Mode**

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.

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

2. Configure the framing mode as LAN PHY and commit.

```bash
[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.

**Release History Table**

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.1R2</td>
<td>Starting with Junos OS Release 14.1R2, PTX5000 supports the P2-10G-40G-QSFPP PIC on the FPC2-PTX-PIA FPC.</td>
</tr>
</tbody>
</table>

**Related Documentation**

- P2-10G-40G-QSFPP PIC Overview on page 428
- Requirements on page 441
- Overview on page 441
- Configuration on page 441
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 441
- Configuring the Framing Mode on an Interface on page 442
- Configuring the Interface Options on page 442
- Verification on page 443

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]
   ```
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

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 gigether-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 gigether-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
  Input rate   : 0 bps (0 pps)
  Output rate  : 0 bps (0 pps)
  Active alarms: LINK
  Active defects: LINK
  PCS statistics: Seconds
    Bit errors    
    Errored blocks
  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.

**Release History Table**

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
</table>

**Related Documentation**
- P2-10G-40G-QSFPP PIC Overview on page 428
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.

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.2</td>
<td>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).</td>
</tr>
<tr>
<td>12.1R2</td>
<td>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).</td>
</tr>
</tbody>
</table>

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 in 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 1327
- Configuring 10-Gigabit Ethernet Framing on page 447
- 10-Gigabit Ethernet Framing Overview on page 445
- 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 1327
- 10-Gigabit Ethernet Framing Overview on page 445
- Understanding WAN Framing for 10-Gigabit Ethernet Trio Interfaces on page 446
- Ethernet Interfaces Feature Guide for Routing Devices
CHAPTER 24

Configuring 10-Gigabit Ethernet Notification of Link Down Alarm

- Gigabit Ethernet Notification of Link Down Alarm Overview on page 449
- 10-Gigabit Ethernet Notification of Link Down for Optics Options Overview on page 449
- Configuring Gigabit Ethernet Notification of Link Down Alarm on page 450
- Configuring 10-Gigabit Ethernet Link Down Notification for Optics Options Alarm or Warning on page 450

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 450
- asynchronous-notification on page 1229
- 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 450.

Related Documentation
- Configuring 10-Gigabit Ethernet Link Down Notification for Optics Options Alarm or Warning on page 450
- 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 449
- Ethernet Interfaces Feature Guide for Routing Devices
- asynchronous-notification on page 1229

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 1074
- warning on page 1124
- 10-Gigabit Ethernet Notification of Link Down for Optics Options Overview on page 449
- Ethernet Interfaces Feature Guide for Routing Devices
CHAPTER 25

Configuring 40-Gigabit Ethernet PICs

- 40-Gigabit Ethernet PIC Overview on page 451
- Configuring 40-Gigabit Ethernet PICs on page 453

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 453. 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 453
• 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 280 and “Configuring a Logical Interface for Trunk Mode” on page 281.

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 110.
   • 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 110 and “10-port 10-Gigabit Ethernet LAN/WAN PIC Overview” on page 413.

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 671, “Configuring MAC Address Filtering” on page 676, and “Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview” on page 691.

Related Documentation

- 40-Gigabit Ethernet PIC Overview on page 451
- Configuring Gigabit Ethernet Policers on page 671
- Configuring MAC Address Filtering on page 676
- Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview on page 691
CHAPTER 26

Configuring 100-Gigabit Ethernet PICs/MICs

- 100-Gigabit Ethernet Interfaces Overview on page 455
- MPC3E MIC Overview on page 458
- 100-Gigabit Ethernet Type 4 PIC with CFP Overview on page 459
- Configuring 100-Gigabit Ethernet Type 4 PIC With CFP on page 462
- Configuring VLAN Steering Mode for 100-Gigabit Ethernet Type 4 PIC with CFP on page 466
- 100-Gigabit Ethernet Type 5 PIC with CFP Overview on page 468
- 100-Gigabit Ethernet Interfaces Interoperability on page 471
- Interoperability Between the 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and PF-1CGE-CFP on page 473
- Interoperability Between the 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and P1-PTX-2-100GE-CFP on page 474
- Configuring the Interoperability Between the 100-Gigabit Ethernet PICs PF-1CGE-CFP and PD-ICE-CFP-FPC4 on page 475
- Configuring the Interoperability Between the 100-Gigabit Ethernet PICs P1-PTX-2-100GE-CFP and PD-ICE-CFP-FPC4 on page 478

100-Gigabit Ethernet Interfaces Overview

- MX Series 100-Gigabit Ethernet Interfaces on page 455
- PTX Series 100-Gigabit Ethernet Interfaces on page 456
- T Series 100-Gigabit Ethernet Interfaces on page 457

MX Series 100-Gigabit Ethernet Interfaces

Table 35 on page 456 lists the 100-Gigabit Ethernet interfaces supported by MX Series routers.
### Table 35: MX Series 100-Gigabit Ethernet Interfaces

<table>
<thead>
<tr>
<th>Interface Module</th>
<th>Model Number</th>
<th>Routers Supported</th>
<th>For More Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-Gigabit Ethernet MIC with CFP</td>
<td>MIC3-3D-1X100GE-CFP</td>
<td>MX240</td>
<td>100-Gigabit Ethernet MIC with CFP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“MPC3E MIC Overview” on page 458</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MX480</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>MX960</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>MX2010</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>MX2020</td>
<td></td>
</tr>
<tr>
<td>100-Gigabit Ethernet MIC with CXP</td>
<td>MIC3-3D-1X100GE-CXP</td>
<td>MX240</td>
<td>100-Gigabit Ethernet MIC with CXP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“MPC3E MIC Overview” on page 458</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MX480</td>
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<td></td>
<td></td>
<td>MX960</td>
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<tr>
<td></td>
<td></td>
<td>MX2010</td>
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<tr>
<td></td>
<td></td>
<td>MX2020</td>
<td></td>
</tr>
<tr>
<td>100-Gigabit Ethernet ports on the MPC4E</td>
<td>MPC4E-3D-2CGE-8XGE</td>
<td>MX240</td>
<td>MPC4E on MX Series Routers Overview</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2x100GE + 8x10GE MPC4E</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MX480</td>
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<td></td>
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<td>MX960</td>
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<td></td>
<td></td>
<td>MX2010</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>MX2020</td>
<td></td>
</tr>
<tr>
<td>100-Gigabit Ethernet MIC with CFP2</td>
<td>MIC6-100G-CFP2</td>
<td>MX2010</td>
<td>100-Gigabit Ethernet MIC with CFP2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MX2020</td>
<td></td>
</tr>
<tr>
<td>100-Gigabit Ethernet MIC with CXP(4 Ports)</td>
<td>MIC6-100G-CXP</td>
<td>MX2010</td>
<td>100-Gigabit Ethernet MIC with CXP (4 Ports)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MX2020</td>
<td></td>
</tr>
</tbody>
</table>

### PTX Series 100-Gigabit Ethernet Interfaces

**Table 36 on page 456** lists the 100-Gigabit Ethernet interfaces supported by PTX Series routers.

### Table 36: PTX Series 100-Gigabit Ethernet Interfaces

<table>
<thead>
<tr>
<th>PIC</th>
<th>Model Number</th>
<th>Routers Supported</th>
<th>For More Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-Gigabit Ethernet PIC with CFP</td>
<td>P1-PTX-2-100GE-CFP</td>
<td>PTX5000</td>
<td>100-Gigabit Ethernet PIC with CFP (PTX Series)</td>
</tr>
<tr>
<td>100-Gigabit Ethernet PIC with CFP2</td>
<td>P2-100GE-CFP2</td>
<td>PTX5000</td>
<td>100-Gigabit Ethernet PIC with CFP2 (PTX Series)</td>
</tr>
</tbody>
</table>
Table 36: PTX Series 100-Gigabit Ethernet Interfaces (continued)

<table>
<thead>
<tr>
<th>PIC</th>
<th>Model Number</th>
<th>Routers Supported</th>
<th>For More Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-Gigabit Ethernet OTN PIC</td>
<td>P2-100GE-OTN</td>
<td>PTX5000</td>
<td>100-Gigabit Ethernet OTN PIC with CFP2 (PTX Series)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&quot;Understanding the P2-100GE-OTN PIC&quot; on page 611</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&quot;Configuring OTN Interfaces on P2-100GE-OTN PIC&quot; on page 615</td>
</tr>
<tr>
<td>100-Gigabit DWDM OTN PIC</td>
<td>PI-PTX-2-100G-WDM</td>
<td>PTX5000</td>
<td>100-Gigabit DWDM OTN PIC (PTX Series)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PTX3000</td>
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</tbody>
</table>

T Series 100-Gigabit Ethernet Interfaces

Table 37 on page 457 lists the 100-Gigabit Ethernet interfaces supported by T Series routers.

Table 37: T Series 100-Gigabit Ethernet Interfaces

<table>
<thead>
<tr>
<th>PIC</th>
<th>Model Number</th>
<th>Routers Supported</th>
<th>For More Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-Gigabit Ethernet PIC with CFP (Type 4)</td>
<td>PD-1CE-CFP-FPC4</td>
<td>T1600</td>
<td>100-Gigabit Ethernet PIC with CFP (T1600 Router)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T4000</td>
<td>100-Gigabit Ethernet PIC with CFP (T4000 Router)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&quot;100-Gigabit Ethernet Type 4 PIC with CFP Overview&quot; on page 459</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&quot;Configuring 100-Gigabit Ethernet Type 4 PIC With CFP&quot; on page 462</td>
</tr>
<tr>
<td>100-Gigabit Ethernet PIC with CFP (Type 5)</td>
<td>PF-1CGE-CFP</td>
<td>T4000</td>
<td>100-Gigabit Ethernet PIC with CFP (T4000 Router)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&quot;100-Gigabit Ethernet Type 5 PIC with CFP Overview&quot; on page 468</td>
</tr>
</tbody>
</table>

Related Documentation

- MICs Supported by MX Series Routers
- MPCs Supported by MX Series 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-QSFPP)

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 MPC3E on MX Series Routers
- 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 462
- *TI600 Core Router Hardware Guide*
- *100-Gigabit Ethernet PIC with CFP (TI600 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 PIC0 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.
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 671, “Configuring MAC Address Filtering” on page 676, and “Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview” on page 691.

   ![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.

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.2</td>
<td>Starting with Junos OS Release 13.2, aggregated Ethernet supports mixed rates and mixed modes on 100-Gigabit Ethernet PIC.</td>
</tr>
</tbody>
</table>

   Related Documentation
   • 100-Gigabit Ethernet Type 4 PIC with CFP Overview on page 459
   • Configuring Gigabit Ethernet Policers on page 671
   • Configuring MAC Address Filtering on page 676
   • Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview on page 691

   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 steering 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 1322
- sa-multicast (100-Gigabit Ethernet) on page 1513
- vlan-rule (100-Gigabit Ethernet Type 4 PIC with CFP) on page 1616
- vlan-steering (100-Gigabit Ethernet Type 4 PIC with CFP) on page 1617

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-1CGE-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 671, “Configuring MAC Address Filtering” on page 676, and “Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview” on page 691.

• 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 38 on page 470 lists the capabilities of 100-Gigabit Ethernet Type 5 PIC with CFP.

Table 38: Capabilities of 100-Gigabit Ethernet Type 5 PIC with CFP

<table>
<thead>
<tr>
<th>Capability</th>
<th>Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum logical interfaces per PIC</td>
<td>4093</td>
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<tr>
<td>Maximum logical interfaces per port</td>
<td>For IPv4 the limit is 4093.</td>
</tr>
<tr>
<td></td>
<td>For IPv6 the limit is 1022.</td>
</tr>
</tbody>
</table>

Related Documentation

• Configuring 100-Gigabit Ethernet Type 4 PIC With CFP on page 462
• Configuring Gigabit Ethernet Policers on page 671
• Configuring MAC Address Filtering on page 676
• Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview on page 691
**100-Gigabit Ethernet Interfaces Interoperability**

Juniper Networks Junos operating system (Junos OS) supports a variety of 100-Gigabit Ethernet interfaces. The 100-Gigabit Ethernet standard, introduced by IEEE 802.3ba-2010, enables transmission of Ethernet frames at the rate of 100 gigabits per second (Gbps). It is used for very high speed transmission of voice and data signals across the numerous world-wide fiber-optic networks.

Interface interoperability refers to the ability of an interface to interoperate with other router interfaces. You can enable interoperability between different 100-Gigabit Ethernet interfaces by performing specific configuration tasks. The following sections list the 100-Gigabit Ethernet interfaces, corresponding interoperable interfaces, and links to the interoperability tasks and reference information.

- Interoperability of the MIC-3D-1X100GE-CFP MIC with PICs on Other Routers on page 471
- Interoperability of the MPC4E-3D-2CGE-8XGE MPC with PICs on Other Routers on page 471
- Interoperability of the P1-PTX-2-100GE-CFP PIC with PICs on Other Routers on page 471
- Interoperability of the PD-1CE-CFP-FPC4 PIC with PICs or MICs on Other Routers on page 472

**Interoperability of the MIC-3D-1X100GE-CFP MIC with PICs on Other Routers**

Table 39 on page 471 lists the interoperability with the 100-Gigabit Ethernet MIC with CFP.

*Table 39: 100-Gigabit Ethernet MIC with CFP (MIC3-3D-1X100GE-CFP) Interoperability*

<table>
<thead>
<tr>
<th>Interoperates with...</th>
<th>For More Information...</th>
</tr>
</thead>
<tbody>
<tr>
<td>T Series</td>
<td>100-Gigabit Ethernet PIC with CFP (Type 4) (PD-ICE-CFP-FPC4)</td>
</tr>
</tbody>
</table>

**Interoperability of the MPC4E-3D-2CGE-8XGE MPC with PICs on Other Routers**

Table 40 on page 471 lists the interoperability with the MPC4E.

*Table 40: MPC4E Interoperability*

<table>
<thead>
<tr>
<th>Interoperates with...</th>
<th>For More Information...</th>
</tr>
</thead>
<tbody>
<tr>
<td>T Series</td>
<td>100-Gigabit Ethernet PIC with CFP (Type 4) (PD-1CECFP-FPC4)</td>
</tr>
</tbody>
</table>

**Interoperability of the P1-PTX-2-100GE-CFP PIC with PICs on Other Routers**

Table 41 on page 472 lists the interoperability with 100-Gigabit Ethernet PIC with CFP (Type 5).
### Table 41: 100-Gigabit Ethernet PIC with CFP (Type 5) (P1-PTX-2-100GE-CFP) Interoperability

<table>
<thead>
<tr>
<th>Interoperates with…</th>
<th>For More Information…</th>
</tr>
</thead>
<tbody>
<tr>
<td>T Series</td>
<td>100-Gigabit Ethernet PIC with CFP (Type 4) (PD-1CE-CFP-FPC4)</td>
</tr>
</tbody>
</table>

“Interoperability Between the 100-Gigabit Ethernet PICs PD-ICE-CFP-FPC4 and P1-PTX-2-100GE-CFP” on page 474

“Configuring the Interoperability Between the 100-Gigabit Ethernet PICs P1-PTX-2-100GE-CFP and PD-ICE-CFP-FPC4” on page 478

---

### Interoperability of the PD-ICE-CFP-FPC4 PIC with PICs or MICs on Other Routers

Table 42 on page 472 lists the 100-Gigabit Ethernet PIC with CFP (Type 4).

### Table 42: 100-Gigabit Ethernet PIC with CFP (Type 4) PD-ICE-CFP-FPC4 Interoperability

<table>
<thead>
<tr>
<th>Interoperates with…</th>
<th>For More Information…</th>
</tr>
</thead>
<tbody>
<tr>
<td>T Series</td>
<td>100-Gigabit Ethernet PIC with CFP (Type 5) (PF-1CGE-CFP)</td>
</tr>
</tbody>
</table>

“Configuring the Interoperability Between the 100-Gigabit Ethernet PICs PF-1CGE-CFP and PD-ICE-CFP-FPC4” on page 475

forwarding-mode

sa-multicast

| MX Series            | 100-Gigabit Ethernet MIC with CFP (MIC3-3D-1X100GE-CFP) |

Configuring 100-Gigabit Ethernet MICs to Interoperate with Type 4 100-Gigabit Ethernet PICs (PD-ICE-CFP-FPC4) Using SA Multicast Mode

| PTX Series           | 100-Gigabit Ethernet PIC with CFP (Type 5) (P1-PTX-2-100GE-CFP) |

“Interoperability Between the 100-Gigabit Ethernet PICs PD-ICE-CFP-FPC4 and P1-PTX-2-100GE-CFP” on page 474

“Configuring the Interoperability Between the 100-Gigabit Ethernet PICs P1-PTX-2-100GE-CFP and PD-ICE-CFP-FPC4” on page 478

<table>
<thead>
<tr>
<th>Related Documentation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Configuring the Interoperability Between the 100-Gigabit Ethernet PICs PF-1CGE-CFP and PD-ICE-CFP-FPC4 on page 475</td>
<td></td>
</tr>
<tr>
<td>• Configuring the Interoperability Between the 100-Gigabit Ethernet PICs P1-PTX-2-100GE-CFP and PD-ICE-CFP-FPC4 on page 478</td>
<td></td>
</tr>
<tr>
<td>• Configuring MPC4E (MPC4E-3D-2CGE-8XGE) to Interoperate with 100-Gigabit Ethernet PICs on Type 4 FPC Using SA Multicast Mode</td>
<td></td>
</tr>
<tr>
<td>• Configuring 100-Gigabit Ethernet MICs to Interoperate with Type 4 100-Gigabit Ethernet PICs (PD-ICE-CFP-FPC4) Using SA Multicast Mode</td>
<td></td>
</tr>
</tbody>
</table>
You can enable interoperability between the 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and PF-1CGE-CFP by:

- Enabling source address (SA) multicast bit steering mode on the 100-Gigabit Ethernet PIC PF-1CGE-CFP.
- Configuring the two 50-Gigabit Ethernet physical interfaces on the 100-Gigabit Ethernet PIC PD-1CE-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 Gpbs 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.
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-ICE-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-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 the 100-Gigabit Ethernet PIC 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 P1-PTX-2-100GE-CFP.

On the 100-Gigabit Ethernet PIC PD-1CE-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-1CE-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 478
- sa-multicast on page 1514
- Interoperability Between the 100-Gigabit Ethernet PICs PD-ICE-CFP-FPC4 and PF-1CGE-CFP on page 473

Configuring the Interoperability Between the 100-Gigabit Ethernet PICs PF-1CGE-CFP and PD-ICE-CFP-FPC4

You can enable interoperability between the 100-Gigabit Ethernet PICs PD-ICE-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 475
- Configuring Two 50-Gigabit Ethernet Physical Interfaces on the 100-Gigabit Ethernet PIC PD-ICE-CFP-FPC4 as One Aggregated Ethernet Interface on page 476

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-ICE-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 operation mode (SA multicast bit steering mode).
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.

See Also
- Interoperability Between the 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and PF-1CGE-CFP on page 473
- 100-Gigabit Ethernet PIC with CFP (T1600 Router)
- 100-Gigabit Ethernet PIC with CFP (T4000 Router)

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 PI-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 PI-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.
For example:

```
[edit chassis]
user@host# set aggregated devices ethernet device-count count
```

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;
  }
}
```

See Also
- Configuring Junos OS for Supporting Aggregated Devices on page 133
- 802.3ad on page 1205
Related Documentation
• Interoperability Between the 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and PF-1CE-CFP on page 473
  • 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-1CE-CFP-FPC4

You can enable interoperability between the 100-Gigabit Ethernet PICs PD-1CE-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 478
• Configuring Two 50-Gigabit Ethernet Physical Interfaces on the 100-Gigabit Ethernet PIC PD-1CE-CFP-FPC4 as One Aggregated Ethernet Interface on page 479

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-1CE-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-1CE-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 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 PIDs 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;
    }
}
```

See Also
- Configuring Junos OS for Supporting Aggregated Devices on page 133
- 802.3ad on page 1205

Related Documentation
- Interoperability Between the 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and P1-PTX-2-100GE-CFP on page 474
- sa-multicast on page 1514
- Interoperability Between the 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and PF-1CGE-CFP on page 473
CHAPTER 27

Configuring Rate Selectability

- Understanding Rate Selectability on page 482
- Guidelines for Configuring Rate Selectability on page 486
- Understanding Interface Naming Convention for MPC7E-MRATE on page 487
- Understanding Interface Naming Conventions for MIC-MRATE on page 488
- Understanding Interface Naming Conventions for MX10003 MPC on page 492
- Understanding Interface Naming Conventions for JNP10K-LC2101 on page 493
- Understanding Interface Naming Conventions for MPC10E-15C-MRATE on page 495
- Supported Active Physical Ports for Configuring Rate Selectability to Prevent Oversubscription on page 497
- Supported Active Physical Ports for Configuring Rate Selectability to Prevent Oversubscription on MX10003 MPC on page 500
- Supported Active Physical Rate-Selectable Ports to Prevent Oversubscription on MX204 Router on page 502
- Supported Active Physical Ports for Rate Selectability to Prevent Oversubscription on MPC10E-15C-MRATE on page 505
- Configuring Rate Selectability on MIC-MRATE to Enable Different Port Speeds on page 507
- Configuring Rate Selectability on MPC7E (Multi-Rate) to Enable Different Port Speeds on page 511
- MX10003 MPC Rate-Selectability Overview on page 516
- MX204 Router Rate-Selectability Overview on page 521
- MPC10E-15C-MRATE Rate-Selectability Overview on page 528
- Configuring Rate Selectability on MX10003 MPC to Enable Different Port Speeds on page 531
- Configuring Rate Selectability on MX204 to Enable Different Port Speeds on page 534
- Configuring Rate Selectability on JNP10K-2101 MPC to Enable Different Port Speeds on page 538
- Configuring Rate Selectability on MPC10E-15C-MRATE to Enable Different Port Speeds on page 542
- Understanding Interface Naming Conventions for MIC-MACSEC-20GE on page 545
Understanding Rate Selectability

The maximum amount of data that can be transmitted through a port at any given second either by a network device or by a component of the network device (such as a line card) is known as the port speed. Port speed is measured in kilobits per second (Kbps), gigabits per second (Gbps), and terabits per second (Tbps). If a port can be configured to multiple speeds, the port is known as a rate-selectable port. Because the port is part of a network device (router or switch) or a network component (such as MPC, MIC) the component is known as a rate-selectable component. For instance, if a Modular Port Concentrator (MPC) supports multiple speeds, it is known as a rate-selectable MPC. If a Modular Interface Card (MIC) supports multiple speeds, it is known as a rate-selectable MIC. The term multi-rate in the name of a component also indicates support for more than one speed.

Rate selectability enables you to configure the port speed either at the port level or at the PIC or MIC level. To configure all ports to operate at the same speed, you configure rate selectability at the MIC or PIC level. To configure different port speeds for each port, you configure rate selectability at the port level, in which case only the ports that are configured are enabled.

When you configure rate selectability at the MIC or PIC level, all the ports of the MIC or PIC that support the configured speed operate at that speed. To prevent switch fabric interface oversubscription—for example, with the Switch Fabric Board SFB or SFB2—and to ensure a guaranteed bandwidth, you can specify the number of active ports that operate at the configured speed. For instance, on a router with SFB, if you want only eight ports of the MIC to operate at 40 Gbps, you can configure the MIC to operate at 40 Gbps and enable the eight ports that you want to operate at that speed. The remaining ports of the MIC are automatically disabled. For example, on MPC8E with MIC-MRATE, you can configure four 100-Gigabit Ethernet interfaces and two 40-Gigabit Ethernet interfaces per MIC. All other interfaces are automatically disabled. Configuring rate selectability at the MIC level helps you configure the operating speed of the MIC easily.

NOTE: The total port speed of the MIC cannot exceed the forwarding capacity of the Packet Forwarding Engine.

Configuring rate selectability at the port level provides you the flexibility of operating the ports of the MIC at different supported speeds. For example, you can configure four 10-Gigabit Ethernet interfaces on port 0, one 40-Gigabit Ethernet interface on port 1, and one 100-Gigabit Ethernet interface on port 2.
NOTE: When you configure rate selectability at the port level, ensure that you plug in transceivers to the ports according to the speeds that you configure. For instance, use 4x duplex LC breakout transceivers to configure 10-Gigabit Ethernet interfaces, fiber-optic 40-gigabit QSFP+ transceivers to configure 40-Gigabit Ethernet interfaces, and fiber-optic 100-gigabit QSFP28 transceivers to configure 100-Gigabit Ethernet interfaces.

Rate Selectability on MPC7E-MRATE

MPC7E (MPC7E-MRATE) is a fixed-configuration MPC and is supported on MX240, MX480, MX960, MX2010, and MX2020 routers. MPC7E-MRATE contains two built-in PICs, PIC 0 and PIC 1. Each PIC has six physical ports that support quad small form-factor pluggable plus (QSFP+) transceivers. The default port speed is 10 Gbps for all ports. Each of the six ports of PIC 0 and PIC 1 supports speeds of 10 Gbps and 40 Gbps. However, only ports 2 and 5 on both the PICs support 100 Gbps speed.

MPC7E-MRATE has an aggregate forwarding capacity of 480 Gbps and a forwarding capacity of 240 Gbps on each Packet Forwarding Engine. Oversubscription of Packet Forwarding Engine capacity is not supported. The demand on each Packet Forwarding Engine must be less than or equal to its forwarding capacity. For instance, for MPC7E-MRATE, the demand on each Packet Forwarding Engine must be less than or equal to 240 Gbps.

For information about the naming conventions for interfaces on MPC7E-MRATE MPC, see “Understanding Interface Naming Convention for MPC7E-MRATE” on page 487.

Rate Selectability on MIC-MRATE

MPC8E (MX2K-MPC8E) and MPC9E (MX2K-MPC9E) support two separate slots for MICs as field replaceable units (FRUs). Each of the MIC slots supports only one MIC–MIC-MRATE. MIC-MRATE consists of 12 physical ports that support QSFP+ transceivers and multiple port speeds of 100 Gbps, 40 Gbps, and 10 Gbps. You can configure a port to operate in a specific speed based on your requirement. The default port speed is 10 Gbps for all ports. MIC-MRATE also supports breakout transceivers, which you can use to split a 40-Gigabit Ethernet port into four 10-Gigabit Ethernet ports. MIC-MRATE ports can be split into a maximum of 48 10-Gigabit Ethernet interfaces.

MPC8E has an aggregate forwarding capacity of 960 Gbps and a forwarding capacity of 240 Gbps on each Packet Forwarding Engine. MPC9E has an aggregate forwarding capacity of 1600 Gbps and a forwarding capacity of 400 Gbps on each Packet Forwarding Engine. Oversubscription of Packet Forwarding Engine capacity is not supported. The demand on each Packet Forwarding Engine must be less than or equal to its forwarding capacity. For instance, for MPC8E, the demand on each Packet Forwarding Engine must be less than or equal to 240 Gbps and for MPC9E, the demand per Packet Forwarding Engine must be less than or equal to 400 Gbps.

On MPC8E with MIC-MRATE, you can configure four 100-Gigabit Ethernet interfaces and two 40-Gigabit Ethernet interfaces per MIC. All other interfaces are automatically disabled. On MPC9E with MIC-MRATE, you can configure eight ports as 100-Gigabit Ethernet
interfaces and the other ports can be configured only as 40-Gigabit Ethernet Interfaces or 10-Gigabit Ethernet interfaces.

For information about the naming conventions for interfaces on MPC8E and MPC9E, see “Understanding Interface Naming Conventions for MIC-MRATE” on page 488.

Rate Selectability on JNP10K-LC2101

JNP10K-LC2101 is a fixed-configuration MPC and is supported on MX10008 routers. JNP10K-LC2101 contains six built-in PICs, PIC 0 to PIC 5. Each PIC has four physical ports that support quad small form-factor pluggable plus (QSFP+) transceivers. The default port speed is 10 Gbps for all ports. Each of the four ports of PIC 0 to PIC 5 supports speeds of 10 Gbps (using breakout cables), 40 Gbps, and 100 Gbps.

MX10008 routers support eight JNP10K-LC2101 MPCs. By default, each JNP10K-LC2101 MPC provides a maximum bandwidth of 1.44 Tbps. JNP10K-LC2101 has six Packet Forwarding Engines, each providing a maximum bandwidth of up to 240 Gbps, which cannot be oversubscribed. You can configure JNP10K-LC2101 to provide an increased bandwidth of 2.4 Tbps. The demand on each Packet Forwarding Engine must be less than or equal to its forwarding capacity. For instance, by default, for JNP10K-LC2101, the demand on each Packet Forwarding Engine must be less than or equal to 240 Gbps. However, if you have configured JNP10K-LC2101 to provide an increased bandwidth of 2.4 Tbps, the demand on each Packet Forwarding Engine must be less than or equal to 480 Gbps.

For information about the naming conventions for interfaces on JNP10K-LC2101 MPC, see “Understanding Interface Naming Conventions for JNP10K-LC2101” on page 493.

Rate Selectability on MIC-MACSEC-20GE

The MIC-MACSEC-20GE MIC provides 128-bit and 256-bit MACsec encryption on all the twenty 1GE and on the two 10GE ports in the following hardware configuration:

- Installed directly on the MX80 and MX104 routers
- Installed on MPC1, MPC2, MPC3, MPC2E, MPC3E, MPC2E-NG, and MPC3E-NG line cards on the MX240, MX480, and MX960 routers

By default, 128-bit MACsec encryption is supported.

The twenty 1-Gigabit Ethernet SFP ports distribute the ports across PIC0 and PIC1, that are logical PICs on the physical MIC. The two 10-Gigabit Ethernet SFP+ ports are physically located on PIC1. But, the 10-Gigabit interfaces are created by distributing the ports in either of the PICs. For information about the naming conventions for interfaces on MIC-MACSEC-20GE, see “Understanding Interface Naming Conventions for MIC-MACSEC-20GE” on page 545.
NOTE:

- When the pic-mode is changed from 1-Gbps to 10-Gbps or vice versa, the Flexible PIC Concentrator (FPC) in MX240, MX480, MX960 routers and the Forwarding Engine Board (FEB) in MX80, MX104 routers undergoes an automatic bounce or reboot.

- When the MIC-MACSEC-20GE is operating in the 10-Gbps mode, all the other 1-Gbps ports are disabled.

**Rate Selectability on MPC10E-15C-MRATE**

MPC10E-15C-MRATE (15x100G) is a fixed-configuration MPC for MX240, MX480, and MX960 routers, that is capable of delivering up to 1.5T per-slot bandwidth. It consists of three PFE complexes per MPC and each PFE is capable of delivering up to 500G throughput. It supports three PICs per MPC, one PIC per PFE. Each PIC hosts five QSFP28 (5xQSFP28) ports that supports 4x10-Gbps, 40-Gbps, and 100-Gbps speeds using QSFP+, QSFP28+ optics types. The 4x10-Gbps speed is supported using breakout cables. The MPC10E-15C-MRATE MPC can be plugged into the MX240, MX480, and MX960 routers only. MPC10E-15C-MRATE is not supported on the MX2000 or the MX10000 lines of routers.

For information about the naming conventions for interfaces on MPC10E-15C-MRATE, see “Understanding Interface Naming Conventions for MPC10E-15C-MRATE MPC” on page 495.

**Related Documentation**

- Configuring Rate Selectability on MPC7E (Multi-Rate) to Enable Different Port Speeds on page 511
- Configuring Rate Selectability on MIC-MRATE to Enable Different Port Speeds on page 507
- Guidelines for Configuring Rate Selectability on page 486
- Supported Active Physical Ports for Configuring Rate Selectability to Prevent Oversubscription on page 497
- Understanding Interface Naming Conventions for MIC-MRATE on page 488
- Understanding Rate Selectability on page 482
- MPC10E-15C-MRATE Rate-Selectability Overview on page 528
- Supported Active Physical Ports for Rate Selectability to Prevent Oversubscription on MPC10E-15C-MRATE on page 505
- Configuring Rate Selectability on MPC10E-15C-MRATE to Enable Different Port Speeds on page 542
Guidelines for Configuring Rate Selectability

This topic describes the guidelines to consider when configuring rate selectability at the port level or the PIC or MIC level.

- If rate selectability is not configured, all ports of the MIC-MRATE MIC and MPC7E-MRATE MPC operate as four 10-Gigabit Ethernet interfaces by default. Therefore, when booting the MPC:
  - If rate selectability is not configured or if invalid port speeds are configured, an alarm is generated to indicate that the configuration is invalid. All the ports operate as four 10-Gigabit Ethernet interfaces.
  - If valid port speeds are configured, the PIC and MIC operate at the configured speed.
- When you change an existing port speed configuration at the port level, you must reset the MPC7E-MRATE PIC for the configuration to take effect.

Similarly, when you change an existing port speed configuration at the port level for MPC8E or MPC9E, you must reset the MIC for the configuration to take effect. You can use the `request chassis mic mic-slot mic-slot-number fpc-slot fpc-slot-number (offline | online)` command to reset the MIC and apply your configuration changes.

An alarm is generated indicating the change in port speed configuration.
- When you change an existing port speed configuration with an invalid port speed configuration, an alarm is generated indicating that the port speed configuration is invalid. For example, on the MPC7E-MRATE, if you configure the port speed of port 3 as 100 Gbps, it is an invalid configuration. MPC7E-MRATE supports 100 Gbps only on ports 2 and 5. The MPC continues to operate using the existing port speed configuration or the default port speed.
  - You cannot configure rate selectability at the PIC level and the port level simultaneously. Error messages are displayed when you try to commit such configurations.
  - When you configure rate selectability at the port level, only the configured ports are enabled. Other ports are disabled.

Guidelines for Configuring Rate Selectability for JNP10K-LC2101

This topic describes the guidelines to consider when configuring rate selectability at the port level or the PIC level for JNP10K-LC2101:

- Each port on the JNP10K-LC2101 MPC supports speeds of 10 Gbps (using breakout cables), 40 Gbps, and 100 Gbps. However, JNP10K-LC2101 MPC does not support bandwidth oversubscription. So, when you configure the ports on all PICs, ensure that the demand on each Packet Forwarding Engine is less than or equal to its forwarding capacity. The default port speed for all PICs is 10G.
- When you change an existing port speed configuration at the port level, you must reset the PIC for the configuration to take effect. When you change an existing port speed configuration at the PIC level, the JNP10K-LC2101 automatically resets the PIC.
When you change the number of active ports using the `number-of-ports` command, you must reset the PIC for the configuration to take effect. Interfaces are created only for active ports. Only the ports you configure are known as the active ports. The number of active ports enables you to handle bandwidth oversubscription.

**NOTE:** You cannot configure the number of active ports at the port level. If you attempt to configure the number of active ports at the port level, an error message is displayed.

- You cannot configure rate selectability at the PIC level and the port level simultaneously. Error messages are displayed when you try to commit such configurations.
- When you change an existing port speed configuration with an *invalid* port speed configuration, an alarm is generated indicating that the port speed configuration is invalid. The MPC continues to operate using the existing port speed configuration or the default port speed.

### Related Documentation
- Configuring Rate Selectability on MPC7E (Multi-Rate) to Enable Different Port Speeds on page 511
- Configuring Rate Selectability on MIC-MRATE to Enable Different Port Speeds on page 507
- Understanding Rate Selectability on page 482

### Understanding Interface Naming Convention for MPC7E-MRATE

MPC7E (MPC7E-MRATE) is a fixed-configuration MPC and contains two built-in PICs, PIC 0 and PIC 1. Each of the six ports of PIC 0 and PIC 1 support multiple port speeds of 100 Gbps, 40 Gbps, and 10 Gbps and can be configured as 10-Gigabit Ethernet and 40-Gigabit Ethernet interfaces. However, you can configure only ports 2 and 5 on both the PICs as 100-Gigabit Ethernet interfaces.

MPC7E-MRATE has an aggregate forwarding capacity of 480 Gbps and a forwarding capacity of 240 Gbps on each Packet Forwarding Engine. Oversubscription of Packet Forwarding Engine capacity is not supported. The demand on each Packet Forwarding Engine must be less than or equal to its forwarding capacity. For instance, for MPC7E-MRATE, the demand on each Packet Forwarding Engine must be less than or equal to 240 Gbps.

The 40-Gigabit Ethernet and 100-Gigabit Ethernet interfaces configured on the MPC7E-MRATE MPC follow the naming convention `et-fpc-slot/pic-slot/port-number`. The 10-Gigabit Ethernet interfaces configured on the MPC7E-MRATE MPC follow the naming convention `xe-fpc-slot/pic-slot/port-number:[logical-port-number].`

For example, `et-0/0/2` indicates either a 40-Gigabit Ethernet or a 100-Gigabit Ethernet interface configured on port 2 of PIC 0 of the MPC7E-MRATE MPC that is installed in the MPC slot 0. `xe-0/0/1:3` indicates a 10-Gigabit Ethernet interface configured on logical port 3 of physical port 1 of the MPC7E-MRATE MPC that is installed in the MPC slot 0.
Table 43 on page 488 lists the naming conventions for interfaces on MPC7E-MRATE for MX240, MX480, MX960, MX2010, and MX2020 routers.

Table 43: Interface Naming Convention for MPC7E-MRATE

<table>
<thead>
<tr>
<th>Packet Forwarding Engine</th>
<th>10-Gigabit Ethernet Interface</th>
<th>40-Gigabit Ethernet Interface</th>
<th>100-Gigabit Ethernet Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>xe-x/0/0/[0-3]</td>
<td>et-x/0/0</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/1:[0-3]</td>
<td>et-x/0/1</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/2:[0-3]</td>
<td>et-x/0/2</td>
<td>et-x/0/2</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/3:[0-3]</td>
<td>et-x/0/3</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/4:[0-3]</td>
<td>et-x/0/4</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/5:[0-3]</td>
<td>et-x/0/5</td>
<td>et-x/0/5</td>
</tr>
<tr>
<td>1</td>
<td>xe-x/1/0/[0-3]</td>
<td>et-x/1/0</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/1:[0-3]</td>
<td>et-x/1/1</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/2:[0-3]</td>
<td>et-x/1/2</td>
<td>et-x/1/2</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/3:[0-3]</td>
<td>et-x/1/3</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/4:[0-3]</td>
<td>et-x/1/4</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/5:[0-3]</td>
<td>et-x/1/5</td>
<td>et-x/1/5</td>
</tr>
</tbody>
</table>

Related Documentation
- Configuring Rate Selectability on MPC7E (Multi-Rate) to Enable Different Port Speeds on page 511
- Supported Active Physical Ports for Configuring Rate Selectability to Prevent Oversubscription on page 497
- Understanding Rate Selectability on page 482

Understanding Interface Naming Conventions for MIC-MRATE

MIC-MRATE consists of twelve ports that support multiple port speeds of 100 Gbps, 40 Gbps, and 10 Gbps. MIC-MRATE is supported on MPC8E (MX2K-MPC8E) and MPC9E (MX2K-MPC9E) on MX2000 line of routers.

Starting with Junos OS Release 17.3R1, MIC-MRATE is supported on MX10003 MPC on MX10003 routers.
NOTE: By default, the MIC-MRATE ports are configured as 10-Gigabit Ethernet ports.

MPC8E has a forwarding capacity of 240 Gbps for each Packet Forwarding Engine. In Junos OS Release 16.1R1 and later, you can upgrade MPC8E to provide an increased bandwidth of 1600 Gbps (1.6 Tbps), by using an add-on license. After you configure the bandwidth 1.6T statement, MPC8E provides an increased bandwidth of 1.6 Tbps. The forwarding capacity is increased to 400 Gbps for each Packet Forwarding Engine.

MPC9E has a forwarding capacity of 400 Gbps for each Packet Forwarding Engine. Packet Forwarding Engine oversubscription is not supported. So, demand on each Packet Forwarding Engine should be less than or equal to its forwarding capacity. For MPC8E, demand on each Packet Forwarding Engine should be less than or equal to 240 Gbps and for MPC9E, demand on each Packet Forwarding Engine should be less than or equal to 400 Gbps.

NOTE: On MPC8E with MIC-MRATE, you can configure four ports as 100-Gigabit Ethernet interfaces. On MPC9E with MIC-MRATE and on MPC8E configured to operate at 1.6 Tbps by using an add-on license, you can configure eight ports as 100-Gigabit Ethernet interfaces.

The 40-Gigabit Ethernet and 100-Gigabit Ethernet interfaces configured on the MIC-MRATE MIC follow thenaming convention et-fpc-slot/pic-slot/port-number. The 10-Gigabit Ethernet interfaces configured on the MIC-MRATE MIC follow the naming convention xe-fpc-slot/pic-slot/port-number:logical-port-number.

For example, xe-0/0/0:3 indicates a 10-Gigabit Ethernet interface configured on logical port 3 of physical port 1 of the MIC-MRATE MIC that is installed in the MPC slot 0. The interface name et-0/0/2 indicates either a 40-Gigabit Ethernet interface or a 100-Gigabit Ethernet interface configured on port 2 of MIC-MRATE MIC that is installed in the MPC slot 0.

Table 44 on page 490 lists the naming conventions used for interfaces on MIC-MRATE when installed on slot 0 of MPC8E and MPC9E. Table 45 on page 490 lists the naming conventions used for interfaces on MIC-MRATE when installed on slot 1 of MPC8E and MPC9E. MPC8E and MPC9E support two MIC-MRATE MICs each.

NOTE: The x in et-x/0/0 and xe-x/0/0:[0-3] refers to the MPC slot number.
### Table 44: Interface Naming Convention for MIC-MRATE Installed on Slot 0 of MPC8E and MPC9E

<table>
<thead>
<tr>
<th>Packet Forwarding Engine</th>
<th>10-Gigabit Ethernet Interface</th>
<th>40-Gigabit Ethernet Interface</th>
<th>100-Gigabit Ethernet Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>xe-x/0/0/[0-3]</td>
<td>et-x/0/0</td>
<td>et-x/0/0</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/1/[0-3]</td>
<td>et-x/0/1</td>
<td>et-x/0/1</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/2/[0-3]</td>
<td>et-x/0/2</td>
<td>et-x/0/2</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/3/[0-3]</td>
<td>et-x/0/3</td>
<td>et-x/0/3</td>
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<tr>
<td></td>
<td>xe-x/0/4/[0-3]</td>
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<td>-</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/5/[0-3]</td>
<td>et-x/0/5</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>xe-x/0/6/[0-3]</td>
<td>et-x/0/6</td>
<td>et-x/0/6</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/7/[0-3]</td>
<td>et-x/0/7</td>
<td>et-x/0/7</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/8/[0-3]</td>
<td>et-x/0/8</td>
<td>et-x/0/8</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/9/[0-3]</td>
<td>et-x/0/9</td>
<td>et-x/0/9</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/10/[0-3]</td>
<td>et-x/0/10</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/11/[0-3]</td>
<td>et-x/0/11</td>
<td>-</td>
</tr>
</tbody>
</table>

### Table 45: Interface Naming Convention for MIC-MRATE Installed on Slot 1 of MPC8E and MPC9E

<table>
<thead>
<tr>
<th>Packet Forwarding Engine</th>
<th>10-Gigabit Ethernet Interface</th>
<th>40-Gigabit Ethernet Interface</th>
<th>100-Gigabit Ethernet Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>xe-x/1/0/[0-3]</td>
<td>et-x/1/0</td>
<td>et-x/1/0</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/1/[0-3]</td>
<td>et-x/1/1</td>
<td>et-x/1/1</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/2/[0-3]</td>
<td>et-x/1/2</td>
<td>et-x/1/2</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/3/[0-3]</td>
<td>et-x/1/3</td>
<td>et-x/1/3</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/4/[0-3]</td>
<td>et-x/1/4</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/5/[0-3]</td>
<td>et-x/1/5</td>
<td>-</td>
</tr>
</tbody>
</table>
Table 45: Interface Naming Convention for MIC-MRATE Installed on Slot 1 of MPC8E and MPC9E (continued)

<table>
<thead>
<tr>
<th>Packet Forwarding Engine</th>
<th>10-Gigabit Ethernet Interface</th>
<th>40-Gigabit Ethernet Interface</th>
<th>100-Gigabit Ethernet Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>xe-x/1/6:[0-3]</td>
<td>et-x/1/6</td>
<td>et-x/1/6</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/7:[0-3]</td>
<td>et-x/1/7</td>
<td>et-x/1/7</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/8:[0-3]</td>
<td>et-x/1/8</td>
<td>et-x/1/8</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/9:[0-3]</td>
<td>et-x/1/9</td>
<td>et-x/1/9</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/10:[0-3]</td>
<td>et-x/1/10</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/11:[0-3]</td>
<td>et-x/1/11</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 46 on page 491 lists the naming conventions used for interfaces on MIC-MRATE when installed on slot 0 of MX10003 MPC.

Table 46: Interface Naming Convention for MIC-MRATE Installed on Slot 0 of Mx10003MPC

<table>
<thead>
<tr>
<th>Packet Forwarding Engine</th>
<th>10-Gigabit Ethernet Interface</th>
<th>40-Gigabit Ethernet Interface</th>
<th>100-Gigabit Ethernet Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>xe-x/0/0:[0-3]</td>
<td>et-x/0/0</td>
<td>et-x/0/0</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/1:[0-3]</td>
<td>et-x/0/1</td>
<td>et-x/0/1</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/2:[0-3]</td>
<td>et-x/0/2</td>
<td>et-x/0/2</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/3:[0-3]</td>
<td>et-x/0/3</td>
<td>et-x/0/3</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/4:[0-3]</td>
<td>et-x/0/4</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/5:[0-3]</td>
<td>et-x/0/5</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>xe-x/0/6:[0-3]</td>
<td>et-x/0/6</td>
<td>et-x/0/6</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/7:[0-3]</td>
<td>et-x/0/7</td>
<td>et-x/0/7</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/8:[0-3]</td>
<td>et-x/0/8</td>
<td>et-x/0/8</td>
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<tr>
<td></td>
<td>xe-x/0/9:[0-3]</td>
<td>et-x/0/9</td>
<td>et-x/0/9</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/10:[0-3]</td>
<td>et-x/0/10</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/11:[0-3]</td>
<td>et-x/0/11</td>
<td>-</td>
</tr>
</tbody>
</table>
The MX10003 MPC supports a Multi-Rate 12xQSFP28 Ethernet MIC (model numbers: JNP-MIC1 and JNP-MIC1-MACSEC) and the fixed-port PIC (6xQSFP).

Each of the 6 ports of the PIC supports 10-Gigabit Ethernet and 40-Gigabit Ethernet interfaces. Each of the 12 ports of the modular MIC supports 10-Gigabit Ethernet, 40-Gigabit Ethernet, and 100-Gigabit Ethernet interfaces. All the ports of the modular MIC can be configured as 100-Gigabit Ethernet interfaces.

The 40-Gigabit Ethernet and 100-Gigabit Ethernet interfaces configured on the MX10003 MPC follow the naming convention \texttt{et-fpc-slot/pic-slot/port-number}. The 10-Gigabit Ethernet interfaces follow the naming convention \texttt{xe-fpc-slot/pic-slot/port-number:[logical-port-number]}.

For example, \texttt{xe-0/0/1:3} indicates a 10-Gigabit Ethernet interface configured on logical port 3 of physical port 1 of the modular MIC that is installed in the MPC slot 1. The interface name \texttt{et-0/0/2} indicates either a 40-Gigabit Ethernet interface or a 100-Gigabit Ethernet interface configured on port 2 of modular MIC that is installed in the MPC slot 1.

Table 47 on page 492 lists the naming conventions used for interfaces on the fixed-port PIC when installed in slot 1 of the MX10003 MPC. Table 48 on page 493 lists the naming conventions used for interfaces on the modular MIC when installed in slot 1 of the MPC.

\textbf{NOTE:} The \textit{x} in \texttt{et-x/0/0} and \texttt{xe-x/0/0:[0-3]} refers to the MPC slot number.

\begin{table}[h]
\centering
\caption{Interface Naming Convention for the Fixed-Port PIC Installed in Slot 1 of MX10003 MPC}
\begin{tabular}{|c|c|c|c|}
\hline
Packet & 10-Gigabit Ethernet Interface & 40-Gigabit Ethernet Interface & 100-Gigabit Ethernet Interface \\
Forwarding Engine & & & \\
\hline
0 & \texttt{xe-x/0/0:[0-3]} & \texttt{et-x/0/0} & -- \\
 & \texttt{xe-x/0/1:[0-3]} & \texttt{et-x/0/1} & -- \\
1 & \texttt{xe-x/0/2:[0-3]} & \texttt{et-x/0/2} & -- \\
 & \texttt{xe-x/0/3:[0-3]} & \texttt{et-x/0/3} & -- \\
2 & \texttt{xe-x/0/4:[0-3]} & \texttt{et-x/0/4} & -- \\
 & \texttt{xe-x/0/5:[0-3]} & \texttt{et-x/0/5} & -- \\
\hline
\end{tabular}
\end{table}
Table 48: Interface Naming Convention for Modular MIC Installed in Slot 1 of MX10003 MPC

<table>
<thead>
<tr>
<th>Packet Forwarding Engine</th>
<th>10-Gigabit Ethernet Interface</th>
<th>40-Gigabit Ethernet Interface</th>
<th>100-Gigabit Ethernet Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>xe-x/1/0:[0-3]</td>
<td>et-x/1/0</td>
<td>et-x/1/0</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/1:[0-3]</td>
<td>et-x/1/1</td>
<td>et-x/1/1</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/2:[0-3]</td>
<td>et-x/1/2</td>
<td>et-x/1/2</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/3:[0-3]</td>
<td>et-x/1/3</td>
<td>et-x/1/3</td>
</tr>
<tr>
<td>1</td>
<td>xe-x/1/4:[0-3]</td>
<td>et-x/1/4</td>
<td>et-x/1/4</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/5:[0-3]</td>
<td>et-x/1/5</td>
<td>et-x/1/5</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/6:[0-3]</td>
<td>et-x/1/6</td>
<td>et-x/1/6</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/7:[0-3]</td>
<td>et-x/1/7</td>
<td>et-x/1/7</td>
</tr>
<tr>
<td>2</td>
<td>xe-x/1/8:[0-3]</td>
<td>et-x/1/8</td>
<td>et-x/1/8</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/9:[0-3]</td>
<td>et-x/1/9</td>
<td>et-x/1/9</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/10:[0-3]</td>
<td>et-x/1/10</td>
<td>et-x/1/10</td>
</tr>
<tr>
<td></td>
<td>xe-x/1/11:[0-3]</td>
<td>et-x/1/11</td>
<td>et-x/1/11</td>
</tr>
</tbody>
</table>

Related Documentation

- Supported Active Physical Ports for Configuring Rate Selectability to Prevent Oversubscription on MX10003 MPC on page 500
- MX10003 MPC on MX10003 Router Overview

Understanding Interface Naming Conventions for JNP10K-LC2101

JNP10K-LC2101 is a fixed-configuration MPC and contains six built-in PICs, PIC 0 to PIC 5. Each PIC supports 4 ports. All ports support multiple port speeds of 100 Gbps, 40 Gbps, and 10 Gbps and can be configured as 10-Gigabit Ethernet, 40-Gigabit Ethernet, and 100-Gigabit Ethernet interfaces.

JNP10K-LC21010 has a forwarding capacity of 240 Gbps for each Packet Forwarding Engine. JNP10K-LC2101 has six Packet Forwarding Engines. In Junos OS Release 18.2R1 and later, you can upgrade JNP10K-LC2101 to provide an increased bandwidth of 2400 Gbps (2.4Tbps), by using an add-on license. After you configure the bandwidth 2.4T statement, JNP10K-LC2101 provides an increased bandwidth of 2.4 Tbps. The forwarding capacity is increased to 400 Gbps for each Packet Forwarding Engine. Packet Forwarding
Engine oversubscription is not supported. So, demand on each Packet Forwarding Engine should be less than or equal to its forwarding capacity.

The 40-Gigabit Ethernet and 100-Gigabit Ethernet interfaces configured on the JNP10K-LC2101 MPC follow the naming convention `et-fpc-slot/pic-slot/port-number`. The 10-Gigabit Ethernet interfaces configured on the JNP10K-LC2101 MPC follow the naming convention `xe-fpc-slot/pic-slot/port-number:[logical-port-number]`.

For example, `xe-0/0/1:3` indicates a 10-Gigabit Ethernet interface configured on logical port 3 of physical port 1 of the JNP10K-LC2101 MPC that is installed in the MPC slot 0. The interface name `et-0/0/2` indicates either a 40-Gigabit Ethernet interface or a 100-Gigabit Ethernet interface configured on port 2 of the JNP10K-LC2101 MPC that is installed in the MPC slot 0.

**NOTE:** Each Packet Forwarding Engine maps to a single built-in PIC on the JNP10K-LC2101.

Table 49 on page 494 lists the naming conventions used for interfaces on JNP10K-LC2101 for MX10008 routers. MX10008 routers support 8 JNP10K-LC2101 MPCs.

**NOTE:** The x in `et-x/0/0` and `xe-x/0/0:[0-3]` refers to the MPC slot number.

### Table 49: Interface Naming Convention for JNP10K-LC2101 MPC

<table>
<thead>
<tr>
<th>Packet Forwarding Engine</th>
<th>10-Gigabit Ethernet Interface</th>
<th>40-Gigabit Ethernet Interface</th>
<th>100-Gigabit Ethernet Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td><code>xe-x/0/0:[0-3]</code></td>
<td><code>et-x/0/0</code></td>
<td><code>et-x/0/0</code></td>
</tr>
<tr>
<td></td>
<td><code>xe-x/0/1:[0-3]</code></td>
<td><code>et-x/0/1</code></td>
<td><code>et-x/0/1</code></td>
</tr>
<tr>
<td></td>
<td><code>xe-x/0/2:[0-3]</code></td>
<td><code>et-x/0/2</code></td>
<td><code>et-x/0/2</code></td>
</tr>
<tr>
<td></td>
<td><code>xe-x/0/3:[0-3]</code></td>
<td><code>et-x/0/3</code></td>
<td><code>et-x/0/3</code></td>
</tr>
<tr>
<td>1</td>
<td><code>xe-x/1/0:[0-3]</code></td>
<td><code>et-x/1/0</code></td>
<td><code>et-x/1/0</code></td>
</tr>
<tr>
<td></td>
<td><code>xe-x/1/1:[0-3]</code></td>
<td><code>et-x/1/1</code></td>
<td><code>et-x/1/1</code></td>
</tr>
<tr>
<td></td>
<td><code>xe-x/1/2:[0-3]</code></td>
<td><code>et-x/1/2</code></td>
<td><code>et-x/1/2</code></td>
</tr>
<tr>
<td></td>
<td><code>xe-x/1/3:[0-3]</code></td>
<td><code>et-x/1/3</code></td>
<td><code>et-x/1/3</code></td>
</tr>
</tbody>
</table>
Table 49: Interface Naming Convention for JNP10K-LC2101 MPC (continued)

<table>
<thead>
<tr>
<th>Packet Forwarding Engine</th>
<th>10-Gigabit Ethernet Interface</th>
<th>40-Gigabit Ethernet Interface</th>
<th>100-Gigabit Ethernet Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>xe-x/2/0:[0-3]</td>
<td>et-x/2/0</td>
<td>et-x/2/0</td>
</tr>
<tr>
<td></td>
<td>xe-x/2/1[0-3]</td>
<td>et-x/2/1</td>
<td>et-x/2/1</td>
</tr>
<tr>
<td></td>
<td>xe-x/2/2:[0-3]</td>
<td>et-x/2/2</td>
<td>et-x/2/2</td>
</tr>
<tr>
<td></td>
<td>xe-x/2/3:[0-3]</td>
<td>et-x/2/3</td>
<td>et-x/2/3</td>
</tr>
<tr>
<td>3</td>
<td>xe-x/3/0:[0-3]</td>
<td>et-x/3/0</td>
<td>et-x/3/0</td>
</tr>
<tr>
<td></td>
<td>xe-x/3/1[0-3]</td>
<td>et-x/3/1</td>
<td>et-x/3/1</td>
</tr>
<tr>
<td></td>
<td>xe-x/3/2:[0-3]</td>
<td>et-x/3/2</td>
<td>et-x/3/2</td>
</tr>
<tr>
<td></td>
<td>xe-x/3/3:[0-3]</td>
<td>et-x/3/3</td>
<td>et-x/3/3</td>
</tr>
<tr>
<td>4</td>
<td>xe-x/4/0:[0-3]</td>
<td>et-x/4/0</td>
<td>et-x/4/0</td>
</tr>
<tr>
<td></td>
<td>xe-x/4/1[0-3]</td>
<td>et-x/4/1</td>
<td>et-x/4/1</td>
</tr>
<tr>
<td></td>
<td>xe-x/4/2:[0-3]</td>
<td>et-x/4/2</td>
<td>et-x/4/2</td>
</tr>
<tr>
<td></td>
<td>xe-x/4/3:[0-3]</td>
<td>et-x/4/3</td>
<td>et-x/4/3</td>
</tr>
<tr>
<td>5</td>
<td>xe-x/5/0:[0-3]</td>
<td>et-x/5/0</td>
<td>et-x/5/0</td>
</tr>
<tr>
<td></td>
<td>xe-x/5/1[0-3]</td>
<td>et-x/5/1</td>
<td>et-x/5/1</td>
</tr>
<tr>
<td></td>
<td>xe-x/5/2:[0-3]</td>
<td>et-x/5/2</td>
<td>et-x/5/2</td>
</tr>
<tr>
<td></td>
<td>xe-x/5/3:[0-3]</td>
<td>et-x/5/3</td>
<td>et-x/5/3</td>
</tr>
</tbody>
</table>

Related Documentation
- Understanding Rate Selectability on page 482
- JNP10K-LC2101 MPC on MX10008 Routers Overview

Understanding Interface Naming Conventions for MPC10E-15C-MRATE MPC

Starting with Junos OS Release 19.1R1, the MPC10E-15C-MRATE (15x100G) is introduced for MX240, MX480, MX960 platforms, that is capable of delivering up to 1.5 terabits per-slot bandwidth. The MPC10E-15C-MRATE consists of three Packet Forwarding Engines (PFE) per MPC and each PFE is capable of delivering up to 500Gbps throughput. It supports three PICs per MPC, that is, one PIC per PFE, and five ports per PIC (that is,
fifteen ports per MPC). Each PIC contains 5xQSFP28 ports that supports 100-Gbps, 40-Gbps, and 10-Gbps speeds using QSFP28 and QSFP+ optics. The 10-Gbps speed is supported by using break out cables.

**NOTE:**
- MPC10E-15C-MRATE is only supported on MX240, MX480, MX960 routers and not on MX2000 series and MX10000 lines of routers.
- If you install the MPC10E-15C-MRATE, then the Switch Control Board MX-SCBE3 must be installed in the router in order for the MPC10E-15C-MRATE to come online.
- By default, the MPC10E-15C-MRATE ports are configured as 100-Gigabit Ethernet ports.

The interface names for the 10-Gigabit Ethernet interfaces uses the prefix xe- while the interface names for 40 and 100 interfaces uses the prefix et-. When multiple interfaces (or IFDs) are supported in a physical port, the colon (:) notation is used in the interface naming conventions (Example: 4x10GE interfaces). The colon (:) is used as a delimiter to differentiate the multiple interfaces (or IFDs) in a physical port.

By default, the 100-Gigabit Ethernet and 40-Gigabit Ethernet interfaces appear in the et-fpc/pic/port format. When the 40-Gigabit Ethernet interfaces are channelized as 10-Gigabit Ethernet interfaces, the interface names appear in the xe-fpc/pic/port:channel format, where channel can be a value of 0 through 3.

**NOTE:** In the interface naming convention et-x/y/z and xe-x/y/z:[0-3]:
- x refers to the FPC slot number.
- y refers to the PIC slot number. The valid range is 0 to 2.
- z refers to the physical port number. The valid range is 0 to 4.

<table>
<thead>
<tr>
<th>PIC</th>
<th>10-Gigabit Ethernet Interface</th>
<th>40-Gigabit Ethernet Interface</th>
<th>100-Gigabit Ethernet Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>xe-x/0/0:0-3</td>
<td>et-x/0/0</td>
<td>et-x/0/0</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/1:0-3</td>
<td>et-x/0/1</td>
<td>et-x/0/1</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/2:0-3</td>
<td>et-x/0/2</td>
<td>et-x/0/2</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/3:0-3</td>
<td>et-x/0/3</td>
<td>et-x/0/3</td>
</tr>
<tr>
<td></td>
<td>xe-x/0/4:0-3</td>
<td>et-x/0/4</td>
<td>et-x/0/4</td>
</tr>
</tbody>
</table>
### Table 50: Interface Naming Convention for MPC10E-15C-MRATE (continued)

<table>
<thead>
<tr>
<th>PIC</th>
<th>10-Gigabit Ethernet Interface</th>
<th>40-Gigabit Ethernet Interface</th>
<th>100-Gigabit Ethernet Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><code>xe-x/1/0:[0-3]</code></td>
<td><code>et-x/1/0</code></td>
<td><code>et-x/1/0</code></td>
</tr>
<tr>
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<td><code>xe-x/1/1:[0-3]</code></td>
<td><code>et-x/1/1</code></td>
<td><code>et-x/1/1</code></td>
</tr>
<tr>
<td></td>
<td><code>xe-x/1/2:[0-3]</code></td>
<td><code>et-x/1/2</code></td>
<td><code>et-x/1/2</code></td>
</tr>
<tr>
<td></td>
<td><code>xe-x/1/3:[0-3]</code></td>
<td><code>et-x/1/3</code></td>
<td><code>et-x/1/3</code></td>
</tr>
<tr>
<td></td>
<td><code>xe-x/1/4:[0-3]</code></td>
<td><code>et-x/1/4</code></td>
<td><code>et-x/1/4</code></td>
</tr>
<tr>
<td>2</td>
<td><code>xe-x/2/0:[0-3]</code></td>
<td><code>et-x/2/0</code></td>
<td><code>et-x/2/0</code></td>
</tr>
<tr>
<td></td>
<td><code>xe-x/2/1:[0-3]</code></td>
<td><code>et-x/2/1</code></td>
<td><code>et-x/2/1</code></td>
</tr>
<tr>
<td></td>
<td><code>xe-x/2/2:[0-3]</code></td>
<td><code>et-x/2/2</code></td>
<td><code>et-x/2/2</code></td>
</tr>
<tr>
<td></td>
<td><code>xe-x/2/3:[0-3]</code></td>
<td><code>et-x/2/3</code></td>
<td><code>et-x/2/3</code></td>
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<tr>
<td></td>
<td><code>xe-x/2/4:[0-3]</code></td>
<td><code>et-x/2/4</code></td>
<td><code>et-x/2/4</code></td>
</tr>
</tbody>
</table>

**Related Documentation**
- Supported Active Physical Ports for Rate Selectability to Prevent Oversubscription on MPC10E-15C-MRATE on page 505
- MPC10E-15C-MRATE Rate-Selectability Overview on page 528
- Configuring Rate Selectability on MPC10E-15C-MRATE to Enable Different Port Speeds on page 542

**Supported Active Physical Ports for Configuring Rate Selectability to Prevent Oversubscription**

MPC7E-MRATE has an aggregate forwarding capacity of 480 Gbps and a forwarding capacity of 240 Gbps on each Packet Forwarding Engine. Oversubscription of Packet Forwarding Engine capacity is not supported. The demand on each Packet Forwarding Engine must be less than or equal to its forwarding capacity. For instance, on MPC7E-MRATE, the demand on each Packet Forwarding Engine must be less than or equal to 240 Gbps.

**NOTE:** By default, the MPC7E-MRATE ports are configured as 10-Gigabit Ethernet ports.

When you configure rate selectability at the MIC level, all the ports supporting that port speed are enabled by default. This can lead to fabric oversubscription in certain cases. To prevent fabric oversubscription, you can configure the number of active ports that
operate at the configured speed by using the `number-of-ports` `number-of-active-physical-ports` configuration statement. Additionally, interfaces are created only for the active ports.

**NOTE:** You cannot configure the number of active ports when you configure rate selectability at the port level.

Table 51 on page 498 lists the active physical ports on MPC7E-MRATE.

### Table 51: Active Physical Ports on MPC7E-MRATE MPC for Configuring Rate Selectability at PIC Level

<table>
<thead>
<tr>
<th>Ports Configured (number-of-ports Statement)</th>
<th>Active Physical Ports for Different Configured Speeds</th>
<th>10-Gigabit Ethernet</th>
<th>40-Gigabit Ethernet</th>
<th>100-Gigabit Ethernet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>0,1</td>
<td>0,1</td>
<td>2,5</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>0,1,2</td>
<td>0,1,2</td>
<td>2,5</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>0,1,2,3</td>
<td>0,1,2,3</td>
<td>2,5</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>0,1,2,3,4</td>
<td>0,1,2,3,4</td>
<td>2,5</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>0,1,2,3,4,5</td>
<td>0,1,2,3,4,5</td>
<td>2,5</td>
</tr>
</tbody>
</table>

MPC8E has a forwarding capacity of 240 Gbps for each Packet Forwarding Engine. MPC9E has a forwarding capacity of 400 Gbps for each Packet Forwarding Engine. Oversubscription of Packet Forwarding Engine capacity is not supported. The demand on each Packet Forwarding Engine must be less than or equal to its forwarding capacity. For instance, on MPC8E, the demand on each Packet Forwarding Engine must be less than or equal to 240 Gbps and on MPC9E, the demand on each Packet Forwarding Engine must be less than or equal to 400 Gbps.

**NOTE:** By default, the MIC-MRATE ports are configured as 10-Gigabit Ethernet ports.

Table 52 on page 499, Table 53 on page 499 list the active physical ports on MPC8E and MPC9E.
### Table 52: Active Physical Ports on MIC-MRATE on MPC8E MPC for Configuring Rate Selectability at MIC Level

<table>
<thead>
<tr>
<th>Ports Configured (number-of-ports Statement)</th>
<th>Active Physical Ports for Different Configured Speeds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10-Gigabit Ethernet</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0, 6</td>
</tr>
<tr>
<td>3</td>
<td>0, 1, 6</td>
</tr>
<tr>
<td>4</td>
<td>0, 1, 6, 7</td>
</tr>
<tr>
<td>5</td>
<td>0, 1, 2, 6, 7</td>
</tr>
<tr>
<td>6</td>
<td>0, 1, 2, 6, 7, 8</td>
</tr>
<tr>
<td>7</td>
<td>0, 1, 2, 3, 6, 7, 8</td>
</tr>
<tr>
<td>8</td>
<td>0, 1, 2, 3, 6, 7, 8, 9</td>
</tr>
<tr>
<td>9</td>
<td>0, 1, 2, 3, 4, 6, 7, 8, 9</td>
</tr>
<tr>
<td>10</td>
<td>0, 1, 2, 3, 4, 6, 7, 8, 9, 10</td>
</tr>
<tr>
<td>11</td>
<td>0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10</td>
</tr>
<tr>
<td>12</td>
<td>0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11</td>
</tr>
</tbody>
</table>

### Table 53: Active Physical Ports on MIC-MRATE on MPC9E MPC and MPC8E MPC in 1.6T Mode for Configuring Rate Selectability at MIC Level

<table>
<thead>
<tr>
<th>Ports Configured (number-of-ports Statement)</th>
<th>Active Physical Ports for Different Configured Speeds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10-Gigabit Ethernet</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0, 6</td>
</tr>
<tr>
<td>3</td>
<td>0, 1, 6</td>
</tr>
<tr>
<td>4</td>
<td>0, 1, 6, 7</td>
</tr>
<tr>
<td>5</td>
<td>0, 1, 2, 6, 7</td>
</tr>
<tr>
<td>6</td>
<td>0, 1, 2, 6, 7, 8</td>
</tr>
<tr>
<td>7</td>
<td>0, 1, 2, 3, 6, 7, 8</td>
</tr>
</tbody>
</table>
### Table 53: Active Physical Ports on MIC-MRATE on MPC9E MPC and MPC8E MPC in 1.6T Mode for Configuring Rate Selectability at MIC Level (continued)

<table>
<thead>
<tr>
<th>Ports Configured (number-of-ports Statement)</th>
<th>Active Physical Ports for Different Configured Speeds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10-Gigabit Ethernet</td>
</tr>
<tr>
<td>8</td>
<td>0, 1, 2, 3, 6, 7, 8, 9</td>
</tr>
<tr>
<td>9</td>
<td>0, 1, 2, 3, 4, 6, 7, 8, 9</td>
</tr>
<tr>
<td>10</td>
<td>0, 1, 2, 3, 4, 6, 7, 8, 9, 10</td>
</tr>
<tr>
<td>11</td>
<td>0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10</td>
</tr>
<tr>
<td>12</td>
<td>0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11</td>
</tr>
</tbody>
</table>

**Related Documentation**

- Configuring Rate Selectability on MPC7E (Multi-Rate) to Enable Different Port Speeds on page 511
- Configuring Rate Selectability on MIC-MRATE to Enable Different Port Speeds on page 507
- Understanding Rate Selectability on page 482

**Supported Active Physical Ports for Configuring Rate Selectability to Prevent Oversubscription on MX10003 MPC**

When you configure rate selectability at the MIC level, all the ports supporting that port speed are enabled by default. This can lead to fabric oversubscription in certain cases. To prevent fabric oversubscription, you can configure the number of active ports that operate at the configured speed by using the `number-of-ports` `number-of-active-physical-ports` configuration statement. Additionally, interfaces are created only for the active ports.

NOTE: You cannot configure the number of active ports when you configure rate selectability at the port level.

Starting in Junos OS Release 17.3R1, the MX10003 MPC supports rate selectability to prevent oversubscription of the Packet Forwarding Engine bandwidth.

Table 54 on page 501 lists the active physical ports on MX10003 MPC for Configuring Rate Selectability at the MIC Level.
### Table 54: Active Physical Ports on the MX10003 MPC for configuring rate selectability at the MIC level

<table>
<thead>
<tr>
<th>Ports Configured (number-of-ports Statement)</th>
<th>Active Physical Ports for Different Configured Speeds</th>
<th>10-Gigabit Ethernet</th>
<th>40-Gigabit Ethernet</th>
<th>100-Gigabit Ethernet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>0, 4</td>
<td>0, 4</td>
<td>0, 4</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>0, 4, 8</td>
<td>0, 4, 8</td>
<td>0, 4, 8</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>0, 1, 4, 8</td>
<td>0, 1, 4, 8</td>
<td>0, 1, 4, 8</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>0, 1, 4, 5, 8</td>
<td>0, 1, 4, 5, 8</td>
<td>0, 1, 4, 5, 8</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>0, 1, 4, 5, 8, 9</td>
<td>0, 1, 4, 5, 8, 9</td>
<td>0, 1, 4, 5, 8, 9</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>0, 1, 2, 4, 5, 8, 9</td>
<td>0, 1, 2, 4, 5, 8, 9</td>
<td>0, 1, 2, 4, 5, 8, 9</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>0, 1, 2, 4, 5, 6, 8, 9</td>
<td>0, 1, 2, 4, 5, 6, 8, 9</td>
<td>0, 1, 2, 4, 5, 6, 8, 9</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>0, 1, 2, 4, 5, 6, 8, 9, 10</td>
<td>0, 1, 2, 4, 5, 6, 8, 9, 10</td>
<td>0, 1, 2, 4, 5, 6, 8, 9, 10</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>0, 1, 2, 3, 4, 5, 6, 8, 9, 10</td>
<td>0, 1, 2, 3, 4, 5, 6, 8, 9, 10</td>
<td>0, 1, 2, 3, 4, 5, 6, 8, 9, 10</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10</td>
<td>0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10</td>
<td>0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11</td>
<td>0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11</td>
<td>0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11</td>
</tr>
</tbody>
</table>

Table 55 on page 501 lists the active physical ports on MX10003 MPC for Configuring Rate Selectability at PIC Level.

### Table 55: Active Physical Ports on MX10003 MPC for configuring rate selectability at the PIC level

<table>
<thead>
<tr>
<th>Ports Configured (number-of-ports Statement)</th>
<th>Active Physical Ports for Different Configured Speeds</th>
<th>10-Gigabit Ethernet</th>
<th>40-Gigabit Ethernet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>0, 2</td>
<td>0, 2</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>0, 2, 4</td>
<td>0, 2, 4</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>0, 1, 2, 4</td>
<td>0, 1, 2, 4</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>0, 1, 2, 3, 4</td>
<td>0, 1, 2, 3, 4</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>0, 1, 2, 3, 4, 5</td>
<td>0, 1, 2, 3, 4, 5</td>
</tr>
</tbody>
</table>
Supported Active Physical Rate-Selectable Ports to Prevent Oversubscription on MX204 Router

The maximum capacity of an MX204 router is 400 Gbps, which cannot be oversubscribed. In MX204, the network ports are available in two groups (referred to as PICs), with restrictions around the number and type of ports that can be configured without oversubscription.

Starting in Junos OS Release 17.4R1, the MX204 supports rate selectability to prevent oversubscription of the Packet Forwarding Engine bandwidth. The MX204 Packet Forwarding Engine has four 100-Gigabit Ethernet QSFP28 ports (referred to as PIC 0 ports) and eight 10-Gigabit Ethernet ports (referred to as PIC 1 ports). Each of the PIC 0 ports can be used as either a 100-Gigabit Ethernet QSFP28 port or a 40-Gigabit Ethernet QSFP port, or they can be configured as four 10-Gigabit Ethernet ports (using a breakout cable).

If you configure rate selectability at the PIC level, all the ports supporting that port speed are enabled by default. This can lead to oversubscription in certain cases. To prevent the oversubscription, you can configure the number of active ports that operate at the configured speed by using the `number-of-ports number-of-active-physical-ports` configuration statement. Additionally, interfaces are created only for the active ports.

NOTE:
- You cannot configure the number of active ports when you configure rate selectability at the port level.

Invalid Port Configuration

You must try to avoid configuring ports that can lead to oversubscription.

Following is an example of an invalid configuration:

```
4x100GE + 8X10GE
```

If you try to commit an invalid configuration, the configuration gets committed, but the port is not activated. This is because Junos OS allows you to configure a port before a line card is inserted. You will get an error message in the output of the `show chassis alarms` command and also in the log messages.

NOTE: When you are in port configuration mode, all the ports are configured as 10-Gigabit Ethernet.
Configuring Active Ports on MX204 Router with Rate Selectability

Table 56 on page 503 summarizes the active ports with number-of-ports configured but without any rate selectability configuration for an MX204 router. Because there is no rate selectability configured, the default speed is used in these cases.

Table 56: Active Physical Ports on the MX204 Router for Configuring Rate Selectability at PIC level

<table>
<thead>
<tr>
<th>PIC</th>
<th>Number of Ports (number-of-ports Statement)</th>
<th>Active Ports</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PIC Level 10-Gigabit Ethernet Profile</td>
<td>PIC Level 40-Gigabit Ethernet Profile</td>
</tr>
<tr>
<td>PIC 0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0, 1</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0, 1, 2</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0, 1, 2, 3</td>
</tr>
<tr>
<td>PIC 1</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0, 1</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0, 1, 2</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0, 1, 2, 3</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>0, 1, 2, 3, 4</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>0, 1, 2, 3, 4, 5</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>0, 1, 2, 3, 4, 5, 6</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>0, 1, 2, 3, 4, 5, 6, 7</td>
</tr>
</tbody>
</table>

Table 57 on page 504 summarizes the active ports without number-of-ports configured but with rate selectability at PIC-level configuration for an MX204 router.
### Table 57: Without number-of-ports But with Rate Selectability at PIC Level for MX204 Router

<table>
<thead>
<tr>
<th>PIC</th>
<th>Active Ports</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PIC-Level 10-Gigabit Ethernet</td>
</tr>
<tr>
<td>PIC 0</td>
<td>0-3</td>
</tr>
<tr>
<td>PIC 1</td>
<td>0-7</td>
</tr>
</tbody>
</table>

Table 58 on page 504 summarizes the active ports with number-of-ports configured and rate selectability at PIC-level configuration for an MX204 router.

### Table 58: With number-of-ports Rate Selectability at PIC level for MX204 Router

<table>
<thead>
<tr>
<th>PIC</th>
<th>Number of Ports (number-of-ports Statement)</th>
<th>Active Ports</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PIC-Level 10-Gigabit Ethernet</td>
</tr>
<tr>
<td>PIC 0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0,1</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0,1,2</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0,1,2,3</td>
</tr>
<tr>
<td>PIC 1</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0,1</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0,1,2</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0,1,2,3</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>0,1,2,3,4</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>0,1,2,3,4,5</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>0,1,2,3,4,5,6</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>0,1,2,3,4,5,6,7</td>
</tr>
</tbody>
</table>

### Related Documentation
- MX204 Router Overview
- MX204 Router Rate-Selectability Overview on page 521
Configuring Rate Selectability on MX204 to Enable Different Port Speeds on page 534

Supported Active Physical Ports for Rate Selectability to Prevent Oversubscription on MPC10E-15C-MRATE

When you configure speed at the PIC level, all the ports supporting that port speed are enabled by default. This could lead to Packet Forwarding Engine (PFE) oversubscription. To prevent oversubscription, configure the number of active ports that operate at the configured speed by using the `number-of-ports number-of-active-physical-ports` configuration statement. Additionally, interfaces are created only for the active ports.

**NOTE:** You cannot configure the number of active ports when you configure rate at the port level.

Starting in Junos OS Release 19.1R1, the MPC10E-15C-MRATE supports rate selectability to prevent oversubscription of the PFE bandwidth.

Table 59 on page 505 summarizes the active ports with `number-of-ports` and without any rate selectability configuration for MPC10E-15C-MRATE. Because there is no rate selectability configured, the default mode and no `pic-mode` configuration is applied.

**Table 59: Active Ports with number-of-ports and without rate-selectability**

<table>
<thead>
<tr>
<th>Number of Active Ports</th>
<th>10-Gigabit Ethernet</th>
<th>40-Gigabit Ethernet</th>
<th>100-Gigabit Ethernet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>-</td>
<td>0,1</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>0,1,2</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>0,1,2,3</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>-</td>
<td>0,1,2,3,4</td>
</tr>
</tbody>
</table>

Table 60 on page 505 lists the active ports without `number-of-ports` and with rate selectability at PIC level for MPC10E-15C-MRATE.

**Table 60: Active Ports without number-of-ports and with speed configured at PIC level**

<table>
<thead>
<tr>
<th>PIC Type</th>
<th>10-Gigabit Ethernet</th>
<th>40-Gigabit Ethernet</th>
<th>100-Gigabit Ethernet</th>
</tr>
</thead>
<tbody>
<tr>
<td>5xQSFP28 PIC (PIC 0)</td>
<td>0,1,2,3,4</td>
<td>0,1,2,3,4</td>
<td>0,1,2,3,4</td>
</tr>
</tbody>
</table>
Table 60: Active Ports without number-of-ports and with speed configured at PIC level (continued)

<table>
<thead>
<tr>
<th>PIC Type</th>
<th>Active Ports with speed configured at PIC level</th>
<th>10-Gigabit Ethernet</th>
<th>40-Gigabit Ethernet</th>
<th>100-Gigabit Ethernet</th>
</tr>
</thead>
<tbody>
<tr>
<td>5xQSFP28 PIC (PIC 0)</td>
<td>0, 1, 2, 3, 4</td>
<td>0, 1, 2, 3, 4</td>
<td>0, 1, 2, 3, 4</td>
<td></td>
</tr>
<tr>
<td>5xQSFP28 PIC (PIC 1)</td>
<td>0, 1, 2, 3, 4</td>
<td>0, 1, 2, 3, 4</td>
<td>0, 1, 2, 3, 4</td>
<td></td>
</tr>
</tbody>
</table>

Table 61 on page 506 list the active ports with number-of-ports and rate selectability at PIC level for MPC10E-15C-MRATE.

Table 61: Active Ports with number-of-ports and rate selectability at PIC level

<table>
<thead>
<tr>
<th>PIC Type</th>
<th>Number of Active Ports</th>
<th>Active Ports with speed configured at PIC level</th>
<th>10-Gigabit Ethernet</th>
<th>40-Gigabit Ethernet</th>
<th>100-Gigabit Ethernet</th>
</tr>
</thead>
<tbody>
<tr>
<td>5xQSFP28 PIC (PIC 0)</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>0, 1</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>0, 1, 2</td>
<td>0, 1, 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>0, 1, 2, 3</td>
<td>0, 1, 2, 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>0, 1, 2, 3, 4</td>
<td>0, 1, 2, 3, 4</td>
<td></td>
</tr>
<tr>
<td>5xQSFP28 PIC (PIC 1)</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>0, 1</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>0, 1, 2</td>
<td>0, 1, 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>0, 1, 2, 3</td>
<td>0, 1, 2, 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>0, 1, 2, 3, 4</td>
<td>0, 1, 2, 3, 4</td>
<td></td>
</tr>
<tr>
<td>5xQSFP28 PIC (PIC 2)</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>0, 1</td>
<td>0, 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>0, 1, 2</td>
<td>0, 1, 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>0, 1, 2, 3</td>
<td>0, 1, 2, 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>0, 1, 2, 3, 4</td>
<td>0, 1, 2, 3, 4</td>
<td></td>
</tr>
</tbody>
</table>
Configuring Rate Selectability on MIC-MRATE to Enable Different Port Speeds

Rate selectability enables you to configure the port speed either at the port level or at the MIC level. To configure all ports to operate at the same speed, you configure rate selectability at the MIC level, in which case you cannot configure the speed of individual ports. To configure rate selectability at the MIC level, use the `pic-mode` statement and specify the port speed. To configure different port speeds for each port, you configure rate selectability at the port level, in which case only the ports that are configured are enabled. To configure rate selectability at the port level, use the `speed` statement to specify the speed of individual ports. This topic describes how to configure port speeds at the port level and at the MIC level.

NOTE: The `pic` in the configuration commands refers to the MRATE MIC. To specify `pic-number`, specify the MRATE MIC slot. For instance, when you use the `edit chassis fpc fpc-slot-number pic pic-slot-number` statement, specify the MPC slot number and the MIC-MRATE slot number.

Configuring Rate Selectability on MIC-MRATE at MIC Level

To configure all ports to operate at the same speed, you configure rate selectability at the MIC level. The default port speed is 10 Gbps for all ports. When you configure rate selectability at the MIC level, all the ports of the MIC that support the configured speed operate at that speed. To prevent oversubscription and ensure a guaranteed bandwidth, you can specify the number of active ports that operate at the configured speed by using the `number-of-ports number-of-active-physical-ports` statement. MIC-MRATE supports port speeds of 10 Gbps, 40 Gbps, and 100 Gbps.

For MPC8E, you can only configure 4 ports of the 12 MIC-MRATE ports with 100 Gbps port speed and the other ports are disabled. So, if you configure 100G as the operating speed for ports 0, 1, 6, and 7, then the other ports are disabled on MPC8E. Similarly, when you configure the port speed as 100 Gbps at the MIC level on MPC9E, you can only configure 8 ports of the 12 MIC-MRATE ports to operate with that speed. So, if you configure 100G as the operating speed for ports 0, 1, 2, 3, 6, 7, 8, and 9, then the other ports are disabled on MPC9E. However, enabling port speed of 40 Gbps or 10 Gbps at the MIC level, enables all ports and sets the desired port speed on all ports.
To configure rate selectability at the MIC level:

1. In configuration mode, navigate to the `edit chassis fpc fpc-slot pic pic-number` hierarchy level.

   ```
   [edit ]
   user@host# edit chassis fpc fpc-slot pic pic-number
   ```

   For example:

   ```
   [edit ]
   user@host# edit chassis fpc 4 pic 0
   ```

2. Configure the `pic-mode pic-speed` statement to set the operating speed for the MIC. All ports of the MIC that support the configured speed operate at the configured speed. Values for the `pic-speed` option include: 10G, 40G, and 100G.

   ```
   [edit chassis fpc fpc-slot pic pic-number]
   user@host# set pic-mode pic-speed
   ```

   For example:

   ```
   [edit chassis fpc 4 pic 0]
   user@host# set pic-mode 10G
   ```

3. (Optional) To prevent oversubscription, you can choose to configure the number of active ports that operate at the port speed configured in Step 2. For information about the number of active ports and specific port numbers on MPC7E-MRATE, MPC8E, and MPC9E see “Supported Active Physical Ports for Configuring Rate Selectability to Prevent Oversubscription” on page 497.

   ```
   [edit chassis fpc fpc-slot pic pic-number]
   user@host# set number-of-ports number-of-active-physical-ports
   ```

   For example:

   ```
   [edit chassis fpc 4 pic 0]
   user@host# set number-of-ports 8
   ```

4. Verify the configuration.

   ```
   [edit chassis fpc 4 pic 0]
   user@host# show
   pic-mode 10G;
   number-of-ports 8;
   ```

5. Commit your configuration changes.
In this example, you have configured 8 ports on MIC-MRATE with port speed of 10 Gbps. The other ports are disabled.

**Configuring Rate Selectability on MIC-MRATE at Port Level**

To configure different port speeds for each port, you configure rate selectability at the port level. Only the ports that are configured are enabled. Other ports are automatically disabled. Configuring rate selectability at the port level provides you the flexibility of operating individual ports of the MIC at different supported speeds. For example, on MPC9E with MIC-MRATE, you can configure four 100-Gigabit Ethernet interfaces on ports 0, 1, 6, and 7 and two 40-Gigabit Ethernet interfaces on ports 3 and 8. You can use breakout transceivers to configure each 40-Gigabit Ethernet Interfaces as four 10-Gigabit Ethernet interfaces.

**NOTE:** When you change the port speed at the port level, you must rest the MPC for the configuration to take effect. Because resetting the MPC takes several minutes and since it affects all the PFES, you can choose to use the request chassis mic mic-slot mic-slot-number fpc-slot fpc-slot-number (offline | online) command to reset the MIC and apply your configuration changes. An alarm is generated indicating the change in port speed. For guidelines on configuring rate selectability, see “Guidelines for Configuring Rate Selectability” on page 486.

To configure rate selectability at the port level:

1. In configuration mode, navigate to the [edit chassis fpc fpc-slot pic pic-number] hierarchy level.

   ```
   [edit ]
   user@host# edit chassis fpc fpc-slot pic pic-number
   ```

   For example:

   ```
   [edit ]
   user@host# edit chassis fpc 4 pic 0
   ```

2. To indicate the speed at which the ports operate, configure the speed statement for the desired ports. According to your requirements, you can choose the 10G, 40G, or 100G speed options.

   ```
   [edit chassis fpc fpc-slot pic pic-number]
   user@host# set port port-number speed (10G | 40G | 100G)
   ```

   For example:

   ```
   [edit chassis fpc 4 pic]
   user@host# set port 0 speed 100G
   user@host# set port 1 speed 100G
   user@host# set port 3 speed 40G
   ```
setport6speed100G
setport7speed100G
setport8speed40g

NOTE: All the twelve ports of MIC-MRATE support 10-Gbps and 40-Gbps port speeds. On MPC8E with MIC-MRATE, you can configure 4 ports out of the twelve MIC-MRATE ports with a port speed of 100 Gbps. On MPC9E with MIC-MRATE, you can configure 8 ports out of the twelve MIC-MRATE ports with a port speed of 100 Gbps.

3. Verify the configuration.

[edit chassis fpc 4 pic 0]
user@host# show
port 0 { speed 100g; }
port 1 { speed 100g; }
port 3 { speed 40g; }
port 6 { speed 100g; }
port 7 { speed 100g; }
port 8 { speed 40g; }

4. Commit your configuration changes.

In this example, you have configured 4 ports on MIC-MRATE with port speed of 100 Gbps and 2 ports with port speed of 40 Gbps. The total capacity per MIC, based on this configuration, is 480 Gbps. MIC-MRATE has two Packet Forwarding Engines. The forwarding capacity for each Packet Forwarding Engine is 400 Gbps for MPC9E and 240 Gbps for MPC8E. The configured value does not exceed the forwarding capacity and so is a valid configuration.

Related Documentation
- number-of-ports
- pic-mode
- speed
- Supported Active Physical Ports for Configuring Rate Selectability to Prevent Oversubscription on page 497
Understanding Rate Selectability on page 482

Configuring Rate Selectability on MPC7E (Multi-Rate) to Enable Different Port Speeds

Each of the six ports of PIC 0 and PIC 1 of an MPC7E-MRATE MPC supports port speeds of 10 Gbps and 40 Gbps. However, only ports 2 and 5 of both the PICs support port speed of 100 Gbps. Because the MPC7E-MRATE MPC is rate-selectable, you can choose to configure all supported ports of the MPC to operate at the same supported speed or configure all the ports at different supported speeds.

You configure rate selectability at the PIC level if you intend to operate all the ports of the MPC7E-MRATE MPC at the same speed. That is, you can choose to configure the PIC to operate at a supported speed, and then all the supported ports of the PIC operate at the configured speed. For example, if you choose to configure PIC 0 at 100-Gbps speed, only ports 2 and 5 of PIC 0 operate at 100-Gbps speed, while the other ports of the PIC are disabled. Similarly, if you choose to configure PIC 0 at 10-Gbps or 40-Gbps speed, all the ports of the PIC are enabled to operate at those speeds. Additionally, you can prevent oversubscription by specifying the number of active physical ports that operate at 10-Gbps, 40-Gbps, and 100-Gbps speeds.

You configure rate selectability at the port level if you intend to operate different ports of the MPC7E-MRATE MPC at different supported speeds. That is, you configure each port to operate at a supported speed.

NOTE: The MPC7E-MRATE MPC supports an aggregate bandwidth of 480 Gbps, and each of the two PICs supports a bandwidth limit of 240 Gbps. If the aggregate port capacity configured exceeds 240 Gbps per PIC, the configuration is not supported.

Configuring Rate Selectability at PIC Level on page 511
Configuring Rate Selectability at Port Level on page 513

Configuring Rate Selectability at PIC Level

To configure rate selectability at the PIC level:

1. In configuration mode, navigate to the [edit chassis fpc fpc-slot pic pic-number] hierarchy level.

   ```
   [edit ]
   user@host# edit chassis fpc fpc-slot pic pic-number
   ```

   For example:

   ```
   [edit ]
   user@host# edit chassis fpc 4 pic 0
   ```
2. Configure the `pic-mode` statement to set the operating speed for the PIC’s ports. According to your requirements, you can choose from the options 10G, 40G, or 100G.

   ```
   [edit chassis fpc fpc-slot pic pic-number]
   user@host# set pic-mode pic-speed
   ```

   For example:

   ```
   [edit chassis fpc 4 pic 0]
   user@host# set pic-mode 10G
   ```

3. (Optional) To prevent oversubscription, you can choose to configure the number of ports that operate at the mode configured in Step 2.

   ```
   [edit chassis fpc fpc-slot pic pic-number]
   user@host# set number-of-ports number-of-active-physical-ports
   ```

   For example:

   ```
   [edit chassis fpc 4 pic 0]
   user@host# set number-of-ports 6
   ```

4. Verify the configuration.

   ```
   [edit chassis fpc 4 pic 0]
   user@host# show
   pic-mode 10G;
   number-of-ports 6;
   ```

5. Commit your configuration changes.

   If the `number-of-ports` statement is not configured, all the ports that support the speed configured in Step 2 are enabled. That is, depending on that selection, ports 0 through 5 are enabled for speeds of 10-gigabit or 40-gigabit, while ports 2 and 5 are enabled for 100-gigabit. Table 62 on page 512 lists the physical ports that are enabled when the `number-of-ports` statement is configured.

Table 62: Active Physical Ports on MPC7E-MRATE MPC Based on the number-of-ports Configuration

<table>
<thead>
<tr>
<th>Ports Configured (number-of-ports Statement)</th>
<th>Active Physical Ports for Different Configured Speeds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10-Gigabit</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0, 1</td>
</tr>
<tr>
<td>3</td>
<td>0, 1, 2</td>
</tr>
<tr>
<td>4</td>
<td>0, 1, 2, 3</td>
</tr>
</tbody>
</table>
Table 62: Active Physical Ports on MPC7E-MRATE MPC Based on the number-of-ports Configuration (continued)

<table>
<thead>
<tr>
<th>Ports Configured (number-of-ports Statement)</th>
<th>Active Physical Ports for Different Configured Speeds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10-Gigabit</td>
</tr>
<tr>
<td>5</td>
<td>0,1,2,3,4</td>
</tr>
<tr>
<td>6</td>
<td>0,1,2,3,4,5</td>
</tr>
</tbody>
</table>

Configuring Rate Selectability at Port Level

To configure rate selectability at the port level:

1. In configuration mode, navigate to the [edit chassis fpc fpc-slot pic pic-number] hierarchy level.

```plaintext
[edit ]
user@host# edit chassis fpc fpc-slot pic pic-number
```

For example:

```plaintext
[edit ]
user@host# edit chassis fpc 4 pic 0
```

2. To indicate the speed at which the ports operate, configure the `speed` statement for the desired ports. According to your requirements, you can choose the `10g`, `40g`, or `100g` speed options.

```plaintext
[edit chassis fpc fpc-slot pic pic-number]
user@host# set port port-number speed (10g | 40g | 100g)
```

For example:

```plaintext
[edit chassis fpc 4 pic 0]
user@host# set port 0 speed 10g
user@host# set port 1 speed 10g
user@host# set port 2 speed 100g
user@host# set port 3 speed 40g
```

**NOTE:** All the six ports of PIC 0 and PIC 1 of an MPC7E-MRATE MPC support 10-Gbps and 40-Gbps port speeds. However, only ports 2 and 5 of both the PICs support 100-Gbps speed.

3. Verify the configuration.

```plaintext
[edit chassis fpc 4 pic 0]
user@host# show
```
4. Commit your configuration changes.

```c
port 0 {
    speed 10g;
}
port 1 {
    speed 10g;
}
port 2 {
    speed 100g;
}
port 3 {
    speed 40g;
}
```
NOTE:

Note the following when configuring rate selectability on an MPC7E-MRATE MPC:

- If rate selectability is not configured, all ports of the MPC7E-MRATE MPC operate as four 10-Gigabit Ethernet interfaces by default. Therefore, when booting the MPC:
  - If rate selectability is not configured or if invalid port speeds are configured, each port operates as four 10-Gigabit Ethernet interfaces. An alarm is generated to indicate that the ports of the MPC7E-MRATE MPC are operating as four 10-Gigabit Ethernet interfaces.
  - If valid port speeds are configured, the MPC PICs operate at the configured speed.
- When you change an existing port speed configuration, you must reset the MPC for the configuration to take effect. Because resetting the MPC takes several minutes and as it affects all the Packet Forwarding Engines, you can choose to use the request chassis pic pic-slot number-of-ports pic-slot fpc-slot fpc-slot-number (online | offline) command to apply your configuration changes quickly. An alarm is generated indicating the change in port speed configuration.
  - When you change an existing port speed configuration with an invalid port speed configuration, an alarm is generated indicating that the port speed configuration is invalid. The MPC continues to operate using the previously configured valid port speed configuration. However, if the MPC or PIC is restarted with the committed invalid port configuration, all ports of the MPC operate as four 10-Gigabit Ethernet interfaces by default.
  - You cannot configure rate selectability at the PIC level and the port level simultaneously. Error messages are displayed when you try to commit such configurations.
  - When you configure rate selectability at the port level, only the configured ports are enabled. Other ports are disabled.
  - Logical interfaces can be created only on ports that are enabled.

Related Documentation

- MPC7E (Multi-Rate) on MX Series Routers Overview
- pic-mode
- speed
- number-of-ports
MX10003 MPC Rate-Selectability Overview

MX10003 MPC supports a Multi-Rate 12xQSFP28 Ethernet Modular Interface Card (MIC) and a fixed-port PIC (6xQSFP). The MX10003 Packet Forwarding Engine has 6x40GE QSFP ports on the fixed-port PIC and 12x100GE QSFP28 ports on the MIC. For more information see MX10003 MPC (Multi-Rate). Rate selectability enables you to configure the port speed either at the port level or at the MIC level. To configure all ports to operate at the same speed, you configure rate selectability at the MIC or PIC level. For more information see "Configuring Rate Selectability on MX10003 MPC at MIC/PIC Level" on page 531. To configure different port speeds for each port, you configure rate selectability at the port level, in which case only the ports that are configured are enabled. For more information see "Configuring Rate Selectability on MX10003 MPC at Port Level" on page 533.

The ports on the MX10003 MPC are called rate-selectable or multirate ports as they support multiple port speeds. You can choose to configure all supported ports of the fixed port PIC or the MIC to operate at the same speed or configure all the ports at different supported speeds. However, all the PIC or MIC ports do not support all the port speeds. For example, you can choose to configure:

- A port in 4x10GE mode using QSFP-4x10GE optics and 4x10GE breakout cables.
- A port in 40GE mode using QSFP optics.
- A port in 100GE mode using QSFP28 optics.
- A port in 1GE mode (for the ports that is already operating in 10GE mode only) using QSFP-4x10GE optics on fixed PIC and non-MacSEC MIC.

---

NOTE:

- You can use the port-checker tool to check whether the combination of ports you want to use is valid or not.
- You can use the Hardware Compatibility Tool to find information about the pluggable transceivers supported on MX10003 router.

---

The MX10003 MPC supports three Packet Forwarding Engines. The forwarding capacity of each Packet Forwarding Engine is 400Gbps which cannot be oversubscribed.

The MIC supports 12 ports. Each Packet Forwarding Engine is mapped to 4 ports of the MIC. Port 0 through port 3 are mapped to PFE0, port 4 through port 7 are mapped to PFE1, and port 8 through port 11 are mapped to PFE2. The fixed-port PIC supports 6 ports. Each Packet Forwarding Engine is mapped to two ports of the fixed-port PIC. Port 0 and port 1 are mapped to PFE0, port 2 and port 3 are mapped to PFE1, and port 4 and port 5 are mapped to PFE2. You can use the command show chassis pic fpc-slot slot-number pic-slot slot-number to display Packet Forwarding Engine mapping information and port speed information.
Table 63 on page 517 summarizes the Packet Forwarding Engine mapping and the supported port speeds.

Table 63: Rate Selectability of MX10003 MPC

<table>
<thead>
<tr>
<th>PIC</th>
<th>Port Number</th>
<th>Port Speed Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIC 0 (Fixed-port PIC)</td>
<td>0–5</td>
<td>40-Gigabit Ethernet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4x10-Gigabit Ethernet</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>NOTE:</strong> You can configure one or all 10G port operating in 4X10-Gigabit Ethernet mode to operate in 1-Gigabit Ethernet mode.</td>
</tr>
<tr>
<td>PIC 1 (Multi-Rate MIC)</td>
<td>0–11</td>
<td>100-Gigabit Ethernet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40-Gigabit Ethernet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4x10-Gigabit Ethernet</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>NOTE:</strong> On non-MACsec MIC, you can configure one or all the 4X10-Gigabit Ethernet port to 1-Gigabit Ethernet mode.</td>
</tr>
</tbody>
</table>

Starting with Junos OS Release 18.1R1, the non-MACsec MIC on the MX10003 routers support 1-Gigabit Ethernet mode also on 10-Gigabit Ethernet mode ports.

Each of the 100-Gigabit Ethernet or 40-Gigabit Ethernet port can be split to four 10-Gigabit Ethernet ports that can be configured to operate as 1-Gigabit Ethernet port. You can also use 4x10GE LR breakout optics (QSFP-4X10GE-LR) at the MX10003 end and 1-Gigabit Ethernet EX optics at the remote end. It is only optional to use Juniper optics (SFP-GE40KM) at the remote end, as any vendor’s EX (not SX or LX) optics can be used. Refer to Hardware Compatibility Tool for the list of pluggable transceivers supported on MX10003 router.

On MX10003 routers, when the port operates in 10-Gbps speed, you can change the operating speed to 1Gbps using the configuration **speed 1G** as follows:

```
set interfaces interface-name gigether-options speed 1g
```

Refer **speed (Gigabit Ethernet interface)** for more details.

Once you commit this configuration, the operating speed of the 10-Gbps port changes to 1-Gbps speed, but the **show interface** command displays for the field **Physical interface** (that is, the interface name prefix) as XE_/_/ and the **Speed Configuration** (that is, operating port speed) as **1GE**. On fixed-port PIC and non-MACsec MIC, you can configure one or all 10-Gbps port operating in 4X10-Gbps speed to operate in 1-Gbps speed.

1-Gbps speed is only supported in non-autonegotiation mode.
NOTE:

- Any interface operating at 10-Gigabit Ethernet mode can be independently converted to 1-Gigabit Ethernet mode. For example, in multi-rate connections through split cables, when one of the ports operates at 1GE mode, the other three ports can still be configured in 1GE or 10GE mode.

- The MACsec MIC does not support 1-Gbps speed.

- The rate selectability at PIC level and port level does not support 1-Gbps speed. But you can configure the port configured at 10-Gbps speed to operate at 1-Gbps speed using the `speed (Gigabit Ethernet interface)` configuration statement at Gigabit Ethernet interface level.

- The 1-Gbps operation mode is only supported in non-autonegotiation mode.

- ISSU is not supported for the interfaces that are configured with 1-Gigabit Ethernet mode. If ISSU upgrade is carried out in 1-Gigabit Ethernet mode, then the behavior is unexpected and traffic loss can be expected. Refer `request vmhost software in-service-upgrade` for more details.

To view the speed configured for the interface, execute the `show interfaces extensive` command. The `Speed Configuration` output parameter in the command output indicates the current operation speed of the interface. If the interface is configured with 1-Gbps speed, then `Speed Configuration` displays `1G`; if the interface is configured with 10-Gbps speed, `Speed Configuration` displays `AUTO`.

For example:

```
user@host>show interfaces xe-0/1/11:0 extensive
Physical interface: xe-0/1/11:0, Enabled, Physical link is Up
  Interface index: 284, SNMP ifIndex: 609, Generation: 383
  Link-level type: Ethernet, MTU: 9192, MRU: 9200, LAN-PHY mode, Speed: 10Gbps,
  BPDU Error: None, Loop Detect PDU Error: None, MAC-REWRITE Error: None,
  Loopback: None, Source filtering: Disabled, Flow control: Enabled,
  Speed Configuration: 1G
...
```

In this example, the `Speed Configuration` output parameter displays `1G`, which means the operation speed of `xe-0/1/11:0` interface is 1-Gbps speed.

MX10003 MPC has an aggregate forwarding capacity of 1.2 Tbps and a forwarding capacity of 400 Gbps on each Packet Forwarding Engine. Oversubscription of Packet Forwarding Engine capacity is not supported. The demand on each Packet Forwarding Engine must be less than or equal to its forwarding capacity. For more information see, “Supported Active Physical Ports for Configuring Rate Selectability to Prevent Oversubscription on MX10003 MPC” on page 500. For instance, for MX10003 MPC, the demand on each Packet Forwarding Engine must be less than or equal to 400 Gbps.

For example, on the fixed-port PIC, if you configure the port speed on one ports as 40 Gbps or on two port as 40 Gbps, then you can configure the ports on the MIC in one of the following ways:
• Three 100-Gigabit Ethernet interfaces
• Two 100-Gigabit Ethernet and two 40-Gigabit Ethernet interfaces
• Two 100-Gigabit Ethernet and eight 10-Gigabit Ethernet interfaces

The same rule is applicable to all Packet Forwarding Engines independently.

**NOTE:** Only the Interface that is already operating at 10GE mode can be configured to operate at 1GE mode using the `speed (Gigabit Ethernet interface)` configuration statement as follows:

```
set interfaces interface-name gigether-options speed 1g
```

Table 64 on page 519 summarizes the port mode configuration at the Packet Forwarding Engine level.

**Table 64: PFE Based Port Mode Configuration**

<table>
<thead>
<tr>
<th>Port Speed configuration on PIC1 (Gbps)</th>
<th>Port speed configuration on PIC0 (Gbps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
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<td>100</td>
<td>100</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 65 on page 519 summarizes the PIC mode configuration.

**Table 65: PIC Mode Configuration**

<table>
<thead>
<tr>
<th>Port Speed configuration on PIC1 (Gbps)</th>
<th>Port speed configuration on PIC0 (Gbps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>40</td>
<td>40</td>
</tr>
</tbody>
</table>

*Configure the number of ports to 0.*

Note the following caveats while configuring rate selectability on the MX10003 MPC:
• By default, the MX10003 router comes up with the PIC mode where all the interface operates at the same speed of 10-Gbps. That is, by default, both the PICs (PIC 0 and PIC 1) operate at 10-Gbps speed. To use different port speeds, you must first switch to the port mode and then change the default speed.

To change the default speed, you must select a port and configure a different port speed on it and reset both the PICs for the configuration to take effect. For example, select 40GE or 100GE on PIC 1 and 10GE on PIC 0. For this configuration to take effect, you must reset both PICs.

• Regardless of the line card—MIC (PIC1) or fixed-port PIC (PIC0) installed—you must configure both the PICs and all the associated ports, under the [edit chassis] hierarchy. Configuring ports on only one of the PICs results in an invalid configuration.

• The port speed configuration on the fixed-port PIC and the MIC must be homogenous. However, at port level you can configure port speeds in heterogeneous mode. For more information, see Configuring Rate Selectability on MX10003 MPC at Port Level.

For example, if you want to configure the port speed as 10 Gbps, the port speed of the fixed-port PIC and the MIC should be configured to 10 Gbps. If you want to configure the port speed as 40 Gbps, the port speed of the fixed-port PIC and the MIC should be configured to 40 Gbps. However, if you choose to configure all ports of the MX10003 MPC to operate as 100-Gigabit Ethernet interfaces, the ports on the MIC have to be configured to 100 Gbps and the number-of-ports number-of-active-physical-ports statement on the fixed-port PIC must be set to 0.

• When you configure rate selectability at the port level, only the configured ports are active. Other ports are disabled.

• When you choose an existing port speed configuration with an invalid port speed configuration, an alarm is generated indicating that the port speed configuration is invalid.

• You cannot configure the ports which will oversubscribe the Packet Forwarding Engine. For example, a combination of eleven 100-Gigabit Ethernet interfaces on the MIC and ten 10-Gigabit Ethernet interfaces on the fixed-port PIC will result in an invalid configuration. If you try to commit an invalid configuration, the configuration will get committed. However, the port will not be activated. You can execute the show chassis alarms to display the error message.

• You cannot configure rate selectability at the PIC level and the port level simultaneously. Error messages are displayed when you try to commit such configurations.

Invalid Port Configuration

You cannot configure the ports which will oversubscribe the Packet Forwarding Engine.

For example, a combination of eleven 100-Gigabit Ethernet interfaces on the MIC and ten 10-Gigabit Ethernet interfaces on the fixed-port PIC will result in an invalid configuration. If you try to commit an invalid configuration, the configuration will get committed. However, the port will not be activated. You can execute the show chassis alarms to display the error message. The valid configuration in this case would be eleven
100-Gigabit Ethernet interfaces on the MIC and eight 10-Gigabit Ethernet interfaces on the fixed-port PIC.

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.1R1</td>
<td>Starting with Junos OS Release 18.1R1, the non-MACsec MIC on the MX10003 routers support 1-Gigabit Ethernet mode also on 10-Gigabit Ethernet mode ports.</td>
</tr>
</tbody>
</table>

Related Documentation

- **MX10003 MPC on MX10003 Router Overview**
- Supported Active Physical Ports for Configuring Rate Selectability to Prevent Oversubscription on MX10003 MPC on page 500
- Configuring Rate Selectability on MX10003 MPC to Enable Different Port Speeds on page 531
- **speed (Gigabit Ethernet interface)**

**MX204 Router Rate-Selectability Overview**

The maximum amount of data that can be transmitted through a port at any given second either by a network device or by a component of the network device (such as a line card) is known as the port speed. Port speed is measured in kilobits per second (Kbps), gigabits per second (Gbps), and terabits per second (Tbps). If a port can be configured to support both single and multiple speeds, the port is known as a rate-selectable port. Because the port is part of a network device (router or switch) or a network component (such as MPC, MIC) the component is known as a rate-selectable component. Rate selectability enables you to configure different port speeds at the port level or at the PIC level.

The MX204 has four rate-selectable ports (referred to a PIC 0 ports) that can be configured as 100-Gigabit Ethernet ports or 40-Gigabit Ethernet port, or each port can be configured as four 10-Gigabit Ethernet ports (by using a breakout cable). The MX204 also has eight 10-Gigabit Ethernet ports (referred to as PIC 1 ports). On PIC 0 and PIC 1, you can configure the 10-Gigabit Ethernet port(s) to operate in 1-Gigabit Ethernet mode (using **speed (Gigabit Ethernet interface)** command). The four rate-selectable ports supports QSFP28/QSFP+ transceivers whereas the eight 10-Gigabit Ethernet ports supports SFP+ transceivers. Knowing the exact details of the port speeds for the PICs helps you to choose the speeds to configure on the ports or on the PICs. You can view the port speeds of the PIC by executing **show chassis pic** command. For more information, see MX204 Router Overview and “Supported Active Physical Rate-Selectable Ports to Prevent Oversubscription on MX204 Router” on page 502.

If your configuration does not comply to the following rules, it is an invalid configuration. In this case, the invalid configuration will not take in to effect and the router stays with the prior configuration:

- The MX204 routers contains one Packet Forwarding Engine that has a total of four ‘MACs’ (otherwise called as ‘port groups’). Two MACs out of four are pre-configured
as 1x100GE each and cannot be changed. The other two MACs can be channelized as one of the following each – either one 100-Gigabit Ethernet ports, or three 40-Gigabit Ethernet ports (or one or more ports can be channelized down to 10-Gigabit Ethernet ports too), or 12 10-Gigabit Ethernet ports.

NOTE:

• One Gigabit Ethernet port can also be substituted for 10-Gigabit Ethernet ports.
• You cannot use the same MAC (or ‘port groups’) on both PICs.

• Two modes - PIC and port modes are supported and both PICs must be running in same mode:
  • PIC mode is the default mode that shares MAC across PICs, and all ports on both PICs run at the same speed. On MX204 routers contain 24 10-Gigabit Ethernet ports as all 4 ports on PIC 0 are channelized down to four 10-Gigabit Ethernet ports (16) and using all eight 10-Gigabit Ethernet ports on PIC 1.
  • Port mode allows you to run ports at different speeds.
  • You cannot spread or share MACs across PICs.

NOTE:

• By default, the MX204 router comes up with the PIC mode where all the interface operates at the same speed of 10-Gbps. that is, by default, both the PICs (PIC 0 and PIC 1) operate at 10-Gbps speed. To use different port speeds, you must first switch to the port mode and then change the default speed.

To change the default speed, you must select a port and configure a different port speed on it and reset both the PICs for the configuration to take effect. For example, select 40GE or 100GE on PIC 0 and 10GE on PIC 1. For this configuration to take effect, you must reset both PICs.

• Not all port combinations will work. So, it is recommended to use the port-checker tool to check whether the combination of ports you want to use is valid or not.

• You can use the Hardware Compatibility Tool to find information about the pluggable transceivers supported on MX204 router.

The MX204 router supports two types of rate selectability configuration options:

• PIC Level Configuration: To configure all ports to operate at the same speed, you configure rate selectability at the PIC level.

• Port Level Configuration: To configure different port speeds for each port, you configure rate selectability at the port level, in which case only the ports that are configured are enabled.
To configure all ports to operate at the same speed, configure rate selectability at the PIC level, in which case you cannot configure the speed of individual ports. To configure rate selectability at the PIC level, use the `pic-mode` statement and specify the port speed. To configure different port speeds for each port, configure rate selectability at the port level, in which case only the ports that are configured are enabled. To configure rate selectability at the port level, use the `speed` statement to specify the speed of individual ports.

The examples below show the sample CLI command output of the port speed capability of the 4-port PIC 0 with QSFP+ transceivers and the 8-port PIC 1 with SFP+ transceivers on the MX204 router.

```
user@host> show chassis pic fpc-slot 0 pic-slot 0
...  
Port Speed Information:  
  Port   Capable Port Speeds
  0      4x10GE, 40GE, 100GE
  1      4x10GE, 40GE, 100GE
  2      4x10GE, 40GE, 100GE
  3      4x10GE, 40GE, 100GE
...  
user@host> show chassis pic fpc-slot 0 pic-slot 1
...  
Port Speed Information:  
  Port   Capable Port Speeds
  0      10GE
  1      10GE
  2      10GE
  3      10GE
  4      10GE
  5      10GE
  6      10GE
  7      10GE
...  
```

Table 63 on page 517 summarizes the rate selectability of the MX204 routers.

Table 66: Rate Selectability of MX204 Routers

<table>
<thead>
<tr>
<th>PIC</th>
<th>Port Number</th>
<th>Port Speed Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIC 0</td>
<td>0–3</td>
<td>100-Gigabit Ethernet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40-Gigabit Ethernet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4x10-Gigabit Ethernet</td>
</tr>
</tbody>
</table>

**NOTE:**
- Default port speed is 4x10 Gigabit Ethernet.
- Supports 1–Gbps speed on 10 Gigabit Ethernet ports.
Table 66: Rate Selectability of MX204 Routers (continued)

<table>
<thead>
<tr>
<th>PIC</th>
<th>Port Number</th>
<th>Port Speed Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIC 1</td>
<td>0–7</td>
<td>10 Gigabit Ethernet</td>
</tr>
</tbody>
</table>

**NOTE:** Supports 1–Gbps speed on 10 Gigabit Ethernet ports.

Starting with Junos OS Release 18.1R1, the 10-Gbps port can operate in 1-Gbps mode also.

Each of the four 100-Gigabit Ethernet or 40-Gigabit Ethernet port can be split to four 10-Gigabit Ethernet ports that can be configured to operate as 1-Gigabit Ethernet port. You can also use 4x10GE LR breakout optics (QSFPP-4X10GE-LR) at the MX204 end and 1-Gigabit Ethernet EX optics at the remote end. It is only optional to use Juniper optics (SFP-GE40KM) at the remote end, as any vendor’s EX (not SX or LX) optics can be used. Refer to Hardware Compatibility Tool for the list of pluggable transceivers supported on MX204 router.

MX204 router also support 1-Gigabit Ethernet port on the fixed 10-Gigabit Ethernet SFP ports with 1GE SFPs in it.

On MX204 routers, when the port is operating in 10-Gbps speed, you can change the operating speed to 1Gpbs using the configuration statement `Speed 1G` as follows:

```
set interfaces interface-name gigether-options speed 1g
```

Refer `speed (Gigabit Ethernet interface)` for more details.

Once you commit this configuration, the operating speed of the 10-Gbps port changes to 1-Gbps speed, but the `show interface` command displays for the field `Physical interface` (that is, the interface name prefix) as `XE/` and the `Speed Configuration` (that is, operating port speed) as `1GE`.

On MRATE PIC, each channel per port can be configured individually as 1-Gigabit Ethernet port.

---

**NOTE:**

- The interface name prefix must be xe.
- The rate selectability at PIC level and port level does not support 1-Gbps speed. But you can configure the port configured at 10-Gbps speed to operate at 1-Gbps speed using the `speed (Gigabit Ethernet interface)` configuration statement at Gigabit Ethernet interface level.
- The 1-Gbps operation mode is supported with `speed 1g` configuration. For optics other than SFP-T, in 1G mode, the peer interfaces must be configured to non-autonegotiation mode.
To view the speed configured for the interface, execute the `show interfaces extensive` command. The `Speed Configuration` output parameter in the command output indicates the current operation speed of the interface. If the interface is configured with 1-Gbps speed, then `Speed Configuration` displays 1G; if the interface is configured with 10-Gbps speed, `Speed Configuration` displays AUTO.

For example:

```
user@host> show interfaces xe-0/1/11:0 extensive
Physical interface: xe-0/1/11:0, Enabled, Physical link is Up
Interface index: 284, SNMP ifIndex: 609, Generation: 383
Link-level type: Ethernet, MTU: 9192, MRU: 9200, LAN-PHY mode, Speed: 10Gbps,
BPDU Error: None, Loop Detect PDU Error: None, MAC-REWRITE Error: None,
Loopback: None, Source filtering: Disabled, Flow control: Enabled,
Speed Configuration: 1G
```

In this example, the `Speed Configuration` output parameter displays 1G, which means the operation speed of xe-0/1/11:0 interface is 1-Gbps speed.

**User-Configurable Rate Selectability of MX204 Routers**

You can also configure rate selectability on MX204 routers. 

Table 67 on page 525 summarizes the user-configurable rate selectability of MX204 routers.

**Table 67: Configurable Rate Selectability of MX204 Router**

<table>
<thead>
<tr>
<th>Port Speed Configuration on PIC 0 (Gbps)</th>
<th>Port Speed Configuration on PIC 1 (Gbps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Configure the number of active ports to 0.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>40</td>
<td>0</td>
</tr>
<tr>
<td>Configure the number of active ports to 0.</td>
<td></td>
</tr>
</tbody>
</table>

Only the Interface that is already operating at 10GE mode can be configured to operate at 1GE mode using `speed (Gigabit Ethernet interface)` configuration statement as follows:

```
set interfaces interface-name gigether-options speed 1g
```

**NOTE:** The MX204 router does not support heterogeneous mode. That is, in PIC mode if 40-Gbps or 100-Gbps speed is configured on PIC 0, then the `number-of-ports` on PIC 1 must be configured to 0 only.
Maximum number of 10/40/100GE ports Configurable at PIC and Port Mode

Following table summarizes the maximum number of 10/40/100 Gigabit Ethernet ports per PIC configurable at PIC and port levels:

Table 68: Maximum number of 10/40/100 Gigabit Ethernet ports Configurable at PIC and Port Level

<table>
<thead>
<tr>
<th>Maximum Ports</th>
<th>Maximum Ports configurable at PIC Mode (on both PIC0 and PIC1)</th>
<th>Maximum Ports Configurable at Port Mode (on both PIC0 and PIC1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/1 Gigabit Ethernet Ports</td>
<td>24</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Which means 16 ports from PIC 0 and 8 Ports from PIC 1.</td>
<td>Which means 12 ports from PIC 0 and 8 Ports from PIC 1.</td>
</tr>
<tr>
<td>40 Gigabit Ethernet Ports</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Only 4 ports from PIC 0 as PIC 1 supports only 10 Gbps Speed.</td>
<td>Only 4 ports from PIC 0 as PIC 1 supports only 10 Gbps Speed.</td>
</tr>
<tr>
<td>100 Gigabit Ethernet Ports</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Only 4 ports from PIC 0 as PIC 1 supports only 10 Gbps Speed.</td>
<td>Only 4 ports from PIC 0 as PIC 1 supports only 10 Gbps Speed.</td>
</tr>
</tbody>
</table>

Port Configuration - PIC Level

On PIC 0, if each of the four ports is configured to operate at 100-Gbps speed, then you must configure all the 8 ports at PIC 1 to 0 (using number-of-ports statement). On PIC 0, if ports 0, 1, and 2 are set to 100-Gbps, and port 3 is set to 10-Gbps or 40-Gbps, then you should configure all the 8 ports at PIC 1 to 0 (using number-of-port statement), and so on as listed in the below table.

The following table only lists few valid combination of port speeds on PIC 0 and PIC1 of MX204 router. You are not limited to configure only the below mentioned example port configurations. For more valid port configuration values, refer port-checker tool.

Table 69: Port Configuration at PIC Level in MX204 Routers

<table>
<thead>
<tr>
<th>Port Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIC 0</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>Configure the number of active ports to 0.</td>
</tr>
</tbody>
</table>

| 100       | 100       |
| 100       | 10/40     |
| 0         |          |
| Configure the number of active ports to 0. |

| 100       | 100       |
| 10/40     | 10/40     |
| 10/40     | 10        |
| 10        | 10        |
| 10        | 10        |
| 10        | 10        |
| 10        | 10        |
| 10        | 10        |

| 100       | 10/40     |
| 10/40     | 10/40     |
| 10/40     | 10        |
| 10        | 10        |
| 10        | 10        |
| 10        | 10        |
| 10        | 10        |
| 10        | 10        |
**Table 69: Port Configuration at PIC Level in MX204 Routers (continued)**

<table>
<thead>
<tr>
<th>Port Mode</th>
<th>PIC 0</th>
<th>PIC 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10/40</td>
<td>10/40</td>
</tr>
</tbody>
</table>

Configure the number of ports to 0.

<table>
<thead>
<tr>
<th>PIC Mode</th>
<th>PIC 0 (with four rate-selectable ports)</th>
<th>PIC 1 (with eight 10-Gigabit Ethernet ports)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>40</td>
<td>40</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

Configure the number of active ports to 0.

Configure all the eight 10-Gigabit Ethernet ports to 10.

**NOTE:** Only the Interface that is already operating at 10GE mode can be configured to operate at 1GE mode using `speed (Gigabit Ethernet interface)` configuration statement as follows:

`set interfaces interface-name gigether-options speed 1g`

**Release History Table**

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.1R1</td>
<td>Starting with Junos OS Release 18.1R1, the 10-Gbps port can operate in 1-Gbps mode also.</td>
</tr>
</tbody>
</table>

**Related Documentation**

- Supported Active Physical Rate-Selectable Ports to Prevent Oversubscription on MX204 Router on page 502
- Configuring Rate Selectability on MX204 to Enable Different Port Speeds on page 534
- `speed`
- `speed (Gigabit Ethernet interface)`
- `show chassis pic on page 1945`
- `number-of-ports`
MPC10E-15C-MRATE Rate-Selectability Overview

MPC10E-15C-MRATE (15x100G) is a fixed-configuration Modular Port Concentrator (MPC) for MX240, MX480, and MX960 routers, that is capable of delivering up to 1.5T per-slot bandwidth. It consists of three PFE complexes per MPC and each PFE is capable of delivering up to 500G throughput. It supports three PICs per MPC, one PIC per PFE. Each PIC hosts five QSFP28 (5xQSFP28) ports that supports 4x10-Gbps, 40-Gbps, and 100-Gbps speeds using QSFP+, QSFP28 optics types. The 4x10-Gbps speed is supported using breakout cables.

For more information, see “Configuring Rate Selectability on MPC10E-15C-MRATE at PIC Level” on page 531. To configure different port speeds for each port, you configure rate selectability at the port level, in which case only the ports that are configured are enabled. For more information, see “Configuring Rate Selectability on MPC10E-15C-MRATE at Port Level” on page 533.

The ports on the MPC10E-15C-MRATE are called rate-selectable or multirate ports as they support multiple port speeds. You can choose to configure all ports in a PIC to operate at the same speed or configure all the ports at different supported speeds.

In MPC10E-15C-MRATE, you can choose to configure:

- A port in 4x10-Gigabit Ethernet mode using QSFP-4x10-Gigabit Ethernet optics and 4x10-Gigabit Ethernet breakout cables.
- A port in 40-Gigabit Ethernet mode using QSFP optics.
- A port in 100-Gigabit Ethernet mode using QSFP28 optics.

**NOTE:**

- When you change the speed at PIC level, the PIC restarts automatically with the new configured speed.
- When you change the speed of a particular port explicitly (by port-level speed configuration), then only that particular port is reset automatically and other ports in that PIC remain unaffected.

The MPC10E-15C-MRATE supports three Packet Forwarding Engines (PFEs). The forwarding capacity of each Packet Forwarding Engine is 500Gbps which cannot be oversubscribed. The MPC10E-15C-MRATE supports 15 ports. Each PFE is mapped to 5 ports of the PIC. Use the command `show chassis pic fpc-slot slot-number pic-slot slot-number` to display PFE mapping information and port speed information.

Table 63 on page 517 summarizes the Packet Forwarding Engine mapping and the supported port speeds.
Table 70: Rate Selectability of MPC10E-15C-MRATE

<table>
<thead>
<tr>
<th>PIC</th>
<th>Port Number</th>
<th>Port Speed Supported</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIC 0 (or PFE 0)</td>
<td>0-4</td>
<td>40-Gigabit Ethernet</td>
<td>• 4x10GE support using QSFP-4x10GE breakout optics.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4x10-Gigabit Ethernet</td>
<td>• 1x40GE support using QSFP optics.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100-Gigabit Ethernet</td>
<td>• 1x100GE support using QSFP28 optics.</td>
</tr>
<tr>
<td>PIC 1 (or PFE 1)</td>
<td>0-4</td>
<td>40-Gigabit Ethernet</td>
<td>NOTE: By default, all the active ports operate in 100-Gigabit Ethernet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4x10-Gigabit Ethernet</td>
<td>mode.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100-Gigabit Ethernet</td>
<td></td>
</tr>
<tr>
<td>PIC 2 (or PFE 2)</td>
<td>0-4</td>
<td>40-Gigabit Ethernet</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4x10-Gigabit Ethernet</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>100-Gigabit Ethernet</td>
<td></td>
</tr>
</tbody>
</table>

To view the speed configured for the interface, execute the show interfaces extensive command. The Speed output parameter in the command output indicates the current operation speed of the interface.

For example:

```
user@host>show interfaces et-4/1/0 extensive
Physical interface: et-4/1/0, Enabled, Physical link is Up
    Interface index: 220, SNMP ifIndex: 539, Generation: 223
    Link-level type: Ethernet, MTU: 1514, MRU: 1522, Speed: 100Gbps, BPDU Error: None,
    Loop Detect PDU Error: None, Loopback: Disabled, Source filtering: Disabled, Flow control: Enabled
    Pad to minimum frame size: Disabled
    Device flags : Present Running
    Interface flags: SNMP-Traps Internal: 0x4000
    Link flags : None
    CoS queues : 8 supported, 8 maximum usable queues
   Schedulers : 0
    Hold-times : Up 0 ms, Down 0 ms
    Damping : half-life: 0 sec, max-suppress: 0 sec, reuse: 0, suppress: 0, state: unsuppressed
    Current address: 00:ca:fe:91:00:01, Hardware address: f4:a7:39:a8:b5:7e
    Last flapped : 2019-01-03 13:17:40 PST (00:02:43 ago)
    Statistics last cleared: Never
    ...  
```

In this example, the Speed output parameter displays **100Gbps**, which means the operation speed of et-4/1/0 interface is 100-Gbps.

Note the following important information while configuring rate selectability on the MPC10E-15C-MRATE:
• By default, the MPC10E-15C-MRATE comes up with the PIC mode where all the interface operates at the same speed of 100-Gbps. That is, by default, all the PICs (PIC 0, PIC 1, and PIC 2) operate at 100-Gbps speed.

• When you configure rate selectability at the port level, only the configured ports are created in that PIC. Other ports are not created.

• You cannot configure rate selectability at the PIC level and the port level simultaneously. Commit fails when you try to apply such configuration.

User-Configurable Rate Selectability of MPC10E-15C-MRATE

You can also configure rate selectability on MPC10E-15C-MRATE.

Table 71 on page 530 summarizes the user-configurable rate selectability of MPC10E-15C-MRATE.

### Table 71: Port speed capability of MPC10E-15C-MRATE

<table>
<thead>
<tr>
<th>PIC</th>
<th>PIC level Profile</th>
<th>Port level Profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>100G</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>40G</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>10G</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**NOTE:** Different PICs in the MPC10E-15C-MRATE can operate at different speeds. That is, PIC speed at one PIC has no bearing on the other PICs in the MPC.

**Related Documentation**

- MPC10E-15C-MRATE Rate-Selectability Overview on page 528
- Supported Active Physical Ports for Rate Selectability to Prevent Oversubscription on MPC10E-15C-MRATE on page 505
- Configuring Rate Selectability on MPC10E-15C-MRATE to Enable Different Port Speeds on page 542
- speed (Gigabit Ethernet interface)
- MPC10E-15C-MRATE Overview
Configuring Rate Selectability on MX10003 MPC to Enable Different Port Speeds

Rate selectability enables you to configure the port speed either at the port level or at the MIC level. To configure all ports to operate at the same speed, configure rate selectability at the MIC level, in which case you cannot configure the speed of individual ports. To configure rate selectability at the MIC level, use the `pic-mode` statement and specify the port speed. To configure different port speeds for each port, configure rate selectability at the port level, in which case only the ports that are configured are enabled. To configure rate selectability at the port level, use the `speed` statement to specify the speed of individual ports. This topic describes how to configure port speeds at the port level and at the MIC or PIC level.

NOTE: Regardless of the line card—MIC (PIC1) or fixed-port PIC (PIC0) installed—you must configure both the PICs and all the associated ports, under the `[edit chassis]` hierarchy. Configuring ports on only one of the PICs results in an invalid configuration.

• Configuring Rate Selectability on MX10003 MPC at MIC/PIC Level on page 531
• Configuring Rate Selectability on MX10003 MPC at Port Level on page 533

Configuring Rate Selectability on MX10003 MPC at MIC/PIC Level

To configure all ports to operate at the same speed, configure rate selectability at the MIC or PIC level. When you configure rate selectability at the MIC or PIC level, all the ports of the MIC that support the configured speed operate at that speed. To prevent oversubscription and to ensure a guaranteed bandwidth, specify the number of active ports that operate at the configured speed by using the `number-of-ports number-of-active-physical-ports` statement. The MX10003 MPC supports port speeds of 10 Gbps, 40 Gbps, and 100 Gbps.

To configure rate selectability at the MIC/PIC level:

1. In configuration mode, navigate to the `[edit chassis fpc fpc-slot pic pic-number]` hierarchy level.

```
[edit]
user@host# edit chassis fpc fpc-slot pic pic-number
```

For example:

```
[edit]
user@host# edit chassis fpc 0 pic 0
```

2. Configure the `pic-mode pic-speed` statement to set the operating speed for the MIC. All ports of the MIC that support the configured speed operate at the configured speed. Values for the `pic-speed` option are 10G, 40G, and 100G.
[edit chassis fpc fpc-slot pic pic-number]
user@host# set pic-mode pic-speed

For example:

[edit chassis fpc 0 pic 0]
user@host# set pic-mode 10G

3. (Optional) To prevent oversubscription, you can choose to configure the number of active ports that operate at the port speed configured in Step 2. For information about the number of active ports and specific port numbers on the MX10003 MPC, see “Supported Active Physical Ports for Configuring Rate Selectability to Prevent Oversubscription on MX10003 MPC” on page 500.

[edit chassis fpc fpc-slot pic pic-number]
user@host# set number-of-ports number-of-active-physical-ports

For example:

[edit chassis fpc 0 pic 0]
user@host# set number-of-ports 8

4. Verify the configuration.

[edit chassis fpc 0 pic 0]
user@host# show
  pic-mode 10G;
  number-of-ports 8;

5. Commit your configuration changes.

In this example, you have configured 8 ports on the MPC with port speed of 10 Gbps. The other ports are disabled.
Configuring Rate Selectability on MX10003 MPC at Port Level

To configure different port speeds for each port, you configure rate selectability at the port level. Only the ports that are configured are enabled. Other ports are automatically disabled. Configuring rate selectability at the port level provides you the flexibility of operating individual ports of the PIC at different supported speeds.

If you want to configure a port speed of 40 Gbps on the MIC and the fixed-port PIC, you can choose any of the following example configurations:

- Configure one port of the fixed-port PIC as a 40-Gigabit Ethernet interface and three ports of the MIC as 40-Gigabit Ethernet interfaces.
- Configure two ports of the fixed-port PIC as 40-Gigabit Ethernet interfaces and three ports of the MIC as 40-Gigabit Ethernet interfaces.
- Configure three ports of the MIC as 40-Gigabit Ethernet interfaces and two ports of the fixed-port PIC as 40-Gigabit Ethernet interfaces.
- Configure four ports of the MIC as 40-Gigabit Ethernet interfaces only.

NOTE: While configuring rate selectability, when you switch to PIC mode from port mode or vice-versa, the PIC is reset automatically. However, when you change the port speed at the port level, the PIC has to be reset by executing the request chassis pic pic-slot mic-slot-number fpc-slot fpc-slot-number (offline | online) command. For guidelines on configuring rate selectability, see “Guidelines for Configuring Rate Selectability” on page 486.

To configure rate selectability at the port level:

1. In configuration mode, navigate to the [edit chassis fpc fpc-slot pic pic-number] hierarchy level.

   ```plaintext
   [edit ]
   user@host# edit chassis fpc fpc-slot pic pic-number
   ```

   For example:

   ```plaintext
   [edit ]
   user@host# edit chassis fpc 0 pic 0
   ```

2. To indicate the speed at which the ports operate, configure the speed statement for the desired ports. According to your requirements, you can choose the 10G, 40G, and 100G speed options.

   ```plaintext
   [edit chassis fpc fpc-slot pic pic-number]
   user@host# set port port-number speed (10G | 40G | 100G)
   ```

   For example:
3. Verify the configuration.

```plaintext
[edit chassis fpc 0 pic 0]
user@host# show port 0 {
  speed 10g;
}
port 1 {
  speed 10g;
}
port 3 {
  speed 40g;
}
```

4. Commit your configuration changes.

In this example, you have configured 2 ports with port speed of 10 Gbps and 1 port with port speed of 40 Gbps.

---

**NOTE:** Starting in Junos OS Release 18.1R1, the 10-Gbps port can operate in 1-Gbps mode also using the `speed (Gigabit Ethernet interface)` configuration statement at Gigabit Ethernet interface level. Refer to “MX10003 MPC Rate-Selectability Overview” on page 516 for more details.

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**Related Documentation**
- number-of-ports
- pic-mode
- speed
- Understanding Rate Selectability on page 482

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**Configuring Rate Selectability on MX204 to Enable Different Port Speeds**

Rate selectability enables you to configure the port speed either at the port level or at the PIC level. To configure all ports to operate at the same speed, configure rate selectability at the PIC level, in which case you cannot configure the speed of individual ports. To configure rate selectability at the PIC level, use the `pic-mode` statement and specify the port speed. To configure different port speeds for each port, configure rate selectability at the port level, in which case only the ports that are configured are enabled. To configure rate selectability at the port level, use the `speed` statement to specify the
speed of individual ports. This topic describes how to configure port speeds at the port level and at the PIC level.

Note the following caveats while configuring rate selectability on the MX204 routers:

1. If rate selectability is not configured, all ports of the MX204 router operate as 10-Gigabit Ethernet interfaces.
2. In PIC mode, the MX204 router does not support heterogeneous mode. That is, in PIC mode if 40-Gbps or 100-Gbps speed is configured on PIC 0, then the number-of-ports on PIC 1 must be configured to 0 only. For more information, see “MX204 Router Rate-Selectability Overview” on page 521.
3. The heterogeneous mode is supported only on port mode.
4. When you configure rate selectability at the port level, only the configured ports are active. Other ports are disabled.
5. When you choose an existing port speed configuration with an invalid port speed configuration, an alarm is generated indicating that the port speed configuration is invalid.
6. You cannot configure rate selectability at the PIC level and the port level simultaneously. Error messages are displayed when you try to commit such configurations.

Configuring Rate Selectability on MX204 at PIC Level

To configure all ports to operate at the same speed, you configure rate selectability at the PIC level. When you configure rate selectability at the PIC level, all the ports of the PIC that support the configured speed operate at that speed. To prevent oversubscription and ensure a guaranteed bandwidth, you can specify the number of active ports that operate at the configured speed by using the number-of-ports number-of-active-physical-ports statement. The MX204 has four rate-selectable ports (referred to as PIC 0 ports) that can be configured as 100-Gigabit Ethernet ports or 40-Gigabit Ethernet port, or each port can be configured as four 10-Gigabit Ethernet ports (by using a breakout cable). The MX204 also has eight 10-Gigabit Ethernet ports (referred to as PIC 1 ports).

To configure rate selectability at the PIC level:

1. In configuration mode, navigate to the [edit chassis fpc fpc-slot pic pic-number] hierarchy level.

```
[edit ]
user@host# edit chassis fpc fpc-slot pic pic-number
```

For example:

```
[edit ]
user@host# edit chassis fpc 0 pic 0
```
2. Configure the `pic-mode pic-speed` statement to set the operating speed for the PIC. All ports of the PIC that support the configured speed operate at the configured speed. Values for the `pic-speed` option are 10G, 40G, and 100G.

```
[edit chassis fpc fpc-slot pic pic-number]
user@host# set pic-mode pic-speed
```

For example:

```
[edit chassis fpc 0 pic 0]
user@host# set pic-mode 10G
```

3. (Optional) To prevent oversubscription, you can choose to configure the number of active ports that operate at the port speed configured in Step 2. For information about the number of active ports and specific port numbers on the MX204 routers see “Supported Active Physical Rate-Selectable Ports to Prevent Oversubscription on MX204 Router” on page 502.

```
[edit chassis fpc fpc-slot pic pic-number]
user@host# set number-of-ports number-of-active-physical-ports
```

For example:

```
[edit chassis fpc 0 pic 0]
user@host# set number-of-ports 4
```

4. Verify the configuration.

```
[edit chassis fpc 0 pic 0]
user@host# show
pic-mode 10G;
number-of-ports 4;
```

5. Commit your configuration changes.

In this example, you have configured 4 ports on the PIC0 with port speed of 10 Gbps.
Configuring Rate Selectability on MX204 at Port Level

To configure different port speeds for each port, you configure rate selectability at the port level. Only the ports that are configured are enabled. Other ports are automatically disabled. Configuring rate selectability at the port level provides you the flexibility of operating individual ports of the PIC at different supported speeds.

NOTE: When you change the port speed at the port level, you must reset the PIC for the configuration to take effect. Resetting the PIC takes several minutes and affects all the Packet Forwarding Engines. To avoid this, use the request chassis pic pic-slot mic-slot fpc-slot fpc-slot-number (offline | online) command to reset the PIC and apply your configuration changes. An alarm is generated indicating the change in port speed. For guidelines on configuring rate selectability, see “Guidelines for Configuring Rate Selectability” on page 486.

To configure rate selectability at the port level:

1. In configuration mode, navigate to the [edit chassis fpc fpc-slot pic pic-number] hierarchy level.

   [edit ]
   user@host# edit chassis fpc fpc-slot pic pic-number

   For example:

   [edit ]
   user@host# edit chassis fpc 0 pic 0

2. To indicate the speed at which the ports operate, configure the speed statement for the desired ports. According to your requirements, you can choose the 10G, 40G, or 100G speed options.

   [edit chassis fpc fpc-slot pic pic-number]
   user@host# set port port-number speed (10G | 40G | 100G)

   For example:

   [edit chassis fpc 0 pic 0]
   user@host# set port 0 speed 100G
   user@host# set port 1 speed 40G
   user@host# set port 2 speed 40G
   user@host# set port 3 speed 10G

3. Verify the configuration.

   [edit chassis fpc 0 pic 0]
   user@host# show
4. Commit your configuration changes.

In this example, you have configured 2 ports on the PIC0 with port speed of 40 Gbps, 1 port with port speed of 10 Gbps, and 1 port with port speed of 100 Gbps.

NOTE: Starting in Junos OS Release 18.1R1, the 10-Gbps port can operate in 1-Gbps mode also using the `speed (Gigabit Ethernet interface)` configuration statement at Gigabit Ethernet interface level. Refer to “MX10003 MPC Rate-Selectability Overview” on page 516 for more details.

Related Documentation
- number-of-ports
- pic-mode
- speed
- Understanding Rate Selectability on page 482
- MX204 Router Overview
- MX204 Router Rate-Selectability Overview on page 521
- Supported Active Physical Rate-Selectable Ports to Prevent Oversubscription on MX204 Router on page 502
- request chassis pic

Configuring Rate Selectability on JNP10K-2101 MPC to Enable Different Port Speeds

Rate selectability enables you to configure the port speed either at the port level or at the PIC level. To configure all ports to operate at the same speed, configure rate selectability at the PIC level, in which case you cannot configure the speed of individual ports. To configure rate selectability at the PIC level, use the `pic-mode` statement and specify the port speed. To configure different port speeds for each port, configure rate selectability at the port level, in which case only the ports that are configured are enabled. To configure rate selectability at the port level, use the `speed` statement to specify the
speed of individual ports. This topic describes how to configure port speeds at the port level and at the PIC level.

- Configuring Rate Selectability on JNP10K-2101 MPC at PIC Level on page 539
- Configuring Rate Selectability on JNP10K-LC2101 MPC at Port Level on page 540

### Configuring Rate Selectability on JNP10K-2101 MPC at PIC Level

To configure all ports to operate at the same speed, configure rate selectability at the PIC level. When you configure rate selectability at the PIC level, all the ports of the PIC that support the configured speed operate at that speed. To prevent oversubscription and to ensure a guaranteed bandwidth, specify the number of active ports that operate at the configured speed by using the `number-of-ports number-of-active-physical-ports` statement. The JNP10K-LC2101 MPC supports port speeds of 10 Gbps, 40 Gbps, and 100 Gbps.

To configure rate selectability at the PIC level:

1. In configuration mode, navigate to the `[edit chassis fpc fpc-slot pic pic-number]` hierarchy level.

   ```
   [edit ]
   user@host# edit chassis fpc fpc-slot pic pic-number
   ```

   For example:

   ```
   [edit ]
   user@host# edit chassis fpc 5 pic 2
   ```

2. Configure the `pic-mode pic-speed` statement to set the operating speed for the PIC. All ports of the PIC that support the configured speed operate at the configured speed. Values for the `pic-speed` option are 10G, 40G, and 100G.

   ```
   [edit chassis fpc fpc-slot pic pic-number]
   user@host# set pic-mode pic-speed
   ```

   For example:

   ```
   [edit chassis fpc 5 pic 2]
   user@host# set pic-mode 10G
   ```

3. (Optional) To prevent oversubscription, you can choose to configure the number of active ports that operate at the port speed configured in Step 2.
For example:

```
[edit chassis fpc fpc-slot pic pic-number]
user@host# set number-of-ports number-of-active-physical-ports
```

4. Verify the configuration.

```
[edit chassis fpc 5 pic 2]
user@host# show
pic-mode 10G;
number-of-ports 2;
```

5. Commit your configuration changes.

In this example, you have configured 2 ports on the MPC with port speed of 10 Gbps. The other ports are disabled.

### Configuring Rate Selectability on JNP10K-LC2101 MPC at Port Level

To configure different port speeds for each port, you configure rate selectability at the port level. Only the ports that are configured are enabled. Other ports are automatically disabled. Configuring rate selectability at the port level provides you the flexibility of operating individual ports of the PIC at different supported speeds.

#### NOTE:

While configuring rate selectability, when you switch to PIC mode from port mode or vice-versa, the PIC is reset automatically. However, when you change the port speed at the port level, the PIC has to be reset by executing the `request chassis pic pic-slot mic-slot-number fpc-slot fpc-slot-number (offline | online)` command. For guidelines on configuring rate selectability for JNP10K-LC2101, see “Guidelines for Configuring Rate Selectability” on page 486.

To configure rate selectability at the port level:

1. In configuration mode, navigate to the `[edit chassis fpc fpc-slot pic pic-number]` hierarchy level.

```
[edit ]
user@host# edit chassis fpc fpc-slot pic pic-number
```

For example:

```
[edit ]
user@host# edit chassis fpc 0 pic 0
```
2. To indicate the speed at which the ports operate, configure the `speed` statement for the desired ports. According to your requirements, you can choose the 10G, 40G, and 100G speed options.

**NOTE:** If you configure the speed as 100 Gbps for 3 ports and the Packet Forwarding Engine bandwidth is 240 Gbps, an alarm is raised as it is an invalid configuration. The value of only the first two ports support 100 Gbps. The other ports are disabled.

```
[edit chassis fpc fpc-slot pic pic-number]
user@host# set port port-number speed (10G | 40G | 100G)
```

For example:
```
[edit chassis fpc 0 pic 0]
user@host# set port 0 speed 10G
user@host# set port 1 speed 10G
user@host# set port 3 speed 40G
```

3. Verify the configuration.

```
[edit chassis fpc 0 pic 0]
user@host# show
port 0 {
    speed 10g;
}
port 1 {
    speed 10g;
}
port 3 {
    speed 40g;
}
```

4. Commit your configuration changes.

In this example, you have configured 2 ports with port speed of 10 Gbps and 1 port with port speed of 40 Gbps.

### Related Documentation
- `number-of-ports`
- `pic-mode`
- `speed`
- Understanding Rate Selectability on page 482
Configuring Rate Selectability on MPC10E-15C-MRATE to Enable Different Port Speeds

Rate selectability enables you to configure the port speed either at the port level or at the PIC level:

- To configure all ports to operate at the same speed, configure rate selectability at the PIC level, in which case you cannot configure the speed of individual ports. To configure rate selectability at the PIC level, use the `pic-mode` statement and specify the port speed.

- To configure different port speeds for each port in a PIC, configure rate selectability at the port level, in which case only the ports that are configured are created. To configure rate selectability at the port level, use the `speed` statement to specify the speed of individual ports.

- (Channelized mode) To specify the number of IFDs (or interfaces) that need to be created on a physical port for a specified speed, use the `number-of-sub-ports <number-of-sub-ports>` configuration statement. For example, on a given port that supports 4x10GE mode, if the `number-of-sub-ports` is 2, then two IFDs are created, namely `xe-x/y/z:0` and `xe-x/y/z:1`.

The `number-of-sub-ports` configuration statement can be used with rate selectability configuration at both PIC level and port level. The `number-of-sub-ports` configuration statement is effective only when the port speed is 10-Gbps. By default, four channels (or IFDs) is created for the 10-Gbps ports.

This topic describes how to configure port speeds at the port level and at the PIC level.

- Configuring Rate Selectability on MPC10E-15C-MRATE at PIC Level on page 542
- Configuring Rate Selectability on MPC10E-15C-MRATE at Port Level on page 544

Configuring Rate Selectability on MPC10E-15C-MRATE at PIC Level

To configure all ports to operate at the same speed, configure rate selectability at the PIC level. When you configure rate selectability at the PIC level, all the ports of the PIC that support the configured speed operate at that speed. To prevent oversubscription and to ensure a guaranteed bandwidth, specify the number of active ports that operate at the configured speed by using the `number-of-ports number-of-active-physical-ports` statement. The MPC10E-15C-MRATE MPC supports port speeds of 10 Gbps, 40 Gbps, and 100 Gbps.

To configure rate selectability at the PIC level:

1. In configuration mode, navigate to the `[edit chassis fpc fpc-slot pic pic-number]` hierarchy level.

   ```
   [edit ]
   user@host# edit chassis fpc fpc-slot pic pic-number
   ```

   For example:
2. Configure the `pic-mode pic-speed` statement to set the operating speed for the PIC. All ports of the PIC that support the configured speed operate at the configured speed. Values for the `pic-speed` option are 10G, 40G, and 100G.

```plaintext
[edit chassis fpc fpc-slot pic pic-number]
user@host# set pic-mode pic-speed
```

For example:

```plaintext
[edit chassis fpc 0 pic 0]
user@host# set pic-mode 10G
```

3. (Optional) To prevent oversubscription, you can choose to configure the number of active ports that operate at the port speed configured in Step 2. For information about the number of active ports and specific port numbers on the MPC10E-15C-MRATE MPC, see “Supported Active Physical Ports for Rate Selectability to Prevent Oversubscription on MPC10E-15C-MRATE” on page 505.

```plaintext
[edit chassis fpc fpc-slot pic pic-number]
user@host# set number-of-ports number-of-active-physical-ports
```

For example:

```plaintext
[edit chassis fpc 0 pic 0]
user@host# set number-of-ports 4
```

4. Verify the configuration.

```plaintext
[edit chassis fpc 0 pic 0]
user@host# show
pic-mode 10G;
n number-of-ports 4;
```

5. Commit your configuration changes.

In this example, you have configured four ports on the MPC with port speed of 10 Gbps. The other ports are disabled.
Configuring Rate Selectability on MPC10E-15C-MRATE at Port Level

To configure different port speeds for each port, you configure rate selectability at the port level. Only the configured ports are enabled. Other ports are automatically disabled. Configuring rate selectability at the port level provides you the flexibility of operating individual ports of the PIC at different supported speeds.

**NOTE:** While configuring rate selectability, when you switch to PIC mode from port mode or vice-versa, the PIC is reset automatically. For guidelines on configuring rate selectability, see “Guidelines for Configuring Rate Selectability” on page 486.

To configure rate selectability at the port level:

1. In configuration mode, navigate to the `[edit chassis fpc fpc-slot pic pic-number]` hierarchy level.

   ```
   [edit ]
   user@host# edit chassis fpc fpc-slot pic pic-number
   ```

   For example:

   ```
   [edit ]
   user@host# edit chassis fpc 0 pic 0
   ```

2. To indicate the speed at which the ports operate, configure the `speed` statement for the desired ports. According to your requirements, you can choose the 10G, 40G, and 100G speed options.

   ```
   [edit chassis fpc fpc-slot pic pic-number]
   user@host# set port port-number speed (10G | 40G | 100G)
   ```

   For example:

   ```
   [edit chassis fpc 0 pic 0]
   user@host# set port 0 speed 10G
   user@host# set port 1 speed 10G
   user@host# set port 3 speed 40G
   ```

3. Verify the configuration.

   ```
   [edit chassis fpc 0 pic 0]
   user@host# show port 0 {
     speed 10g;
   }
   port 1 {
     speed 10g;
   }
   ```
4. Commit your configuration changes.

In this example, you have configured two ports with port speed of 10 Gbps and one port with port speed of 40 Gbps.

---

### Understanding Interface Naming Conventions for MIC-MACSEC-20GE

By default, MIC-MACSEC-20GE operates in 1-Gigabit Ethernet mode. In this mode, the ports in the MIC are created as “ge” interfaces distributed across PIC0 and PIC1.

In 10-Gigabit Ethernet mode, the ports in the MIC will be created as “xe” interfaces on each on PIC 0 and PIC 1. In this mode, the 10G ports physically map to the front panel port 8 and 9 on the second PIC of the MIC (that is marked on the front panel of the MIC).

**NOTE:** In the 10G mode, only the marked ports are operational and other physical ports are disabled.

<table>
<thead>
<tr>
<th>PIC</th>
<th>1-Gigabit Ethernet Interface</th>
<th>10-Gigabit Ethernet Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIC 0</td>
<td>ge-x/0/[0-9]</td>
<td>xe-x/0/0</td>
</tr>
<tr>
<td>PIC 1</td>
<td>ge-x/1/[0-9]</td>
<td>xe-x/1/0</td>
</tr>
<tr>
<td>PIC 2</td>
<td>ge-x/2/[0-9]</td>
<td>xe-x/2/0</td>
</tr>
<tr>
<td>PIC 3</td>
<td>ge-x/3/[0-9]</td>
<td>xe-x/3/0</td>
</tr>
</tbody>
</table>
You should use the **pic-mode 10G** configuration command to set the PIC to operate in 10G mode. Both the PICs on a MIC must be configured in the same pic-mode, otherwise the configuration does not take effect. A chassis alarm is raised indicating a mis-configuration. Any mis-configuration will cause the PICs to assume default pic-mode, that is, to be in 20x1GE where all ports are in 1GE port speed.

**NOTE:** The 10-Gbps-capable ports (ports 8 and 9) of the 2x10GE/20x1GE MIC-MACSEC-20GE may show the link status as up while the peer side is down. In this case, it is recommended to disable auto-negotiation and set the speed to 1-Gbps on the peer side to bring the link up on the peer side.

The MIC-MACSEC-20GE MIC also provides 128-bit and 256-bit MACsec encryption on all the twenty 1GE and on the two 10GE ports in the following hardware configuration:

- Installed directly on the MX80 and MX104 routers
- Installed on MPC1, MPC2, MPC3, MPC3E, MPC2E, MPC2E-NG, and MPC3E-NG line cards on the MX240, MX480, and MX960 routers

By default, 128-bit MACsec encryption is supported.

The twenty 1-Gigabit Ethernet SFP ports distributes the ports across PIC0 and PIC1, that are logical PICs on the physical MIC. The two 10-Gigabit Ethernet SFP+ ports are physically located on PIC1. But, the 10-Gigabit interfaces are created by distributing the ports in either of the PICs.

**NOTE:**

- When the pic-mode is changed from 1-Gbps to 10-Gbps or vice versa, the Flexible PIC Concentrator (FPC) in MX240, MX480, MX960 routers and the Forwarding Engine Board (FEB) in MX80, MX104 routers undergoes an automatic bounce or a reboot.
- When the MIC-MACSEC-20GE is operating in the 10-Gbps mode, all the other 1-Gbps ports are disabled.

**Related Documentation**

- Understanding Rate Selectability on page 482
- Configuring Media Access Control Security (MACsec) on MX Series Routers
- cipher-suite on page 1248
- MPC1 on MX Series Routers Overview
- MPC2 on MX Series Routers Overview
- MPC3E on MX Series Routers Overview
Configuring Port Speed on Multi-Rate MICs

Configuring a port speed allows you to enable rate-selectability on a per-port basis. When you configure a speed on a per-port basis, you can use the same MIC hardware as you upgrade your network from OC3 to OC12 or OC48 speeds.

This feature is supported on MX Series routers with SONET/SDH OC3/STM1 (Multi-Rate) MICs (MIC-3D-8OC3OC12-4OC48-SFP and MIC-3D-4OC3OC12-1OC48-SFP), Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP (MIC-3D-8CHOC3-4CHOC12 and MIC-3D-4CHOC3-2CHOC12), and ATM MICs with SFP (MIC-3D-8OC3-2OC12-ATM).

To configure a port speed on the chassis for enabling rate-selectability on a per-port basis:

1. At the [edit chassis] hierarchy level in configuration mode, 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 oc12-stm4 ;
   user@host# set fpc fpc-slot pic pic-number port port-number speed oc3-stm1 ;
   user@host# set fpc fpc-slot pic pic-number port port-number speed oc48-stm16 ;`

   **NOTE:** You can configure the oc12-stm4, oc3-stm1, and oc48-stm16 port speed options for SONET/SDH OC3/STM1 (Multi-Rate) MICs. However, for Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP and ATM MICs, you can configure only the oc12-stm4 and oc3-stm1 port speed options.

   (MX Series with MPCs and ATM MICs with SFP) To configure up to OC12 CBR bandwidth speed per virtual circuit (VC) on an ATM MIC with SFP (MIC-3D-8OC3-2OC12-ATM), specify oc12-stm4 as the speed for the specified port. You can configure the oc12-stm4 port speed option only for ports 0 and 4 on an ATM MIC. If you configure the oc12-stm4 port speed option for port 0, then ports 1, 2, and 3 are disabled. Similarly, if you configure the oc12-stm4 port speed for port 4, then ports 5, 6, and 7 are disabled.

   For example:

   `[edit chassis]
   user@host# set fpc 3 pic 0 port 0 speed oc12-stm4`

2. Verify the configuration:
By default, rate-selectability is enabled on MX Series routers with SONET/SDH OC3/STM1 (Multi-Rate) MICs, Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP, and ATM MICs.

To disable rate-selectability on the 8-port SONET/SDH OC3/STM1 (Multi-Rate) MIC:

1. At the [edit chassis] hierarchy level in configuration mode, disable rate-selectability by using the no-multi-rate statement.

```
[edit chassis]
user@host# set fpc fpc-slot pic pic-number no-multi-rate
```

For example:

```
[edit chassis]
user@host# set fpc 3 pic 0 no-multi-rate
```

**NOTE:**
- The no-multi-rate statement is supported only on MIC-3D-8OC3OC12-4OC48.
- The no-multi-rate statement enables the first four ports [0 – 3] exclusively at OC48/STM16 speed.
- The no-multi-rate statement disables the last four ports [4 – 7].

2. Verify the configuration:

```
[edit chassis]
user@host# show fpc 3 {
    pic 0 {
        no-multi-rate;
    }
}
```
NOTE: You can disable rate-selectability by using the no-multi-rate statement only on the 8-port SONET/SDH OC3/STM1 (Multi-Rate) MIC with SFP. The no-multi-rate statement has no effect on the 4-port SONET/SDH OC3/STM1 (Multi-Rate) MIC with SFP, the Channelized SONET/SDH OC3/STM1 (Multi-Rate) MICs with SFP, or the ATM MIC.

Related Documentation
- speed
- no-multi-rate

Configuring Port Speed

Starting with Junos OS Release 15.1, some PICs support multiple port speeds. This procedure describes how to configure the port speed for these types of PICs.

To configure a PIC's port speed:
1. Navigate to the [edit chassis] hierarchy level.
2. Enter the port-speed statement at the [edit chassis fpc slot-number pic pic-number port port-number] hierarchy level.

```
[edit chassis]
user@host# set fpc fpc-slot pic pic-number port port-number port-speed ;
```

3. Specify the port speed that needs 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 port speed 10G;
user@host# set fpc fpc-slot pic pic-number port port-number port speed 40G;
user@host# set fpc fpc-slot pic pic-number port port-number port speed 100G;
```

Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.1</td>
<td>Starting with Junos OS Release 15.1, some PICs support multiple port speeds.</td>
</tr>
</tbody>
</table>

Related Documentation
- speed
Understanding Interface Naming Conventions for MPC1

MPC1 facilitates configuration compatibility and enables you to replace an MX DPC with an MPC1 or MPC2 without requiring configuration change. The chassis daemon process (chassisd) creates physical interfaces for the tunnels only if it finds an associated tunnel bandwidth configuration.

The naming convention for virtual tunnels, for example is as follows:

vt-mpc-slot/pic-slot/port-number.

On MPC1, the PIC slot could be 0 or 1. Both the PIC slots are associated with the Packet Forwarding Engine PFE 0. Table 73 on page 551 summarizes the MIC/PIC mapping for MPC1E and MPC1EQ.
<table>
<thead>
<tr>
<th>MIC Type</th>
<th>Number of PICs per MIC</th>
<th>PIC Slot</th>
<th>PIC</th>
<th>Interfaces Name</th>
<th>PFE Mapping</th>
</tr>
</thead>
<tbody>
<tr>
<td>20x1GE</td>
<td>2</td>
<td>0</td>
<td>PIC0:10x1GE</td>
<td>ge-x/0/0</td>
<td>PFE0</td>
</tr>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ge-x/2/2</td>
<td></td>
</tr>
</tbody>
</table>

Table 73: MIC/PIC Mapping for MPC1E and MPC1E-Q
<table>
<thead>
<tr>
<th>MIC Type</th>
<th>Number of PICs per MIC</th>
<th>MIC Slot</th>
<th>PIC</th>
<th>Interfaces Name</th>
<th>PFE Mapping</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-x/2/3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ge-x/2/4</td>
<td></td>
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Table 73: MIC/PIC Mapping for MPC1E and MPC1E-Q (continued)

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Table 73: MIC/PIC Mapping for MPC1E and MPC1E-Q (continued)

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Related Documentation
- MPC1 on MX Series Routers Overview

Understanding Interface Naming Conventions for MPC2

MPC2 facilitates configuration compatibility and enables you to replace an MX DPC with an MPC1 or MPC2 without requiring configuration change. The chassis daemon process (chassisd) creates physical interfaces for the tunnels only if it finds an associated tunnel bandwidth configuration.
The naming convention for virtual tunnels, for example is as follows:

vt-mpc-slot/pic-slot/port-number.

On MPC2, the pic-slot could be of the range 0 through 3. The logical pic slot 0 and slot 1 are associated with PFE 0 and logical MIC slot 2 and slot 3 are associated with PFE 1. Table 74 on page 556 summarizes the MIC/PIC mapping for MPC2E, MPC2E-Q, and MPC2E-EQ.
### Table 74: MIC/PIC Mapping for MPC2E, MPC2E-Q, and MPC2E-EQ

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Table 74: MIC/PIC Mapping for MPC2E, MPC2E-Q, and MPC2E-EQ (continued)

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Table 74: MIC/PIC Mapping for MPC2E, MPC2E-Q, and MPC2E-EQ (continued)

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### Table 74: MIC/PIC Mapping for MPC2E, MPC2E-Q, and MPC2E-EQ (continued)

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Table 74: MIC/PIC Mapping for MPC2E, MPC2E-Q, and MPC2E-EQ (continued)

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Related Documentation
- MPC2 on MX Series Routers Overview
CHAPTER 28

Configuring Gigabit Ethernet OTN Options

- Gigabit Ethernet OTN Options on page 562
- 10-Gigabit Ethernet OTN Options Configuration Overview on page 563
- Ethernet DWDM Interface Wavelength Overview on page 564
- Configuring the 10-Gigabit or 100-Gigabit Ethernet DWDM Interface Wavelength on page 564
- Understanding the P1-PTX-24-10G-W-SFPP PIC on page 566
- Configuring OTN Interfaces on P1-PTX-24-10G-W-SFPP PIC on page 571
- 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
- Understanding the features of ACX6360 on page 575
- Interface Mapping and Modulation format for ACX6360 on page 578
- Supported Optics Options on ACX6360 Routers on page 579
- Understanding Pre-FEC BER Monitoring and BER Thresholds on page 582
- Supported Forward Error Correction Modes on MX Series Routers on page 586
- Supported Forward Error Correction Modes on PTX Series Routers on page 587
- Supported Forward Error Correction Modes on ACX6360 Router on page 587
- Configuring 100-Gigabit DWDM OTN PICs on page 588
- Supported OTN Options on PTX Series Routers on page 591
- Supported OTN Options on MX Series Routers on page 598
- Supported OTN Options on ACX6360 Routers on page 606
- Understanding the P2-100GE-OTN PIC on page 611
- Configuring OTN Interfaces on P2-100GE-OTN PIC on page 615
- Understanding the MIC3-100G-DWDM MIC on page 619
- Configuring OTN Interfaces on MIC3-100G-DWDM MIC on page 623
- Understanding the PTX-5-100G-WDM PIC on page 627
- Configuring OTN Interfaces on PTX-5-100G-WDM PIC on page 631
- Understanding the PTX10K-LC1104 Line Card on page 636
- Interface Mapping and Modulation format for PTX10K-LC1104 Line Card on page 638
- Supported OTN Options on PTX10008 and PTX10016 Series Routers on page 639
Gigabit Ethernet OTN Options

The following example shows the configuration settings for Gigabit Ethernet OTN options:

```
[edit interfaces ge-fpc/pic/port]
figure-options {  
    bytes (figure-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 563
- 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 otnt-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 otnt-options statement at the [edit interfaces interfaceType-fpc/pic/port] hierarchy level.

Related Documentation

- otnt-options on page 1445
Ethernet Interfaces Feature Guide for Routing Devices

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:


By default, the wavelength is 1550.12 nanometers (nm), which corresponds to 193.40 terahertz (THz).

Table 75 on page 564 shows configurable wavelengths and the corresponding frequency for each configurable wavelength.

<table>
<thead>
<tr>
<th>Wavelength (nm)</th>
<th>Frequency (THz)</th>
<th>Wavelength (nm)</th>
<th>Frequency (THz)</th>
<th>Wavelength (nm)</th>
<th>Frequency (THz)</th>
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</thead>
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<td>1528.38</td>
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<td>194.40</td>
<td>1556.15</td>
<td>192.65</td>
</tr>
</tbody>
</table>

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 75 on page 564 shows configurable wavelengths and the corresponding frequency for each configurable wavelength.
Table 75: Wavelength-to-Frequency Conversion Matrix (continued)

<table>
<thead>
<tr>
<th>Wavelength (nm)</th>
<th>Frequency (THz)</th>
<th>Wavelength (nm)</th>
<th>Frequency (THz)</th>
<th>Wavelength (nm)</th>
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Table 75: Wavelength-to-Frequency Conversion Matrix (continued)

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</table>

Related Documentation

- Ethernet DWDM Interface Wavelength Overview on page 564
- Ethernet Interfaces Feature Guide for Routing Devices
- wavelength on page 1125

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 567
- Layer 2 and Layer 3 Features on page 569
- OTN Alarms and Defects on page 569
- TCA Alarms on page 570
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 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 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)

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:

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

2. Enable the OTN mode as OTU2e, OTU1e, or OTU2 for the interface.

   ```plaintext
   [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 to 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.

   ```plaintext
   [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.

   ```plaintext
   [edit interfaces interface-name otn-options]
   user@host# settti(odu-dapi|odu-expected-receive-dapi|odu-expected-receive-sapi |odu-sapi|otu-dapi|otu-expected-receive-dapi|otu-expected-receive-sapi| otu-sapi) ttl-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.

   ```plaintext
   [edit interfaces interface-name otn-options]
   user@host# set trigger(oc-lof|oc-lom|oc-los|oc-tsf|odu-ais|odu-bdi|odu-bei |odu-lae|odu-lck|odu-oci|odu-sd|odu-ttim|opu-ptim|otu-ais|otu-bdi| otu-fec-deg|otu-fec-exe|otu-lae|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|odu-tca-ses|odu-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
    ```
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 566
- optics-options on page 1444
- otn-options on page 1445
- signal-degrade on page 1111
- preemptive-fast-reroute on page 1108

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 582 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 611 for more information.
See “Supported OTN Options on PTX Series Routers” on page 591 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 588
- 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 2006
- `optics-options` on page 1444
- `otn-options` on page 1445

**Understanding the features of ACX6360**

Starting in Junos OS Release 18.2R1, the ACX6360 routers with CFP2-DCO pluggable coherent optics, provide high density long haul OTN transport solution.

The following sections explain the features in detail:

- Interface Features on page 576
- Section on page ?
Interface Features

The following interface features are supported on the ACX6360:

- Compliant with ITU G.709.
- Supports 8 CFP2 DCO optical modules.
- Supports minimum channel spacing of 6.25GHz.
- Ethernet pause frames—you can halt the Ethernet interface from transmitting packets for a configured period of time.
- Soft-decision forward error correction mode (SDFEC)—QPSK-100G, 8QAM-200G and 16QAM-200G modes of operation are supported.

Diagnostics tools:
- Line loopback
- Local loopback
- Fast reroute (FRR)—Based on configurable pre-FEC or configurable Q threshold for signal degrade.

SNMP management based on RFC 3591, Definitions of Managed Objects for the Optical Interface Type:
- Black Link MIB—jnx-bl.mib
- IFOTN MIB—jnx-ifotn.mib
- Optics MIB—jnx-optics.mib
- FRU MIB—jnx-fru.mib
- Threshold-crossing alerts
- BER performance monitoring
- FEC performance monitoring
- Optical performance monitoring

OTN Alarms and Defects

The following OTN alarms and defects are supported on the ACX6360 routers:

- SSF—Server Signal Failure
- TSF—Trail Signal Fail
- 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-SSF—Server Signal Fail
• OTU-TSF—Trail Signal Fail
• PRE_FEC_SD
• FE_PRE_FEC_SD
• 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-TTIM—DAPI or SAPI mismatch from expected to receive
• ODU-BEI—Backward Error Indication
• ODU-LTC—Loss of tandem connection
• ODU-SSF—Server Signal Fail
• ODU-TSF—Trail Signal Fail
• ODU-CSF—Client 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**

- Interface Mapping and Modulation format for ACX6360 on page 578
- Supported OTN Options on ACX6360 Routers on page 606
ACX6360 routers support 8 CFP2-DCO optical modules. For each CFP2-DCO optical module, 1 ot interface is created. Hence, 8 ot interfaces are created for ACX6360 routers. ACX6360 routers support only 100GE et interfaces and up to 2 et interfaces can be mapped to 1 ot interface, depending on the configured CFP2-DCO rate- 100G or 200G.

The optical interface to et mapping is displayed in the following table:

<table>
<thead>
<tr>
<th>&quot;ot-&quot;</th>
<th>Modulation Format</th>
<th>Mapped “et” Interface(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ot-0/1/0</td>
<td>QPSK-100G</td>
<td>et-0/1/0</td>
</tr>
<tr>
<td></td>
<td>8QAM-200G</td>
<td>et-0/1/0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-0/1/1</td>
</tr>
<tr>
<td></td>
<td>16QAM-200G</td>
<td>et-0/1/0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-0/1/1</td>
</tr>
<tr>
<td>ot-0/1/1</td>
<td>QPSK-100G</td>
<td>et-0/1/2</td>
</tr>
<tr>
<td></td>
<td>8QAM-200G</td>
<td>et-0/1/2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-0/1/3</td>
</tr>
<tr>
<td></td>
<td>16QAM-200G</td>
<td>et-0/1/2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-0/1/3</td>
</tr>
<tr>
<td>ot-0/1/2</td>
<td>QPSK-100G</td>
<td>et-0/1/4</td>
</tr>
<tr>
<td></td>
<td>8QAM-200G</td>
<td>et-0/1/4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-0/1/5</td>
</tr>
<tr>
<td></td>
<td>16QAM-200G</td>
<td>et-0/1/4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-0/1/5</td>
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<td>QPSK-100G</td>
<td>et-0/1/6</td>
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<td>8QAM-200G</td>
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<td></td>
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<td>et-0/1/6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-0/1/7</td>
</tr>
<tr>
<td>&quot;ot-&quot; interface</td>
<td>Modulation Format</td>
<td>Mapped &quot;et&quot; interface(s)</td>
</tr>
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<td>-------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>ot-0/1/4</td>
<td>QPSK-100G</td>
<td>et-0/1/8</td>
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<td>8QAM-200G</td>
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<td>et-0/1/14</td>
</tr>
<tr>
<td></td>
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<td>et-0/1/15</td>
</tr>
</tbody>
</table>

**Related Documentation**
- Understanding the features of ACX6360 on page 575

**Supported Optics Options on ACX6360 Routers**

Table 76 on page 580 lists the statements that are supported on ACX6360 routers at the [edit interfaces interface-name optics-options] hierarchy level.
Table 76: Statements Supported on ACX6360 Routers

<table>
<thead>
<tr>
<th>Statement</th>
<th>Options</th>
<th>Release</th>
<th>Interfaces Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>fec</td>
<td>sdfe0</td>
<td>sdfe05</td>
<td>18.3R1</td>
</tr>
<tr>
<td>high-polarization</td>
<td>-</td>
<td>18.2R1</td>
<td>ot</td>
</tr>
<tr>
<td>laser-enable</td>
<td>-</td>
<td>18.2R1</td>
<td>ot</td>
</tr>
<tr>
<td>los-alarm-threshold</td>
<td>-</td>
<td>18.2R1</td>
<td>ot</td>
</tr>
<tr>
<td>los-warn-threshold</td>
<td>-</td>
<td>18.2R1</td>
<td>ot</td>
</tr>
<tr>
<td>modulation-format</td>
<td>(16qam</td>
<td>8qam</td>
<td>qpsk)</td>
</tr>
<tr>
<td>signal-degrade</td>
<td>ber-threshold-clear value</td>
<td>18.3R1</td>
<td>ot</td>
</tr>
<tr>
<td></td>
<td>ber-threshold-signal-degrade value</td>
<td>18.3R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>interval value</td>
<td>18.3R1</td>
<td></td>
</tr>
<tr>
<td></td>
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<td>18.3R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>q-threshold-signal-degrade-clear</td>
<td>18.3R1</td>
<td></td>
</tr>
</tbody>
</table>
### Table 76: Statements Supported on ACX6360 Routers (continued)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Options</th>
<th>Release</th>
<th>Interfaces Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>tca</td>
<td>carrier-frequency-offset-high-tca</td>
<td>18.2R1</td>
<td>ot</td>
</tr>
<tr>
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<td>(enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>carrier-frequency-offset-low-tca</td>
<td>18.2R1</td>
<td>ot</td>
</tr>
<tr>
<td></td>
<td>(enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>fec-ber</td>
<td>18.2R1</td>
<td>ot</td>
</tr>
<tr>
<td></td>
<td>(enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>fec-corrected-errors-high-tca</td>
<td>18.2R1</td>
<td>ot</td>
</tr>
<tr>
<td></td>
<td>(enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>fec-ucorrected-words-high-tca</td>
<td>18.2R1</td>
<td>ot</td>
</tr>
<tr>
<td></td>
<td>(enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>laser-frequency-error-high-tca</td>
<td>18.2R1</td>
<td>ot</td>
</tr>
<tr>
<td></td>
<td>(enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>laser-frequency-error-low-tca</td>
<td>18.2R1</td>
<td>ot</td>
</tr>
<tr>
<td></td>
<td>(enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>pam-histogram-high-tca</td>
<td>18.2R1</td>
<td>ot</td>
</tr>
<tr>
<td></td>
<td>(enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>residual-isí-high-tca</td>
<td>18.2R1</td>
<td>ot</td>
</tr>
<tr>
<td></td>
<td>(enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>residual-isí-low-tca</td>
<td>18.2R1</td>
<td>ot</td>
</tr>
<tr>
<td></td>
<td>(enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>rx-power-high-tca</td>
<td>18.2R1</td>
<td>ot</td>
</tr>
<tr>
<td></td>
<td>(enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>rx-power-low-tca</td>
<td>18.2R1</td>
<td>ot</td>
</tr>
<tr>
<td></td>
<td>(enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>snr-low-tca</td>
<td>18.2R1</td>
<td>ot</td>
</tr>
<tr>
<td></td>
<td>(enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
</tbody>
</table>
### Related Documentation

- Supported Forward Error Correction Modes on ACX6360 Router on page 587

### 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

Starting in Junos OS Release 18.3R1, Optical transport interfaces on ACX6360 Routers support monitoring the condition of an optical link by using the pre-forward error correction (pre-FEC) bit error rate (BER). Refer to “Supported Forward Error Correction Modes on ACX6360 Router” on page 587 for more details.
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 32 on page 583. 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 32: Pre-FEC BER Monitoring](image)

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 `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 Q²-factor measurements (also known as Q-factor). Q²-factor is expressed in units of decibels relative to a Q²-factor of zero (dBQ). Q²-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 Q²-factor to BER to enter them in the CLI by using scientific notation. BER can be converted to Q²-factor by using the following equation:

\[
Q^2\text{-factor} = 20 \times \log_{10}(\sqrt{2} \times \text{erfcinv}(2 \times \text{BER})))
\]

**TIP:** To convert between Q²-factor and BER in a spreadsheet program, you can approximate the values by using the following formulas:

- To calculate Q²-factor:
  \[
  = 20 \times \log_{10}(−\text{NORMSINV}(\text{BER}))
  \]

- To calculate BER:
  \[
  = 1 − \text{NORMSDIST}(10^{-0.05 \times Q^2\text{-factor}}))
  \]
Table 77 on page 585 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 77: Example—Signal Degrade and Clear Threshold Values at 1 dBQ

<table>
<thead>
<tr>
<th>PIC</th>
<th>FEC Type</th>
<th>FEC Limit</th>
<th>Signal Degrade Threshold</th>
<th>Clear Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Q^2-Factor</td>
<td>BER</td>
<td>Q^2-Factor</td>
</tr>
<tr>
<td>P1-PTX-2-100G-WDM</td>
<td>SD-FEC</td>
<td>6.7 dBQ</td>
<td>1.5E-2</td>
<td>7.7 dBQ</td>
</tr>
<tr>
<td>P2-100GE-OTN</td>
<td>G.709 GFEC</td>
<td>11.5 dBQ</td>
<td>8.0E-5</td>
<td>12.5 dBQ</td>
</tr>
<tr>
<td>P1-PTX-24-10G-W-SFP+</td>
<td>G.975.11.4 (UFEC)</td>
<td>9.1 dBQ</td>
<td>2.2E-3</td>
<td>10.1 dBQ</td>
</tr>
<tr>
<td></td>
<td>G.975.11.7 (EFEC)</td>
<td>9.6 dBQ</td>
<td>1.3E-3</td>
<td>10.6 dBQ</td>
</tr>
<tr>
<td></td>
<td>G.709 GFEC</td>
<td>11.5 dBQ</td>
<td>8.0E-5</td>
<td>12.5 dBQ</td>
</tr>
</tbody>
</table>

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^2-factor to BER). Table 78 on page 585 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 78: Example—Signal Degrade and Clear Thresholds After Configuration

<table>
<thead>
<tr>
<th>PIC</th>
<th>FEC Type</th>
<th>FEC Limit</th>
<th>Signal Degrade Threshold</th>
<th>Clear Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Q^2-Factor</td>
<td>BER</td>
<td>Q^2-Factor</td>
</tr>
<tr>
<td>P1-PTX-2-100G-WDM</td>
<td>SD-FEC</td>
<td>6.7 dBQ</td>
<td>1.5E-2</td>
<td>9.7 dBQ</td>
</tr>
<tr>
<td>P2-100GE-OTN</td>
<td>G.709 GFEC</td>
<td>11.5 dBQ</td>
<td>8.0E-5</td>
<td>14.5 dBQ</td>
</tr>
</tbody>
</table>

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Table 78: Example—Signal Degrade and Clear Thresholds After Configuration (continued)

<table>
<thead>
<tr>
<th>PIC</th>
<th>FEC Type</th>
<th>FEC Limit Q²-Factor</th>
<th>BER</th>
<th>Signal Degrade Threshold Q²-Factor</th>
<th>BER</th>
<th>Clear Threshold Q²-Factor</th>
<th>BER</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1-PTX-24-10G-W-SFPP</td>
<td>G.975.11.4 (UFEC)</td>
<td>9.1 dBQ</td>
<td>2.2E-3</td>
<td>12.1 dBQ</td>
<td>2.8E-5</td>
<td>13.1 dBQ</td>
<td>3.1E-6</td>
</tr>
<tr>
<td></td>
<td>G.975.11.7 (EFEC)</td>
<td>9.6 dBQ</td>
<td>1.3E-3</td>
<td>12.6 dBQ</td>
<td>1.1E-5</td>
<td>13.6 dBQ</td>
<td>9.1E-7</td>
</tr>
<tr>
<td></td>
<td>G.709 GFEC</td>
<td>11.5 dBQ</td>
<td>8.0E-5</td>
<td>14.5 dBQ</td>
<td>4.8E-8</td>
<td>15.5 dBQ</td>
<td>1.1E-9</td>
</tr>
</tbody>
</table>

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.

Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.3R1</td>
<td>Starting in Junos OS Release 18.3R1, Optical transport interfaces on ACX6360 Routers support monitoring the condition of an optical link by using the pre-forward error correction (pre-FEC) bit error rate (BER).</td>
</tr>
</tbody>
</table>

Related Documentation

- 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
- Configuring 100-Gigabit DWDM OTN PICs on page 588
- Supported OTN Options on ACX6360 Routers on page 606
- Supported Forward Error Correction Modes on ACX6360 Router on page 587

Supported Forward Error Correction Modes on MX Series Routers

Table 79 on page 586 lists the FEC modes that are supported on MX 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 line card:

**Supported Forward Error Correction Modes on MX Series Routers**

<table>
<thead>
<tr>
<th>Line Card</th>
<th>FEC Mode</th>
<th>Port Speed</th>
<th>Junos Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPC5E-40G10G</td>
<td>(gfec</td>
<td>efec</td>
<td>none</td>
</tr>
</tbody>
</table>

Supported Forward Error Correction Modes on MX Series Routers
Table 79: FEC modes Supported on MX Series Routers (continued)

<table>
<thead>
<tr>
<th>Line Card</th>
<th>FEC Mode</th>
<th>Port Speed</th>
<th>Junos Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPC5E-100G10G</td>
<td>(gfec</td>
<td>efec</td>
<td>none</td>
</tr>
<tr>
<td>MIC6-10G-OTN</td>
<td>(gfec</td>
<td>efec</td>
<td>none</td>
</tr>
<tr>
<td>MIC6-100G-CFP2</td>
<td>(gfec</td>
<td>none )</td>
<td>100G (GFEC only)</td>
</tr>
<tr>
<td>MIC3-100G-DWDM</td>
<td>gfec</td>
<td>hgfec</td>
<td>sdfec</td>
</tr>
</tbody>
</table>

Related Documentation
- fec on page 1085
- Understanding Pre-FEC BER Monitoring and BER Thresholds on page 582

Supported Forward Error Correction Modes on PTX Series Routers

Table 80 on page 587 lists the FEC modes that are supported on PTX Series routers at the [edit interfaces interface-name otn-options] hierarchy level.

Table 80: FEC Modes Supported on PTX Series Routers

<table>
<thead>
<tr>
<th>Line Card</th>
<th>FEC Mode</th>
<th>Port Speed</th>
<th>Junos Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1-PTX-24-10G-W-SFPP</td>
<td>(gfec</td>
<td>efec</td>
<td>none</td>
</tr>
<tr>
<td>P2-10G-40G-QSFPP</td>
<td>(gfec</td>
<td>efec</td>
<td>none</td>
</tr>
<tr>
<td>P2-100GE-OTN</td>
<td>(gfec</td>
<td>none )</td>
<td>100G (GFEC only)</td>
</tr>
<tr>
<td>P1-PTX-2-100G-WDM</td>
<td>(gfec-sdfec)</td>
<td>100G</td>
<td>13.2 (PTX5000) 13.3 (PTX3000)</td>
</tr>
<tr>
<td>PTX-5-100G-WDM</td>
<td>gfec</td>
<td>sdfec</td>
<td>100G</td>
</tr>
</tbody>
</table>

Related Documentation
- fec on page 1085
- Understanding Pre-FEC BER Monitoring and BER Thresholds on page 582

Supported Forward Error Correction Modes on ACX6360 Router

Table 79 on page 586 lists the FEC modes that are supported on ACX6360 routers at the [edit interfaces interface-name optics-options] hierarchy level.
Table 81: FEC modes Supported on ACX6360 Routers

<table>
<thead>
<tr>
<th>FEC Mode</th>
<th>Modulation Format</th>
<th>Port Speed</th>
<th>Junos Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>sdfec</td>
<td>QPSK</td>
<td>100G</td>
<td>18.3R1</td>
</tr>
<tr>
<td>sdfec15</td>
<td>QPSK</td>
<td>100G</td>
<td>18.3R1</td>
</tr>
<tr>
<td>sdfec15</td>
<td>8-QAM</td>
<td>200G</td>
<td>18.3R1</td>
</tr>
<tr>
<td>sdfec15</td>
<td>16-QAM</td>
<td>200G</td>
<td>18.3R1</td>
</tr>
</tbody>
</table>

Related Documentation
- fec on page 1085
- Understanding Pre-FEC BER Monitoring and BER Thresholds on page 582
- Supported OTN Options on ACX6360 Routers on page 606

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 574.

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 Integrated Transceiver 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 **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 582 for more information about pre-FEC BER monitoring and determining BER threshold settings.

**Related Documentation**
- optics-options on page 1444
- otn-options on page 1445
- signal-degrade on page 1111
- preemptive-fast-reroute on page 1108
Supported OTN Options on PTX Series Routers

Table 76 on page 580 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 82: Statements Supported on 100-Gigabit Ethernet PICs on PTX Series Routers

<table>
<thead>
<tr>
<th>Statement</th>
<th>Options</th>
<th>PI-PTX-2-100G-WDM (PTX5000 / PTX3000)</th>
<th>P2-100GE-OTN (PTX5000)</th>
<th>P[PTX5000] (PTX5000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>bytes</td>
<td>transmit-payload-type value</td>
<td>13.2/13.3</td>
<td>14.1R2</td>
<td>14.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fec</td>
<td>(efec</td>
<td>gfec</td>
<td>gfec-sdfec</td>
<td>none</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>insert-odu-lck</td>
<td>-</td>
<td>13.2/13.3</td>
<td>14.1R2</td>
<td>14.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>insert-odu-oci</td>
<td>-</td>
<td>13.2/13.3</td>
<td>14.1R2</td>
<td>14.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>is-ma</td>
<td></td>
<td>13.2/13.3</td>
<td>NA</td>
<td>14.2</td>
</tr>
<tr>
<td></td>
<td>no-is-ma</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>laser-enable</td>
<td>-</td>
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Table 82: Statements Supported on 100-Gigabit Ethernet PICs on PTX Series Routers (continued)

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### Table 82: Statements Supported on 100-Gigabit Ethernet PICs on PTX Series Routers (continued)

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### Table 82: Statements Supported on 100-Gigabit Ethernet PICs on PTX Series Routers (continued)

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Table 82: Statements Supported on 100-Gigabit Ethernet PICs on PTX Series Routers (continued)

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## Table 82: Statements Supported on 100-Gigabit Ethernet PICs on PTX Series Routers (continued)

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<td>otu-ttim</td>
<td>(hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
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Table 82: Statements Supported on 100-Gigabit Ethernet PICs on PTX Series Routers (continued)

<table>
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<tr>
<th>Statement</th>
<th>Options</th>
<th>P1-PTX-2-100G-WDM (PTX5000 / PTX3000)</th>
<th>P2-100GE-OTN (PTX5000)</th>
<th>P1-PTX-24-10G-W-SFPP (PTX5000)</th>
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<tbody>
<tr>
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<td>odu-dapi identifier</td>
<td>13.2/13.3</td>
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<td>13.2/13.3</td>
<td>14.1R2</td>
<td>14.2</td>
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<td>identifier</td>
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<td>odu-expected-receive-sapi</td>
<td>13.2/13.3</td>
<td>14.1R2</td>
<td>14.2</td>
</tr>
<tr>
<td></td>
<td>identifier</td>
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<td>odu-sapi</td>
<td>13.2/13.3</td>
<td>14.1R2</td>
<td>14.2</td>
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<td>13.2/13.3</td>
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<td>14.1R2</td>
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</table>

Related Documentation
- 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
- Configuring 100-Gigabit DWDM OTN PICs on page 588

Supported OTN Options on MX Series Routers

Table 83 on page 599 lists the statements that are supported on 100-Gigabit Ethernet MICs on MX 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 83: Statements Supported on 100-Gigabit Ethernet MICs on MX Series Routers

<table>
<thead>
<tr>
<th>Statement</th>
<th>Options</th>
<th>MIC6-100G-CFP2 (MX2010 / MX2020)</th>
<th>MIC3-100G-DWDM (MX240, MX480, MX960, MX2010, and MX2020)</th>
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<td>gfec</td>
<td>gfec-sdfec</td>
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<td></td>
<td>(gfec,hgfec,sdfec)</td>
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<td>15.1F5</td>
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<td>13.3R3</td>
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<td>-</td>
<td>13.3R3</td>
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<tr>
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<td>no-start-measurement</td>
<td>start-measurement</td>
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<td>ber-threshold-clear value</td>
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<td>ber-threshold-signal-degrade value</td>
<td>13.3R3</td>
<td>15.1F5</td>
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<td></td>
<td>interval value</td>
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### Table 83: Statements Supported on 100-Gigabit Ethernet MICs on MX Series Routers (continued)

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<tr>
<th>Statement</th>
<th>Options</th>
<th>MIC6-100G-CFP2 (MX2010 / MX2020)</th>
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<td>no-enable-tca</td>
<td>threshold</td>
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<td>odu-tca-es</td>
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<tr>
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<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
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<td>no-enable-tca</td>
<td>threshold</td>
</tr>
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</tr>
<tr>
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<td>no-enable-tca</td>
<td>threshold</td>
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<tr>
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<td>no-enable-tca</td>
<td>threshold</td>
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<td>threshold</td>
</tr>
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<td>15.1F5</td>
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<td>threshold</td>
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<td>threshold</td>
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### Table 83: Statements Supported on 100-Gigabit Ethernet MICs on MX Series Routers (continued)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Options</th>
<th>MIC6-100G-CFP2 (MX2010 / MX2020)</th>
<th>MIC3-100G-DWDM (MX240, MX480, MX960, MX2010, and MX2020)</th>
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<td>otu-tca-uas</td>
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<td>no-enable-tca</td>
<td>threshold</td>
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</table>
Table 83: Statements Supported on 100-Gigabit Ethernet MICs on MX Series Routers (continued)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Options</th>
<th>MIC6-100G-CFP2 (MX2010 / MX2020)</th>
<th>MIC3-100G-DWDM (MX240, MX480, MX960, MX2010, and MX2020)</th>
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<tbody>
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<td>up</td>
<td>ignore)</td>
</tr>
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<td>NA</td>
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</tr>
<tr>
<td>Statement</td>
<td>Options</td>
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Table 83: Statements Supported on 100-Gigabit Ethernet MICs on MX Series Routers (continued)

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<tr>
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<th>Options</th>
<th>MIC6-100G-CFP2 (MX2010 / MX2020)</th>
<th>MIC3-100G-DWDM (MX240, MX480, MX960, MX2010, and MX2020)</th>
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<tbody>
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<td>no-odu-sapi-first-byte-nul</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>otu-dapi identifier</td>
<td>13.3R3</td>
<td>15.1F5</td>
</tr>
<tr>
<td></td>
<td>otu-dapi-first-byte-nul</td>
<td>no-odu-dapi-first-byte-nul</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>otu-expected-receive-dapi identifier</td>
<td>13.3R3</td>
<td>15.1F5</td>
</tr>
<tr>
<td></td>
<td>otu-expected-receive-dapi-first-byte-nul</td>
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<td>15.1F5</td>
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<td>otu-expected-receive-sapi identifier</td>
<td>13.3R3</td>
<td>15.1F5</td>
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<td></td>
<td>otu-sapi identifier</td>
<td>13.3R3</td>
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<td>otu-sapi-first-byte-nul</td>
<td>no-odu-sapi-first-byte-nul</td>
<td>NA</td>
</tr>
</tbody>
</table>

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Supported OTN Options on ACX6360 Routers

Table 84 on page 606 lists the statements that are supported on ACX6360 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>
<thead>
<tr>
<th>Statement</th>
<th>Options</th>
<th>Junos Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>bytes (otn-options)</td>
<td>transmit-payload-type value</td>
<td>18.3R1</td>
</tr>
<tr>
<td>insert-odu-lck</td>
<td>-</td>
<td>18.3R1</td>
</tr>
<tr>
<td>insert-odu-oci</td>
<td>-</td>
<td>18.3R1</td>
</tr>
<tr>
<td>is-ma</td>
<td>no-is-ma</td>
<td>-</td>
</tr>
<tr>
<td>line-loopback</td>
<td>no-line-loopback</td>
<td>-</td>
</tr>
<tr>
<td>local-loopback</td>
<td>no-local-loopback</td>
<td>-</td>
</tr>
<tr>
<td>odu-ttim-action-enable</td>
<td>no-odu-ttim-action-enable</td>
<td>-</td>
</tr>
<tr>
<td>otu-ttim-action-enable</td>
<td>no-otu-ttim-action-enable</td>
<td>-</td>
</tr>
<tr>
<td>prbs</td>
<td>no-prbs</td>
<td>-</td>
</tr>
<tr>
<td>preemptive-fast-reroute</td>
<td>backward-frr-enable</td>
<td>no-backward-frr-enable</td>
</tr>
<tr>
<td>signal-degrade-monitor-enable</td>
<td>no-signal-degrade-monitor-enable</td>
<td>18.3R1</td>
</tr>
<tr>
<td>odu-backward-frr-enable</td>
<td>no-odu-backward-frr-enable</td>
<td>NA</td>
</tr>
<tr>
<td>odu-signal-degrade-monitor-enable</td>
<td>no-odu-signal-degrade-monitor-enable</td>
<td>NA</td>
</tr>
<tr>
<td>Statement</td>
<td>Options</td>
<td>Junos Version</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------------------------------------------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>tca</td>
<td>odu-tca-bbe (enable-tca</td>
<td>no-enable-tca</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>odu-tca-bbe-fe (enable-tca</td>
<td>no-enable-tca</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>odu-tca-es (enable-tca</td>
<td>no-enable-tca</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>odu-tca-es-fe (enable-tca</td>
<td>no-enable-tca</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>odu-tca-ses (enable-tca</td>
<td>no-enable-tca</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>odu-tca-ses-fe (enable-tca</td>
<td>no-enable-tca</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>odu-tca-uas (enable-tca</td>
<td>no-enable-tca</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>otu-tca-bbe (enable-tca</td>
<td>no-enable-tca</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>otu-tca-bbe-fe (enable-tca</td>
<td>no-enable-tca</td>
</tr>
<tr>
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<td></td>
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<tr>
<td></td>
<td>otu-tca-es (enable-tca</td>
<td>no-enable-tca</td>
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<tr>
<td></td>
<td>otu-tca-es-fe (enable-tca</td>
<td>no-enable-tca</td>
</tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>otu-tca-ses (enable-tca</td>
<td>no-enable-tca</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>otu-tca-ses-fe (enable-tca</td>
<td>no-enable-tca</td>
</tr>
</tbody>
</table>
### Table 84: Statements Supported on ACX6360 Routers (continued)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Options</th>
<th>Junos Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>otu-tca-uas</td>
<td>(enable-tca</td>
<td>no-enable-tca</td>
</tr>
<tr>
<td>otu-tca-uas-fe</td>
<td>(enable-tca</td>
<td>no-enable-tca</td>
</tr>
</tbody>
</table>
### Table 84: Statements Supported on ACX6360 Routers (continued)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Options</th>
<th>Junos Version</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>trigger trigger-identifier</code></td>
<td><code>oc-lof</code> (hold-time (down</td>
<td>up)</td>
</tr>
<tr>
<td></td>
<td><code>oc-lom</code> (hold-time (down</td>
<td>up)</td>
</tr>
<tr>
<td></td>
<td><code>oc-tsf</code> (hold-time (down</td>
<td>up)</td>
</tr>
<tr>
<td></td>
<td><code>odu-ais</code> (hold-time (down</td>
<td>up)</td>
</tr>
<tr>
<td></td>
<td><code>odu-bdi</code> (hold-time (down</td>
<td>up)</td>
</tr>
<tr>
<td></td>
<td><code>odu-bei</code> (hold-time (down</td>
<td>up)</td>
</tr>
<tr>
<td></td>
<td><code>odu-iae</code> (hold-time (down</td>
<td>up)</td>
</tr>
<tr>
<td></td>
<td><code>odu-lck</code> (hold-time (down</td>
<td>up)</td>
</tr>
<tr>
<td></td>
<td><code>odu-oci</code> (hold-time (down</td>
<td>up)</td>
</tr>
<tr>
<td></td>
<td><code>odu-sd</code> (hold-time (down</td>
<td>up)</td>
</tr>
<tr>
<td></td>
<td><code>odu-ttim</code></td>
<td>18.3R1</td>
</tr>
<tr>
<td></td>
<td><code>opu-ptim</code> (hold-time (down</td>
<td>up)</td>
</tr>
<tr>
<td></td>
<td><code>otu-ais</code> (hold-time (down</td>
<td>up)</td>
</tr>
<tr>
<td></td>
<td><code>otu-bdi</code> (hold-time (down</td>
<td>up)</td>
</tr>
<tr>
<td></td>
<td><code>otu-iae</code> (hold-time (down</td>
<td>up)</td>
</tr>
<tr>
<td></td>
<td><code>otu-sd</code> (hold-time (down</td>
<td>up)</td>
</tr>
<tr>
<td></td>
<td><code>otu-ttim</code> (hold-time (down</td>
<td>up)</td>
</tr>
</tbody>
</table>
Table 84: Statements Supported on ACX6360 Routers (continued)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Options</th>
<th>Junos Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>tti tti-identifier</td>
<td>odu-dapi identifier</td>
<td>18.3R1</td>
</tr>
<tr>
<td></td>
<td>odu-expected-receive-dapi</td>
<td>18.3R1</td>
</tr>
<tr>
<td></td>
<td>identifier</td>
<td></td>
</tr>
<tr>
<td></td>
<td>odu-expected-receive-sapi</td>
<td>18.3R1</td>
</tr>
<tr>
<td></td>
<td>identifier</td>
<td></td>
</tr>
<tr>
<td></td>
<td>odu-sapi identifier</td>
<td>18.3R1</td>
</tr>
<tr>
<td></td>
<td>identifier</td>
<td></td>
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<tr>
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<td>otu-dapi identifier</td>
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<td>otu-expected-receive-dapi</td>
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<td>otu-sapi identifier</td>
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<tr>
<td></td>
<td>identifier</td>
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</table>

Related Documentation
- Understanding Pre-FEC BER Monitoring and BER Thresholds on page 582
- Supported Forward Error Correction Modes on ACX6360 Router on page 587
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 configure the interfaces on the P2-100GE-OTN PIC on PTX5000 routers, 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 120.

Starting from Junos OS Release 15.1, you can configure 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 611
- Layer 2 and Layer 3 Features on page 613
- OTN Alarms and Defects on page 614
- TCA Alarms on page 614

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 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.

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-OTNPIC:

• 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)

Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.1</td>
<td>Starting from Junos OS Release 15.1, you can configure the interfaces on the P2-100GE-OTN PIC on PTx5000 routers, to be a part of the mixed rates and mixed mode aggregated Ethernet bundles.</td>
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</tr>
</tbody>
</table>

Related Documentation
• Configuring OTN Interfaces on P2-100GE-OTN PIC on page 615

Configuring OTN Interfaces on P2-100GE-OTN PIC

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.
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-tsf | odu-ais | odu-bdi | odu-bei | odu-lae | odu-ick | odu-ocl | odu-sd | odu-tdtim | opu-ptim | otu-ais | otu-bdi | otu-fec-deg | otu-fec-exe | odu-lae | odu-sd | odu-tdtim) (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 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]
    ```
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.

```
user@host# set odu-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 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.
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 1444
- otn-options on page 1445
- signal-degrade on page 1111
- preemptive-fast-reroute on page 1108

Understanding the MIC3-100G-DWDM MIC

Starting from Junos OS Release 15.1F5, the 100-Gigabit DWDM OTN MIC—MIC3-100G-DWDM—is supported on MPC3E (MX-MPC3E-3D) and MPC3E NG (MPC3E-3D-NG) on the MX240, MX480, MX960, MX2010, and MX2020 routers. The MIC3-100G-DWDM MIC provides a single 100-Gigabit Ethernet interface port that supports DP-QPSK with coherent reception and OTU4 and OTU4 (v) framing modes.

The interfaces on MIC3-100G-DWDM MIC are named with prefix `et`. For more information, see Interface Naming Overview.
The following sections explain the features of this MIC in detail:

- Interface Features on page 620
- Layer 2 and Layer 3 Features on page 621
- OTN Alarms and Defects on page 621

### Interface Features

The following interface features are supported on the MIC3-100G-DWDM MIC:

- Single port 100-Gigabit Ethernet interface with OTU4 (v) framing, DP-QPSK modulation with coherent reception using a CFP2-ACO DWDM optical transceiver.
- Gigabit Ethernet local loopback.
- Diagnostics tools:
  - Line loopback
  - Local loopback
  - Optical Channel Data Unit (ODU) Open Connection Error
  - Optical Channel Data Unit (ODU) Lock Maintenance Signal
- Types of forward error corrections (FEC):
  - GFEC (generic forward error correction)
  - HGFEC (high gain forward error correction)
  - SDFEC (soft-decision forward error correction)
- The following MIB modules continue to be supported (and no new MIB is introduced):
  - MIB module to describe Black Link extension to RFC 3591 (jnxoptIfExtMibModule)
  - MIB module to manage the OTN interface (jnxIfOtnMib)
  - MIB module to manage the Optics interface (jnxIfOpticsMib)
  - MIB module to manage OTN FRUs (jnxFruMib)
- Interoperability with the 100-Gigabit DWDM OTN PIC (P1-PTX-2-100G-WDM) is not supported.
- Support for interoperability with other vendors’ 100 Gigabit Ethernet interfaces.
- 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
• 15-minute and 1-day performance monitoring and historic statistics.
  • Near-end and far-end performance monitoring
  • Threshold-crossing alarms
  • BER performance monitoring
  • FEC performance monitoring
  • Optical performance monitoring
• Insertion, monitoring, and display of OTN header overhead
• Transport interface and state model (GR-1093)

Layer 2 and Layer 3 Features

The following Layer 2 and Layer 3 features are supported on the MIC3-100G-DWDM MIC:
• Per-port destination address MAC filter.
• Per-port source address MAC filter.
• Per-physical interface source address MAC filter.
• Maximum of 1000 source MAC filter per physical interface.
• Maximum of 32,000 filter terms to share across all filter features.
• Flexible VLAN tagging.
• 802.3 ah OAM.
• 802.1 ag OAM.

OTN Alarms and Defects

The following OTN alarms and defects are supported on the MIC3-100G-DWDM MIC:

Optical Channel (OC) Alarms and Defects
• OC-LOS—Loss Of Signal
• OC-LOF—Loss Of Frame
• OC-LOM—Loss Of Multiframe
• OC-Wavelength-Lock—Wavelength Lock

Optical Channel Data Unit (ODU) Defects
• ODU-AIS—ODU Alarm Indication Signal
• ODU-BDI—ODU Backward Defect Indication
• ODU-BIAE—ODU Backward Incoming Alignment Error
• ODU-IAE—ODU Incoming Alignment Error
• ODU-LCK—ODU Locked
- ODU-LTC—ODU Loss of Tandem Connection
- ODU-OCI—ODU Open Connection Error
- ODU-SSF—ODU Server Signal Failure
- ODU-TSF—ODU Trail Signal Failure
- ODU-TTIM—ODU Trail Trace Identifier Mismatch

Optical Channel Transport Unit (OTU) Defects
- OTU-AIS—OTU Alarm Indication Signal
- OTU-BDI—OTU Backward Defect Indication
- OTU-BIAE—OTU Backward Incoming Alignment Error
- OTU-FEC-DEG—OTU Forward Error Correction Degrade
- OTU-FEC-EXCESS-FEC—OTU Forward Error Correction Excessive FEC Errors
- OTU-IAE—OTU Incoming Alignment Error
- OTU-SSF—OTU Server Signal Failure
- OTU-TSF—OTU Trail Signal Failure
- OTU-TTIM—OTU Trail Trace Identifier Mismatch

Threshold-Crossing 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 minutes 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 (UES)

### Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.1F5</td>
<td>Starting from Junos OS Release 15.1F5, the 100-Gigabit DWDM OTN MIC—MIC3-100G-DWDM—is supported on MPC3E (MX-MPC3E-3D) and MPC3E NG (MPC3E-3D-NG) on the MX240, MX480, MX960, MX2010, and MX2020 routers.</td>
</tr>
</tbody>
</table>

### Related Documentation
- Before You Begin Installing or Upgrading the Firmware
- Configuring OTN Interfaces on MIC3-100G-DWDM MIC on page 623
- Configuring Packet Optical Networks with PTX Series Devices
Configuring OTN Interfaces on MIC3-100G-DWDM MIC

Starting from Junos OS Release 15.1F5, the 100-Gigabit DWDM OTN MIC—MIC3-100G-DWDM—is supported on MPC3E (MX-MPC3E-3D) and MPC3E NG (MPC3E-3D-NG) on the MX240, MX480, MX960, MX2010, and MX2020 routers. To configure an OTN interface on the MIC3-100G-DWDM MIC, you must configure interface-specific options and OTN-related options for the interface.

To configure the interface-specific options:

1. Configure VLAN tagging at the [edit interface interface-name] hierarchy level, where interface-name is in the et-fpc/pic/port format.

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

2. Configure the maximum transmission unit (MTU) size in bytes for the interface.

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

3. Configure a VLAN ID for the interface.

   ```
   [edit interfaces interface-name]
   user@host# set vlan-id number
   ```

4. Configure the family for the interface.

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

5. Configure an IP address for the interface.

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

To configure the optics-specific options on the interface:

1. Specify the optical transmit laser output power in dBm at the [edit interface interface-name optics-options] hierarchy level. The default transmit laser output value is 0 dBm.

   ```
   [edit interfaces interface-name optics-options]
   user@host# set tx-power value
   ```
2. Specify the wavelength of the optics in nanometers. For a list of wavelengths supported, see `wavelength`.

```
[edit interfaces interface-name optics-options]
user@host# set wavelength nm
```

To configure the OTN-specific options on the interface:

1. At the `[edit interfaces interface-name otn-options]` 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
```

2. 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 | odu-dapi | odu-expected-receive-dapi | odu-expected-receive-sapi | odu-sapi)
```

3. By default, triggers are ignored. Specify defect triggers and the set the trigger hold time for the trigger. Possible values for the trigger hold time are as follows: down—Delay before marking interface down when defect occurs (1..65534 milliseconds) and up—Delay before marking interface up when defect is absent (1.65534 milliseconds).

```
NOTE: The hold time value only impacts the alarm reporting time and does not mark an interface down when the defect occurs. To mark the interface up or down, you must also configure the physical interface hold time at the [edit interfaces interface-name] hierarchy level.
```

```
[edit interfaces interface-name otn-options]
user@host# set trigger (oc-lof | oc-lom | oc-los | oc-tsf | odu-ais | odu-bdi | odu-bei | odu-lae | odu-lck | odu-oci | odu-sd | odu-ttim | opu-ptim | otu-ais | otu-bdi | otu-fec-deg | otu-fec-exe | otu-lae | otu-sd | otu-ttim) (hold-time (down value | up value) | ignore)
```

4. Enable the threshold crossing alarms for the OTN interface along with the trigger for the defect.

```
[edit interfaces interface-name otn-options]
```
5. 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
```

6. Configure the forward error correction (FEC) mode for the OTN interface. Possible values are: Generic Forward Error Correction (GFEC), or High Gain Forward Error Correction (HGFEC) or Soft Decision Forward Error Correction (SDFEC). The default forward error correction mode is SDFEC.

```
[edit interfaces interface-name otn-options]
user@host# set fec (gfec | hgfec | sdfec)
```

7. 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
```

8. 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
```

9. 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
```

10. 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
```

11. 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 out-ttim-action-enable
```

12. Configure the OTN payload pseudorandom binary sequence (PRBS) on the OTN interface.
13. Configure the line rate or speed of the OTN signal to OTU4 (100Gbps) for the OTN interface.

   - **NOTE:** If you specify a value other than OTU4, the value is ignored. To verify the line rate, use the `show interfaces interface-name extensive` command.

14. 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.

15. 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.
   - ODU backward FRR—Insert the ODU status into the transmitted OTN frames and monitor the received OTN frames for the ODU BER status.
   - Monitoring of signal degradation of pre-FEC OTN frames.
   - Monitoring of signal degradation of ODU BER in the received OTN frames.
16. 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

- Understanding the MIC3-100G-DWDM MIC on page 619
- optics-options on page 1444
- otn-options on page 1445
- signal-degrade on page 1111
- preemptive-fast-reroute on page 1108

### Understanding the PTX-5-100G-WDM PIC

Starting with Junos OS Release 15.1F6, the 5-port 100-Gigabit DWDM OTN PIC—PTX-5-100G-WDM—is supported on the PTX3000 and the PTX5000 routers. The PTX-5-100G-WDM PIC provides five 100-Gigabit Ethernet interface ports that support dual-polarization quadrature phase shift keying (DP-QPSK) modulation with coherent reception and OTU4 and OTU4 (v) framing modes.

The interfaces on the PTX-5-100G-WDM PIC are named with the prefix `et`. For more information, see `Interface Naming Overview`.

**NOTE:** The 5-port 100-Gigabit DWDM OTN PIC is not directly interoperable with the 2-port 100-Gigabit DWDM OTN PIC (P1-PTX-2-100G-WDM), but they can both operate over the same DWDM line system.
The following sections explain the features of this PIC in detail:

- Interface Features on page 628
- Layer 2 and Layer 3 Features on page 629
- OTN Alarms and Defects on page 629

**Interface Features**

The following interface features are supported on the PTX-5-100G-WDM PIC:

- Five-port 100-Gigabit Ethernet interface with OTU4 (v) framing and DP-QPSK modulation with coherent reception using a CFP2-ACOD DWDM optical transceiver.
- Gigabit Ethernet local loopback.
- Diagnostics tools:
  - Line loopback
  - Local loopback
  - Optical Channel Data Unit (ODU) Open Connection Error
  - Optical Channel Data Unit (ODU) Lock Maintenance Signal
- Types of forward error corrections (FEC):  
  - GFEC (generic forward error correction)

  **NOTE:** GFEC mode is not supported on Junos OS Release 15.1F6. Junos OS Release 15.1F6-S1 supports GFEC mode. Contact customer support for the Junos OS Release 15.1F6-S1.

  - SDFEC (soft-decision forward error correction)

- The following MIB features continue to be supported (and no new MIB is introduced):
  - MIB module to describe Black Link extension to RFC 3591 (jnxxoptIfExtMibModule). The Black Link extension enables an optical transceiver of a vendor to introduce an optical signal over an optical network from another vendor.
  - MIB module to manage the OTN interface (jnxxIfOtnMib)
  - MIB module to manage the Optics interface (jnxxIfOpticsMib)
  - MIB module to manage OTN FRUs (jnxxFruMib)
- Interoperability with other vendors’ 100 Gigabit-Ethernet interfaces.
- 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
• 15-minute and 1-day performance monitoring and historic statistics.
  • Near-end and far-end performance monitoring
  • Threshold-crossing alarms
  • BER performance monitoring
  • FEC performance monitoring
  • Optical performance monitoring
• Insertion, monitoring, and display of OTN header overhead
• Transport interface and state model (GR-1093)

**Layer 2 and Layer 3 Features**

The following Layer 2 and Layer 3 features are supported on the PTX-5-100G-WDM PIC:

• Per-port destination address MAC filter.
• Per-port source address MAC filter.
• Per-physical interface source address MAC filter.
• Maximum of 1000 source MAC filter per physical interface.
• Maximum of 32,000 filter terms to share across all filter features.
• Flexible VLAN tagging.
• 802.3 ah OAM.
• 802.1 ag OAM.

**OTN Alarms and Defects**

The following OTN alarms and defects are supported on the PTX-5-100G-WDM PIC:

**Optical Channel Alarms and Defects**

• OC-LOS—Loss Of Signal
• OC-LOF—Loss Of Frame
• OC-LOM—Loss Of Multiframe
• OC-Wavelength-Lock—Wavelength Lock

**Optical Channel Data Unit (ODU) Defects**

• ODU-AIS—ODU Alarm Indication Signal
• ODU-BDI—ODU Backward Defect Indication
• ODU-BIAE—ODU Backward Incoming Alignment Error
Optical Channel Transport Unit (OTU) Defects

- OTU-AIS—OTU Alarm Indication Signal
- OTU-BDI—OTU Backward Defect Indication
- OTU-BIAE—OTU Backward Incoming Alignment Error
- OTU-FEC-DEG—OTU Forward Error Correction Degrade
- OTU-FEC-EXCESS-FEC—OTU Forward Error Correction Excessive FEC Errors
- OTU-IAE—OTU Incoming Alignment Error
- OTU-SSF—OTU Server Signal Failure
- OTU-TSF—OTU Trail Signal Failure
- OTU-TTIM—OTU Trail Trace Identifier Mismatch

Threshold Crossing Alarms

Threshold-crossing alarms (TCAs) 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 (UES)

Related Documentation

- Before You Begin Installing or Upgrading the Firmware
- Configuring OTN Interfaces on PTX-5-100G-WDM PIC on page 631
- Installing Firmware on the 5-Port 100-Gigabit DWDM OTN PIC (PTX-5-100G-WDM)
- Upgrading Firmware on the 5-Port 100-Gigabit DWDM OTN PIC (PTX-5-100G-WDM)
- Configuring Packet Optical Networks with PTX Series Devices
### Configuring OTN Interfaces on PTX-5-100G-WDM PIC

Starting from Junos OS Release 15.1F6, the 5-port 100-Gigabit DWDM OTN PIC—PTX-5-100G-WDM—is supported on the PTX3000 and the PTX5000 routers. To configure an OTN interface on the PTX-5-100G-WDM PIC, you must configure interface-specific options, optics-specific options and OTN-related options for the interface.

To configure the interface-specific options:

1. Configure VLAN tagging at the [edit interface interface-name] hierarchy level, where interface-name is in the et-fpc/pic/port format.
   ```
   [edit interfaces interface-name]
   user@host# set vlan-tagging
   ```

2. Configure the maximum transmission unit (MTU) size in bytes for the interface. Possible values: 256 through 16,000.
   ```
   [edit interfaces interface-name]
   user@host# set mtu value
   ```

3. Set the unit VLAN ID, family and the IP address of the interface. Possible values for the VLAN ID: 1 through 4094. Specify the family as inet.
   ```
   [edit interfaces interface-name unit 0]
   user@host# set vlan-id number
   user@host# set family family-name
   user@host# set address address
   ```

To configure the optics-specific options on the interface:

1. Specify the optical transmit laser output power in dBm at the [edit interface interface-name optics-options] hierarchy level. The default transmit laser output value is 0 dBm.
   ```
   [edit interfaces interface-name optics-options]
   user@host# set tx-power value
   ```

2. Specify the wavelength of the optics in nanometers. For a list of wavelengths supported, see wavelength.
   ```
   [edit interfaces interface-name optics-options]
   user@host# set wavelength nm
   ```
To configure the OTN-specific options on the interface:

1. At the [edit interfaces interface-name otn-options] hierarchy level, 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

2. Set a 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 | odu-dapi | odu-expected-receive-dapi | odu-expected-receive-sapi | odu-sapi)

3. Specify defect triggers and the set the trigger hold time for the trigger. By default, triggers are ignored. Possible values for the trigger hold time are as follows: down and up.
   - down—Delay before marking interface down when defect occurs (1 through 65534 milliseconds)
   - up—Delay before marking interface up when defect is absent (1 through 65534 milliseconds).

   [edit interfaces interface-name otn-options]
   user@host# set trigger (oc-lof | oc-lom | oc-los | oc-tsf | odu-ais | odu-bdi | odu-bel | odu-iae | odu-icid | odu-ocid | odu-sdr | odu-ttim | opu-ptrim | odu-ais | odu-bdi | odu-fec-deg | odu-fec-exe | odu-iae | odu-sd | odu-ttim) (hold-time (down value | up value) | ignore)

   NOTE: The hold time value only impacts the alarm reporting time and does not mark an interface down when the defect occurs. To mark the interface up or down, you must also configure the physical interface hold time at the [edit interfaces interface-name] hierarchy level.

4. Enable the threshold-crossing alarms (TCAs) for the OTN interface along with the trigger for the defect. Threshold-crossing alarms (TCAs) 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.

   [edit interfaces interface-name otn-options]
5. 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

6. Configure the forward error correction (FEC) mode for the OTN interface. Possible values are: generic forward error correction (GFEC), or high-gain forward error correction (HG-FEC) or soft-decision forward error correction (SD-FEC). The default forward error correction mode is SD-FEC.

   [edit interfaces interface-name otn-options]
   user@host# set fec (gfec |hgfc | sdfec)

7. Enable line loopback or local host loopback for the OTN interface. Loopback testing enables you to verify the connectivity of a circuit. In line loopback, instead of transmitting the signal toward the far-end device, the signal is sent back to the originating router. In local loopback, the signal is transmitted to the channel service unit (CSU) and then to the far-end device.

   [edit interfaces interface-name otn-options]
   user@host# set line-loopback
   user@host# set local-loopback

8. 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

9. 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

10. 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

11. 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 out-ttim-action-enable
12. Configure the OTN payload pseudorandom binary sequence (PRBS) on the OTN interface.

   ```
   [edit interfaces interface-name otn-options]
   user@host# set prbs
   ```

13. Configure the line rate or speed of the OTN signal to otu4 (100 Gbps) for the OTN interface.

   **NOTE:** If you specify a value other than otu4, the value is ignored. To verify the line rate, use the `show interfaces interface-name extensive` command.

   ```
   [edit interfaces interface-name otn-options]
   user@host# set rate otu4
   ```

14. 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
   ```

15. 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.
16. 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 preemptive-fast-reroute]
user@host# set odu-signal-degrade-monitor-enable

- 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-signal-degrade 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

Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.1F6</td>
<td>Starting from Junos OS Release 15.1F6, the 5-port 100-Gigabit DWDM OTN PIC—PTX-5-100G-WDM—is supported on the PTX3000 and the PTX5000 routers.</td>
</tr>
</tbody>
</table>

Related Documentation

- Before You Begin Installing or Upgrading the Firmware
- Installing Firmware on the 5-Port 100-Gigabit DWDM OTN PIC (PTX-5-100G-WDM)
- Understanding the PTX-5-100G-WDM PIC on page 627
- Upgrading Firmware on the 5-Port 100-Gigabit DWDM OTN PIC (PTX-5-100G-WDM)
- optics-options on page 1444
- otn-options on page 1445
- signal-degrade on page 1111
- preemptive-fast-reroute on page 1108
Understanding the PTX10K-LC1104 Line Card

The PTX10K-LC1104 line card provides up to 1.2 Tbps packet forwarding for cloud providers, service providers, and enterprises that need coherent dense wavelength-division multiplexing (DWDM) with MACsec security features.

The PTX10K-LC1104 line card is supported on Junos OS Release 18.3R1 and later.

The following sections explain the features of the PTX10K-LC1104 line card in detail:

- Software Features on page 636
- OTN Alarms and Defects on page 637

Software Features

The following interface features are supported on the PTX10K-LC1104:

- Compliant with ITU G.709 and G.798
- Performance monitoring features such as alarms, threshold-crossing alarms, OTU/ODU error seconds, and FEC and bit error rate (BER) statistics.
- SNMP management of the MIC based on RFC 3591, Managed Objects for the Optical Interface Type, including the following:
  - Black Link MIB–jnx-bl.mib
  - IFOTN MIB–jnx-ifotn.mib
  - Optics MIB–jnx-optics.mib
  - FRU MIB–jnx-fru.mib
- User-configurable optics options:
  - Modulation format: 16QAM, 8QAM, QPSK
  - FEC mode (15% SDFEC or 25% SDFEC)
  - Differential and non-differential encoding modes
  - Transmit (TX) laser enable and disable
  - TX output power
  - Wavelength
  - Threshold crossing alarms (TCAs)
- IEEE 802.1ag OAM
- IEEE 802.3ah OAM
- IFINFO/IFMON
- IEEE 802.3ad link aggregation
- Flexible Ethernet services encapsulation
- Flexible VLAN tagging
- Source address MAC accounting per logical interface
- Source address MAC filter per port
- Source address MAC filter per logical interface
- Destination address MAC filter per port
- Up to 8000 logical interfaces shared across all ports on a single PFE

**OTN Alarms and Defects**

The following OTN alarms and defects are supported on the PTX10K-LC1104 line card:

**Optical Channel (OC) Alarms and Defects**
- OC-LOS—Loss Of Signal
- OC-LOF—Loss Of Frame
- OC-LOM—Loss Of Multiframe
- OC-Wavelength-Lock—Wavelength Lock

**Optical Channel Data Unit (ODU) Defects**
- ODU-AIS—ODU Alarm Indication Signal
- ODU-BDI—ODU Backward Defect Indication
- ODU-IAE—ODU Incoming Alignment Error
- ODU-LCK—ODU Locked
- ODU-LTC—ODU Loss of Tandem Connection
- ODU-OCI—ODU Open Connection Error
- ODU-SSF—ODU Server Signal Failure
- ODU-TSF—ODU Trail Signal Failure
- ODU-TTIM—ODU Trail Trace Identifier Mismatch

**Optical Channel Transport Unit (OTU) Defects**
- OTU-AIS—OTU Alarm Indication Signal
- OTU-BDI—OTU Backward Defect Indication
- OTU-BIAE—OTU Backward Incoming Alignment Error
- OTU-FEC-DEG—OTU Forward Error Correction Degraded
- OTU-FEC-EXCESS-FEC—OTU Forward Error Correction Excessive FEC Errors
- OTU-IAE—OTU Incoming Alignment Error
- OTU-SSF—OTU Server Signal Failure
• OTU-TSF—OTU Trail Signal Failure
• OTU-TTIM—OTU Trail Trace Identifier Mismatch

Threshold-Crossing 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 minutes 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 (UES)

Related Documentation

• Configuring OTN Interface Options on PTX10K-LC1104 on page 650

Interface Mapping and Modulation format for PTX10K-LC1104 Line Card

The PTX10K-LC1104 line card supports 3 optical modules and 2 ports per optical modules. 2 ot interfaces are created for an optical module. Hence, 6 ot interfaces are created for a line card. The optical interface to et interface mapping is shown in the following table:

<table>
<thead>
<tr>
<th>&quot;ot-&quot; interface</th>
<th>Modulation Format</th>
<th>Mapped &quot;et&quot; interface(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ot-0/0/0</td>
<td>QPSK</td>
<td>et-x/0/0</td>
</tr>
<tr>
<td></td>
<td>8QAM</td>
<td>et-x/0/0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-x/0/1</td>
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<td></td>
<td>16QAM</td>
<td>et-x/0/0</td>
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<td></td>
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<td>et-x/0/1</td>
</tr>
<tr>
<td>ot-0/0/1</td>
<td>QPSK</td>
<td>et-x/0/2</td>
</tr>
<tr>
<td></td>
<td>8QAM</td>
<td>et-x/0/1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-x/0/2</td>
</tr>
<tr>
<td></td>
<td>16QAM</td>
<td>et-x/0/2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>et-x/0/3</td>
</tr>
<tr>
<td>“ot-&quot; interface</td>
<td>Modulation Format</td>
<td>Mapped “et” interface(s)</td>
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<tr>
<td>----------------</td>
<td>-----------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>ot-0/0/2</td>
<td>QPSK</td>
<td>et-x/0/4</td>
</tr>
<tr>
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<td>8QAM</td>
<td>et-x/0/4</td>
</tr>
<tr>
<td></td>
<td>16QAM</td>
<td>et-x/0/4</td>
</tr>
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<td>ot-0/0/3</td>
<td>QPSK</td>
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<td>8QAM</td>
<td>et-x/0/5</td>
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<td></td>
<td>16QAM</td>
<td>et-x/0/6</td>
</tr>
<tr>
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<td>QPSK</td>
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<td>16QAM</td>
<td>et-x/0/8</td>
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<td>et-x/0/10</td>
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</tbody>
</table>

**Related Documentation**
- Understanding the PTX10K-LC1104 Line Card on page 636

**Supported OTN Options on PTX10008 and PTX10016 Series Routers**

Table 76 on page 580 lists the statements that are supported on the PTX10K-LC1104 line card on PTX10008 and PTX10016 routers at the [edit interfaces interface-name otn-options] hierarchy level.
Table 85: Statements Supported on PTX10K-LC1104 line cards

<table>
<thead>
<tr>
<th>Statement</th>
<th>Options</th>
<th>Release</th>
<th>Interfaces Supported (ot/et)</th>
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</thead>
<tbody>
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<td>bytes (otn-options)</td>
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<td>gfec</td>
<td>gfec-sdfec</td>
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<td>-</td>
<td>18.3R1</td>
<td>et</td>
</tr>
<tr>
<td>insert-odu-oci</td>
<td>-</td>
<td>18.3R1</td>
<td>et</td>
</tr>
<tr>
<td>is-ma</td>
<td>no-is-ma</td>
<td>18.3R1</td>
<td>et</td>
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<td>no-laser-enable</td>
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<td>ot</td>
</tr>
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<td>no-line-loopback</td>
<td>18.3R1</td>
<td>ot</td>
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<td>et</td>
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<td>et</td>
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<td>no-start-measurement</td>
<td>start-measurement</td>
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<td>ber-threshold-clear value</td>
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<td>et</td>
</tr>
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<td>ber-threshold-signal-degrade value</td>
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<td>et</td>
</tr>
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<td>interval value</td>
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<td>et</td>
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<td>18.3R1</td>
<td>et</td>
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<td>et</td>
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<td>Statement</td>
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<td>Interfaces Supported (ot/et)</td>
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Table 85: Statements Supported on PTX10K-LC1104 line cards (continued)

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<th>Release</th>
<th>Interfaces Supported (ot/et)</th>
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18.3R1
### Table 85: Statements Supported on PTX10K-LC1104 line cards (continued)

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<th>Statement</th>
<th>Options</th>
<th>Release</th>
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<td>odu-bei</td>
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</tr>
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<td>(hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
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<td></td>
<td>odu-oci</td>
<td>18.3R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td></td>
<td>odu-sd</td>
<td>18.3R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td></td>
<td>odu-ttim</td>
<td>18.3R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>opu-ptim</td>
<td>18.3R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td></td>
<td>otu-ais</td>
<td>18.3R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td></td>
<td>otu-bdi</td>
<td>18.3R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
</tbody>
</table>
**Table 85: Statements Supported on PTX10K-LC1104 line cards (continued)**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Options</th>
<th>Release</th>
<th>Interfaces Supported (ot/et)</th>
</tr>
</thead>
<tbody>
<tr>
<td>otu-fec-deg</td>
<td>(hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td>otu-fec-exe</td>
<td>(hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td>otu-iae</td>
<td>(hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td>otu-sd</td>
<td>(hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td>otu-ttim</td>
<td>(hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td>tti tti-identifier</td>
<td>odu-dapi identifier</td>
<td>18.3R1</td>
<td>et</td>
</tr>
<tr>
<td></td>
<td>odu-expected-receive-dapi identifier</td>
<td>18.3R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>odu-expected-receive-sapi identifier</td>
<td>18.3R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>odu-sapi identifier</td>
<td>18.3R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>odu-dapi identifier</td>
<td>18.3R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>odu-expected-receive-dapi identifier</td>
<td>18.3R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>odu-expected-receive-sapi identifier</td>
<td>18.3R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>odu-sapi identifier</td>
<td>18.3R1</td>
<td></td>
</tr>
</tbody>
</table>

---

**Supported Optics Options on PTX10008 and PTX10016 Series Routers**

Table 86 on page 646 lists the statements that are supported on PTX10008 and PTX10016 Series routers at the [edit interfaces interface-name optics-options] hierarchy level.
### Table 86: Statements Supported on PTX10008 and PTX10016 Series Routers

<table>
<thead>
<tr>
<th>Statement</th>
<th>Options</th>
<th>Release</th>
<th>Interfaces Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>alarm low-light-alarm</td>
<td>link-down</td>
<td>syslog</td>
<td>18.3R1</td>
</tr>
<tr>
<td>tca carrier-frequency-offset-tca</td>
<td>(enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td>tx-power</td>
<td>dbm</td>
<td>18.3R1</td>
<td>ot</td>
</tr>
<tr>
<td>warning low-light-warning</td>
<td>link-down</td>
<td>syslog</td>
<td>18.3R1</td>
</tr>
<tr>
<td>laser-enable</td>
<td>no-laser-enable</td>
<td>-</td>
<td>18.3R1</td>
</tr>
<tr>
<td>line-loopback</td>
<td>no-line-loopback</td>
<td>-</td>
<td>18.3R1</td>
</tr>
<tr>
<td>prbs</td>
<td>no-prbs</td>
<td>-</td>
<td>18.3R1</td>
</tr>
<tr>
<td>signal-degrade</td>
<td>ber-threshold-clear value</td>
<td>18.3R1</td>
<td>ot</td>
</tr>
<tr>
<td></td>
<td>ber-threshold-signal-degrade value</td>
<td>18.3R1</td>
<td>ot</td>
</tr>
<tr>
<td></td>
<td>interval value</td>
<td>18.3R1</td>
<td>ot</td>
</tr>
<tr>
<td>Statement</td>
<td>Options</td>
<td>Release</td>
<td>Interfaces Supported</td>
</tr>
<tr>
<td>-----------</td>
<td>---------</td>
<td>---------</td>
<td>----------------------</td>
</tr>
<tr>
<td>tca</td>
<td>odu-tca-bbe (enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>odu-tca-bbe-fe (enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>odu-tca-es (enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>odu-tca-es-fe (enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>odu-tca-ses (enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>odu-tca-ses-fe (enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>odu-tca-uas (enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>otu-tca-bbe (enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>otu-tca-bbe-fe (enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>otu-tca-es (enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>otu-tca-es-fe (enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>otu-tca-ses (enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td>otu-tca-ses-fe (enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
</tbody>
</table>
### Table 86: Statements Supported on PTX10008 and PTX10016 Series Routers (continued)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Options</th>
<th>Release</th>
<th>Interfaces Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>otu-tca-uas</code></td>
<td>`(enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><code>otu-tca-uas-fe</code></td>
<td>`(enable-tca</td>
<td>no-enable-tca</td>
<td>threshold</td>
</tr>
</tbody>
</table>
Table 86: Statements Supported on PTX10008 and PTX10016 Series Routers (continued)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Options</th>
<th>Release</th>
<th>Interfaces Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>trigger trigger-identifier</td>
<td>oc-lof (hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td></td>
<td>oc-lom (hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td></td>
<td>oc-los (hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td></td>
<td>oc-tsf (hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td></td>
<td>oc-wavelength-lock (hold-time</td>
<td>down</td>
<td>up)</td>
</tr>
<tr>
<td></td>
<td>odu-ais (hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td></td>
<td>odu-bdi (hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td></td>
<td>odu-bei (hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td></td>
<td>odu-lae (hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td></td>
<td>odu-lck (hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td></td>
<td>odu-oci (hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td></td>
<td>odu-sd (hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td></td>
<td>odu-ttim</td>
<td>18.3R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>odu-ptim (hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td></td>
<td>otu-ais (hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td></td>
<td>otu-bdi (hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td></td>
<td>otu-fec-deg (hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
</tbody>
</table>
Table 86: Statements Supported on PTX10008 and PTX10016 Series Routers (continued)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Options</th>
<th>Release</th>
<th>Interfaces Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>otu-fec-exe</td>
<td>(hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td>otu-iae</td>
<td>(hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td>otu-sd</td>
<td>(hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
<tr>
<td>otu-ttim</td>
<td>(hold-time (down</td>
<td>up)</td>
<td>ignore)</td>
</tr>
</tbody>
</table>

Configuring OTN Interface Options on PTX10K-LC1104

The PTX10K-LC1104 line card provides up to 1.2 Tbps packet forwarding for cloud providers, service providers, and enterprises that need coherent dense wavelength-division multiplexing (DWDM) with MACsec security features. The PTX10K-LC1104 line card is supported on Junos OS Release 18.3R1 and later.

Each PTX10K-LC1104 has 6 physical interfaces (ot-x/x/x) that connect to one of three built-in flexible rate optical transponders. Each transponder connects four 100-Gigabit Ethernet logical interfaces (et-x/x/x) to one of three forwarding ASICs.

To configure the optics-specific options on the interface:

1. Specify the modulation format at the [edit interface interface-name optics-options] hierarchy level.

   ```
   [edit interfaces interface-name optics-options]
   user@host# set modulation-format (qpsk|8qam|16qam)
   ```

2. Specify encoding.

   ```
   [edit interfaces interface-name optics-options]
   user@host# set encoding (differential|non-differential)
   ```

3. Specify the optical transmit laser output power in dBm. The default transmit laser output value is 0 dBm.

   ```
   [edit interfaces interface-name optics-options]
   user@host# set tx-power value
   ```

4. Specify the wavelength of the optics in nanometers. For a list of wavelengths supported, see wavelength.
To configure the OTN-specific options on the interface:

1. At the `edit interfaces interface-name otn-options` 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
   ```

2. Set antrail 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)
   ```

3. By default, triggers are ignored. Specify defect triggers and the set the trigger hold time for the trigger. Possible values for the trigger hold time are as follows: down—Delay before marking interface down when defect occurs (1..65534 milliseconds) and up—Delay before marking interface up when defect is absent (1..65534 milliseconds).

   ```
   [edit interfaces interface-name otn-options]
   user@host# set trigger (oc-lof | oc-lom | oc-los | oc-tsf | odu-ais | odu-bdi | odu-bei | odu-iae | odu-lick | odu-oci | odu-sd | odu-ttim | opu-ptim | odu-ais | odu-bdi | odu-fec-deg | odu-fec-exe | odu-iae | odu-sd | odu-ttim) (hold-time (down value | up value) | ignore)
   ```

   **NOTE:** The hold time value only impacts the alarm reporting time and does not mark an interface down when the defect occurs. To mark the interface up or down, you must also configure the physical interface hold time at the `edit interfaces interface-name` hierarchy level.

4. Enable the threshold crossing alarms for the OTN interface along with the trigger for the defect.

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

5. 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]
   ```
6. Configure the forward error correction (FEC) mode for the OTN interface. Possible values are: Generic Forward Error Correction (GFEC), or High Gain Forward Error Correction (HGFEC) or Soft Decision Forward Error Correction (SDFEC). The default forward error correction mode is SDFEC.

   [edit interfaces interface-name otn-options]
   user@host# set fec (gfec | hgfec | sdfec)

7. 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

8. 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

9. Enable an ODU open connection indication signal on the OTN interface to send to send the signal pattern 01100110.

   [edit interfaces interface-name otn-options]
   user@host# set insert-odu-oci

10. 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

11. 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 out-ttim-action-enable

12. Configure the OTN payload pseudorandom binary sequence (PRBS) on the OTN interface.

    [edit interfaces interface-name otn-options]
    user@host# set prbs
13. Configure the line rate or speed of the OTN signal to OTU4 (100Gbps) for the OTN interface.

   **NOTE:** If you specify a value other than OTU4, the value is ignored. To verify the line rate, use the `show interfaces interface-name extensive` command.

   ```
   [edit interfaces interface-name otn-options]
   user@host# set rate otu4
   ```

14. 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
   ```

15. 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]
     ```
16. 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 1444
- otn-options on page 1445
- signal-degrade on page 1111
- preemptive-fast-reroute on page 1108
- Understanding the PTX10K-LC1104 Line Card on page 636

**Understanding ODU Path Delay Measurement on OTN Networks for Performance Monitoring**

Performance monitoring is an important requirement in any network, including the optical transport networks (OTN). The key parameters that impact performance are bit error rate (BER) and delay. Delays in data communication over a network impact the network latency. Network latency is the time taken for a packet of data to travel from a designated point to another designated point. If there are less delays, the network latency is low. You can measure latency by sending a packet and then receiving it as it is returned back to you; the time taken for the round-trip indicates the latency.

The optical channel data unit (ODU) path delay measurement offers in-service delay measurement. Delay (or latency) is measured by transmitting a known pattern (delay measurement pattern) in a selected bit of the delay measurement (DM) field and measuring the number of frames that are missed when the delay measurement pattern
is received at the transmitting end. For instance, if the transmitted delay measurement bit is 11111111100 and the received delay measurement bit is 11100000000, the delay measurement starts at frame 2 and ends at frame 8. This can be detected by the change in value between the transmitted bit and the received bit.

<table>
<thead>
<tr>
<th>Frame#</th>
<th>10 9 8 7 6 5 4 3 2 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tx DM bit</td>
<td>1 1 1 1 1 1 1 0 0</td>
</tr>
<tr>
<td>Rx DM bit</td>
<td>1 1 1 0 0 0 0 0 0</td>
</tr>
</tbody>
</table>

The result of the delay measurement is 6 frames (8 - 2).

Guidelines for Configuring Delay Measurement

When you configure in-service delay measurement, we recommend that you follow certain guidelines to ensure that you obtain accurate delay measurement.

- Unidirectional delay measurement is not supported. The in-service delay measurement is specific to round-trip delay measurement and for optical channel data units only.
- Delay measurement on different framers for the MIC and PIC is different. So, the delay measurement values are different.
- Resiliency is not supported for path delay measurement.
- Links at the local and remote interfaces must be active before you configure delay measurement.
- Do not perform delay measurement tests when ODU maintenance signals are injected.
- Do not configure local loopback and network loopback with remote loopback because the loopback data is overwritten by the delay measurement pattern.

**NOTE:** If a link failure occurs after you begin measuring delay, delay measurement fails. You must re-enable measurement of delay on the local interface to measure delay.

Related Documentation

- 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
- 100-Gigabit DWDM OTN MIC with CFP2-ACO
- 100-Gigabit DWDM OTN PIC with CFP2-ACO (PTX Series)
- Configuring OTN Interfaces on MIC3-100G-DWDM MIC on page 623
- Configuring OTN Interfaces on PTX-5-100G-WDM PIC on page 631
- Disabling ODU Path Delay Measurement on OTN Networks for Performance Monitoring on page 658
- Enabling ODU Path Delay Measurement on OTN Networks for Performance Monitoring on page 656
- remote-loop-enable on page 1110
Enabling ODU Path Delay Measurement on OTN Networks for Performance Monitoring

Delay measurement is disabled by default. This topic explains the broad steps for measuring the optical channel data units (ODU) path delay on optical transport networks (OTN). First, enable remote loopback on the remote interface and commit the configuration. This enables the remote interface to loop back the delay measurement pattern to the local interface. Then, start delay measurement at the local interface and view the results.

**NOTE:** Do not enable remote loopback on both ends (local and remote). If you enable remote loopback on both interfaces, the delay measurement pattern is looped back continuously between the two interfaces.

Before you start measuring delay in the ODU path on OTN, complete the following tasks:

- Ensure that the links are active at the local and remote interfaces and alarms are not configured.
- Ensure that there is a delay of 10 seconds before enabling remote loopback. Also, ensure that there is a delay of 10 seconds after enabling remote loopback at the remote interface and before you start measuring delay.
- Ensure that the delay measurement tests are not performed when ODU maintenance signals are injected.
- Ensure that the local loopback and network loopback are also not specified because the looped-back data is overwritten by the delay measurement pattern.

**NOTE:** If link failure occurs after you begin measuring delay, delay measurement fails. You must re-enable measurement of delay on the local interface to measure delay.

To enable ODU path delay measurement, first enable remote loopback of the delay measurement pattern on the remote interface and then start measurement of the delay.

1. Enable remote loopback on the remote interface by including the `remote-loop-enable` statement at the `[edit]` hierarchy level.

   ```
   [edit]
   user@host# set interfaces interfacename otn-options odu-delay-management remote-loop-enable
   ```

2. After enabling remote loopback, commit the configuration.
3. Start delay measurement on the local interface by including the `start-measurement` statement at the [edit] hierarchy level.

```
[edit]
user@host# set interface interfacename otn-options odu-delay-management
        start-measurement
```

4. After enabling measurement of delay on the local interface, commit the configuration.

```
[edit]
user@host# commit
```

5. To view the delay measurement values, from the operational mode, enter the `show interfaces extensive` command.

```
user@host> show interfaces interfacename extensive
```

```
... 
ODU Delay Management: 
Start Measurement: True 
Remote Loop Enable: False 
Result: 0 micro seconds 
... 
```

**Related Documentation**

- 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
- 100-Gigabit DWDM OTN MIC with CFP2-ACO
- 100-Gigabit DWDM OTN PIC with CFP2-ACO (PTX Series)
- Configuring OTN Interfaces on MIC3-100G-DWDM MIC on page 623
- Configuring OTN Interfaces on PTX-5-100G-WDM PIC on page 631
- Disabling ODU Path Delay Measurement on OTN Networks for Performance Monitoring on page 658
- remote-loop-enable on page 1110
- Understanding ODU Path Delay Measurement on OTN Networks for Performance Monitoring on page 654
- Understanding the MIC3-100G-DWDM MIC on page 619
- Understanding the PTX-5-100G-WDM PIC on page 627
Disabling ODU Path Delay Measurement on OTN Networks for Performance Monitoring

Delay measurement is disabled by default. If you enabled optical channel data unit (ODU) path delay measurement by using the `remote-loop-enable` and `start-measurement` statements, you can use this procedure to disable delay measurement.

**NOTE:** You can also use the `delete` or `deactivate` command to disable remote loopback on the remote interface. For instance, you can use the delete interfaces `interfacename` otn-options odu-delay-management remote-loop-enable or deactivate interface `interfacename` otn-options odu-delay-management remote-loop-enable command to disable remote loopback on the remote interface.

To disable ODU path delay measurement, first disable remote loopback of the delay measurement pattern on the remote interface and then stop delay measurement:

1. Stop delay measurement on the local interface by including the `stop-measurement` statement at the `[edit]` hierarchy level.

   ```
   [edit]
   user@host# set interface interfacename otn-options odu-delay-management stop-measurement
   ```

2. After you stop delay measurement on the local interface, commit the configuration.

   ```
   [edit]
   user@host# commit
   ```

3. Disable remote loopback on the remote interface by including the `no-remote-loop-enable` statement at the `[edit]` hierarchy level.

   ```
   [edit]
   user@host# set interfaces interfacename otn-options odu-delay-management no-remote-loop-enable
   ```

4. After disabling remote loopback on the remote interface, commit the configuration.

   ```
   [edit]
   user@host# commit
   ```

5. To verify that remote loopback is disabled and delay is not measured, enter the `show interfaces extensive` command, from the operational mode.

   ```
   user@host> show interfaces interfacename extensive
   ```
ODU Delay Management:
Start Measurement: False
Remote Loop Enable: False
Result: 0 micro seconds

Related Documentation
- 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
- 100-Gigabit DWDM OTN MIC with CFP2-ACO
- 100-Gigabit DWDM OTN PIC with CFP2-ACO (PTX Series)
- Configuring OTN Interfaces on MIC3-100G-DWDM MIC on page 623
- Configuring OTN Interfaces on PTX-5-100G-WDM PIC on page 631
- Enabling ODU Path Delay Measurement on OTN Networks for Performance Monitoring on page 656
- remote-loop-enable on page 1110
- Understanding ODU Path Delay Measurement on OTN Networks for Performance Monitoring on page 654
- Understanding the MIC3-100G-DWDM MIC on page 619
- Understanding the PTX-5-100G-WDM PIC on page 627
CHAPTER 29

Configuring Gigabit Ethernet Accounting and Policing

- Capabilities of Gigabit Ethernet IQ PICs and Gigabit Ethernet PICs with SFPs on page 661
- Configuring MAC Address Accounting on page 663
- MAC Address Accounting for Dynamically Learned Addresses on Aggregated Ethernet Interfaces Overview on page 664
- Accounting of the Layer 2 Overhead Attribute in Interface Statistics on page 665
- Configuring Layer 2 Overhead Accounting in Interface Statistics on page 668
- Verifying the Accounting of Layer 2 Overhead in Interface Statistics on page 669
- Configuring Gigabit Ethernet Policers on page 671
- Configuring Gigabit Ethernet Two-Color and Tricolor Policers on page 678

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 87 on page 662 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 87: Capabilities of Gigabit Ethernet IQ and Gigabit Ethernet with SFPs

<table>
<thead>
<tr>
<th>Capability</th>
<th>Gigabit Ethernet IQ (SFP)</th>
<th>Gigabit Ethernet (SFP)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Layer 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>802.3ad link aggregation</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Maximum VLANs per port</td>
<td>384</td>
<td>1023</td>
</tr>
<tr>
<td>Maximum transmission unit (MTU) size</td>
<td>9192</td>
<td>9192</td>
</tr>
<tr>
<td>MAC learning</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>MAC accounting</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>MAC filtering</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Destinations per port</td>
<td>960</td>
<td>960</td>
</tr>
<tr>
<td>Sources per port</td>
<td>64</td>
<td>64</td>
</tr>
<tr>
<td>Hierarchical MAC policers</td>
<td>Yes, premium and aggregate</td>
<td>No, aggregate only</td>
</tr>
<tr>
<td>Multiple TPID support and IP service for nonstandard TPIDs</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Multiple Ethernet encapsulations</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Dual VLAN tags</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>VLAN rewrite</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Layer 2 VPNs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VLAN CCC</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Port-based CCC</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Extended VLAN CCC Virtual Metropolitan Area Network (VMAN) Tag Protocol</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>CoS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIC-based egress queues</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Queued VLANs</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
Table 87: Capabilities of Gigabit Ethernet IQ and Gigabit Ethernet with SFPs (continued)

<table>
<thead>
<tr>
<th>Capability</th>
<th>Gigabit Ethernet IQ (SFP)</th>
<th>Gigabit Ethernet (SFP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VPLS</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

For more information about configuring VPLS, see the Junos OS VPNs Library for Routing Devices.

You can also configure CoS on logical IQ interfaces. For more information, see the Class of Service Feature Guide (Routers and EX9200 Switches).

Related Documentation
- Configuring Gigabit Ethernet Policers on page 671
- Configuring Gigabit Ethernet Two-Color and Tricolor Policers on page 678
- Configuring MAC Address Accounting on page 663
- 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 gigether-options ethernet-switch-profile]` hierarchy level:

```
[edit interfaces interface-name gigether-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 ae aggregated-ether-options ethernet-switch-profile]` hierarchy level:

```
[edit interfaces ae 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.

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

Junos OS supports 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 ae
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` 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 form 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.

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.1</td>
<td>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.</td>
</tr>
</tbody>
</table>

**Release History Table**

**Related Documentation**
- [mac-learn-enable on page 1399](#)

**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. Starting with Junos OS Release 13.2, configuring the logical interface statistics to include Layer 2 is supported on 10-Gigabit Ethernet interfaces on MX Series routers with MPC4E. Starting with Junos OS Release 13.3, `account-layer2-overhead` is not supported on MX Series routers with MPC3E (on both PIC and logical interface levels).

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 88 on page 666 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 88: Adjustment Bytes for Logical Interfaces over Ethernet Interfaces

<table>
<thead>
<tr>
<th>Encapsulation Type on Logical Interfaces</th>
<th>Number of Adjustment Bytes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethernet DIXv2 (IP datagrams over Ethernet)</td>
<td>18</td>
<td>Untagged (includes CRC)</td>
</tr>
<tr>
<td>Ethernet DIXv2 (IP datagrams over Ethernet)</td>
<td>22</td>
<td>Single-tagged (includes CRC)</td>
</tr>
<tr>
<td>Ethernet DIXv2 (IP datagrams over Ethernet)</td>
<td>26</td>
<td>Double-tagged (includes CRC)</td>
</tr>
<tr>
<td>VLAN Bridge</td>
<td>4</td>
<td>CRC</td>
</tr>
<tr>
<td>VLAN CCC</td>
<td>4</td>
<td>CRC</td>
</tr>
<tr>
<td>VLAN TCC</td>
<td>18</td>
<td>Untagged (includes CRC)</td>
</tr>
<tr>
<td>VLAN TCC</td>
<td>22</td>
<td>Single-tagged (includes CRC)</td>
</tr>
<tr>
<td>VLAN TCC</td>
<td>26</td>
<td>Double-tagged (includes CRC)</td>
</tr>
<tr>
<td>VLAN VPLS</td>
<td>4</td>
<td>CRC</td>
</tr>
</tbody>
</table>
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.
Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.3</td>
<td>Starting with Junos OS Release 13.3, account-layer2-overhead is not supported on MX Series routers with MPC3E (on both PIC and logical interface levels).</td>
</tr>
<tr>
<td>13.2</td>
<td>Starting with Junos OS Release 13.2, configuring the logical interface statistics to include Layer 2 is supported on 10-Gigabit Ethernet interfaces on MX Series routers with MPC4E.</td>
</tr>
</tbody>
</table>

Related Documentation

- Configuring Layer 2 Overhead Accounting in Interface Statistics on page 668
- Verifying the Accounting of Layer 2 Overhead in Interface Statistics on page 669
- account-layer2-overhead on page 1209
- 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 668

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

See Also

• Accounting of the Layer 2 Overhead Attribute in Interface Statistics on page 665
• Verifying the Accounting of Layer 2 Overhead in Interface Statistics on page 669
• account-layer2-overhead on page 1209
• Ethernet Interfaces Feature Guide for Routing Devices

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:

```
user@host> show interfaces ge-5/2/0 statistics detail
```

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.
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, Runts: 0, Policed discards: 0, L3 in completes: 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-forward 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
Policer: Input: __default_arp_policer__

Related Documentation
- Accounting of the Layer 2 Overhead Attribute in Interface Statistics on page 665
- Configuring Layer 2 Overhead Accounting in Interface Statistics on page 668
- show interfaces on page 2060
- show interfaces statistics
- Ethernet Interfaces Feature Guide for Routing Devices

Configuring Gigabit Ethernet Policers
- Overview on page 672
- Configuring a Policer on page 672
- Specifying an Input Priority Map on page 673
- Specifying an Output Priority Map on page 674
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 \text{k} (1000), \text{m} (1,000,000), or \text{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 \text{ieee802.1p premium} statement at the [edit interfaces interface-name gigether-options ethernet-policer-profile input-priority-map] hierarchy level:

\[
\text{[edit interfaces interface-name gigether-options ethernet-policer-profile input-priority-map]
ieee802.1p premium [ values ];}
\]

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 676.

**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 89 on page 674 shows the predefined forwarding classes and their associated queue assignments.

Table 89: Default Forwarding Classes

<table>
<thead>
<tr>
<th>Forwarding Class Name</th>
<th>Queue</th>
</tr>
</thead>
<tbody>
<tr>
<td>best-effort</td>
<td>0</td>
</tr>
<tr>
<td>expedited-forwarding</td>
<td>1</td>
</tr>
<tr>
<td>assured-forwarding</td>
<td>2</td>
</tr>
<tr>
<td>network-control</td>
<td>3</td>
</tr>
</tbody>
</table>

For more information about CoS forwarding classes, see the Class of Service Feature Guide (Routers and EX9200 Switches). For a configuration example, see “Example: Configuring Gigabit Ethernet Policers” on page 676.

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:

```plaintext
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 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 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: 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 674.

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 14.

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 677
- Example Configuration on page 677
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 {
  gigether-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;
    }
  }
}
```
Related Documentation

- Capabilities of Gigabit Ethernet IQ PICs and Gigabit Ethernet PICs with SFPs on page 661
- Configuring Gigabit Ethernet Two-Color and Tricolor Policers on page 678
- Configuring MAC Address Accounting on page 663
- Configuring a Policer Overhead
- Ethernet Interfaces Feature Guide for Routing Devices

Configuring Gigabit Ethernet Two-Color and Tricolor Policers

- Overview on page 678
- Configuring a Policer on page 680
- Applying a Policer on page 680
- Example: Configuring and Applying a Policer on page 681

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).

Starting in Junos OS Release 13.1, traffic is classified into three categories: Green, Red, and Yellow. Following list describes the 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 671), 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 and the Class of Service Feature Guide (Routers and EX9200 Switches).

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;
}
```
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 {
literal-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;
  }
}

## Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.1</td>
<td>Starting in Junos OS Release 13.1, traffic is classified into three categories: Green, Red, and Yellow.</td>
</tr>
</tbody>
</table>

## Related Documentation
- Capabilities of Gigabit Ethernet IQ PICs and Gigabit Ethernet PICs with SFPs on page 661
- Configuring Gigabit Ethernet Policers on page 671
- Configuring MAC Address Accounting on page 663
- Configuring a Policer Overhead
- Ethernet Interfaces Feature Guide for Routing Devices
CHAPTER 30

Configuring Gigabit Ethernet Autonegotiation

- Gigabit Ethernet Autonegotiation Overview on page 683
- Configuring Gigabit Ethernet Autonegotiation on page 683

**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 Metro 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 on page 683
- *Ethernet Interfaces Feature Guide for Routing Devices*

**Configuring Gigabit Ethernet Autonegotiation**

- Configuring Gigabit Ethernet Autonegotiation with Remote Fault on page 684
- Configuring Flow Control on page 684
- Configuring Autonegotiation Speed on MX Series Routers on page 684
- Displaying Autonegotiation Status on page 685
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 gigether-options]` hierarchy level.

```
[edit interfaces ge-fpc/pic/port gigether-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 gigether-options]` hierarchy level. For more information, see "Configuring Flow Control" on page 12.

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 | auto-10m-100m)` 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.

Starting from Junos OS Release 14.2, the `auto-10m-100m` option allows the fixed tri-speed port to auto negotiate with ports limited by 100m or 10m maximum speed. This option must be enabled only for Tri-rate MPC port, that is, 3D 40x 1GE (LAN) RJ45 MIC on MX platform. This option does not support other MICs on MX platform.

You can disable auto MDI/MDIX using the `no-auto-mdix` statement at the `[edit interfaces ge-fpc/pic/port gigether-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.
NOTE: Starting in Junos OS Release 14.2, on MX Series routers with Tri-rate Enhanced DPC (DPCE-R-40GE-TX), when you configure the interface speed using the auto-10m-100m option, the speed is negotiated to the highest value possible (100 Mbps), if the same value is configured on both sides of the link. However, when you view the interface speed of the DPC, using the show interfaces command, the value of the speed is not accurately displayed. For instance, if you configure the speed of the Tri-rate enhanced DPC, as 100Mbps on both sides of the link, the interface speed of the DPC is negotiated to 100 Mbps. However, the interface speed of the DPC displays 1 bps. This is an issue with the show interfaces command only. The actual interface speed is 100 Mbps.

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 90 on page 685 and Table 91 on page 687 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 90: Mode and Autonegotiation Status (Local)

<table>
<thead>
<tr>
<th>Transmit</th>
<th>Receive</th>
<th>Mode</th>
<th>LED</th>
<th>Link</th>
<th>Autonegotiation Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>ON</td>
<td>Default</td>
<td>Green</td>
<td>UP</td>
<td>Complete</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>Default</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>Default</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>Default</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Default</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Default</td>
<td>Green</td>
<td>UP</td>
<td>No-autonegotiation</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>Default</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>Default</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Default</td>
<td>Green</td>
<td>UP</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Default</td>
<td>Red</td>
<td>DOWN</td>
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<tr>
<td>ON</td>
<td>ON</td>
<td>No-autonegotiation</td>
<td>Green</td>
<td>UP</td>
<td>Incomplete</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>No-autonegotiation</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
</tbody>
</table>
### Table 90: Mode and Autonegotiation Status (Local) (continued)

<table>
<thead>
<tr>
<th>Transmit</th>
<th>Receive</th>
<th>Mode</th>
<th>LED</th>
<th>Link</th>
<th>Autonegotiation Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>ON</td>
<td>No-autonegotiation</td>
<td>Green</td>
<td>UP</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>No-autonegotiation</td>
<td>Red</td>
<td>DOWN</td>
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</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>No-autonegotiation</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Explicit</td>
<td>Green</td>
<td>UP</td>
<td>Complete</td>
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<td>ON</td>
<td>OFF</td>
<td>Explicit</td>
<td>Red</td>
<td>DOWN</td>
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</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>Explicit</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>Explicit</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Explicit</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Explicit</td>
<td>Green</td>
<td>UP</td>
<td>No-autonegotiation</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>Explicit</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>Explicit</td>
<td>Green</td>
<td>UP</td>
<td>Complete</td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>Explicit+RFI-Offline</td>
<td>Green</td>
<td>UP</td>
<td>Complete</td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>Explicit+RFI-Offline</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Explicit+RFI-Offline</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Explicit+RFI-Offline</td>
<td>Green</td>
<td>UP</td>
<td>No-autonegotiation</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>Explicit+RFI-Offline</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>Explicit+RFI-Offline</td>
<td>Green</td>
<td>UP</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>Explicit+RFI-Offline</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Explicit+RFI-Offline</td>
<td>Red</td>
<td>DOWN</td>
<td>Complete</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>Explicit+RFI-Offline</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
</tbody>
</table>
### Table 90: Mode and Autonegotiation Status (Local) (continued)

<table>
<thead>
<tr>
<th>Transmit</th>
<th>Receive</th>
<th>Mode</th>
<th>LED</th>
<th>Link</th>
<th>Autonegotiation Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>ON</td>
<td>Explicit+RFI-Online</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>Explicit+RFI-Online</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Explicit+RFI-Online</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Explicit+RFI-Online</td>
<td>Green</td>
<td>UP</td>
<td>No-autonegotiation*</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>Explicit+RFI-Online</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>Explicit+RFI-Online</td>
<td>Green</td>
<td>UP</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>Explicit+RFI-Online</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Explicit+RFI-Online</td>
<td>Green</td>
<td>UP</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Explicit+RFI-Online</td>
<td>Red</td>
<td>DOWN</td>
<td>Complete</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>Explicit+RFI-Online</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>Explicit+RFI-Online</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>Explicit+RFI-Online</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Explicit+RFI-Online</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Explicit+RFI-Online</td>
<td>Green</td>
<td>UP</td>
<td>Complete</td>
</tr>
</tbody>
</table>

### Table 91: Mode and Autonegotiation Status (Remote)

<table>
<thead>
<tr>
<th>Transmit</th>
<th>Receive</th>
<th>Mode</th>
<th>LED</th>
<th>Link</th>
<th>Autonegotiation Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>ON</td>
<td>Default</td>
<td>Green</td>
<td>UP</td>
<td>Complete</td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Default</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>Default</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>Default</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>Default</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>No-autonegotiation</td>
<td>Green</td>
<td>UP</td>
<td>Incomplete</td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>No-autonegotiation</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>Transmit</td>
<td>Receive</td>
<td>Mode</td>
<td>LED</td>
<td>Link</td>
<td>Autonegotiation Status</td>
</tr>
<tr>
<td>----------</td>
<td>---------</td>
<td>--------------------</td>
<td>------</td>
<td>-------</td>
<td>------------------------</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>No-autonegotiation</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>No-autonegotiation</td>
<td>Green</td>
<td>UP</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>No-autonegotiation</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Explicit</td>
<td>Green</td>
<td>UP</td>
<td>Complete</td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Explicit</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>Explicit</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>Explicit</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>Explicit</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Explicit</td>
<td>Red</td>
<td>DOWN</td>
<td>Complete</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>Explicit</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>Explicit</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>Explicit</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Explicit+RFI-Offline</td>
<td>Red</td>
<td>DOWN</td>
<td>Complete</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>Explicit+RFI-Offline</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>Explicit+RFI-Offline</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>Explicit+RFI-Offline</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Explicit+RFI-Online</td>
<td>Green</td>
<td>UP</td>
<td>Complete</td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>Explicit+RFI-Online</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>Explicit+RFI-Online</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>Explicit+RFI-Online</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>Explicit+RFI-Online</td>
<td>Red</td>
<td>DOWN</td>
<td></td>
</tr>
</tbody>
</table>
Starting from Junos OS Release 14.2, the **auto-10m-100m** option allows the fixed tri-speed port to auto negotiate with ports limited by 100m or 10m maximum speed.

Starting in Junos OS Release 14.2, on MX Series routers with Tri-rate Enhanced DPC (DPCE-R-40GE-TX), when you configure the interface speed using the **auto-10m-100m** option, the speed is negotiated to the highest value possible (100 Mbps), if the same value is configured on both sides of the link.

### Related Documentation
- Gigabit Ethernet Autonegotiation Overview on page 683
- Ethernet Interfaces Feature Guide for Routing Devices
CHAPTER 31

Stacking and Rewriting Gigabit Ethernet VLAN Tags

- Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview on page 691
- Stacking and Rewriting Gigabit Ethernet VLAN Tags on page 692
- Configuring Frames with Particular TPIDs to Be Processed as Tagged Frames on page 695
- Configuring Tag Protocol IDs (TPIDs) on PTX Series Packet Transport Routers on page 696
- Configuring Stacked VLAN Tagging on page 697
- Configuring Dual VLAN Tags on page 697
- Configuring Inner and Outer TPIDs and VLAN IDs on page 698
- Stacking a VLAN Tag on page 701
- Stacking Two VLAN Tags on page 702
- Removing a VLAN Tag on page 703
- Removing the Outer and Inner VLAN Tags on page 703
- Removing the Outer VLAN Tag and Rewriting the Inner VLAN Tag on page 704
- Rewriting the VLAN Tag on Tagged Frames on page 705
- Rewriting a VLAN Tag on Untagged Frames on page 706
- Rewriting a VLAN Tag and Adding a New Tag on page 709
- Rewriting the Inner and Outer VLAN Tags on page 710
- Examples: Stacking and Rewriting Gigabit Ethernet IQ VLAN Tags on page 711
- Understanding Transparent Tag Operations and IEEE 802.1p Inheritance on page 717
- Understanding swap-by-poppush on page 720
- Configuring IEEE 802.1p Inheritance push and swap from the Transparent Tag on page 720

Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview

Stacking and rewriting VLAN tags, commonly known as Q-in-Q tunneling, 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 VLAN being swapped remain the 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 260)

**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. Stacked and rewriting Gigabit-Ethernet VLAN Tags are also referred to as Q-in-Q tunneling.
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 92 on page 694 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 92: Rewrite Operations on Untagged, Single-Tagged, and Dual-Tagged Frames

<table>
<thead>
<tr>
<th>Rewrite Operation</th>
<th>Untagged</th>
<th>Single-Tagged</th>
<th>Dual-Tagged</th>
<th>Number of Tags</th>
</tr>
</thead>
<tbody>
<tr>
<td>pop</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>-1</td>
</tr>
<tr>
<td>push</td>
<td>Sometimes</td>
<td>Yes</td>
<td>Yes</td>
<td>+1</td>
</tr>
<tr>
<td>swap</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>0</td>
</tr>
<tr>
<td>push-push</td>
<td>Sometimes</td>
<td>Yes</td>
<td>Yes</td>
<td>+2</td>
</tr>
<tr>
<td>swap-push</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>+1</td>
</tr>
<tr>
<td>swap-swap</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>0</td>
</tr>
<tr>
<td>pop-pop</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>-2</td>
</tr>
<tr>
<td>pop-swap</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>-1</td>
</tr>
</tbody>
</table>

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**

```ini
[edit interfaces interface-name unit logical-unit-number]
input-vlan-map {
  pop;
}
output-vlan-map {
  push;
}
```

**Interface 2**

```ini
[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 93 on page 695 shows what rewrite operation combinations you can configure. “None” means that no rewrite operation is specified for the VLAN map.
Table 93: Applying Rewrite Operations to VLAN Maps

<table>
<thead>
<tr>
<th>Input VLAN Map</th>
<th>Output VLAN Map</th>
</tr>
</thead>
<tbody>
<tr>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>none</td>
<td>Yes</td>
</tr>
<tr>
<td>push</td>
<td>No</td>
</tr>
<tr>
<td>pop</td>
<td>No</td>
</tr>
<tr>
<td>swap</td>
<td>Yes</td>
</tr>
<tr>
<td>push-push</td>
<td>No</td>
</tr>
<tr>
<td>swap-push</td>
<td>No</td>
</tr>
<tr>
<td>swap-swap</td>
<td>Yes</td>
</tr>
<tr>
<td>pop-pop</td>
<td>No</td>
</tr>
<tr>
<td>pop-swap</td>
<td>No</td>
</tr>
</tbody>
</table>

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 698.

Related Documentation
- Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview on page 691
- Understanding swap-by-poppush on page 720
- swap-by-poppush on page 1545
- 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. The stacked and rewriting Gigabit-Ethernet VLAN
Tags are also referred to as Q-in-Q tunneling. 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 691
- `aggregated-ether-options` on page 1222
- `ethernet-switch-profile` on page 1302
- `gigether-options` on page 1329
- `tag-protocol-id` on page 1553
- 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 695
- Configuring Flexible VLAN Tagging on PTX Series Packet Transport Routers on page 267

## 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 701.

**Related Documentation**
- stacked-vlan-tagging on page 1537
- Stacking a VLAN Tag on page 701
- 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 711.

### 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. The stacked and rewriting Gigabit-Ethernet VLAN Tags are also referred to as Q-in-Q tunneling.

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;
   }
   ```
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.

```plaintext
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 260.

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 [ tpid ] ]` hierarchy level or `[edit interfaces interface-name aggregated-ether-options ethernet-switch-profile tag-protocol-id [ tpid ] ]` hierarchy level. For more information, see “Configuring Frames with Particular TPIDs to Be Processed as Tagged Frames” on page 695.

Table 94 on page 699 and Table 95 on page 700 specify when these statements are required. Table 94 on page 699 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 94: Rewrite Operations and Statement Usage for Input VLAN Maps

<table>
<thead>
<tr>
<th>Rewrite Operation</th>
<th>Input VLAN Map Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>push</td>
<td>vlan-id Optional</td>
</tr>
<tr>
<td></td>
<td>tag-protocol-id Optional</td>
</tr>
<tr>
<td></td>
<td>inner-vlan-id No</td>
</tr>
<tr>
<td></td>
<td>inner-tag-protocol-id No</td>
</tr>
<tr>
<td>pop</td>
<td>vlan-id No</td>
</tr>
<tr>
<td></td>
<td>tag-protocol-id No</td>
</tr>
<tr>
<td></td>
<td>inner-vlan-id No</td>
</tr>
<tr>
<td></td>
<td>inner-tag-protocol-id No</td>
</tr>
<tr>
<td>swap</td>
<td>vlan-id Any</td>
</tr>
<tr>
<td></td>
<td>tag-protocol-id Any</td>
</tr>
<tr>
<td></td>
<td>inner-vlan-id No</td>
</tr>
<tr>
<td></td>
<td>inner-tag-protocol-id No</td>
</tr>
</tbody>
</table>
Table 94: Rewrite Operations and Statement Usage for Input VLAN Maps (continued)

<table>
<thead>
<tr>
<th>Rewrite Operation</th>
<th>Input VLAN Map Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>push-push</td>
<td>Optional Optional Optional optional</td>
</tr>
<tr>
<td>swap-push</td>
<td>Optional Optional Any Any</td>
</tr>
<tr>
<td>swap-swap</td>
<td>Optional Optional Any Any</td>
</tr>
<tr>
<td>pop-swap</td>
<td>No No Any Any</td>
</tr>
<tr>
<td>pop-pop</td>
<td>No No No No</td>
</tr>
</tbody>
</table>

Table 95 on page 700 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 95: Rewrite Operations and Statement Usage for Output VLAN Maps

<table>
<thead>
<tr>
<th>Rewrite Operation</th>
<th>Output VLAN Map Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>push</td>
<td>vlan-id Optional inner-vlan-id inner-tag-protocol-id</td>
</tr>
<tr>
<td>pop</td>
<td>No No No No</td>
</tr>
<tr>
<td>swap</td>
<td>No Optional No No</td>
</tr>
<tr>
<td>push-push</td>
<td>No Optional No Optional</td>
</tr>
<tr>
<td>swap-push</td>
<td>No Optional No Optional</td>
</tr>
<tr>
<td>swap-swap</td>
<td>No Optional No Optional</td>
</tr>
<tr>
<td>pop-swap</td>
<td>No No No Optional</td>
</tr>
<tr>
<td>pop-pop</td>
<td>No No No No</td>
</tr>
</tbody>
</table>

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;
}
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]`
If you include the `push` statement in an interface’s input VLAN map, see Table 93 on page 695 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 260.

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]]` hierarchy level. For more information, see “Configuring Inner and Outer TPIDs and VLAN IDs” on page 698.

### Related Documentation
- `tag-protocol-id` on page 1554
- `unit` on page 1592
- Table 93 on page 695
- 802.1Q VLANs Overview on page 260
- Configuring Inner and Outer TPIDs and VLAN IDs on page 698
- 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:

```plaintext
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 94 on page 699 and Table 95 on page 700 for information about configuring inner and outer VLAN ID values and inner and outer TPID values required for VLAN maps.
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:

```plaintext
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]`

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:

```plaintext
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 94 on page 699 and Table 95 on page 700 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 1354
- output-vlan-map on page 1451
- pop-pop on page 1463
- unit on page 1592

See Table 94 on page 699 and Table 95 on page 700 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 94 on page 699 and Table 95 on page 700 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 1354
- output-vlan-map on page 1451
- pop-swap on page 1464
- unit on page 1592
- See Table 94 on page 699 and Table 95 on page 700 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:

```plaintext
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:

```plaintext
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 260.
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 711.

**Related Documentation**

- *Ethernet Interfaces Feature Guide for Routing Devices*

## Rewriting a VLAN Tag on Untagged Frames

- Overview on page 706
- Example: push and pop with Ethernet CCC Encapsulation on page 708
- Example: push-push and pop-pop with Ethernet CCC Encapsulation on page 708
- Example: push and pop with Ethernet VPLS Encapsulation on page 708
- Example: push-push and pop-pop with Ethernet VPLS Encapsulation on page 709

### Overview

You can rewrite VLAN tags on untagged incoming and outgoing frames with the `ethernet-ccc` and `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 96 on page 707 through Table 98 on page 708 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 (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 96: Input VLAN Map Statements Allowed for ethernet-ccc and ethernet-vpls Encapsulations

<table>
<thead>
<tr>
<th>Operation</th>
<th>vlan-id</th>
<th>tag-protocol-id</th>
<th>inner-vlan-id</th>
<th>inner-tag-protocol-id</th>
</tr>
</thead>
<tbody>
<tr>
<td>push</td>
<td>Yes</td>
<td>Optional</td>
<td>No</td>
<td>Optional</td>
</tr>
<tr>
<td>push-push</td>
<td>Yes</td>
<td>Optional</td>
<td>Yes</td>
<td>Optional</td>
</tr>
</tbody>
</table>

### Table 97: Output VLAN Map Statements Allowed for ethernet-ccc and ethernet-vpls Encapsulations

<table>
<thead>
<tr>
<th>Operation</th>
<th>vlan-id</th>
<th>tag-protocol-id</th>
<th>inner-vlan-id</th>
<th>inner-tag-protocol-id</th>
</tr>
</thead>
<tbody>
<tr>
<td>pop</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>pop-pop</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
Table 98: Rules for Applying Rewrite Operations to VLAN Maps

<table>
<thead>
<tr>
<th>Input VLAN Map</th>
<th>None</th>
<th>pop</th>
<th>pop-pop</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>push</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>push-push</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

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

```c
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

```c
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

```c
ge-3/1/0 {
  encapsulation ethernet-vpls;
}
Example: push-push and pop-pop with Ethernet VPLS Encapsulation

```plaintext
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 1354
- output-vlan-map on page 1451
- pop on page 1462
- pop-pop on page 1463
- push on page 1484
- push-push on page 1485
- unit on page 1592
- *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. The stacked and rewriting Gigabit-Ethernet VLAN Tags are also referred to as Q-in-Q tunneling.

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 94 on page 699 and Table 95 on page 700 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 1354
- output-vlan-map on page 1451
- swap-push on page 1545
- unit on page 1592
- 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: The stacked and rewriting Gigabit-Ethernet VLAN Tags are also referred to as Q-in-Q tunneling.

**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 94 on page 699 and Table 95 on page 700 for information about configuring inner and outer VLAN ID values and inner and outer TPID values required for VLAN maps.

Related Documentation

- 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 711
- Stack Inner and Outer VLAN Tags on page 712
- Swap a VLAN ID on Ingress on page 712
- Swap a VLAN ID on Egress on page 713
- Swap a VLAN ID on Both Ingress and Egress on page 714
- 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 715
- Swap a TPID and VLAN ID Pair for Both VLAN Tags on Ingress and on Egress on page 715
- 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 716
- Pop a TPID and VLAN ID Pair on Ingress; Push a VLAN ID and TPID Pair on Egress on page 716
- Pop an Outer VLAN Tag to Connect an Untagged VPLS Interface to Tagged VPLS Interfaces on page 717

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-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;
    }
}

g-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;
}

[edit interfaces]
ge-4/0/0 {
    vlan-tagging;
    encapsulation vlan-ccc;
    ...
    unit 1 {
        encapsulation vlan-ccc;
        vlan-id 1000;
    }
}

g-4/2/0 {
    vlan-tagging;
    encapsulation vlan-ccc;
    gigether-options {
        ethernet-switch-profile {
            ...
        }
    }

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;
    }
}

g-4/2/0 {
    vlan-tagging;
    encapsulation vlan-ccc;
    gigether-options {
        ethernet-switch-profile {
            ...
        }
    }

SwapaVLANIDonEgress
[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;
}
}

Swapping a VLAN ID on Both Ingress and Egress

download as text
[edit protocols]
mls {
    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;
    }
}

[edit interfaces]
ge-1/1/0 {
    unit 0 {
        vlan-tags {
            inner 0x9100.425;
            outer 0x9200.525;
        }
        input-vlan-map {
            swap-swap;
            inner-tag-protocol-id 0x9100;
        }
    }
    unit 1 {
        encapsulation vlan-ccc;
        vlan-id 2000;
        output-vlan-map {
            swap;
            tag-protocol-id 0x8800;
        }
    }
}

[edit interfaces]
ge-1/1/0 {
    unit 1 [vlan-cc;
            vlan-id 2000;
            output-vlan-map {
                swap;
                tag-protocol-id 0x8800;
            }
    ]
}

[edit protocols]
mls {
    ...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 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

Swap a TPID and VLAN ID Pair for Both VLAN Tags on Ingress and on Egress
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;
}
}

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

[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{
            swap-push;
tag-protocol-id 0x9200;
            inner-tag-protocol-id 0x9100;
        }
    }
}

Pop a TPID and VLAN ID Pair on Ingress; Push a VLAN ID and TPID Pair on Egress

[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;
        }
    }
}
Pop an Outer VLAN Tag to Connect an Untagged VPLS Interface to Tagged VPLS Interfaces

```
[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;
  }
}
```

Related Documentation
- input-vlan-map on page 1354
- output-vlan-map on page 1451
- inner-tag-protocol-id on page 1347
- inner-vlan-id on page 1348
- pop on page 1462
- pop-pop on page 1463
- pop-swap on page 1464
- push on page 1484
- push-push on page 1485
- swap on page 1544
- swap-push on page 1545
- swap-swap on page 1546
- unit on page 1592
- 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 99 on page 718 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 99: VLAN Map Operation and IEEE 802.1p Inheritance**

<table>
<thead>
<tr>
<th>Rewrite Operation</th>
<th>Untagged Logical Interface</th>
<th>Transparent tag IEEE 802.1p Inheritance</th>
<th>Single-tagged Logical Interface</th>
<th>Transparent tag IEEE 802.1p Inheritance</th>
<th>Change in number of tags</th>
</tr>
</thead>
<tbody>
<tr>
<td>push-push</td>
<td>yes</td>
<td>OUTER, INNER</td>
<td>NA</td>
<td>no operation</td>
<td>+2</td>
</tr>
<tr>
<td>swap-push</td>
<td>NA</td>
<td>no operation</td>
<td>yes</td>
<td>OUTER, INNER</td>
<td>+1</td>
</tr>
<tr>
<td>push</td>
<td>yes</td>
<td>OUTER</td>
<td>yes</td>
<td>*none</td>
<td>+1</td>
</tr>
<tr>
<td>swap</td>
<td>NA</td>
<td>NA</td>
<td>yes</td>
<td>OUTER</td>
<td>0</td>
</tr>
</tbody>
</table>

*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 33 on page 718 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 33: swap-push (transparent tag)**

Incoming Packet tags:

- **0x88a8** S.1p 100 0x9100 H.1p 1000
- **(swap-push)**

Outgoing Packet tags: (802.1p copied from transparent tag)

- **0x9100** H.1p 400 0x9100 H.1p 500 0x9100 H.1p 1000
- **Inner VLAN tag**
- **Outer VLAN tag**
- **transparent**

Figure 34 on page 719 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 34: swap-push (no transparent tag)

Incoming Packet tags:

<table>
<thead>
<tr>
<th>Outer</th>
<th>Inner</th>
<th>VLAN Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x88a8</td>
<td>S.1p</td>
<td>100</td>
</tr>
</tbody>
</table>

(swap-push)

Outgoing Packet tags: (802.1p by default as 0)

<table>
<thead>
<tr>
<th>Outer</th>
<th>Inner</th>
<th>VLAN Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x9100</td>
<td>0</td>
<td>400</td>
</tr>
<tr>
<td>0x9100</td>
<td>0</td>
<td>500</td>
</tr>
</tbody>
</table>

Figure 35 on page 719 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 35: push (transparent tag)

Incoming Packet tags:

<table>
<thead>
<tr>
<th>Outer</th>
<th>Inner</th>
<th>VLAN Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x9100</td>
<td>H.1p</td>
<td>1000</td>
</tr>
</tbody>
</table>

(push)

Outgoing Packet tags: (802.1p set from transparent tag)

<table>
<thead>
<tr>
<th>Outer</th>
<th>Inner</th>
<th>VLAN Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x9100</td>
<td>H.1p</td>
<td>400</td>
</tr>
<tr>
<td>0x9100</td>
<td>H.1p</td>
<td>1000</td>
</tr>
</tbody>
</table>

Figure 36 on page 719 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 36: push-push (transparent tag)

Incoming Packet tags:

<table>
<thead>
<tr>
<th>Outer</th>
<th>Inner</th>
<th>VLAN Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x9100</td>
<td>H.1p</td>
<td>1000</td>
</tr>
</tbody>
</table>

(push-push)

Outgoing Packet tags: (802.1p copied from transparent tag)

<table>
<thead>
<tr>
<th>Outer</th>
<th>Inner</th>
<th>VLAN Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x9100</td>
<td>H.1p</td>
<td>400</td>
</tr>
<tr>
<td>0x9100</td>
<td>H.1p</td>
<td>500</td>
</tr>
<tr>
<td>0x9100</td>
<td>H.1p</td>
<td>1000</td>
</tr>
</tbody>
</table>

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 720
- Understanding swap-by-poppush on page 720
- swap-by-poppush on page 1545
- 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 1545
- 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 720
- Understanding Transparent Tag Operations and IEEE 802.1p Inheritance on page 717

**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-802.1 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.

```plaintext
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.

```plaintext
[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 1545
- Understanding IEEE 802.1p Inheritance push and swap from a Transparent Tag
- Understanding swap-by-poppush on page 720
- Understanding Transparent Tag Operations and IEEE 802.1p Inheritance on page 717
PART 3

Operation, Administration, and Management (OAM) for Ethernet Interfaces

- Configuring IEEE 802.1ag OAM Connectivity-Fault Management on page 725
- Configuring IEEE 802.3ah OAM Link-Fault Management on page 817
- Configuring ITU-T Y.1731 Ethernet Service OAM on page 853
- Configuring Ethernet Ring Protection on page 989
- CFM Action Profile to Bring Down a Group of Logical Interfaces on page 1023
CHAPTER 32

Configuring IEEE 802.1ag OAM Connectivity-Fault Management

- Ethernet Operations, Administration, and Maintenance on page 726
- Ethernet OAM Connectivity Fault Management on page 727
- IEEE 802.1ag OAM Connectivity Fault Management Overview on page 728
- Junos OS Support for Performance Monitoring Compliant with Technical Specification MEF 36 on page 733
- Junos OS Support for Chassis ID TLV on page 734
- Creating a Maintenance Domain on page 735
- Configuring Maintenance Intermediate Points (MIPs) on page 736
- Configuring Maintenance Association Intermediate Points in ACX Series on page 738
- Creating a Maintenance Association on page 742
- Continuity Check Protocol Parameters Overview on page 743
- Configuring Continuity Check Protocol Parameters for Fault Detection on page 744
- Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 745
- Configuring MEP Interfaces to Support Ethernet Frame Delay Measurements on page 750
- Configuring Service Protection for VPWS over MPLS Using the MEP Interface on page 752
- Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 757
- Configuring Linktrace Protocol in CFM on page 758
- Configuring Ethernet Local Management Interface on page 759
- Configuring Port Status TLV and Interface Status TLV on page 768
- Configuring MAC Flush Message Processing in CET Mode on page 780
- Example: Configuring an Action Profile Based on Connection Protection TLVs on page 783
- Configuring M120 and MX Series Routers for CCC Encapsulated Packets on page 785
- Configuring Rate Limiting of Ethernet OAM Messages on page 787
- Configuring Unified ISSU for 802.1ag CFM on page 790
- Configuring Continuity Check Messages for Better Scalability on page 793
- Configuring Faster Protection Switching for Point-to-Point Network Topologies on page 794
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 5G Universal Routing Platforms. 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

**Ethernet OAM Connectivity Fault Management**

The most complete connectivity fault management (CFM) is defined in IEEE 802.1ag. This topic emphasizes the use of CFM in a Metro Ethernet environment.

The major features of CFM are:

- Fault monitoring using the continuity check protocol. This is a neighbor discovery and health check protocol that discovers and maintains adjacencies at the VLAN or link level.
- Path discovery and fault verification using the linktrace protocol. Similar to IP traceroute, this protocol maps the path taken to a destination MAC address through one or more bridged networks between the source and destination.
- Fault isolation using the loopback protocol. Similar to IP ping, this protocol works with the continuity check protocol during troubleshooting.

CFM partitions the service network into various administrative domains. For example, operators, providers, and customers might be part of different administrative domains.

Each administrative domain is mapped into one maintenance domain providing enough information to perform its own management, thus avoiding security breaches and making end-to-end monitoring possible. Each maintenance domain is associated with a maintenance domain level from 0 through 7. Level allocation is based on the network hierarchy, where outermost domains are assigned a higher level than the innermost domains.

Customer end points have the highest maintenance domain level. In a CFM maintenance domain, each service instance is called a maintenance association. A maintenance association can be thought as a full mesh of maintenance endpoints (MEPs) having similar characteristics. MEPs are active CFM entities generating and responding to CFM protocol messages.
There is also a maintenance intermediate point (MIP), which is a CFM entity similar to the MEP, but more passive (MIPs only respond to CFM messages).

MEPs can be up MEPs or down MEPs. A link can connect a MEP at level 5 to a MEP at level 7. The interface at level 5 is an up MEP (because the other end of the link is at MEP level 7), and the interface at level 7 is a down MEP (because the other end of the link is at MEP level 5).

In a Metro Ethernet network, CFM is commonly used at two levels:

- By the service provider to check the connectivity among its provider edge (PE) routers
- By the customer to check the connectivity among its customer edge (CE) routers

**NOTE:** The configured customer CFM level must be greater than service provider CFM level.

In many Metro Ethernet networks, CFM is used to monitor connectivity over a VPLS and bridge network.

**NOTE:** In ACX Series routers, OAM for VPLS is supported only on ACX5048, ACX5096, and ACX5448 routers.

**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.

**NOTE:** MX Series Virtual Chassis does not support distributed inline connectivity fault management.

ACX Series routers support CFM on aggregated Ethernet interfaces with continuity check interval of 100 milliseconds or higher.

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:** 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.

**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.

- Starting in Junos OS Release 14.2, 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.

Starting in Junos OS Release 10.3, 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. Starting in Junos OS Release 12.3, CFM does not support Multichassis Link Aggregation (MC-LAG). Do not configure the `mc-ae` statement when you configure CFM.
Starting in Junos OS Release 11.3, 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.

Starting in Junos OS Release 17.4, you can enable support for IEEE 802.1ag CFM on pseudowire service interfaces by configuring maintenance intermediate points (MIPs) on the pseudowire service interfaces. Pseudowire service interfaces support configuring of subscriber interfaces over MPLS pseudowire termination. Termination of subscriber interfaces over PW enables network operators to extend their MPLS domain from the Access/Aggregation network to the service edge and use uniform MPLS label provisioning for a larger portion of their network.

**NOTE:** The CFM MIP session is supported only on the pseudowire services interface and not on the pseudowire services tunnel interface.

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 730
- Best Practices for Configuring 802.1ag Ethernet OAM for VPLS on page 731

**Connectivity Fault Management Key Elements**

Figure 37 on page 730 shows the relationships among the customer, provider, and operator Ethernet bridges, maintenance domains, maintenance association end points (MEPs), and maintenance intermediate points (MIPs).

**Figure 37: Relationship Among MEPS, MIPs, and Maintenance Domain Levels**

<table>
<thead>
<tr>
<th>Customer bridge</th>
<th>Operator 1 bridges</th>
<th>Operator 2 bridges</th>
<th>Customer bridge</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEP or MIP</td>
<td>MEP or MIP</td>
<td>MEP or MIP</td>
<td>MEP or MIP</td>
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<tr>
<td>MEP or MIP</td>
<td>MEP or MIP</td>
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<tr>
<td>MEP or MIP</td>
<td>MEP or MIP</td>
<td>MEP or MIP</td>
<td>MEP or MIP</td>
</tr>
</tbody>
</table>

**MEP:** Maintenance End Point

**MIP:** Maintenance Intermediate Point, also known as a Loopback Point
NOTE: On ACX Series routers, the maintenance intermediate points (MIP) are supported only on the ACX5048 and ACX5096 routers.

A maintenance association is a set of MEPs configured with the same maintenance association identifier and maintenance domain level. Figure 38 on page 731 shows the hierarchical relationships between the Ethernet bridge, maintenance domains, maintenance associations, and MEPs.

Figure 38: 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 728 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.

### Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>17.4R1</td>
<td>Starting in Junos OS Release 17.4, you can enable support for IEEE 802.1ag CFM on pseudowire service interfaces by configuring maintenance intermediate points (MIPs) on the pseudowire service interfaces.</td>
</tr>
<tr>
<td>14.2</td>
<td>Starting in Junos OS Release 14.2, 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).</td>
</tr>
<tr>
<td>12.3</td>
<td>Starting in Junos OS Release 12.3, CFM does not support Multichassis Link Aggregation (MC-LAG). Do not configure the <code>mc-ae</code> statement when you configure CFM.</td>
</tr>
<tr>
<td>11.3</td>
<td>Starting in Junos OS Release 11.3, on T Series and M320 routers, CFM is not supported on interfaces configured with CCC encapsulation.</td>
</tr>
<tr>
<td>10.3</td>
<td>Starting in Junos OS Release 10.3, 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.</td>
</tr>
<tr>
<td>9.3</td>
<td>In Junos OS Release 9.3 and later, CFM also supports aggregated Ethernet interfaces.</td>
</tr>
</tbody>
</table>

### Related Documentation
- [connectivity-fault-management on page 1258](#)
Junos OS Support for Performance Monitoring Compliant with Technical Specification MEF 36

Junos OS release 16.1R1 and later supports performance monitoring that is compliant with Technical Specification MEF 36. Technical Specification MEF 36 specifies the performance monitoring MIB. The performance monitoring MIB is required to manage service operations, administration, and maintenance (OAM) implementations that satisfy the Service OAM requirements and framework specified in MEF 17 and MEF 35, the management objects specified in MEF 7.1, and the performance monitoring functions defined in ITU-T Y.1731 and IEEE 802.1ag.

You can enable MEF-36-compliant performance monitoring by configuring the `measurement-interval` statement at the `[edit protocols oam ethernet cfm performance-monitoring]` hierarchy level.

When MEF-36-compliant performance monitoring is enabled:

- An SNMP get next request for a variable might not fetch the current value unless an SNMP walk is performed before performing the get next request. This limitation applies only to the current statistics for delay measurement, loss measurement, and synthetic loss measurement.
- The output for the field `Current delay measurement statistics` might display a measurement interval of 0 (zero) and an incorrect timestamp until the first cycle time has expired.
- Supported data TLV size for performance monitoring protocol data units (PDUs) is 1386 bytes when MEF-36-compliant performance monitoring is enabled. The TLV size is 1400 bytes in legacy mode.
- The maximum configurable value for the lower threshold bin is 4,294,967,294.
• Frame loss ratio (FLR) is excluded in loss measurements during period of unavailability for synthetic loss measurement only. In case of loss measurement, FLR is included even during period of unavailability.

• During a period of loss of continuity (adjacency down), although SOAM PDUs are not sent, FLR and availability calculations are not stopped. These calculations are performed with the assumption of 100% loss.

• The number of SOAM PDUs that are sent during the first measurement interval might be less than expected. This is because of a delay in detecting the adjacency state at the performance monitoring session level.

• The number of SOAM PDUs transmitted during a measurement interval for a cycle time of 100 ms might not be accurate. For example, in a measurement interval of two minutes with a cycle time 100 ms, the SOAM PDUs transmitted might be in the range of 1198—2000.

**Related Documentation**

- IEEE 802.1ag OAM Connectivity Fault Management Overview on page 728
- measurement-interval on page 1174

**Junos OS Support for Chassis ID TLV**

In Release 16.1R2 and later, you can configure Junos OS to send the sender ID TLV along with the packets. The sender ID TLV is an optional TLV that is sent in continuity check messages (CCMs), loopback messages, and Link Trace Messages (LTMs), as specified in the IEEE 802.1ag standard. The sender ID TLV contains the chassis ID, which is the unique, CFM-based MAC address of the device, and the management IP address, which is an IPv4 or an IPv6 address.

The value of the `length` field in the TLV indicates whether or not the TLV contains the chassis ID information. The possible values for the `length` field are zero (0) or any valid number, which indicates the absence or presence of chassis ID information in the TLV, respectively.

You can enable Junos OS to send the sender ID TLV at the global level by using the `set protocols oam ethernet connectivity-fault-management sendid-tlv send-chassis-tlv` command. If the sender ID TLV is configured at the global level, then the default maintenance domain, maintenance association, and the maintenance association intermediate point (MIP) half function inherit this configuration.

You can also configure the sender ID TLV at the following hierarchy levels:

- `[edit protocols oam ethernet connectivity-fault-management]`.

The sender ID TLV configuration at the maintenance-association level takes precedence over the global-level configuration.
NOTE: The sender ID TLV is supported only for 802.1ag PDUs and is not supported for performance monitoring protocol data units (PDUs).

### Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.1</td>
<td>In Release 16.1R2 and later, you can configure Junos OS to send the sender ID TLV along with the packets.</td>
</tr>
</tbody>
</table>

### Related Documentation

- IEEE 802.1ag OAM Connectivity Fault Management Overview on page 728

### 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 1258
- maintenance-domain on page 1172
- IEEE 802.1ag OAM Connectivity Fault Management Overview on page 728
- Configuring Maintenance Intermediate Points (MIPs) on page 736
- Creating a Maintenance Association on page 742
- Configuring Continuity Check Protocol Parameters for Fault Detection on page 744
- Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 745
- Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 757
- Configuring Linktrace Protocol in CFM on page 758
- Configuring Ethernet Local Management Interface on page 759
- Configuring Port Status TLV and Interface Status TLV on page 768
- Configuring MAC Flush Message Processing in CET Mode on page 780
- Configuring M120 and MX Series Routers for CCC Encapsulated Packets on page 785
- Configuring Rate Limiting of Ethernet OAM Messages on page 787
- `name-format` on page 1178
- `level` on page 1166

**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 1237
- connectivity-fault-management on page 1258
- instance on page 1159
- mip-half-function on page 1177
- virtual-switch on page 1603
Configuring Maintenance Association Intermediate Points in ACX Series

Maintenance Intermediate Point (MIP) provides monitoring capability of intermediate points for services such as Layer 2 bridging, Layer 2 circuit, and Layer 2 VPN. ACX5048 and ACX5096 routers support MIPs for the Ethernet OAM 802.1ag CFM protocol. Use the bridge-domain, interface, and mip-half-function MIP options to specify the MIP configuration.

NOTE: ACX5048 and ACX5096 routers do not support MIP configuration on VPLS services.

NOTE: ACX5448 router do not support MIP.

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.

To display MIP configurations, use the `show oam ethernet connectivity-fault-management mip (bridge-domain | instance-name | interface-name)` command.

The following MIP configurations are supported in ACX5048 and ACX5096 routers:

- MIP with bridge domain
- MIP with circuit cross-connect (CCC)
- MIP with bridge domain when maintenance association end point is configured
- MIP with CCC when maintenance association end point is configured

The following sections describe MIP configuration:

- Configuring the Maintenance Domain Bridge Domain on page 739
- Configuring the Maintenance Domain MIP Half Function on page 739
- Configuring the Maintenance Association Intermediate Points with Bridge Domain on page 739
- Configuring the Maintenance Association Intermediate Points with Circuit Cross-Connect on page 740
- Configuring the Maintenance Association Intermediate Points with Bridge Domain when Maintenance Association End Point is Configured on page 740
- Configuring the Maintenance Intermediate Points with Circuit Cross-Connect when Maintenance Association End Point is Configured on page 741

### Configuring the Maintenance Domain Bridge Domain

To configure the bridge domain, include the `vlans` statement at the `[edit protocols oam ethernet connectivity-fault-management maintenance-domain maintenance-domain-name]` hierarchy level.

**NOTE:** The Layer 2 CLI configurations and show commands for ACX5048 and ACX5096 routers differ compared to other ACX Series routers. For more information, see [Layer 2 Next Generation Mode for ACX Series](#).

### Configuring the Maintenance Domain MIP Half Function

MIP Half Function (MHF) divides MIP functionality into two unidirectional segments, improves visibility with minimal configuration, and improves network coverage by increasing the number of points that can be monitored. MHF extends monitoring capability by responding to loopback and linktrace messages to help isolate faults.

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. To configure the MIP half function, include the `mip-half-function` statement at the `[edit protocols oam ethernet connectivity-fault-management maintenance-domain maintenance-domain-name]` hierarchy level.

### Configuring the Maintenance Association Intermediate Points with Bridge Domain

In ACX5048 and ACX5096 routers, you can configure the MIP with bridge domain. The following is a sample to configure the MIP with bridge domain:

```
[edit protocols]
oam {
```
Configuring the Maintenance Association Intermediate Points with Circuit Cross-Connect

In ACX5048 and ACX5096 routers, you can configure the MIP with circuit cross-connect (CCC). The following is a sample to configure the MIP with CCC:

```plaintext
[edit protocols]
oam {
  ethernet {
    connectivity-fault-management {
      maintenance-domain default-6 {
        interface xe-0/0/42.0;
        mip-half-function default;
      }
    }
  }
}
```

Configuring the Maintenance Association Intermediate Points with Bridge Domain when Maintenance Association End Point is Configured

In ACX5048 and ACX5096 routers, you can configure the MIP with bridge domain when a maintenance association end point (MEP) is configured. The following is a sample to configure the MIP with bridge domain when MEP is configured:

```plaintext
[edit protocols]
oam {
  ethernet {
    connectivity-fault-management {
      maintenance-domain md2 {
        level 5;
        mip-half-function default;
        maintenance-association ma2 {
          continuity-check {
            interval 1s;
          }
          mep 222 {
            interface xe-0/0/42.0;
            direction up;
          }
        }
      }
    }
  }
}
```
Configuring the Maintenance Intermediate Points with Circuit Cross-Connect when Maintenance Association End Point is Configured

In ACX5048 and ACX5096 routers, you can configure the MIP with circuit cross-connect (CCC) when a maintenance association end point (MEP) is configured. The following is a sample to configure the MIP with CCC when MEP is configured:

```plaintext
[edit protocols]
oam {
    ethernet {
        connectivity-fault-management {
            maintenance-domain md2 {
                level 5;
                mip-half-function default;
                maintenance-association ma2 {
                    continuity-check {
                        interval 1s;
                    }
                    mep 222 {
                        interface xe-0/0/42.0;
                        direction up;
                    }
                }
            }
        }
    }
}
```

Related Documentation
- bridge-domain on page 1237
- connectivity-fault-management on page 1258
- instance on page 1159
- mip-half-function on page 1177
- IEEE 802.1ag OAM Connectivity Fault Management Overview on page 728
- Creating a Maintenance Domain on page 735
- Creating a Maintenance Association on page 742
- Configuring Continuity Check Protocol Parameters for Fault Detection on page 744
- Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 745
- Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 757
- Configuring Linktrace Protocol in CFM on page 758
- Configuring Ethernet Local Management Interface on page 759
- Configuring Port Status TLV and Interface Status TLV on page 768
- Configuring MAC Flush Message Processing in CET Mode on page 780
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.
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 by default. You can only disable PPM on the Packet Forwarding Engine. To disable PPM on the Packet Forwarding Engine, 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. 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 autodiscovered 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 autodiscovered 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 728
- Configuring Continuity Check Protocol Parameters for Fault Detection on page 744
- Creating a Maintenance Domain on page 735
- Configuring Maintenance Intermediate Points (MIPs) on page 736
- Creating a Maintenance Association on page 742
- Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 745
- Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 757
- Configuring Linktrace Protocol in CFM on page 758
- Configuring Ethernet Local Management Interface on page 759
- Configuring Port Status TLV and Interface Status TLV on page 768
- Configuring MAC Flush Message Processing in CET Mode on page 780
- Configuring M120 and MX Series Routers for CCC Encapsulated Packets on page 785
- Configuring Rate Limiting of Ethernet OAM Messages on page 787
- Managing Continuity Measurement Statistics on page 936

Configuring Continuity Check Protocol Parameters for Fault Detection

The continuity check protocol is used for fault detection by a maintenance association end point (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 (CCMs) to build a MEP database of all MEPs in the maintenance association.

To configure continuity check protocol parameters:

1. Specify the time to wait in minutes before flushing the MEP database, if no updates occur, with a value from 1 minute through 30,240 minutes. The default value is 10 minutes.

   ![NOTE: Flushing based on the hold timer is applicable only for autodiscovered 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 (duration) between the transmissions of CCMs. 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 duration
```

3. Specify the 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.

```
[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 728
- Continuity Check Protocol Parameters Overview on page 743
- Creating a Maintenance Domain on page 735
- Configuring Maintenance Intermediate Points (MIPs) on page 736
- Creating a Maintenance Association on page 742
- Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 745
- Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 757
- Configuring Linktrace Protocol in CFM on page 758
- Configuring Ethernet Local Management Interface on page 759
- Configuring Port Status TLV and Interface Status TLV on page 768
- Configuring MAC Flush Message Processing in CET Mode on page 780
- Configuring M120 and MX Series Routers for CCC Encapsulated Packets on page 785
- Configuring Rate Limiting of Ethernet OAM Messages on page 787
- Managing Continuity Measurement Statistics on page 936
- Configuring Connectivity Fault Management for Interoperability During Unified In-Service Software Upgrades on page 932

### 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 multiple up MEPs for a single combination of maintenance association ID and maintenance domain ID for interfaces belonging to a particular VPLS service or a bridge domain. 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.

For layer 2 VPNs routing instances (local switching) and EVPN routing instances, you can also configure multiple up MEPs for a single combination of maintenance association ID and maintenance domain ID on logical interfaces. The logical interface can be configured on different devices or on the same device. To support multiple up MEPs on two IFLs, enhanced IP network services must be configured for the chassis.

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 746
- Configuring a remote Maintenance Association End Point (MEP) on page 748

**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.

```plaintext
[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.

```plaintext
[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 5G Universal Routing Platforms, 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 7 through 0 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
```

6. 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
```
7. 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

See Also

• auto-discovery on page 1135
• direction on page 1151
• lowest-priority-defect on page 1170
• priority on page 1186

Configuring a remote Maintenance Association End Point (MEP)

To configure a remote maintenance association end point:

1. 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

2. 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

3. 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.
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 remote-mep
  remote-mep-id]
user@host# set detect-loc
```

See Also
- action-profile on page 1133
- detect-loc on page 1150
- remote-mep on page 1190

Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.3</td>
<td>Starting with Junos OS Release 12.3, for all interfaces configured on Modular Port Concentrators (MPCs) on MX Series 5G Universal Routing Platforms, 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.</td>
</tr>
</tbody>
</table>

Related Documentation
- connectivity-fault-management on page 1258
- IEEE 802.1ag OAM Connectivity Fault Management Overview on page 728
- Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 757
- Configuring Port Status TLV and Interface Status TLV on page 768
- Configuring MAC Flush Message Processing in CET Mode on page 780
- Configuring M120 and MX Series Routers for CCC Encapsulated Packets on page 785
- Configuring Rate Limiting of Ethernet OAM Messages on page 787
- Configuring Service Protection for VPWS over MPLS Using the MEP Interface on page 752
Configuring MEP Interfaces to Support Ethernet Frame Delay Measurements

Ethernet frame delay measurement is a useful tool for providing performance statistics or supporting or challenging Service Level Agreements (SLAs). By default, Ethernet frame delay measurement uses software for timestamping and delay calculations. You can optionally use hardware timing to assist in this process and increase the accuracy of the delay measurement results. This assistance is available on the reception path.

Before you can perform Ethernet frame delay measurements on MX Series routers, you must have done the following:

- Configured Ethernet OAM and CFM correctly
- Prepared the measurement between two compatibly configured MX Series routers
- Enabled the distributed periodic packet management daemon (ppmd)
- Avoided trying to perform Ethernet frame delay measurement on aggregated Ethernet or pseudowire interfaces, which are not supported
- Made sure the hardware-assisted timestamping is supported if that feature is configured

At the end of this configuration, you create two MX Series routers that can perform and display Ethernet frame delay measurements on Ethernet interfaces using optional hardware timestamping. By default, Ethernet frame delay measurement uses software for timestamping and delay calculations. You can optionally use hardware timing to assist in this process and increase the accuracy of the delay measurement results. This assistance is available on the reception path.

To configure hardware-assisted timestamping:

1. 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:

```plaintext
[edit]
protocols {
    oam {
        ethernet {
            connectivity-fault-management {
                performance-monitoring {
                    hardware-assisted-timestamping; # Enable timestamping in hardware.
                }
            }
        }
    }
}
```

2. Ethernet frame delay measurement requires that distributed PPMD is enabled. Before you can gather statistics for Ethernet frame delay measurement, you must make sure that PPMD is configured properly. Without distributed PPMD, delay measurement results are not valid.
To perform Ethernet frame delay measurement, make sure that the following configuration statement is NOT present:

```
[edit routing-options]
ppm {
  no-delegate-processing; # This turns distributed PPMD OFF.
}
```

### Related Documentation
- Ethernet Frame Delay Measurements Overview on page 854
- Triggering an ETH-DM Session on page 984
- Viewing ETH-DM Statistics on page 986
- Configuring One-Way ETH-DM with Single-Tagged Interfaces on page 950
- Configuring Two-Way ETH-DM with Single-Tagged Interfaces on page 955
- Configuring ETH-DM with Un tagged Interfaces
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 100 on page 752 describes the available service protection options.

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>working</td>
<td>Specifies the working path.</td>
</tr>
<tr>
<td>protect</td>
<td>Specifies the protect path.</td>
</tr>
</tbody>
</table>

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.

   ```plaintext
   [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.
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.

```bash
[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.

```bash
[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.

```bash
[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.

```bash
[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.

```bash
[edit protocols oam ethernet connectivity-fault-management maintenance-domain domain-name maintenance-association ma-name 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 5G Universal Routing Platforms, 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
   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 endpoint 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 5G Universal Routing Platforms, 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

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.3</td>
<td>Starting with Junos OS Release 12.3, for all interfaces configured on Modular Port Concentrators (MPCs) on MX Series 5G Universal Routing Platforms, 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.</td>
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</tr>
</tbody>
</table>

Related Documentation

- auto-discovery on page 1135
- interval on page 1162
- name-format on page 1178
- protect-maintenance-association on page 1188
- short-name-format on page 1192
- Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 757
- Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 745
- IEEE 802.1ag OAM Connectivity Fault Management Overview on page 728
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) on page 1154
- default-actions on page 1146
- connectivity-fault-management on page 1258
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.

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
   ```

---

**Related Documentation**

- `age` on page 1217
- `path-database-size` on page 1179
- `connectivity-fault-management` on page 1258
- IEEE 802.1ag OAM Connectivity Fault Management Overview on page 728
- Creating a Maintenance Domain on page 735
- Configuring Maintenance Intermediate Points (MIPs) on page 736
- Creating a Maintenance Association on page 742
- Configuring Continuity Check Protocol Parameters for Fault Detection on page 744
Configuring Ethernet Local Management Interface

- Ethernet Local Management Interface Overview on page 759
- Configuring the Ethernet Local Management Interface on page 761
- Example E-LMI Configuration on page 763

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 39 on page 759.

Figure 39: Scope of the E-LMI Protocol
The E-LMI implementation on ACX and 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.

The E-LMI protocol on ACX Series routers supports Layer 2 circuit and Layer 2 VPN EVC types and enables link-loss forwarding for pseudowire (Layer 2 circuit and Layer 2 VPN) services as follows:

• **Interworking between the connectivity fault management (CFM) protocol and the E-LMI protocol for Layer 2 circuit and Layer 2 VPN.**
  - End-to-end CFM session between UNIs to monitor EVC status.
  - In the case of pseudowire redundancy, CFM can be used to monitor active and backup pseudowire sessions. The EVC status is declared as down to CE devices only when both the active and backup pseudowire sessions go down.

• **Interworking between remote defect indication (RDI) and E-LMI for Layer 2 circuit and Layer 2 VPN.**
  - If a maintenance association end point (MEP) receives an RDI bit set in a continuity check message (CCM) frame, and if RDI fault detection is enabled in the EVC configuration at `edit protocols oam ethernet evcs evc-id evc-protocol cfm management-domain name management-association name faults rdi`, then the pseudowire is declared as down to CE routers through E-LMI.
  
  - If an end-to-end CFM session does not exist between UNIs, the pseudowire (Layer 2 circuit or Layer 2 VPN) up and down state triggers an asynchronous EVC state change message to CE routers through E-LMI.

**NOTE:** ACX Series routers do not support E-LMI for Layer 2 services (bridging).

### Configuring the Ethernet Local Management Interface

To configure E-LMI, perform the following steps:

• [Configuring an OAM Protocol (CFM)](#)

• [Assigning the OAM Protocol to an EVC](#)

• [Enabling E-LMI on an Interface and Mapping CE VLAN IDs to an EVC](#)

#### Configuring an OAM Protocol (CFM)

For information on configuring the OAM protocol (CFM), see “IEEE 802.1ag OAM Connectivity Fault Management Overview” on page 728.
Assigning the OAM Protocol to an EVC

To configure an EVC, you must specify a name for the EVC using the `evcs 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 evc-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] hierarchy level. All VIDs 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 763
- Configuring PE1 on page 764
- Configuring PE2 on page 765
- Configuring Two UNIs Sharing the Same EVC on page 767

**Example Topology**

Figure 40 on page 763 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 40: E-LMI Configuration for a Point-to-Point EVC (SVLAN) Monitored by CFM**

---

Copyright © 2019, Juniper Networks, Inc. 763
Configuring PE1

```conf
[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;
      }
    }
  }
}
Configuring Two UNIs Sharing the Same EVC

```yaml
[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 1258
- IEEE 802.1ag OAM Connectivity Fault Management Overview on page 728
- Creating a Maintenance Domain on page 735
- Configuring Maintenance Intermediate Points (MIPs) on page 736
- Creating a Maintenance Association on page 742
- Configuring Continuity Check Protocol Parameters for Fault Detection on page 744
- Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 745
- Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 757
- Configuring Linktrace Protocol in CFM on page 758
- Configuring Port Status TLV and Interface Status TLV on page 768
- Configuring MAC Flush Message Processing in CET Mode on page 780
- Configuring M120 and MX Series Routers for CCC Encapsulated Packets on page 785

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Configuring Port Status TLV and Interface Status TLV

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 101 on page 768 shows the TLV format and indicates if it is required or optional.

Table 101: Format of TLVs

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Octet (sequence)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>1</td>
<td>Required. If 0, no Length or Value fields follow. If not 0, at least the Length field follows the Type field.</td>
</tr>
<tr>
<td>Length</td>
<td>2–3</td>
<td>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.</td>
</tr>
<tr>
<td>Value</td>
<td>4</td>
<td>Length specified by the Length field. Optional. Not present if the Type field is 0 or if the Length field is 0.</td>
</tr>
</tbody>
</table>

Various TLVs for CFM PDUs

Table 102 on page 768 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 102: Type Field Values for Various TLVs for CFM PDUs

<table>
<thead>
<tr>
<th>TLV or Organization</th>
<th>Type Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>End TLV</td>
<td>0</td>
</tr>
<tr>
<td>Sender ID TLV</td>
<td>1</td>
</tr>
<tr>
<td>Port Status TLV</td>
<td>2</td>
</tr>
</tbody>
</table>
Table 102: Type Field Values for Various TLVs for CFM PDUs (continued)

<table>
<thead>
<tr>
<th>TLV or Organization</th>
<th>Type Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data TLV</td>
<td>3</td>
</tr>
<tr>
<td>Interface Status TLV</td>
<td>4</td>
</tr>
<tr>
<td>Reply Ingress TLV</td>
<td>5</td>
</tr>
<tr>
<td>Reply Egress TLV</td>
<td>6</td>
</tr>
<tr>
<td>LTM Egress Identifier TLV</td>
<td>7</td>
</tr>
<tr>
<td>LTR Egress Identifier TLV</td>
<td>8</td>
</tr>
<tr>
<td>Reserved for IEEE 802.1</td>
<td>9 to 30</td>
</tr>
<tr>
<td>Organization-Specific TLV</td>
<td>31</td>
</tr>
<tr>
<td>Defined by ITU-T Y.1731</td>
<td>32 to 63</td>
</tr>
<tr>
<td>Reserved for IEEE 802.1</td>
<td>64 to 255</td>
</tr>
</tbody>
</table>

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 771
- Interface Status TLV on page 773

## 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 104 on page 771. The format of this TLV is shown in Table 103 on page 771.

Any change in the Port Status TLVs value triggers one extra transmission of that bridge ports MEP CCMs.

### Table 103: Port Status TLV Format

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Octet (Sequence)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type = 2</td>
<td>1</td>
</tr>
<tr>
<td>Length</td>
<td>2–3</td>
</tr>
<tr>
<td>Value (See Table 104 on page 771)</td>
<td>4</td>
</tr>
</tbody>
</table>

### Table 104: Port Status TLV Values

<table>
<thead>
<tr>
<th>Mnemonic</th>
<th>Ordinary Data Passing Freely Through the Port</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>psBlocked</td>
<td>No: <code>enableRmepDefect</code> = false</td>
<td>1</td>
</tr>
<tr>
<td>psUp</td>
<td>Yes: <code>enableRmepDefect</code> = true</td>
<td>2</td>
</tr>
</tbody>
</table>

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:

```plaintext
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 104 on page 771, 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 105 on page 773. The enumerated values are shown in Table 106 on page 774.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Octet (Sequence)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type = 4</td>
<td>1</td>
</tr>
<tr>
<td>Length</td>
<td>2–3</td>
</tr>
<tr>
<td>Value (See Table 106 on page 774)</td>
<td>4</td>
</tr>
</tbody>
</table>
### Table 106: Interface Status TLV Values

<table>
<thead>
<tr>
<th>Mnemonic</th>
<th>Interface Status</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>isUp</td>
<td>up</td>
<td>1</td>
</tr>
<tr>
<td>isDown</td>
<td>down</td>
<td>2</td>
</tr>
<tr>
<td>isTesting</td>
<td>testing</td>
<td>3</td>
</tr>
<tr>
<td>isUnknown</td>
<td>unknown</td>
<td>4</td>
</tr>
<tr>
<td>isDormant</td>
<td>dormant</td>
<td>5</td>
</tr>
<tr>
<td>isNotPresent</td>
<td>notPresent</td>
<td>6</td>
</tr>
<tr>
<td>isLowerLayerDown</td>
<td>lowerLayerDown</td>
<td>7</td>
</tr>
</tbody>
</table>

**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 reenable 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:

```plaintext
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 105 on page 773, 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 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
LBM sent : 0
Valid in-order LBRs received : 0
Valid out-of-order LBRs received : 0
LBRs received with corrupted data : 0
LBRs sent : 0
LTM sent : 0
LTM 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
yes
Statistics:
CCMs sent : 1328
CCMs received out of sequence : 0
LBM sent : 0
Valid in-order LBRs received : 0
Valid out-of-order LBRs received : 0
LBRs received with corrupted data : 0
LBRs sent : 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:

```
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
```
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 41 on page 781 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 42 on page 782 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 A-x100 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:

```bash
[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;
  }
}
```
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 783
- Overview and Topology on page 783
- Configuration on page 784

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 43 on page 784
The following definitions describe the meaning of the device abbreviation and terms used in Figure 43 on page 784.

- **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 780

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**Configuring M120 and MX Series Routers for CCC Encapsulated Packets**

- IEEE 802.1ag CFM OAM Support for CCC Encapsulated Packets Overview on page 785
- CFM Features Supported on Layer 2 VPN Circuits on page 786
- Configuring CFM for CCC Encapsulated Packets on page 786

**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 44: Layer 2 VPN Topology

To monitor the L2VPN circuit, a CFM up MEP (Level 6 in Figure 44 on page 786) 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 44 on page 786).

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;
        }
      }
    }
  }
}
```
See Also

- connectivity-fault-management on page 1258
- IEEE 802.1ag OAM Connectivity Fault Management Overview on page 728
- Creating a Maintenance Domain on page 735
- Configuring Maintenance Intermediate Points (MIPs) on page 736
- Creating a Maintenance Association on page 742
- Configuring Continuity Check Protocol Parameters for Fault Detection on page 744
- Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 745
- Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 757
- Configuring Linktrace Protocol in CFM on page 758
- Configuring Ethernet Local Management Interface on page 759
- Configuring Port Status TLV and Interface Status TLV on page 768
- Configuring MAC Flush Message Processing in CET Mode on page 780
- Configuring Rate Limiting of Ethernet OAM Messages on page 787
- Ethernet Interfaces Feature Guide for Routing Devices

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-policer` 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 {
```
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 728
• Creating a Maintenance Domain on page 735
• Configuring Maintenance Intermediate Points (MIPs) on page 736
• Configuring Continuity Check Protocol Parameters for Fault Detection on page 744
• Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 745
• Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 757
• Configuring Linktrace Protocol in CFM on page 758
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: Starting in Junos OS Release 15.1, 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 728, and you should further observe the additional requirements described in this topic.

Table 107 on page 790 shows the Loss Threshold TLV format.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Octet (sequence)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type=31</td>
<td>1</td>
<td>Required. Required. If 0, no Length or Value fields follow. If not 0, at least the Length field follows the Type field.</td>
</tr>
</tbody>
</table>
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:

```plaintext
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: 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: 
  Loss Threshold: 3 , Flag: 0x0

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.1</td>
<td>Starting in Junos OS Release 15.1, configuring ISSU with CFM (802.1ag) is supported only on MX and PTX routers that support TLV.</td>
</tr>
</tbody>
</table>

**Related Documentation**

- Example: Configuring Ethernet CFM over VPLS on page 808
- IEEE802.1ag OAM Connectivity Fault Management Overview on page 728

### 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 794.
- 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 796.
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 797.

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 798.

Related Documentation

- Configuring Faster Protection Switching for Point-to-Point Network Topologies on page 794
- Configuring Faster Convergence for Dual-Homed Multipoint-to-Multipoint Network Topologies on page 796
- Configuring a Primary VLAN ID for Increased Flexibility on page 797
- Configuring a Remote Maintenance Association to Accept a Different ID on page 798

### 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.

```plaintext
[edit protocols oam]
ethernet {
  connectivity-fault-management {
    action-profile p1 {
      event {
        interface-status-tlv down;
      }
      action {
        interface-down;
      }
    }
  }
}
```
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:

```conf
[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;
            }
            remote-mep 100
        }
        maintenance-association ma2 {
            continuity-check {
                interval 100ms;
                connection-protection-tlv;
            }
            mep 101 {
                interface ge-1/2/0.0;
                direction down;
                auto-discovery;
            }
        }
    }
}
```
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 780
- IEEE 802.1ag OAM Connectivity Fault Management Overview on page 728
- `connectivity-fault-management` on page 1258
- Configuring a CFM Action Profile to Specify CFM Actions for CFM Events on page 757

### 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:

```plaintext
[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 728
- `connection-protection-tlv`
- Creating a Maintenance Association on page 742
- `connectivity-fault-management` on page 1258
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 728
- Creating a Maintenance Association on page 742
- `connectivity-fault-management` on page 1258
- `connection-protection-tlv`
Enabling Enhanced Connectivity Fault Management Mode

You can enable enhanced connectivity fault management (CFM) mode to enable effective Ethernet OAM deployment in scaling networks. On enabling enhanced CFM mode, Junos OS supports 32,000 maintenance association end points (MEPs) and maintenance intermediate points (MIPs) each per chassis for bridge, VPLS, L2VPN, and CCC domains. In previous releases, Junos OS supports 8,000 MEPs and 8000 MIPS per chassis. If you do not enable enhanced CFM, Junos OS continues to support existing number of MIPs and MEPs per chassis.

NOTE: To support enhanced CFM mode, configure the network services mode on the router as enhanced-ip. If the network services mode is not enhanced-ip, and you have enabled enhanced CFM, the following warning message is displayed:

```
[edit protocols oam ethernet]
'connectivity-fault-management'
enhanced ip is not effective please configure enhanced ip and give router reboot
```

To enable enhanced CFM mode, perform the following steps:

1. In configuration mode, go to the [edit protocols oam ethernet connectivity-fault-management] hierarchy level.

```
[edit]
user@host# edit protocols oam ethernet connectivity-fault-management
```

2. Enable effective Ethernet OAM deployment by enabling enhanced CFM mode.

```
[edit protocols oam ethernet connectivity-fault-management ]
user@host# set enhanced-cfm-mode
```

3. Commit the mode change. A warning message is displayed asking you to restart CFM. If you do not restart CFM, CFM is automatically restarted by Junos OS.

```
[edit protocols oam ethernet connectivity-fault-management ]
user@host # commit
[edit protocols oam ethernet] 'connectivity fault management'
CFM mode change is catastrophic. cfmd will be restarted
commit complete
```

4. To verify if the enhanced CFM mode has been configured, use the show oam ethernet connectivity-fault-management state command.

```
[edit protocols oam ethernet connectivity-fault-management ]
user@host# run show oam ethernet connectivity-fault-management
```
enhanced-cfm-mode;
  traceoptions {
    file cfmd.log size 1g;
  }
}

maintenance-domain md6 {
  level 6;
  maintenance-association ma6 {
    continuity-check {
      interval 1s;
    }
    mep 102 {
      interface ge-0/0/0.0;
      direction up;
    }
  }
}

Related Documentation
- enhanced-cfm-mode on page 1152

Understanding CFM Monitoring between CE and PE Devices

You can enable connectivity fault management (CFM) monitoring between provider edge devices and customer edge devices when the customer edge device is not a Juniper device. When the interface is down, CFM propagates the status of the interface in the CC messages. The CC message informs the customer edge device that the provider edge device is down.

You can configure CFM monitoring using either of the following two options:

- Interface Status TLV (Type, Length, and Value)—You can enable connectivity fault management (CFM) monitoring between provider edge devices and customer edge devices when the customer edge device is not a Juniper device by using Interface Status TLV. When the interface is down, CFM propagates the status of the interface using 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. Thus, the customer edge device is aware that the provider edge device is down. To configure CFM monitoring using Interface Status TLV, use the `interface-status-tlv` statement at the `[edit protocols oam ethernet connectivity-fault-management maintenance-domain maintenance-domain maintenance-association maintenance-association continuity-check hierarchy level]`. This is the standard option.

- RDI (Remote Defect Indication)—Starting in Junos OS Release 17.3R1, you can enable connectivity fault management (CFM) monitoring between provider edge devices and customer edge devices when the customer edge device is not a Juniper device by using the remote defect indication (RDI) bit. When you enable CFM monitoring, CFM propagates the status of the provider edge device via the remote defect indication (RDI) bit in the CC messages. Thus, the customer edge device is aware that the provider edge device is down. The RDI bit is cleared when the service is back up. To configure CFM monitoring using the RDI bit, use the `interface-status-send-rdi` statement at the `[edit protocols oam ethernet connectivity-fault-management maintenance-domain`
**maintenance-domain**

**maintenance-association**

**continuity-check**

hierarchy level. This option is required if the customer edge device does not support Interface Status TLV.

**NOTE:** When the interface is set to CCC down and you have configured RDI, then RDI bit is sent. CFM does not monitor the status of the interface. If CCC down is set when the interface is not standby, RDI bit is sent with the CC messages if you have configured RDI.

### Single Active Multi-homing Use Case using RDI bit

Consider the following topology where there are two provider edge devices (PE1 and PE2) as well as two customer edge devices (CE1 and CE2). PE1 is in active state while PE2 is in standby state. CFM down MEP is configured between the PE and CE. CFM detects that the CCC down and because CFM down MEP is configured, the CC messages generated have the RDI bit. The CC messages from PE2 to CE2 have the RDI bit set to indicate the blocked state. When PE2 becomes active, CCM down is cleared and the RDI bit is cleared from the subsequent CC messages.

### Active/Active Multihoming Use case using RDI bit

Consider the topology where there are two provider edge devices (PE1 and PE2) and two customer edge devices (CE1 and CE2). PE1 is in active state while PE2 is in standby state. If CFM down MEP is not configured between the PE and CE to monitor the link connectivity, the CC messages generated do not have the RDI bit. CFM down MEP is configured between the PE and CE. CFM detects that the CCC down and because CFM down MEP is configured, the CC messages generated have the RDI bit. The CC messages from PE2 to CE2 have the RDI bit set to indicate the blocked state. When PE2 becomes active, CCM down is cleared and the RDI bit is cleared from the subsequent CC messages.

### Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>17.3R1</td>
<td>Starting in Junos OS Release 17.3R1, you can enable connectivity fault management (CFM) monitoring between provider edge devices and customer edge devices when the customer edge device is not a Juniper device by using the remote defect indication (RDI) bit.</td>
</tr>
</tbody>
</table>

### Related Documentation

- interface-status-tlv on page 1160
- Configuring Port Status TLV and Interface Status TLV on page 768
- interface-status-send-rdi on page 1161
Example: Configuring Ethernet CFM on Physical Interfaces

This example shows the configuration of Ethernet connectivity fault management (CFM) on physical interfaces.

- Requirements on page 802
- Overview on page 802
- Configuration on page 802

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 45 on page 802. The single boundary is a “down mep” in CFM terminology.

Figure 45: Ethernet CFM on Physical Interfaces

To configure Ethernet CFM on physical interfaces, perform these tasks:
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 726
- Ethernet OAM Connectivity Fault Management on page 727
- Example: Configuring Ethernet CFM over VPLS on page 808
- Example: Configuring Ethernet CFM on Bridge Connections on page 804

### 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 46 on page 805. 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 46: Ethernet CFM over a Bridge Network

Here are the configurations of CFM on the customer routers.

**CFM on L2-CE1**

```conf
[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-site] {
      continuity-check {
        interval 1s;
      }
      mep 700 {
        interface ge-0/2/9.0;
        direction down;
        auto-discovery;
      }
    }
  }
}
```

**CFM on L2-CE2**

```conf
[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;
  }
}
```
Here are the configurations of CFM on the provider routers.

**CFM on PE1**

```plaintext
[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-site2 {
    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;
        }
    }
}
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 47 on page 809. 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 47: 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

```conf
default chassis
fpc 5 {
    pic 0 {
        tunnel-services {
            bandwidth 1g;
        }
    }
}

default 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;
            }
        }
    }
}
```

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[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;
    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;
      }
    }
  }
}
```
Here is the configuration of CFM on L2-E1:

```cml
[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;
        }
      }
    }
  }
}
```

Here is the configuration of CFM L2-CE2:

```cml
[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 726
- Ethernet OAM Connectivity Fault Management on page 727
- Example: Configuring Ethernet CFM on Bridge Connections on page 804
- Example: Configuring Ethernet CFM on Physical Interfaces on page 802
CHAPTER 33

Configuring IEEE 802.3ah OAM Link-Fault Management

- IEEE 802.3ah OAM Link-Fault Management Overview on page 818
- Understanding Ethernet OAM Link Fault Management for ACX Series Routers on page 819
- Configuring IEEE 802.3ah OAM Link-Fault Management on page 821
- Configuring Ethernet 802.3ah OAM on PTX Series Packet Transport Routers on page 822
- Enabling IEEE 802.3ah OAM Support on page 823
- Configuring Link Discovery on page 824
- Configuring the OAM PDU Interval on page 825
- Configuring the OAM PDU Threshold on page 826
- Configuring Threshold Values for Local Fault Events on an Interface on page 827
- Disabling the Sending of Link Event TLVs on page 828
- Detecting Remote Faults on page 828
- Enabling Dying Gasp Functionality on page 829
- Configuring an OAM Action Profile on page 830
- Specifying the Actions to Be Taken for Link-Fault Management Events on page 832
- Monitoring the Loss of Link Adjacency on page 833
- Monitoring Protocol Status on page 834
- Configuring Threshold Values for Fault Events in an Action Profile on page 835
- Applying an Action Profile on page 836
- Setting a Remote Interface into Loopback Mode on page 837
- Enabling Remote Loopback Support on the Local Interface on page 838
- Enabling Nonstop Routing for Ethernet Link Fault Management on Backup Routers on page 839
- Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 842
- Example: Configuring IEEE 802.3ah OAM Support for an Interface on ACX Series on page 844
- Example: Configuring Ethernet LFM Between Provider Edge and Customer Edge on page 846
IEEE 802.3ah OAM Link-Fault Management Overview

Ethernet interfaces capable of running at 100 Mbps or faster on EX Series switches, PTX Series, 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

Starting in Junos OS Release 17.3R1, the Ethernet link fault management daemon (lfmd) runs on the backup Routing Engine as well when graceful Routing Engine switchover (GRES) is configured.

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.
Starting in Junos OS Release 17.3R1, the Ethernet link fault management daemon (lfmd) runs on the backup Routing Engine as well when graceful Routing Engine switchover (GRES) is configured.

### Related Documentation
- Configuring IEEE 802.3ah OAM Link-Fault Management on page 821
- Enabling IEEE 802.3ah OAM Support on page 823
- Configuring Link Discovery on page 824
- Configuring the OAM PDU Interval on page 825
- Configuring the OAM PDU Threshold on page 826
- Configuring Threshold Values for Local Fault Events on an Interface on page 827
- Disabling the Sending of Link Event TLVs on page 828
- Detecting Remote Faults on page 828
- Configuring an OAM Action Profile on page 830
- Specifying the Actions to Be Taken for Link-Fault Management Events on page 832
- Monitoring the Loss of Link Adjacency on page 833
- Monitoring Protocol Status on page 834
- Configuring Threshold Values for Fault Events in an Action Profile on page 835
- Applying an Action Profile on page 836
- Setting a Remote Interface into Loopback Mode on page 837
- Enabling Remote Loopback Support on the Local Interface on page 838
- Enabling Nonstop Routing for Ethernet Link Fault Management on Backup Routers on page 839
- Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 842

### Understanding Ethernet OAM Link Fault Management for ACX Series Routers

The Juniper Networks Junos operating system (Junos OS) for Juniper Networks ACX Series routers allows the Ethernet interfaces on these routers to support the IEEE 802.3ah standard for the Operation, Administration, and Maintenance (OAM) of Ethernet in access networks. The standard defines OAM link fault management (LFM). You can configure IEEE 802.3ah OAM LFM on point-to-point Ethernet links that are connected either directly or through Ethernet repeaters. The IEEE 802.3ah standard meets the requirement for OAM capabilities even as Ethernet moves from being solely an enterprise technology to a WAN and access technology, and the standard remains backward compatible with the existing Ethernet technology.
Ethernet OAM provides 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 LAN identifier for troubleshooting.
- Work independently of the actual Ethernet transport and function over physical Ethernet ports or a virtual service such as a pseudowire.
- Isolate faults over a flat (or single-operator) network architecture or nested or hierarchical (or multiprovider) networks.

The following OAM LFM features are supported on ACX Series routers:

- **Discovery and Link Monitoring**
  The discovery process is triggered automatically when OAM is enabled on the interface. 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. 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 the process. The router performs link monitoring by sending periodic OAM protocol data units (PDUs) to advertise OAM mode, configuration, and capabilities.
  You can specify the number of OAMPDUsthat an interface can skip before the link between peers is considered down.

- **Remote Fault Detection**
  Remote fault detection uses flags and events. Flags are used to convey the following:
  - **Link Fault** means a loss of signal
  - **Dying Gasp** means an unrecoverable condition such as a power failure. In this condition, the local peer informs the remote peer about the failure state. When the remote peer receives a dying-gasp PDU, it takes an action corresponding to the action profile configured with the `link-adjacency-loss` event.

  NOTE: ACX5096 and ACX5048 routers do not support dying-gasp.

  ACX Series routers can generate and receive dying-gasp packets. When LFM is configured on an interface, a dying-gasp PDU is generated for the interface on the following failure conditions:
  - Power failure
  - Packet Forwarding Engine panic or a crash
  - **Critical Event** means an unspecified vendor-specific critical event.

  You can specify the interval at which OAM PDUs are sent for fault detection.
NOTE: ACX Series routers support the receipt of dying-gasp packets, but cannot generate them.

- Remote Loopback Mode
  Remote loopback mode ensures link quality between the router and a remote peer during installation or troubleshooting. In this mode, when the interface receives a frame that is not an OAM PDU or a PAUSE frame, it sends it back on the same interface on which it was received. The link appears to be in the active state. You can use the returned loopback acknowledgement to test delay, jitter, and throughput.

  If a remote data terminal equipment (DTE) supports remote loopback mode, Junos OS can place the remote DTE into loopback mode. 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 and PAUSE frames are looped back. No changes are made to the frames. OAM PDUs continue to be sent and processed.

### Related Documentation
- IEEE 802.1ag OAM Connectivity Fault Management Overview on page 728
- Configuring Ethernet Local Management Interface on page 759
- Ethernet OAM Connectivity Fault Management on page 727

### 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 1307
- `action-profile` on page 1132
IEEE 802.3ah OAM Link-Fault Management Overview on page 818
Enabling IEEE 802.3ah OAM Support on page 823
Configuring Link Discovery on page 824
Configuring the OAM PDU Interval on page 825
Configuring the OAM PDU Threshold on page 826
Configuring Threshold Values for Local Fault Events on an Interface on page 827
Disabling the Sending of Link Event TLVs on page 828
Detecting Remote Faults on page 828
Configuring an OAM Action Profile on page 830
Specifying the Actions to Be Taken for Link-Fault Management Events on page 832
Monitoring the Loss of Link Adjacency on page 833
Monitoring Protocol Status on page 834
Configuring Threshold Values for Fault Events in an Action Profile on page 835
Applying an Action Profile on page 836
Setting a Remote Interface into Loopback Mode on page 837
Enabling Remote Loopback Support on the Local Interface on page 838
Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 842

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.

Beginning in Junos OS Release 12.1, PTX Series routers support 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)

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

```plaintext
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 821
- Configuring Link Discovery on page 824
- Detecting Remote Faults on page 828
- Configuring an OAM Action Profile on page 830

**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:

```plaintext
[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 1373
- IEEE 802.3ah OAM Link-Fault Management Overview on page 818
- Configuring IEEE 802.3ah OAM Link-Fault Management on page 821
- Configuring Link Discovery on page 824
- Configuring the OAM PDU Interval on page 825
- Configuring the OAM PDU Threshold on page 826
- Configuring Threshold Values for Local Fault Events on an Interface on page 827
- Disabling the Sending of Link Event TLVs on page 828
Configure 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 1370](#)
- [IEEE 802.3ah OAM Link-Fault Management Overview on page 818](#)
- [Configuring IEEE 802.3ah OAM Link-Fault Management on page 821](#)
- [Enabling IEEE 802.3ah OAM Support on page 823](#)
- [Configuring the OAM PDU Interval on page 825](#)
- [Configuring the OAM PDU Threshold on page 826](#)
- [Configuring Threshold Values for Local Fault Events on an Interface on page 827](#)
- [Disabling the Sending of Link Event TLVs on page 828](#)
- [Detecting Remote Faults on page 828](#)
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 1454
- IEEE 802.3ah OAM Link-Fault Management Overview on page 818
- Configuring IEEE 802.3ah OAM Link-Fault Management on page 821
- Enabling IEEE 802.3ah OAM Support on page 823
- Configuring Link Discovery on page 824
- Configuring the OAM PDU Threshold on page 826
- Configuring Threshold Values for Local Fault Events on an Interface on page 827
- Disabling the Sending of Link Event TLVs on page 828
- Detecting Remote Faults on page 828
- Configuring an OAM Action Profile on page 830
- Specifying the Actions to Be Taken for Link-Fault Management Events on page 832
- Monitoring the Loss of Link Adjacency on page 833
- Monitoring Protocol Status on page 834
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 1455
- IEEE 802.3ah OAM Link-Fault Management Overview on page 818
- Configuring IEEE 802.3ah OAM Link-Fault Management on page 821
- Enabling IEEE 802.3ah OAM Support on page 823
- Configuring Link Discovery on page 824
- Configuring the OAM PDU Interval on page 825
- Configuring Threshold Values for Local Fault Events on an Interface on page 827
- Disabling the Sending of Link Event TLVs on page 828
- Detecting Remote Faults on page 828
- Configuring an OAM Action Profile on page 830
- Specifying the Actions to Be Taken for Link-Fault Management Events on page 832
- Monitoring the Loss of Link Adjacency on page 833
- Monitoring Protocol Status on page 834
- Configuring Threshold Values for Fault Events in an Action Profile on page 835
- Applying an Action Profile on page 836
- Setting a Remote Interface into Loopback Mode on page 837
- Enabling Remote Loopback Support on the Local Interface on page 838
- Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 842
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 1307
- frame-error on page 1324
- frame-period on page 1325
- frame-period-summary on page 1326
- symbol-period on page 1549
- IEEE 802.3ah OAM Link-Fault Management Overview on page 818
- Configuring IEEE 802.3ah OAM Link-Fault Management on page 821
- Enabling IEEE 802.3ah OAM Support on page 823
- Configuring Link Discovery on page 824
- Configuring the OAM PDU Interval on page 825
- Configuring the OAM PDU Threshold on page 826
- Disabling the Sending of Link Event TLVs on page 828
- Detecting Remote Faults on page 828
- Configuring an OAM Action Profile on page 830
- Specifying the Actions to Be Taken for Link-Fault Management Events on page 832
- Monitoring the Loss of Link Adjacency on page 833
- Monitoring Protocol Status on page 834
- Configuring Threshold Values for Fault Events in an Action Profile on page 835
- Applying an Action Profile on page 836
- Setting a Remote Interface into Loopback Mode on page 837
- Enabling Remote Loopback Support on the Local Interface on page 838
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 1426
- IEEE 802.3ah OAM Link-Fault Management Overview on page 818
- Configuring IEEE 802.3ah OAM Link-Fault Management on page 821
- Enabling IEEE 802.3ah OAM Support on page 823
- Configuring Link Discovery on page 824
- Configuring the OAM PDU Interval on page 825
- Configuring the OAM PDU Threshold on page 826
- Configuring Threshold Values for Local Fault Events on an Interface on page 827
- Detecting Remote Faults on page 828
- Configuring an OAM Action Profile on page 830
- Specifying the Actions to Be Taken for Link-Fault Management Events on page 832
- Monitoring the Loss of Link Adjacency on page 833
- Monitoring Protocol Status on page 834
- Configuring Threshold Values for Fault Events in an Action Profile on page 835
- Applying an Action Profile on page 836
- Setting a Remote Interface into Loopback Mode on page 837
- Enabling Remote Loopback Support on the Local Interface on page 838
- Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 842

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 818
• Configuring IEEE 802.3ah OAM Link-Fault Management on page 821
• Enabling IEEE 802.3ah OAM Support on page 823
• Configuring Link Discovery on page 824
• Configuring the OAM PDU Interval on page 825
• Configuring the OAM PDU Threshold on page 826
• Configuring Threshold Values for Local Fault Events on an Interface on page 827
• Disabling the Sending of Link Event TLVs on page 828
• Configuring an OAM Action Profile on page 830
• Specifying the Actions to Be Taken for Link-Fault Management Events on page 832
• Monitoring the Loss of Link Adjacency on page 833
• Monitoring Protocol Status on page 834
• Configuring Threshold Values for Fault Events in an Action Profile on page 835
• Applying an Action Profile on page 836
• Setting a Remote Interface into Loopback Mode on page 837
• Enabling Remote Loopback Support on the Local Interface on page 838
• Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 842

Enabling Dying Gasp Functionality

Dying gash means an unrecoverable condition such as a power failure. In this condition, the local peer informs the remote peer about the failure state. When the remote peer receives a dying-gasp PDU, it takes an action corresponding to the action profile configured with the link-adjacency-loss event. Dying gash helps to avoid file system corruption.

NOTE: ACX5096 and ACX5048 routers do not support dying-gasp.
ACX Series routers can generate and receive dying-gasp packets. When LFM is configured on an interface, a dying-gasp PDU is generated for the interface on the following failure conditions:

- Power failure
- Packet Forwarding Engine panic or a crash

ACX Series routers support the following CLI statements to enable dying-gasp functionality:

- `dgasp-int`—Enables dying-gasp functionality.
- `dgasp-usb`—Resets USB port during dying-gasp event.

The `dgasp-int` and `dgasp-usb` CLI statements are added under the `[edit system]` hierarchy to enable dying-gasp functionality.

To enable dying-gasp functionality, you need to configure the `dgasp-int` and `dgasp-usb` CLI statements as shown below:

```
root@host% cli
root@host> configure
Entering configuration mode
[edit]
root@host# set system dgasp-int
[edit]
root@host# set system dgasp-usb
[edit]
root@host# commit
commit complete
[edit]
root@host# show system
dgasp-int; dgasp-usb;
```

The dying-gasp functionality is disabled by default.

### Related Documentation
- Understanding Ethernet OAM Link Fault Management for ACX Series Routers on page 819

### 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: Starting from Junos OS Release 14.2, 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.

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.2</td>
<td>Starting from Junos OS Release 14.2</td>
</tr>
</tbody>
</table>

Related Documentation

- action-profile on page 1210
- IEEE 802.3ah OAM Link-Fault Management Overview on page 818
- Configuring IEEE 802.3ah OAM Link-Fault Management on page 821
- Enabling IEEE 802.3ah OAM Support on page 823
- Configuring Link Discovery on page 824
- Configuring the OAM PDU Interval on page 825
- Configuring the OAM PDU Threshold on page 826
- Configuring Threshold Values for Local Fault Events on an Interface on page 827
- Disabling the Sending of Link Event TLVs on page 828
- Detecting Remote Faults on page 828
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.
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;
```
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.
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 1482
- IEEE 802.3ah OAM Link-Fault Management Overview on page 818
- Configuring IEEE 802.3ah OAM Link-Fault Management on page 821
- Enabling IEEE 802.3ah OAM Support on page 823
- Configuring Link Discovery on page 824
- Configuring the OAM PDU Interval on page 825
- Configuring the OAM PDU Threshold on page 826
- Configuring Threshold Values for Local Fault Events on an Interface on page 827
- Disabling the Sending of Link Event TLVs on page 828
- Detecting Remote Faults on page 828
- Configuring an OAM Action Profile on page 830
- Specifying the Actions to Be Taken for Link-Fault Management Events on page 832
- Monitoring the Loss of Link Adjacency on page 833
- Configuring Threshold Values for Fault Events in an Action Profile on page 835
- Applying an Action Profile on page 836
- Setting a Remote Interface into Loopback Mode on page 837
- Enabling Remote Loopback Support on the Local Interface on page 838
- Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 842

### 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 1372
- IEEE 802.3ah OAM Link-Fault Management Overview on page 818
- Configuring IEEE 802.3ah OAM Link-Fault Management on page 821
- Enabling IEEE 802.3ah OAM Support on page 823
- Configuring Link Discovery on page 824
- Configuring the OAM PDU Interval on page 825
- Configuring the OAM PDU Threshold on page 826
- Configuring Threshold Values for Local Fault Events on an Interface on page 827
- Disabling the Sending of Link Event TLVs on page 828
- Detecting Remote Faults on page 828
- Configuring an OAM Action Profile on page 830
- Specifying the Actions to Be Taken for Link-Fault Management Events on page 832
- Monitoring the Loss of Link Adjacency on page 833
- Monitoring Protocol Status on page 834
- Applying an Action Profile on page 836
- Setting a Remote Interface into Loopback Mode on page 837
- Enabling Remote Loopback Support on the Local Interface on page 838
- Example: Configuring IEEE 802.3ah OAM Support on an Interface on page 842

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 1224
- IEEE 802.3ah OAM Link-Fault Management Overview on page 818
- Configuring IEEE 802.3ah OAM Link-Fault Management on page 821
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.
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 OAMPDUs are looped back without any changes to the frames. OAMPDUs 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.
### Enabling Nonstop Routing for Ethernet Link Fault Management on Backup Routers

Starting in Junos OS Release 17.3R1, the Ethernet link fault management daemon (lfmd) runs on the backup Routing Engine as well when graceful Routing Engine switchover (GRES) is configured. When the lfmd daemon runs on the backup Routing Engine as well, the link fault management states are kept in sync and so minimal effort is required by the lfmd daemon post switch over.

To enable Nonstop routing for Ethernet LFM on backup routers:

1. Enable graceful Routing Engine switchover. By default, GRES is disabled. To enable GRES, include the `graceful-switchover` statement at the `[edit chassis redundancy]` hierarchy level. By default, Nonstop routing is disabled. When you enable GRES, NSR is enabled.

   ```
   [edit chassis redundancy]
   user@host# set graceful-switchover
   ```

2. Synchronize the Routing Engine configuration. To synchronize the master Routing Engine configuration with the backup, include the `synchronize` statement at the `[edit system]` hierarchy level.
3. After enabling nonstop routing, commit the configuration.

4. To verify if nonstop routing is enabled on the backup router, at the operational mode, use the `show oam ethernet link-fault-management` command on the master router and then the backup router. Because you have enabled synchronization, the output of the master router and the backup router is identical. However, the statistics maintained by the master router are not synchronized with the backup router.

```
[edit routing options]
user@host# commit
```

```
[edit]
user@host# set commit synchronize
```

```
[edit system]
user@host# set commit synchronize
```

```
[master]
user@host# show oam ethernet link-fault-management ge-0/2/0 detail
```

```markdown
<table>
<thead>
<tr>
<th>Interface: ge-0/2/0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status: Running, Discovery state: Send Any</td>
</tr>
<tr>
<td>Transmit interval: 100ms, PDU threshold: 3 frames, Hold time: 300ms</td>
</tr>
<tr>
<td>Peer address: ac:4b:c8:81:90:a4</td>
</tr>
<tr>
<td>Flags: Remote-Stable Remote-State-Valid Local-Stable 0x50</td>
</tr>
<tr>
<td>OAM receive statistics:</td>
</tr>
<tr>
<td>Information: 0, Event: 0, Variable request: 0, Variable response: 0</td>
</tr>
<tr>
<td>Loopback control: 0, Organization specific: 0</td>
</tr>
<tr>
<td>OAM flags receive statistics:</td>
</tr>
<tr>
<td>Critical event: 0, Dying gasp: 0, Link fault: 0</td>
</tr>
<tr>
<td>OAM transmit statistics:</td>
</tr>
<tr>
<td>Information: 0, Event: 0, Variable request: 0, Variable response: 0</td>
</tr>
<tr>
<td>Loopback control: 786, Organization specific: 0</td>
</tr>
<tr>
<td>OAM received symbol error event information:</td>
</tr>
<tr>
<td>Events: 0, Window: 0, Threshold: 0</td>
</tr>
<tr>
<td>Errors in period: 0, Total errors: 0</td>
</tr>
<tr>
<td>OAM received frame error event information:</td>
</tr>
<tr>
<td>Events: 0, Window: 0, Threshold: 0</td>
</tr>
<tr>
<td>Errors in period: 0, Total errors: 0</td>
</tr>
<tr>
<td>OAM received frame period error event information:</td>
</tr>
<tr>
<td>Events: 0, Window: 0, Threshold: 0</td>
</tr>
<tr>
<td>Errors in period: 0, Total errors: 0</td>
</tr>
<tr>
<td>OAM received frame seconds error event information:</td>
</tr>
<tr>
<td>Events: 0, Window: 0, Threshold: 0</td>
</tr>
<tr>
<td>Errors in period: 0, Total errors: 0</td>
</tr>
<tr>
<td>OAM transmitted symbol error event information:</td>
</tr>
<tr>
<td>Events: 0, Window: 0, Threshold: 0</td>
</tr>
<tr>
<td>Errors in period: 0, Total errors: 0</td>
</tr>
<tr>
<td>OAM transmitted frame error event information:</td>
</tr>
<tr>
<td>Events: 0, Window: 0, Threshold: 0</td>
</tr>
<tr>
<td>Errors in period: 0, Total errors: 0</td>
</tr>
<tr>
<td>OAM current frame error event information:</td>
</tr>
<tr>
<td>Events: 0, Window: 0, Threshold: 0</td>
</tr>
<tr>
<td>Errors in period: 0, Total errors: 0</td>
</tr>
</tbody>
</table>
```
Loopback tracking: Enabled, Loop status: Not Found
Detect LOC: Enabled, LOC status: Not Found
Remote entity information:
  Remote MUX action: forwarding, Remote parser action: forwarding
  Discovery mode: active, Unidirectional mode: unsupported
  Remote loopback mode: unsupported, Link events: supported
  Variable requests: unsupported

Application profile statistics:

<table>
<thead>
<tr>
<th>Profile Name</th>
<th>Invoked</th>
<th>Executed</th>
</tr>
</thead>
<tbody>
<tr>
<td>LK_ADJ_LOSS100_1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>LK_ADJ_LOSS100_2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS100_3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS101_1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>LK_ADJ_LOSS101_2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS101_3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS106_1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS106_2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS106_3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS107_1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS107_2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS107_3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

[backup]

user@host# show oam ethernet link-fault-management ge-0/2/0 detail

Interface: ge-0/2/0
Status: Running, Discovery state: Send Any
  Transmit interval: 100ms, PDU threshold: 3 frames, Hold time: 300ms
  Peer address: ac:4b:c8:81:90:a4
  Flags:Remote-Stable Remote-State-Valid Local-Stable 0x50

OAM receive statistics:
  Information: 0, Event: 0, Variable request: 0, Variable response: 0
  Loopback control: 0, Organization specific: 0

OAM flags receive statistics:
  Critical event: 0, Dying gasp: 0, Link fault: 0

OAM transmit statistics:
  Information: 0, Event: 0, Variable request: 0, Variable response: 0
  Loopback control: 786, 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 received frame seconds 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
Loopback tracking: Enabled, Loop status: Not Found
Detect LOC: Enabled, LOC status: Not Found
Remote entity information:
  Remote MUX action: forwarding, Remote parser action: forwarding
  Discovery mode: active, Unidirectional mode: unsupported
  Remote loopback mode: unsupported, Link events: supported
  Variable requests: unsupported

Application profile statistics:
<table>
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<tbody>
<tr>
<td>LK_ADJ_LOSS100_1</td>
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<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS100_2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS100_3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS101_1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS101_2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS101_3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS106_1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS106_2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS106_3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS107_1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS107_2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS107_3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

NOTE: After the switchover, if issues are observed, use the clear oam ethernet link-fault-management state command for specific sessions. If the issue does not get resolved, restart the lfmd daemon.

Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>17.3R1</td>
<td>Starting in Junos OS Release 17.3R1, the Ethernet link fault management daemon (lfmd) runs on the backup Routing Engine as well when graceful Routing Engine switchover (GRES) is configured.</td>
</tr>
</tbody>
</table>

Related Documentation
- IEEE 802.3ah OAM Link-Fault Management Overview on page 818
- show oam ethernet link-fault-management on page 2312

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 1373
- IEEE 802.3ah OAM Link-Fault Management Overview on page 818
- Configuring IEEE 802.3ah OAM Link-Fault Management on page 821
- Enabling IEEE 802.3ah OAM Support on page 823
- Configuring Link Discovery on page 824
- Configuring the OAM PDU Interval on page 825
- Configuring the OAM PDU Threshold on page 826
- Configuring Threshold Values for Local Fault Events on an Interface on page 827
- Disabling the Sending of Link Event TLVs on page 828
- Detecting Remote Faults on page 828
- Configuring an OAM Action Profile on page 830
- Specifying the Actions to Be Taken for Link-Fault Management Events on page 832
- Monitoring the Loss of Link Adjacency on page 833
- Monitoring Protocol Status on page 834
- Configuring Threshold Values for Fault Events in an Action Profile on page 835
- Applying an Action Profile on page 836
- Setting a Remote Interface into Loopback Mode on page 837
- Enabling Remote Loopback Support on the Local Interface on page 838
Example: Configuring IEEE 802.3ah OAM Support for an Interface on ACX Series

Junos OS for ACX Series routers allows the Ethernet interfaces on these routers to support the IEEE 802.3ah standard for the Operation, Administration, and Maintenance (OAM) of Ethernet in access networks. The standard defines OAM link fault management (LFM). You can configure IEEE 802.3ah OAM LFM on point-to-point Ethernet links that are connected either directly or through Ethernet repeaters.

This example describes how to enable and configure OAM on a Gigabit Ethernet interface.

Requirements

This example uses the following hardware and software components:

- Junos OS Release 12.2 or later for ACX Series routers.
- An ACX1000 or ACX2000 router.

Overview and Topology

In this example, you configure a 10-Gigabit Ethernet interface on an ACX Series router with 802.3ah OAM support, which includes: link discovery, protocol data units (PDUs), remote loopback, negotiation, and event thresholds.

Configuring IEEE 802.3ah OAM on an ACX Series Router

**CLI Quick Configuration**

To quickly configure IEEE 802.3ah Ethernet OAM, copy the following commands and paste them into the CLI:

```
edit
edit protocols oam ethernet link-fault-management
set interface xe-0/0/0 link-discovery active pdu-interval 800 pdu-threshold 4
remote-loopback negotiation-options allow-remote-loopback
set interface xe-0/0/0 event-thresholds frame-error 30 frame-period 50
frame-period-summary 40 symbol-period 20
```

**Step-by-Step Procedure**

To configure IEEE 802.3ah OAM support on an interface:

1. Enable IEEE 802.3ah OAM support on an interface:

   ```
   [edit protocols oam ethernet link-fault-management]
   user@router1# set interface (OAM Link-Fault Management) xe-0/0/0
   ```

2. Specify that the interface initiates the discovery process by setting the link discovery mode to active:

   ```
   user@router# set interface xe-0/0/0 link-discovery active
   ```

3. Set the periodic OAM PDU-sending interval (in milliseconds) to 800:
4. Define the number of OAM PDUs to miss before an error is logged as 4:
   ```
   user@router# set interface xe-0/0/0 pdu-threshold 4
   ```

5. Configure the remote interface into loopback mode so that all frames except OAM PDUs are looped back without any changes:
   ```
   user@router# set interface xe-0/0/0 remote-loopback
   ```

6. Configure remote loopback support for the local interface:
   ```
   user@router# set interface xe-0/0/0 negotiation-options allow-remote-loopback
   ```

7. Set the threshold count for sending frame error events to 30:
   ```
   user@router# set interface xe-0/0/0 event-thresholds frame-error 30
   ```

8. Set the threshold count for sending frame period error events to 50:
   ```
   user@router# set interface xe-0/0/0 event-thresholds frame-period 50
   ```

9. Configure the threshold count for sending frame period summary error events to 40:
   ```
   user@router# set interface xe-0/0/0 event-thresholds frame-period-summary 40
   ```

10. Set the threshold count for sending symbol period events to 20:
    ```
        user@router# set interface xe-0/0/0 event-thresholds symbol-period 20
    ```

**Results**

Check the results of the configuration:

```
[edit]
user@router# show
```

```plaintext
[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;
          };
        }
      }
    }
  }
}
```
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 48 on page 846**.

**Figure 48: 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:

```conf
[edit]
interfaces ge-1/1/0 {
    unit 0 {
        family inet {
            address 11.11.11.1/24;
        }
    }
} protocols {
```
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
- IEEE 802.3ah OAM Link-Fault Management Overview on page 818
- Example: Configuring Ethernet LFM for CCC on page 847
- Example: Configuring Ethernet LFM for Aggregated Ethernet on page 849
- Example: Configuring Ethernet LFM with Loopback Support on page 851

### 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 49 on page 848.

Figure 49: 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;
                }
            }
        }
    }
}
```
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 50 on page 849.

**Figure 50: Ethernet LFM for Aggregated Ethernet**

To configure LFM on an aggregated Ethernet interface between two routers:

1. Configure LFM on Router 1 for AE0:

```plaintext
[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;
            }
        }
    }
}
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 51 on page 851.

Figure 51: Ethernet LFM with Loopback Support

To configure LFM between a PE router and a CE router:

1. Configure LFM loopback on the PE router:

```plaintext
[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:

```plaintext
[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*
- IEEE 802.3ah OAM Link-Fault Management Overview on page 818
- Example: Configuring Ethernet LFM Between Provider Edge and Customer Edge on page 846
- Example: Configuring Ethernet LFM for CCC on page 847
- Example: Configuring Ethernet LFM for Aggregated Ethernet on page 849
CHAPTER 34

Configuring ITU-T Y.1731 Ethernet Service OAM

- Ethernet Frame Delay Measurements Overview on page 854
- Ethernet Frame Loss Measurement Overview on page 860
- Service-Level Agreement Measurement on page 863
- On-Demand Mode for SLA Measurement on page 864
- Proactive Mode for SLA Measurement on page 865
- Ethernet Failure Notification Protocol Overview on page 866
- Ethernet Synthetic Loss Measurement Overview on page 867
- Scenarios for Configuration of ETH-SLM on page 869
- Format of ETH-SLM Messages on page 870
- Transmission of ETH-SLM Messages on page 872
- Guidelines for Configuring ETH-SLM on page 874
- Starting a Proactive ETH-SLM Session on page 875
- Starting an On-Demand ETH-SLM Session on page 880
- Managing ETH-SLM Statistics and ETH-SLM Frame Counts on page 880
- Troubleshooting Failures with ETH-SLM on page 885
- Configuring an Iterator Profile on page 886
- Verifying the Configuration of an Iterator Profile on page 889
- Managing Iterator Statistics on page 892
- Configuring a Remote MEP with an Iterator Profile on page 897
- Damping CFM performance Monitoring Traps and Notifications to Prevent Congestion of The NMS on page 899
- Configuring Statistical Frame Loss Measurement for VPLS Connections on page 899
- Guidelines for Configuring Routers to Support an ETH-DM Session on page 900
- Guidelines for Starting an ETH-DM Session on page 901
- Guidelines for Managing ETH-DM Statistics and ETH-DM Frame Counts on page 903
- Configuring Routers to Support an ETH-DM Session on page 907
- Starting an ETH-DM Session on page 912
Ethernet Frame Delay Measurements Overview

- ITU-T Y.1731 Frame Delay Measurement Feature on page 855
- One-Way Ethernet Frame Delay Measurement on page 857
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.

ACX Series routers support proactive and on-demand modes.

**NOTE:** ACX5048 and ACX5096 routers supports only software-based time stamping for delay measurement.

### 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 52 on page 856 shows the relationships among the customer, provider, and operator Ethernet bridges, maintenance domains, maintenance association end points (MEPs), and maintenance intermediate points (MIPs).

**Figure 52: Relationship of MEPS, MIPs, and Maintenance Domain Levels**

![Diagram of maintenance domains and MEPS/MIPs]

**NOTE:** On ACX Series routers, the maintenance intermediate points (MIP) is supported only on the ACX5048 and ACX5096 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.

**NOTE:** MX Series Virtual Chassis does not support Ethernet frame delay measurement (DM).
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.

NOTE: ACX Series routers do not support one-way Ethernet frame delay measurement.

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. $T_I^{TxDMM}$
2. $T_R^{RxDMM}$
3. $T_R^{TxDMR}$
4. $T_I^{RxDMR}$

A two-way frame delay is calculated as follows:

$$[T_I^{RxDMR} - T_I^{TxDMM}] - [T_R^{TxDMR} - T_R^{RxDMM}]$$

The calculation shows 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 label-switched interface (LSI) pseudowires.
- The ETH-DM feature is supported on aggregated Ethernet interfaces.
- 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 900 and “Enabling the Hardware-Assisted Timestamping Option” on page 911.
• 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 900 and “Ensuring That Distributed ppm Is Not Disabled” on page 909.

• 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 912.

• 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 916.

• 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 High Availability Feature Guide.

• 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 860
  • Guidelines for Configuring Routers to Support an ETH-DM Session on page 900
  • Guidelines for Starting an ETH-DM Session on page 901
  • Guidelines for Managing ETH-DM Statistics and ETH-DM Frame Counts on page 903
  • On-Demand Mode for SLA Measurement on page 864
  • Proactive Mode for SLA Measurement on page 865

**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 854.

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.

**NOTE:** MX Series Virtual Chassis does not support Ethernet frame loss measurement (ETH-LM).

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.

The ETH-LM feature is supported on aggregated Ethernet interfaces.

**NOTE:** Starting Junos OS Release 16.1, 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: Starting with Junos OS Release 16.1, 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.

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.1</td>
<td>Starting Junos OS Release 16.1, 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.</td>
</tr>
<tr>
<td>16.1</td>
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</tr>
</tbody>
</table>

Related Documentation

- Managing Continuity Measurement Statistics on page 936
- On-Demand Mode for SLA Measurement on page 864
- Proactive Mode for SLA Measurement on page 865
- Example: Measuring Ethernet Frame Loss for Single-Tagged LMM/LMR PDUs on page 959
- Example: Measuring Ethernet Frame Loss for Dual-Tagged LMM/LMR PDUs on page 972
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 864.
- Proactive mode—In proactive mode, the measurements are triggered by an iterator application. For more information, see “Proactive Mode for SLA Measurement” on page 865.

For more information about frame delay measurement, see “Ethernet Frame Delay Measurements Overview” on page 854. For more information about frame loss measurement, see “Ethernet Frame Loss Measurement Overview” on page 860. 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 865.
- On-Demand Mode for SLA Measurement on page 864.
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 907. 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 854
- Ethernet Frame Loss Measurement Overview on page 860
- Proactive Mode for SLA Measurement on page 865
- Configuring Routers to Support an ETH-DM Session on page 907.
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.

NOTE: ACX5048 and ACX5096 routers supports iterator cycle time of only 1 second and above.

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 889.
- 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 886.

### 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 1DM 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 1DM 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 886
- Configuring a Remote MEP with an Iterator Profile on page 897
- Ethernet Frame Delay Measurements Overview on page 854
- Ethernet Frame Loss Measurement Overview on page 860
- Verifying the Configuration of an Iterator Profile on page 889
- Managing Iterator Statistics on page 892
- On-Demand Mode for SLA Measurement on page 864

### 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.

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**Related Documentation**

- Configuring the Failure Notification Protocol on page 937
- show oam ethernet fnp interface on page 2306
- show oam ethernet fnp status on page 2310
- show oam ethernet fnp messages on page 2308
- connectivity-fault-management on page 1258
- IEEE 802.1ag OAM Connectivity Fault Management Overview on page 728

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**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).

**NOTE:** MX Series Virtual Chassis does not support Ethernet synthetic loss measurement (ETH-SLM).

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.

**NOTE:** ACX5048 and ACX5096 routers support ETH-SLM for Layer 2 services.

**Related Documentation**
- Transmission of ETH-SLM Messages on page 872
- Format of ETH-SLM Messages on page 870
- Guidelines for Configuring ETH-SLM on page 874
- Scenarios for Configuration of ETH-SLM on page 869
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 867
- Transmission of ETH-SLM Messages on page 872
- Format of ETH-SLM Messages on page 870
- Guidelines for Configuring ETH-SLM on page 874
- Managing ETH-SLM Statistics and ETH-SLM Frame Counts on page 880
- Starting a Proactive ETH-SLM Session on page 875
- Starting an On-Demand ETH-SLM Session on page 880
- Troubleshooting Failures with ETH-SLM on page 885

### 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 OAMPDU 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.
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.

- **RxFlCl**—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 867
- Format of ETH-SLM Messages on page 870
- Guidelines for Configuring ETH-SLM on page 874
- Scenarios for Configuration of ETH-SLM on page 869
- Managing ETH-SLM Statistics and ETH-SLM Frame Counts on page 880
- Starting a Proactive ETH-SLM Session on page 875
- Starting an On-Demand ETH-SLM Session on page 880
- Troubleshooting Failures with ETH-SLM on page 885

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 downstream MEPs on label-switched interfaces (LSIs).

- ETH-SLM is supported on aggregated Ethernet (ae) interfaces.

- 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.

**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 876
- Configuring an Iterator Profile for ETH-SLM on page 877
- Associating the Iterator Profile with MEPs for ETH-SLM on page 878

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.

NOTE: ACX5048 and ACX5096 routers supports iterator cycle time of only 1 second and above.

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]
   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.
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).

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.

7. Verify the configuration.

---

**Related Documentation**

- Ethernet Synthetic Loss Measurement Overview on page 867
- Transmission of ETH-SLM Messages on page 872
- Format of ETH-SLM Messages on page 870
- Guidelines for Configuring ETH-SLM on page 874
- Scenarios for Configuration of ETH-SLM on page 869
- Managing ETH-SLM Statistics and ETH-SLM Frame Counts on page 880
- Starting an On-Demand ETH-SLM Session on page 880
- Troubleshooting Failures with ETH-SLM on page 885
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

<table>
<thead>
<tr>
<th>Eth SLM Measurement Statistics:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SLM packets sent</td>
<td>100</td>
</tr>
<tr>
<td>SLR packets received</td>
<td>100</td>
</tr>
</tbody>
</table>

Accumulated SLM Statistics:

<table>
<thead>
<tr>
<th>TXFCI Value</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Local TXFC1 value</td>
<td>100</td>
</tr>
<tr>
<td>Local RXFC1 value</td>
<td>100</td>
</tr>
<tr>
<td>Last Received SLR frame TXFCF(tc)</td>
<td>100</td>
</tr>
<tr>
<td>Last Received SLR frame TXFCb(tc)</td>
<td>100</td>
</tr>
</tbody>
</table>

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 867
- Transmission of ETH-SLM Messages on page 872
- Format of ETH-SLM Messages on page 870
- Guidelines for Configuring ETH-SLM on page 874
- Scenarios for Configuration of ETH-SLM on page 869
- Managing ETH-SLM Statistics and ETH-SLM Frame Counts on page 880
- Starting a Proactive ETH-SLM Session on page 875
- Troubleshooting Failures with ETH-SLM on page 885

### Managing ETH-SLM Statistics and ETH-SLM Frame Counts

- Displaying ETH-SLM Statistics Only on page 881
- Displaying ETH-SLM Statistics and Frame Counts on page 881
- Displaying ETH-SLM Frame Counts for MEPs by Enclosing CFM Entity on page 882
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`.

**See Also**  
- `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`.

See Also

- `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`.

**See Also**
- `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.

<i>Note: At the router attached to the initiator MEP, you can only display the ETH-SLM frame counts and not the MEP database details.</i>

**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`:
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**:
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

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.

```conf
[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;
nor-remote-trace;
}

Related Documentation

- Ethernet Synthetic Loss Measurement Overview on page 867
- Transmission of ETH-SLM Messages on page 872
- Format of ETH-SLM Messages on page 870
- Guidelines for Configuring ETH-SLM on page 874
- Scenarios for Configuration of ETH-SLM on page 869
- Managing ETH-SLM Statistics and ETH-SLM Frame Counts on page 880
- Starting a Proactive ETH-SLM Session on page 875
- Starting an On-Demand ETH-SLM Session on page 880

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.

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.

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.

13. Configure the disable statement to stop the iterator (that is, disable the iterator profile).

14. Verify the configuration.
Related Documentation

- Proactive Mode for SLA Measurement on page 865
- Configuring a Remote MEP with an Iterator Profile on page 897
- Verifying the Configuration of an Iterator Profile on page 889
- Managing Iterator Statistics on page 892

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 889
- Displaying the Configuration of an Iterator Profile for Loss Measurement on page 890
- Displaying the Configuration of a Remote MEP with an Iterator Profile on page 890
- Disabling an Iterator Profile on page 891

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 886 topic with the following values:

- `profile-name`—`i1`
- `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:

```
user@host# show
```
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 886 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 remote MEP as configured in the “Configuring a Remote MEP with an Iterator Profile” on page 897 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
```
Managing 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
```

<table>
<thead>
<tr>
<th>Iterator statistics:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance domain: md6, Level: 6</td>
</tr>
<tr>
<td>Maintenance association: ma6, Local MEP id: 1000</td>
</tr>
<tr>
<td>Remote MEP id: 103, Remote MAC address: 00:90:69:0a:43:92</td>
</tr>
<tr>
<td>Iterator name: i1, Iterator Id: 1</td>
</tr>
<tr>
<td>Iterator cycle time: 10ms, Iteration period: 1 cycles</td>
</tr>
<tr>
<td>Iterator status: running, Infinite iterations: true</td>
</tr>
<tr>
<td>Counter reset time: 2010-03-19 20:42:39 PDT (2d 18:24 ago)</td>
</tr>
<tr>
<td>Reset reason: Adjacency flap</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Iterator delay measurement statistics:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delay weight: 1, Delay variation weight: 1</td>
</tr>
<tr>
<td>DMM sent : 23898520</td>
</tr>
<tr>
<td>DMM skipped for threshold hit : 11000</td>
</tr>
<tr>
<td>DMM skipped for threshold hit window : 0</td>
</tr>
<tr>
<td>DMR received: 23851165</td>
</tr>
<tr>
<td>DMR out of sequence: 1142</td>
</tr>
<tr>
<td>DMR received with invalid time stamps: 36540</td>
</tr>
<tr>
<td>Average two-way delay: 129 usec</td>
</tr>
<tr>
<td>Average two-way delay variation: 15 usec</td>
</tr>
<tr>
<td>Average one-way forward delay variation: 22 usec</td>
</tr>
<tr>
<td>Average one-way backward delay variation: 22 usec</td>
</tr>
<tr>
<td>Weighted average two-way delay: 134 usec</td>
</tr>
<tr>
<td>Weighted average two-way delay variation: 8 usec</td>
</tr>
<tr>
<td>Weighted average one-way forward delay variation: 6 usec</td>
</tr>
<tr>
<td>Weighted average one-way backward delay variation: 2 usec</td>
</tr>
</tbody>
</table>
Output fields are listed in the approximate order in which they appear.

Table 108: Displaying Iterator Statistics for Ethernet Delay Measurement Output Fields

<table>
<thead>
<tr>
<th>Output Field Name</th>
<th>Output Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance domain</td>
<td>Maintenance domain name.</td>
</tr>
<tr>
<td>Level</td>
<td>Maintenance domain level configured.</td>
</tr>
<tr>
<td>Maintenance association</td>
<td>Maintenance association name.</td>
</tr>
<tr>
<td>Local MEP id</td>
<td>Numeric identifier of the local MEP.</td>
</tr>
<tr>
<td>Remote MEP id</td>
<td>Numeric identifier of the remote MEP.</td>
</tr>
<tr>
<td>Remote MAC address</td>
<td>Unicast MAC address of the remote MEP.</td>
</tr>
<tr>
<td>Iterator name</td>
<td>Name of iterator.</td>
</tr>
<tr>
<td>Iterator Id</td>
<td>Numeric identifier of the iterator.</td>
</tr>
<tr>
<td>Iterator cycle time</td>
<td>Number of cycles (in milliseconds) taken between back-to-back transmission of SLA frames for this connection</td>
</tr>
<tr>
<td>Iteration period</td>
<td>Maximum number of cycles per iteration</td>
</tr>
<tr>
<td>Iterator status</td>
<td>Current status of iterator whether running or stopped.</td>
</tr>
<tr>
<td>Infinite iterations</td>
<td>Status of iteration as infinite or finite.</td>
</tr>
<tr>
<td>Counter reset time</td>
<td>Date and time when the counter was reset.</td>
</tr>
<tr>
<td>Reset reason</td>
<td>Reason to reset counter.</td>
</tr>
<tr>
<td>Delay weight</td>
<td>Calculation weight of delay.</td>
</tr>
<tr>
<td>Delay variation weight</td>
<td>Calculation weight of delay variation.</td>
</tr>
<tr>
<td>DMM sent</td>
<td>Delay measurement message (DMM) PDU frames sent to the peer MEP in this session.</td>
</tr>
<tr>
<td>DMM skipped for threshold hit</td>
<td>Number of DMM frames sent to the peer MEP in this session skipped during threshold hit.</td>
</tr>
<tr>
<td>DMM skipped for threshold hit window</td>
<td>Number of DMM frames sent to the peer MEP in this session skipped during the last threshold hit window.</td>
</tr>
<tr>
<td>DMR received</td>
<td>Number of delay measurement reply (DMR) frames received.</td>
</tr>
<tr>
<td>DMR out of sequence</td>
<td>Total number of DMR out of sequence packets received.</td>
</tr>
</tbody>
</table>
Table 108: Displaying Iterator Statistics for Ethernet Delay Measurement Output Fields (continued)

<table>
<thead>
<tr>
<th>Output Field Name</th>
<th>Output Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMR received with invalid time stamps</td>
<td>Total number of DMR frames received with invalid timestamps.</td>
</tr>
<tr>
<td>Average two-way delay</td>
<td>Average two-way frame delay for the statistics displayed.</td>
</tr>
<tr>
<td>Average two-way delay variation</td>
<td>Average two-way “frame jitter” for the statistics displayed.</td>
</tr>
<tr>
<td>Average one-way forward delay variation</td>
<td>Average one-way forward delay variation for the statistics displayed in microseconds.</td>
</tr>
<tr>
<td>Average one-way backward delay variation</td>
<td>Average one-way backward delay variation for the statistics displayed in microseconds.</td>
</tr>
<tr>
<td>Weighted average two-way delay</td>
<td>Weighted average two-way delay for the statistics displayed in microseconds.</td>
</tr>
<tr>
<td>Weighted average two-way delay variation</td>
<td>Weighted average two-way delay variation for the statistics displayed in microseconds.</td>
</tr>
<tr>
<td>Weighted average one-way forward delay</td>
<td>Weighted average one-way forward delay variation for the statistics displayed in microseconds.</td>
</tr>
<tr>
<td>Weighted average one-way backward delay</td>
<td>Weighted average one-way backward delay variation for the statistics displayed in microseconds.</td>
</tr>
</tbody>
</table>

- 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):

```bash
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 109: Displaying Iterator Statistics for Ethernet Loss Measurement Output Fields

<table>
<thead>
<tr>
<th>Output Field Name</th>
<th>Output Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance domain</td>
<td>Maintenance domain name.</td>
</tr>
<tr>
<td>Level</td>
<td>Maintenance domain level configured.</td>
</tr>
<tr>
<td>Maintenance association</td>
<td>Maintenance association name.</td>
</tr>
<tr>
<td>Local MEP id</td>
<td>Numeric identifier of the local MEP.</td>
</tr>
<tr>
<td>Remote MEP identifier</td>
<td>Numeric identifier of the remote MEP.</td>
</tr>
<tr>
<td>Remote MAC address</td>
<td>Unicast MAC address of the remote MEP.</td>
</tr>
<tr>
<td>Iterator name</td>
<td>Name of iterator.</td>
</tr>
<tr>
<td>Iterator Id</td>
<td>Numeric identifier of the iterator.</td>
</tr>
<tr>
<td>Iterator cycle time</td>
<td>Number of cycles (in milliseconds) taken between back-to-back transmission of SLA frames for this connection</td>
</tr>
<tr>
<td>Iteration period</td>
<td>Maximum number of cycles per iteration</td>
</tr>
<tr>
<td>Iterator status</td>
<td>Current status of iterator whether running or stopped.</td>
</tr>
<tr>
<td>Infinite iterations</td>
<td>Status of iteration as infinite or finite.</td>
</tr>
<tr>
<td>Counter reset time</td>
<td>Date and time when the counter was reset.</td>
</tr>
<tr>
<td>Reset reason</td>
<td>Reason to reset counter.</td>
</tr>
<tr>
<td>LMM sent</td>
<td>Number of loss measurement message (LMM) PDU frames sent to the peer MEP in this session</td>
</tr>
</tbody>
</table>
Table 109: Displaying Iterator Statistics for Ethernet Loss Measurement Output Fields (continued)

<table>
<thead>
<tr>
<th>Output Field Name</th>
<th>Output Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LMM skipped for threshold hit</td>
<td>Number of LMM frames sent to the peer MEP in this session skipped during threshold hit.</td>
</tr>
<tr>
<td>LMM skipped for threshold hit window</td>
<td>Number of LMM frames sent to the peer MEP in this session skipped during the last threshold hit window.</td>
</tr>
<tr>
<td>LMR received</td>
<td>Number of LMRs frames received.</td>
</tr>
<tr>
<td>LMR out of sequence</td>
<td>Total number of LMR out of sequence packets received.</td>
</tr>
<tr>
<td>Near-end (CIR)</td>
<td>Frame loss associated with ingress data frames for the statistics displayed.</td>
</tr>
<tr>
<td>Far-end (CIR)</td>
<td>Frame loss associated with egress data frames for the statistics displayed.</td>
</tr>
<tr>
<td>Near-end (EIR)</td>
<td>Frame loss associated with ingress data frames for the statistics displayed.</td>
</tr>
<tr>
<td>Far-end (EIR)</td>
<td>Frame loss associated with egress data frames for the statistics displayed.</td>
</tr>
</tbody>
</table>

See Also
- Proactive Mode for SLA Measurement on page 865
- Configuring an Iterator Profile on page 886
- Configuring a Remote MEP with an Iterator Profile on page 897
- Verifying the Configuration of an Iterator Profile on page 889
- Ethernet Interfaces Feature Guide for Routing Devices

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:

  ```
  ```
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 865
- Configuring an Iterator Profile on page 886
- Verifying the Configuration of an Iterator Profile on page 889
- Managing Iterator Statistics on page 892
Damping CFM performance Monitoring Traps and Notifications to Prevent Congestion of The NMS

You can dampen the performance monitoring threshold-crossing traps and notifications that are generated every time a threshold-crossing event occurs to prevent congestion of the network management system (NMS).

Damping limits the number of jnxSoamPmThresholdCrossingAlarm traps sent to the NMS by summarizing the flap occurrences over a period of time, known as the flap trap timer, and sends a single jnxSoamPmThresholdFlapAlarm notification to the NMS. You can configure the duration of the flap trap timer to any value from 1 through 360 seconds.

The jnxSoamPmThresholdFlapAlarm notification is generated and sent when the following conditions are met:

- At least one flap has occurred when the flap timer has expired.
- You changed the value of the flap trap timer, which caused the timer to stop.

You can enable damping at the global level for the iterator or you can enable damping at the individual threshold type of the iterator. For instance, to enable damping at the global level, for the iterator, use the following command: `set protocols oam ethernet cfm performance-monitoring sla-iterator-profiles profile-name flap-trap-monitor`. To enable damping at a specific threshold type, for the `avg-fd-two-way-threshold`, use the following command: `set protocols oam ethernet cfm performance-monitoring sla-iterator-profiles profile-name avg-fd-two-way-threshold flap-trap-monitor`.

You can also disable damping.

Related Documentation
- flap-trap-monitor on page 1155

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 900.

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 886.

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 900
- Configuring an Iterator Profile on page 886
- Verifying the Configuration of an Iterator Profile on page 889

**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 900
- **Configuration Options for ETH-DM** on page 901

**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 745.

- 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 742.
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 735.

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.

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 759.

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 854
- Configuring Routers to Support an ETH-DM Session on page 907

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 901
- ETH-DM Session Parameters on page 902
- Restrictions for an ETH-DM Session on page 903

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 735.

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 900 and “Configuring Routers to Support an ETH-DM Session” on page 907.

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 735.
  - CFM maintenance association—Name of an existing maintenance association (MA) within the maintenance domain. For more information, see “Creating a Maintenance Association” on page 742.
  - 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 745.
- 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 *High Availability Feature Guide*.
- 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 854
- Starting an ETH-DM Session on page 912
- Guidelines for Managing ETH-DM Statistics and ETH-DM Frame Counts on page 903
- `monitor ethernet delay-measurement` operational command

**Guidelines for Managing ETH-DM Statistics and ETH-DM Frame Counts**

- ETH-DM Statistics on page 904
- ETH-DM Statistics Retrieval on page 905
• ETH-DM Frame Counts on page 906
• ETH-DM Frame Count Retrieval on page 906

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 854.

• 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 854.

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 110 on page 904 describes the ETH-DM statistics calculated in an ETH-DM session.

Table 110: ETH-DM Statistics

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-way delay (μsec)</td>
<td>For a one-way ETH-DM session, the frame delay, in microseconds, collected at the receiver MEP. To display frame delay statistics for a given one-way ETH-DM session, use the delay-statistics or mep-statistics form of the show oam ethernet connectivity-fault-management command at the receiver MEP for that session.</td>
</tr>
<tr>
<td>Two-way delay (μsec)</td>
<td>For a two-way ETH-DM session, the frame delay, in microseconds, collected at the initiator MEP. 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. To display frame delay statistics for a given two-way ETH-DM session, use the delay-statistics or mep-statistics form of the show oam ethernet connectivity-fault-management command at the initiator MEP for that session.</td>
</tr>
</tbody>
</table>
Table 110: ETH-DM Statistics (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average delay</strong> †</td>
<td>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. When you display ETH-DM statistics using a <code>show</code> command, the Average delay field displays the average one-way and two-frame delays among all ETH-DM statistics collected at the CFM session level. 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 <code>show</code> command to display 100 ETH-DM statistics for that CFM session, the Average delay field displays the average frame delay among all 100 statistics.</td>
</tr>
<tr>
<td><strong>Average delay variation</strong> †</td>
<td>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. When you display ETH-DM statistics using a <code>show</code> command, the Average delay variation field displays the average one-way and two-frame delay variations among all ETH-DM statistics collected at the CFM session level.</td>
</tr>
<tr>
<td><strong>Best-case delay</strong> †</td>
<td>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. When you display ETH-DM statistics using a <code>show</code> command, the Best case delay field displays the lowest one-way and two-frame delays among all ETH-DM statistics collected at the CFM session level.</td>
</tr>
<tr>
<td><strong>Worst-case delay</strong> †</td>
<td>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. When you display ETH-DM statistics using a <code>show</code> command, the Worst case delay field displays the highest one-way and two-frame delays among all statistics collected at the CFM session level.</td>
</tr>
</tbody>
</table>

† When you start a one-way frame delay measurement, the CLI output displays NA (“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.

**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 an ETH-DM session are stored in the CFM database on each router.

Table 111 on page 906 describes the ETH-DM frame counts collected in an ETH-DM session.

Table 111: ETH-DM Frame Counts

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1DMs sent</td>
<td>Number of one-way delay measurement (1DM) PDU frames sent to the peer MEP in this session. Stored in the CFM database of the MEP initiating a one-way frame delay measurement.</td>
</tr>
<tr>
<td>Valid 1DMs received</td>
<td>Number of valid 1DM frames received.</td>
</tr>
<tr>
<td>Invalid 1DMs received</td>
<td>Number of invalid 1DM frames received.</td>
</tr>
<tr>
<td>DMMs sent</td>
<td>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.</td>
</tr>
<tr>
<td>DMRs sent</td>
<td>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.</td>
</tr>
<tr>
<td>Valid DMRs received</td>
<td>Number of valid DMR frames received.</td>
</tr>
<tr>
<td>Invalid DMRs received</td>
<td>Number of invalid DMR frames received.</td>
</tr>
</tbody>
</table>

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)
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 111 on page 906, 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 111 on page 906, 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 854
- Managing ETH-DM Statistics and ETH-DM Frame Counts on page 916
- clear oam ethernet connectivity-fault-management statistics on page 1645 command
- show oam ethernet connectivity-fault-management mep-statistics on page 2274 command
- show oam ethernet connectivity-fault-management delay-statistics on page 2236 command
- show oam ethernet connectivity-fault-management interfaces on page 2244 (detail | extensive) command
- show oam ethernet connectivity-fault-management mep-database on page 2262 command

Configuring Routers to Support an ETH-DM Session

- Configuring MEP Interfaces on page 908
- Ensuring That Distributed ppm Is Not Disabled on page 909
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:

```plaintext
[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:

```plaintext
[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;
      }
    }
  }
}
}
```

See Also  • Ethernet Frame Delay Measurements Overview on page 854
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.

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:

```plaintext
[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:

   ```plaintext
   [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:

   ```plaintext
   [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

Connectivity fault management (CFM) sessions operate in centralized mode over AE interfaces by default. Y.1731 performance monitoring (PM) is supported on centralized CFM sessions over AE interfaces. Also, distribution of CFM session over AE interfaces to line cards is supported from Junos OS Release 13.3. To enable the distribution of CFM sessions and to operate in centralized mode, include the ppm delegate-processing statement at the [edit routing-options ppm] hierarchy level. The mechanism that enables distribution of CFM sessions over AE interfaces provides the underlying infrastructure to support PM over AE interfaces. In addition, periodic packet management (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 performance monitoring processes on the Packet Forwarding Engine.

**See Also**
- Ethernet Frame Delay Measurements Overview on page 854
- Guidelines for Configuring Routers to Support an ETH-DM Session on page 900

### 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;
      }
    }
  }
}
```

**See Also**
- Ethernet Frame Delay Measurements Overview on page 854
- Guidelines for Configuring Routers to Support an ETH-DM Session on page 900

### 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.
### Starting an ETH-DM Session

- Using the monitor ethernet delay-measurement Command on page 912
- Starting a One-Way ETH-DM Session on page 913
- Starting a Two-Way ETH-DM Session on page 914

#### 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:

```plaintext
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>
```
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.

See Also: `monitor ethernet delay-measurement` on page 1653

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 00:05:85:39:4a maintenance-domain md6 maintenance-association ma6 count 10
One-way ETH-DM request to 00:05:85:39:4a, 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.

See Also
- `monitor ethernet delay-measurement` on page 1653

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: 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.

See Also
- `monitor ethernet delay-measurement` on page 1653

Related Documentation
- Ethernet Frame Delay Measurements Overview on page 854
- Guidelines for Starting an ETH-DM Session on page 901
- `monitor ethernet delay-measurement` command
- Guidelines for Managing ETH-DM Statistics and ETH-DM Frame Counts on page 903
- Managing ETH-DM Statistics and ETH-DM Frame Counts on page 916
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
```

--- 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 1653

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
```

--- 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 1653

### Managing ETH-DM Statistics and ETH-DM Frame Counts

**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
  ```

**See Also**
- `show oam ethernet connectivity-fault-management delay-statistics` on page 2236
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`

**See Also**
- `show oam ethernet connectivity-fault-management mep-statistics` on page 2274

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`:
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 ma1 maintenance-association ma1
```

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
```

See Also • show oam ethernet connectivity-fault-management mep-database on page 2262

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

See Also  Managing ETH-DM Statistics and ETH-DM Frame Counts on page 916

Related Documentation

• clear oam ethernet connectivity-fault-management statistics on page 1645
• show oam ethernet connectivity-fault-management delay-statistics on page 2236
• show oam ethernet connectivity-fault-management interfaces on page 2244
• show oam ethernet connectivity-fault-management mep-statistics on page 2274
• show oam ethernet connectivity-fault-management mep-database on page 2262

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 2236

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 2274

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 attached to CFM-enabled Ethernet interfaces on the router:

  user@host> show oam ethernet connectivity-fault-management interfaces detail

Related Documentation

- show oam ethernet connectivity-fault-management mep-database on page 2262

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 2244

### 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 916

### 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;
   ```
Both interfaces will use the same VLAN ID.

2. On each router, attach peer MEPs to the two interfaces. The following configuration is typical:

```conf
[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 854
- Guidelines for Configuring Routers to Support an ETH-DM Session on page 900
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
```

Connectivity fault management (CFM) sessions operate in centralized mode over AE interfaces by default. Y.1731 performance monitoring (PM) is supported on centralized CFM sessions over AE interfaces. Also, distribution of CFM session over AE interfaces to line cards is supported from Junos OS Release 13.3. To enable the distribution of CFM sessions and to operate in centralized mode, include the ppm delegate-processing statement at the [edit routing-options ppm] hierarchy level. The mechanism that enables distribution of CFM sessions over AE interfaces provides the underlying infrastructure to support PM over AE interfaces. In addition, periodic packet management (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 performance monitoring processes on the Packet Forwarding Engine.
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 854
- Guidelines for Configuring Routers to Support an ETH-DM Session on page 900
Enabling Inline Transmission of Continuity Check Messages for Maximum Scaling

Scaling is the ability of a system to handle increasing amounts of work and to continue to function well. Scaling can refer to increasing capacity and the ability to handle increasing workload, number of subscribers or sessions, hardware components, and so on. Continuity check protocol is used for fault detection within a maintenance association. The maintenance association end points (MEPs) 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, 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 CCMs to the forwarding ASIC (that is, to the hardware) by enabling inline transmission of CCMs. Inline transmission of CCMs is also known as inline keepalives or Inline-KA. 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.

To enable inline transmission of CCMs, 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 CCMs to hardware by enabling hardware-assisted keepalives.

   ```
   [edit protocols oam ethernet connectivity-fault-management performance-monitoring]
   user@host# set hardware-assisted-keepalives enable
   ```

   **NOTE:** Inline transmission of CCMs is not enabled when there is a CFM session already established. To enable inline transmission, you must first deactivate the CFM session using the `deactivate` command and then reactivate the CFM session using the `activate` command.

To disable inline transmission, use the `hardware-assisted-keepalives disable` statement. After disabling inline transmission, you must reboot the router for the changes to take effect.

Related Documentation
- Configuring Connectivity Fault Management for Interoperability During Unified In-Service Software Upgrades on page 932
Enabling Inline Mode Of Performance Monitoring To Achieve Maximum Scaling

Performance monitoring is useful for studying the traffic pattern in a network over a period of time. It helps to identify network problems before you are impacted by network defects.

By default, performance monitoring packets are handled by the CPU of a line-card, such as Modular Port Concentrator (MPC). Enabling inline mode of performance monitoring delegates the processing of the protocol data units (PDUs) to the forwarding ASIC (that is, to the hardware). By enabling inline mode of performance monitoring, the load on the CPU of the line-card is reduced and you can configure an increased number of performance monitoring sessions and achieve maximum scaling for service OAM performance monitoring sessions. On MX Series routers, you can configure inline mode of performance monitoring only if the network services mode on the router is configured to enhanced-ip and enhanced connectivity fault management (enhanced-cfm-mode) is configured.

By enabling inline mode of performance monitoring, you can achieve maximum scaling for performance monitoring sessions. To achieve maximum scaling for performance monitoring sessions, you must enable scaling of continuity check messages (CCMs) sessions. To enable scaling of CCM sessions, enable inline transmission of continuity check messages. For more information on inline transmission of continuity check messages, see “Enabling Inline Transmission of Continuity Check Messages for Maximum Scaling” on page 927. To view the supported scaling values for CCM and PM, see “Supported Inline CCM and Inline PM Scaling Values” on page 930.

Inline mode of performance monitoring is supported only for proactive mode of frame delay measurement (Two-way Delay Measurements) and synthetic loss measurements (SLM) sessions. Performance monitoring functions configured using the iterator profile (CFM) are referred to as proactive performance monitoring. Inline mode of performance monitoring for frame loss measurement using service frames (LM) is not supported.

NOTE: MPC3E (MX-MPC3E-3D) and MPC4E (MPC4E-3D-32XGE-SFPP and MPC4E-3D-2CGE-8XGE) do not support inline mode of performance monitoring. User-defined Data TLV is not supported if you have configured inline mode of performance monitoring. Also, only 12 history records per PM sessions are supported.

We recommend that you enable inline mode of performance monitoring before you configure the performance monitoring sessions as the change may interfere with the existing performance monitoring sessions.

To enable inline mode of performance monitoring, perform the following steps:

1. In configuration mode, go to the [edit chassis] hierarchy level and configure the network services mode of the router. The network service mode of the router must be configured as enhanced ip to enable enhanced connectivity fault management (CFM) mode.

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NOTE: If the network services mode is not enhanced-ip, and you have enabled enhanced CFM, the following warning message is displayed:

```
[edit protocols oam ethernet]
'connectivity-fault-management'
enhanced ip is not effective please configure enhanced ip and give router
reboot
```

```
[edit chassis]
user@host# set network-services enhanced-ip
```

2. In configuration mode, go to the [edit protocols oam ethernet
   connectivity-fault-management] hierarchy level and enable enhanced connectivity
   fault management mode by using the enhanced-cfm-mode option.

```
[edit]
user@host# set protocols oam ethernet connectivity-fault-management
   enhanced-cfm-mode
```

3. In configuration mode, go to the [edit protocols oam ethernet
   connectivity-fault-management performance-monitoring] hierarchy level. Configure
   the enhanced iterator profile by using the enhanced-sla-iterator option and specify
   the measurement interval by using the measurement-interval option.

```
[edit]
user@host# edit protocols oam ethernet connectivity-fault-management
   performance-monitoring enhanced-sla-iterator measurement-interval value
```

4. Enable inline performance monitoring.

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring]
user@host# set hardware-assisted-pm
```

5. (Optional) Enable inline transmission of CCMs to enable better scaling if inline
   transmission of CCMs is not automatically enabled.

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring]
user@host# set hardware-assisted-pm
```

NOTE: You can achieve better scaling if both inline performance monitoring
and inline transmission of CCMs is enabled.
6. Commit the configuration.

```plaintext
[edit protocols oam ethernet connectivity-fault-management performance-monitoring]
user@host# commit
```

**Related Documentation**
- Enabling Enhanced Connectivity Fault Management Mode on page 799
- Enabling Inline Transmission of Continuity Check Messages for Maximum Scaling on page 927
- Network Services Mode Overview
- `hardware-assisted-pm`
- Supported Inline CCM and Inline PM Scaling Values on page 930

**Supported Inline CCM and Inline PM Scaling Values**

This topic lists the scaling values for inline mode of performance monitoring and inline transmission of continuity check messages. The scaling values are based on the different cycle-time interval values. Each table lists the maximum number of connectivity fault management (CFM) sessions and performance monitoring (PM) sessions per line card and per chassis when you configure inline CCM, enhanced CFM, and enhanced PM by using the `hardware-assisted-keepalives`, `enhanced-cfm-mode`, and `hardware-assisted-pm` options.

**NOTE:** The scaling values do not consider the load from other protocols in the system and so the actual realized scaling values for line card and chassis vary depending on other protocol configurations and scaling in the system. We recommend that you configure DDoS for CFM. Limit the number of CFM packets, that are sent to the CPU of the line card, to 3000. Limiting the number of packets safeguards the CPU from scaled CFM configurations of various CFM protocol events.

Table 112 on page 930 lists the maximum number of connectivity fault management (CFM) sessions and performance monitoring (PM) sessions per line card and per chassis when you configure both the CCM interval and the PM interval as 1 second.

**Table 112: Scaling Values for CFM and PM (CCM Interval: 1 sec and PM Interval: 1 sec)**

<table>
<thead>
<tr>
<th>CFM Line Card Scale</th>
<th>PM Line Card Scale</th>
<th>CFM Chassis Scale</th>
<th>PM Chassis Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000</td>
<td>4500</td>
<td>16000</td>
<td>16000</td>
</tr>
<tr>
<td>6000</td>
<td>3750</td>
<td>16000</td>
<td>16000</td>
</tr>
</tbody>
</table>
### Table 112: Scaling Values for CFM and PM (CCM Interval: 1 sec and PM Interval: 1 sec) (continued)

<table>
<thead>
<tr>
<th>CFM Line Card Scale</th>
<th>PM Line Card Scale</th>
<th>CFM Chassis Scale</th>
<th>PM Chassis Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>7000</td>
<td>3375</td>
<td>16000</td>
<td>16000</td>
</tr>
<tr>
<td>8000</td>
<td>3000</td>
<td>16000</td>
<td>16000</td>
</tr>
</tbody>
</table>

Table 113 on page 931 lists the maximum number of connectivity fault management (CFM) sessions and performance monitoring (PM) sessions per line card and per chassis when you configure the CCM interval as 1 second and the PM interval as 100 milliseconds.

### Table 113: Scaling Values for CFM and PM (CCM Interval: 1 sec and PM interval: 100 ms)

<table>
<thead>
<tr>
<th>CFM Line Card Scale</th>
<th>PM Line Card Scale</th>
<th>CFM Chassis Scale</th>
<th>PM Chassis Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000</td>
<td>450</td>
<td>12000</td>
<td>4000</td>
</tr>
<tr>
<td>6000</td>
<td>375</td>
<td>12000</td>
<td>4000</td>
</tr>
<tr>
<td>7000</td>
<td>337</td>
<td>12000</td>
<td>4000</td>
</tr>
<tr>
<td>8000</td>
<td>300</td>
<td>12000</td>
<td>4000</td>
</tr>
</tbody>
</table>

Table 114 on page 931 lists the maximum number of connectivity fault management (CFM) sessions and performance monitoring (PM) sessions per line card and per chassis when you configure the CCM interval as 100 milliseconds and the PM interval as 1 second.

### Table 114: Scaling Values for CFM and PM (CCM Interval: 100 ms and PM interval: 1 sec)

<table>
<thead>
<tr>
<th>CFM Line Card Scale</th>
<th>PM Line Card Scale</th>
<th>CFM Chassis Scale</th>
<th>PM Chassis Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000</td>
<td>3000</td>
<td>8000</td>
<td>6000</td>
</tr>
<tr>
<td>3000</td>
<td>3750</td>
<td>8000</td>
<td>6000</td>
</tr>
<tr>
<td>2000</td>
<td>4500</td>
<td>8000</td>
<td>6000</td>
</tr>
<tr>
<td>1000</td>
<td>4500</td>
<td>8000</td>
<td>6000</td>
</tr>
</tbody>
</table>

Table 115 on page 931 lists the maximum number of connectivity fault management (CFM) sessions and performance monitoring (PM) sessions per line card and per chassis when you configure both the CCM interval and the PM interval as 100 milliseconds.

### Table 115: Scaling Values for CFM and PM (CCM Interval: 100 ms and PM interval: 100 ms)

<table>
<thead>
<tr>
<th>CFM Line Card Scale</th>
<th>PM Line Card Scale</th>
<th>CFM Chassis Scale</th>
<th>PM Chassis Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000</td>
<td>300</td>
<td>8000</td>
<td>3000</td>
</tr>
<tr>
<td>3000</td>
<td>375</td>
<td>8000</td>
<td>3000</td>
</tr>
</tbody>
</table>
Table 115: Scaling Values for CFM and PM (CCM Interval: 100 ms and PM interval: 100 ms) (continued)

<table>
<thead>
<tr>
<th>CFM Line Card Scale</th>
<th>PM Line Card Scale</th>
<th>CFM Chassis Scale</th>
<th>PM Chassis Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>450</td>
<td>8000</td>
<td>3000</td>
</tr>
<tr>
<td>1000</td>
<td>450</td>
<td>8000</td>
<td>3000</td>
</tr>
</tbody>
</table>

Related Documentation

- hardware-assisted-pm
- Enabling Inline Mode Of Performance Monitoring To Achieve Maximum Scaling on page 928

Configuring Connectivity Fault Management for Interoperability During Unified In-Service Software Upgrades

Starting in Release 17.1, Junos OS connectivity fault management (CFM), during a unified in-service software upgrade (ISSU), works when the peer device is not a Juniper Networks router. Interoperating with the router of another vendor, the Juniper Networks router retains session information and continues to transmit continuity check message (CCM) PDUs during the unified ISSU. Connectivity fault management continues to operate.

This feature requires the following conditions be met:

- Packet Forwarding Engine keepalives must be enabled to provide inline transmission of CCMs. The feature does not work when the CCMs are transmitted by the CPU of a line card, which is the default transmission method.
- The interval between CCMs must be 1 second.

CFM interoperability during a unified ISSU is supported on the following MPCs: MPC1, MPC2, MPC2-NG, MPC3-NG, MPC5, and MPC6.

To enable CFM interoperability with third-party devices across a unified ISSU:

1. Enable inline keepalives.
   
   [edit protocols oam ethernet connectivity-fault-management performance-monitoring]
   user@host# set hardware-assisted-keepalives enable

2. Set the CCM interval to 1 second.
   
   [edit protocols oam ethernet connectivity-fault-management maintenance-domain md-name maintenance-association ma-name continuity-check]
   user@host# set interval 1s
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 IDM 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 1653

---

### Managing ETH-LM Statistics

- **Displaying ETH-LM Statistics** on page 934
- **Clearing ETH-LM Statistics** on page 935

#### 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 loss-statistics ma1 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

See Also
- clear oam ethernet connectivity-fault-management loss-statistics on page 1643
- show oam ethernet connectivity-fault-management delay-statistics on page 2236
- show oam ethernet connectivity-fault-management interfaces on page 2244 (detail | extensive)
- show oam ethernet connectivity-fault-management mep-statistics on page 2274
- show oam ethernet connectivity-fault-management mep-database on page 2262
- show oam ethernet connectivity-fault-management loss-statistics on page 2258
- Ethernet Interfaces Feature Guide for Routing Devices

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

See Also
- clear oam ethernet connectivity-fault-management loss-statistics on page 1643
- Ethernet Interfaces Feature Guide for Routing Devices

Related Documentation
- Managing ETH-DM Statistics and ETH-DM Frame Counts on page 916
Managing Continuity Measurement Statistics

- Displaying Continuity Measurement Statistics on page 936
- Clearing Continuity Measurement Statistics on page 936

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
  ```

**See Also**
- `show oam ethernet connectivity-fault-management delay-statistics` on page 2236
- *Ethernet Interfaces Feature Guide for Routing Devices*

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
  ```

**See Also**
- `clear oam ethernet connectivity-fault-management continuity-measurement` on page 1641
- *Ethernet Interfaces Feature Guide for Routing Devices*
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

- clear oam ethernet connectivity-fault-management continuity-measurement on page 1641
- show oam ethernet connectivity-fault-management delay-statistics on page 2236
- connectivity-fault-management on page 1258
- IEEE 802.1ag OAM Connectivity Fault Management Overview on page 728
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 938
- Fault Detection in a Maintenance Domain on page 939
- Terms Defined on page 940

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 940.

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.

NOTE: MX Series Virtual Chassis does not support Ethernet alarm indication signal (ETH-AIS).
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 116 on page 939 lists the operational mode commands that you can use in a maintenance domain to check the various parameters pertaining to a MEP.

**Table 116: Operational Mode Commands**

<table>
<thead>
<tr>
<th>To Check</th>
<th>Operational Mode Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whether the AIS configuration is configured correctly on a CFM MEP.</td>
<td><code>show protocols oam ethernet connectivity-fault-management action-profile</code></td>
</tr>
</tbody>
</table>
Table 116: Operational Mode Commands (continued)

<table>
<thead>
<tr>
<th>To Check</th>
<th>Operational Mode Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistics of AIS frames.</td>
<td>show oam ethernet connectivity-fault-management interfaces detail</td>
</tr>
<tr>
<td></td>
<td>show oam ethernet connectivity-fault-management mep-statistics maintenance-domain md-name maintenance-association ma-name remote-mep mep-id local-mep mep-id</td>
</tr>
<tr>
<td>Whether any event has occurred that triggered AIS.</td>
<td>show oam ethernet connectivity-fault-management mep-database maintenance-domain md-name maintenance-association ma-name remote-mep mep-id local-mep mep-id</td>
</tr>
<tr>
<td>Status of CFM sessions for faults that trigger AIS on the MEP.</td>
<td>show oam ethernet connectivity-fault-management interfaces detail</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>MEG</td>
<td>Version (0)</td>
<td>OpCode (AIS-33)</td>
<td>Flags</td>
</tr>
<tr>
<td>End TLV (0)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- 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).
d. 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 117 on page 941:

<table>
<thead>
<tr>
<th>Flags [3:1]</th>
<th>Period Value</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>000-011</td>
<td>Invalid value</td>
<td>Invalid value for AIS</td>
</tr>
<tr>
<td>100</td>
<td>1s</td>
<td>1 frame per second</td>
</tr>
<tr>
<td>101</td>
<td>Invalid value</td>
<td>Invalid value for AIS</td>
</tr>
<tr>
<td>110</td>
<td>1 min</td>
<td>1 frame per minute</td>
</tr>
<tr>
<td>111</td>
<td>Invalid value</td>
<td>Invalid value for AIS</td>
</tr>
</tbody>
</table>

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 943
**Ethernet Alarm Indication Signal Overview**

ACX Series routers support ITU-T Y.1731 Ethernet Alarm Indication Signal function (ETH-AIS) to provide fault management for service providers. ETH-AIS enables you to suppress alarms when a fault condition is detected. Using ETH-AIS, an administrator can differentiate between faults at customer level or faults at provider level.

The advantage of ETH-AIS is:

- Customers need not raise alarms due to lower level failures.
- Customers can get refund based on service unavailability.

When a fault condition is detected, a maintenance end point (MEP) generates ETH-AIS packets to the configured client levels for a specified duration until the fault condition is cleared. Any MEP configured to generate ETH-AIS packets signals to a level higher than its own. A MEP receiving ETH-AIS recognizes that the fault is at a lower level and then suppresses alarms at current level.

ACX Series routers support ETH-AIS PDU generation for server MEPs based on the following defect conditions:

- Loss of connectivity (physical link loss detection)
- Layer 2 circuit or Layer 2 VPN down

Alarm indication signaling is done through the transmission and propagation of ETH-AIS PDUs. ETH-AIS should be enabled on MEPs. A MEP which is configured to issue packets with ETH-AIS information is generally of server layer and continues to transmit periodic packets with ETH-AIS information until the defect condition is cleared. CFM MEPs, upon receiving ETH-AIS PDUs, suppresses loss of continuity alarms associated with its peer MEPs. A MEP resumes loss of continuity alarm generation upon detecting loss of continuity defect conditions in the absence of an ETH-AIS condition.

For point-to-point Ethernet connectivity, a MEP has only a single peer MEP. Therefore, a MEP suppress alarms on its peer MEP when it receives the ETH-AIS information.

For multi-point Ethernet connectivity, a MEP which receives ETH-AIS information cannot determine the exact MEP encountered a fault condition and therefore it will not be able to isolate the exact peer MEP for alarm suppression. ITU-T Y.1731 recommends suppressing alarms for all peer MEPs irrespective of the connectivity status.

AIS transmission—A MEP upon detecting a defect condition transmits ETH-AIS PDUs in a direction opposite to its peer MEPs. The transmission of ETH-AIS PDUs is based on a configured ETH-AIS transmission period. An ETH-AIS transmission period of 1 second is recommended. The first ETH-AIS PDU must be transmitted immediately following the detection of a defect condition.

AIS reception—A MEP upon receiving ETH-AIS PDUs examines it to ensure that its maintenance domain (MD) level corresponds to the same MD level. Upon receiving an ETH-AIS PDU, the MEP detects a defect condition. Following the detection of a defect condition, if there are no ETH-AIS PDUs received within an interval of 3.5 times the
ETH-AIS transmission period indicated in the ETH-AIS PDUs received earlier, the MEP clears the defect condition. After the fault condition is cleared, MEPs continue to report alarms.

NOTE: ACX Series routers do not support ITU-T Y.1731 ETH-AIS for layer 2 services (bridging).

The following are the limitations for server MEP

- Triggering of ETH-AIS messages over services (Layer 2 circuit and Layer 2 VPN) by the link-loss server MEP is done on a best-effort manner. This is because the transmission of ETH-AIS messages is independent of the service status and there is no guarantee for delivering the ETH-AIS messages before service goes down.
- Pseudowire protection with CFM-MEP session is not monitored by the server-MEP because an entity to monitor pseudowire protection already exists for the service (Layer 2 circuit and Layer 2 VPN).

**Related Documentation**

- Configuring Alarm Indication Signal on ACX Series Routers on page 948

**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 944
2. Configuring an Action to Be Taken When an AIS Alarm Is Detected on page 945
3. Attaching the Action Profile to a CFM MEP on page 946

**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.


```
[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
```
Configuring Alarm Indication Signal on ACX Series Routers

ACX Series routers support ITU-T Y.1731 Ethernet Alarm Indication Signal function (ETH-AIS) to provide fault management for service providers. ETH-AIS enables you to suppress alarms when a fault condition is detected.

To support ETH-AIS transmission, the following configuration information is required by a CFM MEP:

- **Client Maintenance Entity Group level**—Maintenance Entity Group (MEG) level at which the immediate client layer Maintenance Domain Intermediate Points (MIPs) and Maintenance Association End Points (MEPs) exist.
- **ETH-AIS transmission period**—Determines the ETH-AIS PDU transmission interval.
- **Priority**—Determines the priority of packets with ETH-AIS information. This is optional.

To configure ETH-AIS in CFM MEP, you need to:

- Configure an action profile with ETH-AIS action
- Attach the action profile to the CFM MEP

To configure an action profile with ETH-AIS action, include the following statements at the [edit protocols oam ethernet connectivity-fault-management] hierarchy level:

```plaintext
[edit protocols oam ethernet connectivity-fault-management]
action-profile action-profile-name {
  event {
    adjacency-loss;
    all-defects;
    cross-connect-ccm;
    errored-ccm;
    receive-ais;
  }
  action {
    log-and-generate-ais {
      level [1-7];
      interval [s | m];
      priority [0-7];
    }
    log-ais;
  }
}
```

To attach an action profile to a CFM MEP, include the following statements at the [edit protocols oam ethernet connectivity-fault-management] hierarchy level:

```plaintext
maintenance-domain maintenance-domain-name {
  level level-number;
  maintenance-association maintenance-domain-name {
  }
}
```
NOTE: You cannot configure a maintenance domain level that is lower than or equal to the level that it is associated with.

To support ETH-AIS transmission, the following configuration information required by a server MEP:

- **Server MEP definition**—Defines the association of server MEP identifier to the server layer.
  - For Layer 2 circuit and Layer 2 VPN, the logical interface connected to a customer network (UNI) would be the identifier for the server layer that needs to be monitored by the server MEP.
  - For physical link loss detection, the physical interface under Ethernet protocol would be the identifier for the server layer that needs to be monitored by the server MEP.

- **Association of server MEP defect**—Defines the association of server MEP defects to ETH-AIS action.

- **Association action profile and server MEP**—Defines the binding of server MEP and action profile.

To configure ETH-AIS in server MEP, you need to:

- Create an action profile with ETH-AIS action for server MEP defects.
- Attach the action profile to a server MEP

To create an action profile, include the following statements at the [edit protocols oam ethernet connectivity-fault-management] hierarchy level:

```
[edit protocols oam ethernet connectivity-fault-management]
action-profile action-profile-name {
  event {
    server-mep-defects {
      link-loss-defect;
      l2circuit-defect;
      l2vpn-defect;
    }
  }
}
```
action {
    log-and-generate-ais {
        level 1…n;
        interval 1 second | 1 minute;
        priority dot1p [range 0-7];
    }
}

To attach an action profile to a server MEP, include the following statement at the [edit protocols oam ethernet connectivity-fault-management] hierarchy level:

```
[edit protocols oam ethernet connectivity-fault-management]
server-mep mep-identifier {
    protocol l2circuit | l2vpn | ethernet {
        interface interface-name;
    }
    action-profile action-profile-name;
}
```

Related Documentation
- Ethernet Alarm Indication Signal Overview on page 942

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;
                }
            }
        }
    }
}
```
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 201 {
              interface ge-5/2/9.0;
              direction down;
              auto-discovery;
            }
          }
        }
      }
    }
  }
}
```
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:oa:43:94, Interface ge-0/2/5.0
MDF 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
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
  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
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
  LTM sent : 0
  LTM 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 count: 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
```

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
LTM sent  : 0
LTM received  : 0
LTR sent  : 0
LTR 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  Two-way delay
(usec)         (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  Two-way delay
(usec)         (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 Overview on page 854
- Configuring MEP Interfaces to Support ETH-DM on page 750
- Triggering an ETH-DM Session on page 984
- Viewing ETH-DM Statistics on page 986
- Configuring Two-Way ETH-DM with Single-Tagged Interfaces on page 955
- Configuring ETH-DM with Untagged Interfaces

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;
                        }
                    }
                }
            }
        }
    }
}
From Router MX-1, start a two-way delay measurement to Router MX-2.

```
user@MX-1> monitor ethernet delay-measurement two-way mep101 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: 108 usec Delay variation: 16 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
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
LBRs 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:
<table>
<thead>
<tr>
<th>Index</th>
<th>One-way delay (usec)</th>
<th>Two-way delay (usec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>92</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>92</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>111</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>119</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>122</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>92</td>
<td></td>
</tr>
</tbody>
</table>
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:**

<table>
<thead>
<tr>
<th>Index</th>
<th>One-way delay (usec)</th>
<th>Two-way delay (usec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>103</td>
</tr>
<tr>
<td>2</td>
<td>92</td>
<td>92</td>
</tr>
<tr>
<td>3</td>
<td>92</td>
<td>92</td>
</tr>
<tr>
<td>4</td>
<td>111</td>
<td>111</td>
</tr>
<tr>
<td>5</td>
<td>110</td>
<td>110</td>
</tr>
<tr>
<td>6</td>
<td>119</td>
<td>119</td>
</tr>
<tr>
<td>7</td>
<td>122</td>
<td>122</td>
</tr>
<tr>
<td>8</td>
<td>92</td>
<td>92</td>
</tr>
<tr>
<td>9</td>
<td>92</td>
<td>92</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>108</td>
</tr>
</tbody>
</table>

**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 Overview on page 854
- Configuring MEP Interfaces to Support ETH-DM on page 750
- Triggering an ETH-DM Session on page 984
- Viewing ETH-DM Statistics on page 986
- Configuring One-Way ETH-DM with Single-Tagged Interfaces on page 950
- Configuring ETH-DM with Untagged Interfaces

### 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 (LRM)
Protocol data units (PDUs). By configuring ETH-LM, you can measure the Ethernet frame loss that occur in your network.

- Requirements on page 960
- Overview and Topology on page 960
- Configuration on page 961
- Verification on page 970

Requirements

This example uses the following hardware and software components:

- Two MX Series 5G Universal Routing Platforms 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 53 on page 960 shows the topology used in this example. VPWS service is configured between two MX Series routers, MX-PE1 and MX PE2.

Figure 53: VPWS Service Configured Between Two MX Series Routers

Level 4 UP MEP for Y1731 packets (MX Series client and MX Series server)

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, mep2, 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, mep1, 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**

- Configuring Router PE1 on page 962
- Configuring Router PE2 on page 966

**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:

```plaintext
[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
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
```
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
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;
        }
      }
    }
  }
}
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
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
```
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;
                }
            }
        }
    }
}
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 on page 970

**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: 0
- 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
```
<table>
<thead>
<tr>
<th>Identifier</th>
<th>MAC address</th>
<th>State</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>00:05:85:76:e5:30</td>
<td>ok</td>
<td>ge-5/0/4.11</td>
</tr>
</tbody>
</table>
```
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 860
- Example: Measuring Ethernet Frame Loss for Dual-Tagged LMM/LMR PDUs on page 972

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 972
- Overview and Topology on page 972
- Configuration on page 973
- Verification on page 983

Requirements

This example uses the following hardware and software components:

- Two MX Series 5G Universal Routing Platforms 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 54 on page 973 shows the topology used in this example. VPWS service is configured between two MX Series routers, MX-PE1 and MX PE2.
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, mep2, 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, mep1, 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

- Configuring Router PE1 on page 975
- Configuring Router PE2 on page 979

### 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:**

```bash
[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
disable
set protocols ldp interface all
disable
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
set protocols oam ethernet connectivity-fault-management maintenance-domain md
set protocols oam ethernet connectivity-fault-management maintenance-domain md
set protocols oam ethernet connectivity-fault-management maintenance-domain md
set firewall three-color-policer abc logical-interface-policer
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
two-rate peak-burst-size 15k

On Router PE2:

[edit]
set interfaces ge-8/0/8 encapsulation flexible-ethernet-services
cryptographic secret 1234
set interfaces ge-8/0/8 unit 11 encapsulation vlan-ccc
cryptographic secret 5678
set interfaces ge-8/0/8 unit 11 layer2-policer input-three-color abc
cryptographic secret 91011
set interfaces ge-8/0/8 unit 11 family ccc
set interfaces ge-8/0/9 enable
cryptographic secret 12345678
set interfaces ge-8/0/9 unit 0 family inet address 12.1.1.1/24
cryptographic secret 78901234
set interfaces ge-8/0/9 unit 0 family mpls
cryptographic secret 45678901
set interfaces ae0 unit 0 family inet
cryptographic secret 01234567
set interfaces lo0 unit 0 family inet address 3.3.3.3/32
cryptographic secret 78901234
set interfaces ge-8/0/8 flexible-vlan-tagging
cryptographic secret 12345678
set interfaces ge-8/0/8 unit 11 vlan-tags outer 2000 inner 1000
cryptographic secret 45678901
set interfaces ge-8/0/8 unit 11 input-vlan-map swap-swap
cryptographic secret 01234567
set interfaces ge-8/0/8 unit 11 input-vlan-map vlan-id 4094
cryptographic secret 78901234
set interfaces ge-8/0/8 unit 11 input-vlan-map inner-vlan-id 4093
cryptographic secret 45678901
set interfaces ge-8/0/8 unit 11 output-vlan-map swap-swap
cryptographic secret 01234567
set routing-options router-id 3.3.3.3
cryptographic secret 78901234
set protocols mpls interface all
cryptographic secret 12345678
set protocols mpls interface fxp0.0 disable
cryptographic secret 78901234
set protocols ospf area 0.0.0.0 interface all
cryptographic secret 12345678
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
cryptographic secret 78901234
set protocols ldp interface all
cryptographic secret 12345678
set protocols ldp interface fxp0.0 disable
cryptographic secret 78901234
set protocols l2circuit neighbor 4.4.4.4 interface ge-8/0/8.11 no-control-word
cryptographic secret 12345678
set protocols l2circuit neighbor 3.3.3.3 interface ge-8/0/8.11 virtual-circuit-id 1003
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.

```plaintext
[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.

```plaintext
[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.

```plaintext
[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 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.

```plaintext
[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.

```plaintext
[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;
    }
  }
```

Chapter 34: Configuring ITU-T Y.1731 Ethernet Service OAM
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;
        }
    }
}
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]
```
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;
  ]
]  
ea0 [
  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;
        }
    }
}

doam {
    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` 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 on page 983

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
    LTM sent : 0
    LTM received : 0
    LTRs sent : 0
    LTRs received : 0
```
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.

## 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 118 on page 985.

### Related Documentation

- Ethernet Frame Loss Measurement Overview on page 860
- Example: Measuring Ethernet Frame Loss for Single-Tagged LMM/LMR PDU on page 959
### Table 118: Monitor Ethernet Delay Command Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Parameter Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>one-way or two-way</td>
<td>NA</td>
<td>Perform a one-way or two-way (round-trip) delay measurement.</td>
</tr>
<tr>
<td>remote-mac-address</td>
<td>Unicast MAC address</td>
<td>Send delay measurement frames to the destination unicast MAC address (use the format xx:xx:xx:xx:xx:xx). Multicast MAC addresses are not supported.</td>
</tr>
<tr>
<td>mep identifier</td>
<td>1–8191</td>
<td>The MEP identifier to use for the measurement. The discovered MAC address for this MEP identifier is used.</td>
</tr>
<tr>
<td>maintenance-domain name</td>
<td>Existing MD name</td>
<td>Specifies an existing maintenance domain (MD) to use for the measurement.</td>
</tr>
<tr>
<td>maintenance-association ma-id</td>
<td>Existing MA identifier</td>
<td>Specifies an existing maintenance association (MA) identifier to use for the measurement.</td>
</tr>
<tr>
<td>count count</td>
<td>1–65535 (default:10)</td>
<td>(Optional) Specifies the number of Ethernet frame delay frames to send. The default is 10.</td>
</tr>
<tr>
<td>wait time</td>
<td>1–255 seconds (default:1)</td>
<td>(Optional) Specifies the number of seconds to wait between frames. The default is 1 second.</td>
</tr>
</tbody>
</table>

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
```

--- Delay measurement statistics ---

Two-way ETH-DM request to 00:11:22:33:44:55, Interface ge-5/2/9.0

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 Overview on page 854
- Configuring MEP Interfaces to Support ETH-DM on page 750
- Viewing ETH-DM Statistics on page 986
- Configuring One-Way ETH-DM with Single-Tagged Interfaces on page 950
- Configuring Two-Way ETH-DM with Single-Tagged Interfaces on page 955
- Configuring ETH-DM with Untagged Interfaces
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 119 on page 986.

### Table 119: Show Ethernet Delay Command Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Parameter Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>maintenance-domain <code>name</code></td>
<td>Existing MD name</td>
<td>Specifies an existing maintenance domain (MD) to use.</td>
</tr>
<tr>
<td>maintenance-association <code>ma-id</code></td>
<td>Existing MA identifier</td>
<td>Specifies an existing maintenance association (MA) identifier to use.</td>
</tr>
<tr>
<td>local-mep identifier</td>
<td>1–8191</td>
<td>When a MEP has been specified, display statistics only for the local MEP.</td>
</tr>
<tr>
<td>remote-mep identifier</td>
<td>1–8191</td>
<td>When a MEP has been specified, display statistics only for the discovered MEP.</td>
</tr>
<tr>
<td>count <code>count</code></td>
<td>1–100 (default:100)</td>
<td>The number of entries to display in the results table. By default, all 100 entries are displayed if they exist.</td>
</tr>
</tbody>
</table>

**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 Overview on page 854
- Configuring MEP Interfaces to Support ETH-DM on page 750
- Triggering an ETH-DM Session on page 984
- Configuring One-Way ETH-DM with Single-Tagged Interfaces on page 950
- Configuring Two-Way ETH-DM with Single-Tagged Interfaces on page 955
- Configuring ETH-DM with Untagged Interfaces
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 991.

**Related Documentation**

- Example: Configuring Ethernet Ring Protection for MX Series Routers on page 992
- Example: Viewing Ethernet Ring Protection Status—Normal Ring Operation on page 1017
- Example: Viewing Ethernet Ring Protection Status—Ring Failure Condition on page 1019
- Ethernet Ring Protection Using Ring Instances for Load Balancing on page 991
- Example: Configuring Load Balancing Within Ethernet Ring Protection for MX Series Routers on page 999
Ethernet Ring Protection Using Ring Instances for Load Balancing

Juniper Network MX Series 5G Universal Routing Platforms 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 989.

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 989
• Example: Configuring Ethernet Ring Protection for MX Series Routers on page 992
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 992
- Router 1 (RPL Owner) Configuration on page 993
- Router 2 Configuration on page 995
- Router 3 Configuration on page 997

Example Topology

The links connecting the three MX Series routers are shown in Figure 55 on page 992.

Figure 55: 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:

```plaintext
[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;
      }
      ring-protection-link-end;
      west-interface {
        control-channel ge-1/2/4;
      }
    }
  }
}

4. Configure Ethernet OAM:

```plaintext
[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:

```conf
[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:

```conf
[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:
protocols {
    protection-group {
        ethernet-ring pg102 {
            east-interface {
                control-channel ge-1/0/2.1;
            }
            west-interface {
                control-channel ge-1/2/1.1;
            }
        }
    }
}

4. Configure Ethernet OAM:

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 [ 
```
4. Configure Ethernet OAM:

```conf
[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 989
- Example: Viewing Ethernet Ring Protection Status—Normal Ring Operation on page 1017
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
- Overview and Topology
- Configuration
- Verification

**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 56 on page 1000 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 56: ERP with Multiple Protection Instances Configured on Three MX Series Routers

Table 120 on page 1000 describes the components of the example topology.

Table 120: Components of the Network Topology

<table>
<thead>
<tr>
<th>Property</th>
<th>Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ring instances</td>
<td>• ring-1—Data channel [200,300]</td>
</tr>
<tr>
<td></td>
<td>• ring-2—Data channel [500,600]</td>
</tr>
<tr>
<td>Customer sites</td>
<td>Two customer sites are connected to AS1:</td>
</tr>
<tr>
<td></td>
<td>• Customer site 1, VLAN 200 and VLAN 300</td>
</tr>
<tr>
<td></td>
<td>• Customer site 2, VLAN 500 and VLAN 600</td>
</tr>
</tbody>
</table>
Table 120: Components of the Network Topology (continued)

<table>
<thead>
<tr>
<th>Property</th>
<th>Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS1 router</td>
<td>CS1 has the following protection group properties:</td>
</tr>
<tr>
<td></td>
<td>- RPL owner—ring-1.</td>
</tr>
<tr>
<td></td>
<td>- East interface—ge-3/2/4.0.</td>
</tr>
<tr>
<td></td>
<td>- West interface—ge-5/2/3.0.</td>
</tr>
<tr>
<td></td>
<td>- Data channel for ring-1—VLAN 200, VLAN 300.</td>
</tr>
<tr>
<td></td>
<td>- Data channel for ring-2—VLAN 500, VLAN 600.</td>
</tr>
<tr>
<td></td>
<td>- Ring protection link end for ring-1—ge-3/2/4.0.</td>
</tr>
<tr>
<td></td>
<td>CS1 has the following routing and bridging properties:</td>
</tr>
<tr>
<td></td>
<td>- Routing instance—vs.</td>
</tr>
<tr>
<td></td>
<td>- Bridge domains:</td>
</tr>
<tr>
<td></td>
<td>- bd100 is associated with vlan-id 100.</td>
</tr>
<tr>
<td></td>
<td>- bd101 is associated with vlan-id 101.</td>
</tr>
<tr>
<td></td>
<td>- bd200 is associated with vlan-id 200.</td>
</tr>
<tr>
<td></td>
<td>- bd300 is associated with vlan-id 300.</td>
</tr>
<tr>
<td></td>
<td>- bd500 is associated with vlan-id 500.</td>
</tr>
<tr>
<td></td>
<td>- bd600 is associated with vlan-id 600.</td>
</tr>
</tbody>
</table>

| CS2 router     | CS2 has the following protection group properties:                        |
|                | - RPL owner—ring-2.                                                      |
|                | - East interface—ge-2/0/4.0.                                              |
|                | - West interface—ge-2/0/8.0.                                              |
|                | - Ring protection link end for ring-2—ge-2/0/8.0.                        |
|                | - Data channel for ring-1—VLAN 200, VLAN 300.                             |
|                | - Data channel for ring-2—VLAN 500, VLAN 600.                             |
|                | CS2 has the following bridging properties:                               |
|                | - bd100 is associated with vlan-id 100.                                   |
|                | - bd101 is associated with vlan-id 101.                                   |
|                | - bd200 is associated with vlan-id 200.                                   |
|                | - bd300 is associated with vlan-id 300.                                   |
|                | - bd500 is associated with vlan-id 500.                                   |
|                | - bd600 is associated with vlan-id 600.                                   |
### Configuration

To enable ERP with ring instances on CS1, CS2, and AS1, perform these tasks:

- Configuring ERP on CS1 on page 1002
- Configuring ERP on CS2 on page 1005
- Configuring ERP on AS1 on page 1008

#### 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:

```bash
[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 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
```

---

**Table 120: Components of the Network Topology (continued)**

<table>
<thead>
<tr>
<th>Property</th>
<th>Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS1 router</td>
<td>AS1 has the following protection group properties:</td>
</tr>
<tr>
<td></td>
<td>• East interface—ge-2/0/5.0.</td>
</tr>
<tr>
<td></td>
<td>• West interface—ge-2/1/1.0.</td>
</tr>
<tr>
<td></td>
<td>• Data channel for ring-1—VLAN 200, VLAN 300.</td>
</tr>
<tr>
<td></td>
<td>• Data channel for ring-2—VLAN 500, VLAN 600.</td>
</tr>
<tr>
<td></td>
<td>AS1 has the following bridging properties:</td>
</tr>
<tr>
<td></td>
<td>• bd100 is associated with vlan-id 100.</td>
</tr>
<tr>
<td></td>
<td>• bd101 is associated with vlan-id 101.</td>
</tr>
<tr>
<td></td>
<td>• bd200 is associated with vlan-id 200.</td>
</tr>
<tr>
<td></td>
<td>• bd300 is associated with vlan-id 300.</td>
</tr>
<tr>
<td></td>
<td>• bd500 is associated with vlan-id 500.</td>
</tr>
<tr>
<td></td>
<td>• bd600 is associated with vlan-id 600.</td>
</tr>
</tbody>
</table>
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
   ```
Results

Check the results of the configuration:

```
user@cs1# set vs bridge-domains bd600 vlan-id 600

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;
            }
          }
        }
      }
    }
  }
```
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 \texttt{ge-2/0/4} to connect CS2 to CS1 and trunk interface \texttt{ge-2/0/8} to connect CS2 to CS1, and configure the family statement as \texttt{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 \texttt{ring-1} and \texttt{ring-2}, and configure \texttt{ring-2} as the ring protection link owner:

```
[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 bd100 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

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
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`:

   ```
   [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 {
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 1011
- Verifying the Data Channel CS1 on page 1012
- Verifying the VLANs on CS1 on page 1012
- Verifying the Ethernet Protection Ring on CS2 on page 1013
- Verifying the Data Channel CS2 on page 1014
- Verifying the VLANs on CS2 on page 1014
- Verifying the Ethernet Protection Ring on AS1 on page 1015
- Verifying the Data Channels on AS1 on page 1015
- Verifying the VLANs on AS1 on page 1016

### 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
```

<table>
<thead>
<tr>
<th>Ethernet Ring</th>
<th>Name</th>
<th>Request/state</th>
<th>No Flush</th>
<th>Ring Protection</th>
<th>Originator</th>
<th>Remote</th>
</tr>
</thead>
<tbody>
<tr>
<td>ring-1</td>
<td>NR</td>
<td>No</td>
<td>Link Blocked</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>
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
```

<table>
<thead>
<tr>
<th>Interface</th>
<th>STP index</th>
<th>Forward State</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-3/2/4</td>
<td>122</td>
<td>forwarding</td>
</tr>
<tr>
<td>ge-5/2/3</td>
<td>123</td>
<td>forwarding</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interface</th>
<th>STP index</th>
<th>Forward State</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-3/2/4</td>
<td>124</td>
<td>discarding</td>
</tr>
<tr>
<td>ge-5/2/3</td>
<td>125</td>
<td>forwarding</td>
</tr>
</tbody>
</table>

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
```

<table>
<thead>
<tr>
<th>Interface</th>
<th>Vlan</th>
<th>STP Index</th>
<th>Bridge Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-3/2/4</td>
<td>200</td>
<td>122</td>
<td>vs/bd200</td>
</tr>
<tr>
<td>ge-5/2/3</td>
<td>200</td>
<td>123</td>
<td>vs/bd200</td>
</tr>
<tr>
<td>ge-3/2/4</td>
<td>300</td>
<td>122</td>
<td>vs/bd300</td>
</tr>
<tr>
<td>ge-5/2/3</td>
<td>300</td>
<td>123</td>
<td>vs/bd300</td>
</tr>
</tbody>
</table>

**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
```

<table>
<thead>
<tr>
<th>Ethernet Ring Name</th>
<th>Node ID</th>
<th>Request/state</th>
<th>No Flush</th>
<th>Ring Protection</th>
<th>Originator</th>
<th>Remote</th>
<th>Link Blocked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ring-1 00:21:59:03:ff:d0</td>
<td>NR</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Ring-2</td>
<td>NR</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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
```

<table>
<thead>
<tr>
<th>Interface</th>
<th>STP index</th>
<th>Forward State</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-2/0/4</td>
<td>44</td>
<td>forwarding</td>
</tr>
<tr>
<td>ge-2/0/8</td>
<td>45</td>
<td>forwarding</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interface</th>
<th>STP index</th>
<th>Forward State</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-2/0/4</td>
<td>46</td>
<td>forwarding</td>
</tr>
<tr>
<td>ge-2/0/8</td>
<td>47</td>
<td>discarding</td>
</tr>
</tbody>
</table>

**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
```

<table>
<thead>
<tr>
<th>Interface</th>
<th>Vlan</th>
<th>STP Index</th>
<th>Bridge Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-2/0/4</td>
<td>200</td>
<td>44</td>
<td>default-switch/bd200</td>
</tr>
<tr>
<td>ge-2/0/8</td>
<td>200</td>
<td>45</td>
<td>default-switch/bd200</td>
</tr>
<tr>
<td>ge-2/0/4</td>
<td>300</td>
<td>44</td>
<td>default-switch/bd300</td>
</tr>
<tr>
<td>ge-2/0/8</td>
<td>300</td>
<td>45</td>
<td>default-switch/bd300</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interface</th>
<th>Vlan</th>
<th>STP Index</th>
<th>Bridge Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-2/0/4</td>
<td>500</td>
<td>46</td>
<td>default-switch/bd500</td>
</tr>
<tr>
<td>ge-2/0/8</td>
<td>500</td>
<td>47</td>
<td>default-switch/bd500</td>
</tr>
<tr>
<td>ge-2/0/4</td>
<td>600</td>
<td>46</td>
<td>default-switch/bd600</td>
</tr>
<tr>
<td>ge-2/0/8</td>
<td>600</td>
<td>47</td>
<td>default-switch/bd600</td>
</tr>
</tbody>
</table>
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-ringaps
```

<table>
<thead>
<tr>
<th>Ethernet Ring Name</th>
<th>Request/state</th>
<th>No Flush</th>
<th>Ring Protection</th>
<th>Originator</th>
<th>Remote Node ID</th>
<th>Link Blocked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ring-1</td>
<td>NR</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>00:21:59:03:ff:d0</td>
<td>Yes</td>
</tr>
<tr>
<td>Ring-2</td>
<td>NR</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>13:22:af:31:fc:00</td>
<td>Yes</td>
</tr>
</tbody>
</table>

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
```

<table>
<thead>
<tr>
<th>Interface</th>
<th>STP index</th>
<th>Forward State</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-2/0/5</td>
<td>22</td>
<td>forwarding</td>
</tr>
<tr>
<td>ge-2/1/1</td>
<td>23</td>
<td>forwarding</td>
</tr>
</tbody>
</table>
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
```

### Related Documentation

- Ethernet Ring Protection Using Ring Instances for Load Balancing on page 991
- Ethernet Ring Protection on page 989
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)**

```bash
user@router2> show protection-group ethernet-ring aps
Ethernet Ring Name Request/state No Flush Ring Protection Link Blocked
pg102 NR No Yes
```

Router 3 will see almost identical information.

```bash
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.

```bash
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.

```bash
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 989
  - Example: Configuring Ethernet Ring Protection for MX Series Routers on page 992
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  Guard 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)**

```plaintext
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.
Chapter 35: Configuring Ethernet Ring Protection

Related Documentation

- *Ethernet Interfaces Feature Guide for Routing Devices*
- Ethernet Ring Protection on page 989
- Example: Configuring Ethernet Ring Protection for MX Series Routers on page 992
- Example: Viewing Ethernet Ring Protection Status—Normal Ring Operation on page 1017
CHAPTER 36

CFM Action Profile to Bring Down a Group of Logical Interfaces

- CFM Action Profile to Bring Down a Group of Logical Interfaces Overview on page 1023
- Configuring a CFM Action Profile to Bring Down a Group of Logical Interfaces on page 1024

CFM Action Profile to Bring Down a Group of Logical Interfaces Overview

With growing networks, there is a requirement of monitoring a large number of services using CFM. To monitor each service, one session per service logical interface is required. If the services are large in number, this method does not scale as the number of sessions are limited. Instead of one CFM session per service, a single CFM session can monitor multiple services.

Also, there are scenarios where the user-to-network interface (UNI) device needs to be brought down based on sessions on network-to-network Interface (NNI) logical interface. Here, the NNI logical interface refers to core interface and UNI physical interface refers to access interface hosting multiple service logical interfaces. Based on core interface monitoring, you can bring down service logical interfaces associated with access interface.

Figure 57 on page 1024 illustrates a topology where a number of services destined to customer-edge (CE) routers share a single port on a provider-edge (PE) router. Each service uses one logical interface. A set of services or logical interfaces (colored in yellow) are destined to one CE router and a set of services or logical interfaces colored in red are destined to another CE router. To monitor each service, you need dedicated down maintenance association end point (MEP) sessions for each service. You can bring down the service by bringing down the service logical interface whenever the session goes down. However, this approach is not scalable if we have large number of services. Monitoring the CFM session on the physical interface is also not feasible because multiple CE routers might be connected and the services to other CE router could be disrupted. To address this issue of monitoring multiple services with a single session, you can create a CCM action profile to bring down a group of logical interfaces by using a CFM session that is configured on a single logical interface.
You can configure CCM action profiles for the following scenarios:

- To bring down a group of logical interfaces all having the same parent port when CCM monitoring session is running on one of the logical interface but on a different parent port.
- To bring down a group of logical interfaces when CCM monitoring session is running on one of the logical interfaces, all belonging to the same parent port.
- To bring down the port, when the CCM monitoring session is running on one of the logical interfaces of a different parent port.

Benefits of Creating CFM Action Profile to Bring Down a Group of Logical Interfaces

- Reduces resource requirement in scaled networks where multiple services need to be monitored.
- Avoids the need to create individual MEP sessions for each service in a topology that includes multiple services to be monitored, thereby enhancing the performance and scalability of the network.

Related Documentation

- Configuring a CFM Action Profile to Bring Down a Group of Logical Interfaces on page 1024

Configuring a CFM Action Profile to Bring Down a Group of Logical Interfaces

To monitor multiple services or IFLs using CFM session configured on a single logical interface, you can create a CCM action profile to bring down a group of logical interfaces. You need to define an action to bring down the interface group in the action profile. You will then define the interface device name and the number of logical interfaces that have to be brought down. A logical interface is represented by a combination of the `interface-device-name` and `unit-list`. The following steps explain the procedure to bring down a group of logical interfaces when the `interface-device-name` and/or `unit-list` are specified.

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.

   ```
   [edit protocols oam ethernet connectivity-fault-management]
   user@host# set action-profile profile-name event [event1, event2, event3..]
   ```
For example,

```plaintext
user@host# set action-profile AP_test event adjacency-loss rdi
```

NOTE: The action interface-group-down will not be supported with events other than adjacency-loss and RDI. Any other events configured results in a commit error.

2. In configuration mode, at the [edit protocols oam ethernet connectivity-fault-management action-profile profile-name] hierarchy level, define the action to bring down the interface group.

```plaintext
[edit protocols oam ethernet connectivity-fault-management action-profile AP-test ]
user@host# set action interface-group-down
```

NOTE: The action interface-group-down will not be supported with other interface related actions. Any other actions configured results in a commit error.

3. At the [edit protocols oam ethernet connectivity-fault-management] hierarchy level, define the maintenance domain. Specify the maintenance-association parameters.

```plaintext
[edit protocols oam ethernet connectivity-fault-management]
user@host# set maintenance-domain domain-name level number maintenance-association ma-name continuity-check interval 1s
```

For example,

```plaintext
user@host# set maintenance-domain md6 level 6 maintenance-association ma6 continuity-check interval 1s
```

4. At the `edit protocols oam ethernet connectivity-fault-management maintenance-domain md-name maintenance-association ma-name`, define the maintenance association endpoint and the associated parameters.

```plaintext
[edit protocols oam ethernet connectivity-fault-management maintenance-domain md-name maintenance-association ma-name]
user@host# set mep mep-id interface interface-name direction down remote -mep mep-id
```

For example,

```plaintext
user@host# set mep 101 interface ge-0/0/0.0 direction down remote -mep 102
```
5. If the action-profile has `interface-group-down` action configured, it is mandatory to configure the `interface-group` at the RMEP level. In the configuration mode at the `[edit protocols oam ethernet connectivity-fault-management maintenance-domain md-name maintenance-association ma-name mep mep-id remote-mep mep-id action-profile profile-name]` include the `interface-group` statement to bring down the interface group marked with the action profile as `interface-group-down`.

```plaintext
[edit protocols oam ethernet connectivity-fault-management maintenance-domain md-name maintenance-association ma-name mep mep-id remote-mep mep-id action-profile profile-name]
user@host# set interface-group
```

For example,

```plaintext
[edit protocols oam ethernet connectivity-fault-management maintenance-domain md6 maintenance-association ma6 mep 101 remote-mep 102 action-profile AP_test]
user@host# set interface-group
```

**NOTE:** If the `interface-group` configuration is not included in the RMEP configuration. The configuration results in commit error.

6. A logical interface is represented by a combination of the `interface-device-name` and `unit-list`. Configure the device interface name and the number of logical interfaces at the `[edit protocols oam ethernet connectivity-fault-management maintenance-domain md-name maintenance-association ma-name mep mep-id remote-mep mep-id action-profile profile-name]` interface-group.

```plaintext
[edit protocols oam ethernet connectivity-fault-management maintenance-domain md-name maintenance-association ma-name mep mep-id remote-mep mep-id action-profile profile-name]
user@host# set interface interface-name
user@host# set unit-list logical-interface-unit-number
```

For example,

```plaintext
[edit protocols oam ethernet connectivity-fault-management maintenance-domain md6 maintenance-association ma6 mep 101 remote-mep 102 action-profile AP_test]
user@host# set interface ge-0/0/0.0
user@host# set unit-list 1223-3344
```

In this configuration example, the interface ge-0/0/0.0 is brought down.
NOTE:

- At least one of the interface-group parameters, interface-device-name or unit-list must be configured. If the interface device name is not configured, the MEP interface is considered as the device name and the logical interface on that device is brought down.

- If the unit-list parameter exceeds the recommended limit, a commit error occurs.

- If the interface-device-name is not specified in the interface-group, the logical interface numbers mentioned in unit-list for the physical interface is brought down.

- If the unit-list is not specified in the interface-group, IFLs are brought down for the configured interface.

7. Verify the configuration using `show protocols oam` command.

```
[edit]
user@host# show protocols oam
ethernet {
    connectivity-fault-management {
        action-profile AP_TEST {
            event {
                adjacency-loss;
                rdi;
            }
            action {
                interface-group-down;
            }
        }
        maintenance-domain md6 {
            level 6;
            maintenance-association ma6 {
                continuity-check {
                    interval 1s;
                }
                mep 102 {
                    interface ge-0/0/0.0;
                    direction down;
                    remote-mep 103 {
                        action-profile AP_TEST;
                        interface-group {
                            ge-0/0/1;
                            unit-list [12 23-33 44];
                        }
                    }
                }
            }
        }
    }
}
```
Related Documentation

- CFM Action Profile to Bring Down a Group of Logical Interfaces Overview on page 1023
PART 4

Troubleshooting Information

- Monitoring and Troubleshooting Ethernet interfaces on page 1031
CHAPTER 37

Monitoring and Troubleshooting Ethernet Interfaces

- Configuring Interface Diagnostics Tools to Test the Physical Layer Connections on page 1031
- Checklist for Monitoring Fast Ethernet and Gigabit Ethernet Interfaces on page 1037
- Monitoring Fast Ethernet and Gigabit Ethernet Interfaces on page 1038
- Performing Loopback Testing for Fast Ethernet and Gigabit Ethernet Interfaces on page 1048
- Locating the Fast Ethernet and Gigabit Ethernet LINK Alarm and Counters on page 1064
- Troubleshooting: 10-Gigabit Ethernet Port Stuck in Down State on page 1068

Configuring Interface Diagnostics Tools to Test the Physical Layer Connections

- Configuring Loopback Testing on page 1031
- Configuring BERT Testing on page 1033
- Starting and Stopping a BERT Test on page 1037

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 121 on page 1032 shows the loopback modes supported on the various interface types.

### Table 121: Loopback Modes by Interface Type

<table>
<thead>
<tr>
<th>Interface</th>
<th>Loopback Modes</th>
<th>Usage Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregated Ethernet, Fast Ethernet, Gigabit Ethernet</td>
<td>Local</td>
<td>“Configuring Ethernet Loopback Capability” on page 19</td>
</tr>
<tr>
<td>Circuit Emulation E1</td>
<td>Local and remote</td>
<td>Configuring E1 Loopback Capability</td>
</tr>
<tr>
<td>Circuit Emulation T1</td>
<td>Local and remote</td>
<td>Configuring T1 Loopback Capability</td>
</tr>
<tr>
<td>E1 and E3</td>
<td>Local and remote</td>
<td>Configuring E1 Loopback Capability and Configuring E3 Loopback Capability</td>
</tr>
<tr>
<td>NxDS0</td>
<td>Payload</td>
<td>Configuring NxDS0 IQ and IQE Interfaces, Configuring T1 and NxDS0 Interfaces, Configuring Channelized OC12/STM4 IQ and IQE Interfaces (SONET Mode), Configuring Fractional E1 IQ and IQE Interfaces, and Configuring Channelized T3 IQ Interfaces</td>
</tr>
</tbody>
</table>
Table 121: Loopback Modes by Interface Type (continued)

<table>
<thead>
<tr>
<th>Interface</th>
<th>Loopback Modes</th>
<th>Usage Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial (V.35 and X.21)</td>
<td>Local and remote</td>
<td>Configuring Serial Loopback Capability</td>
</tr>
<tr>
<td>Serial (EIA-530)</td>
<td>DCE local, DCE remote, local, and remote</td>
<td>Configuring Serial Loopback Capability</td>
</tr>
<tr>
<td>SONET/SDH</td>
<td>Local and remote</td>
<td>Configuring SONET/SDH Loopback Capability to Identify a Problem as Internal or External</td>
</tr>
<tr>
<td>T1 and T3</td>
<td>Local, payload, and remote</td>
<td>Configuring T1 Loopback Capability and Configuring T3 Loopback Capability See also Configuring the T1 Remote Loopback Response</td>
</tr>
</tbody>
</table>

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.

```plaintext
[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.

```plaintext
[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:

```plaintext
[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:

```plaintext
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:

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>all-ones-repeating</td>
<td>Repeating one bits</td>
</tr>
<tr>
<td>all-zeros-repeating</td>
<td>Repeating zero bits</td>
</tr>
<tr>
<td>alternating-double-ones-zeros</td>
<td>Alternating pairs of ones and zeros</td>
</tr>
<tr>
<td>alternating-ones-zeros</td>
<td>Alternating ones and zeros</td>
</tr>
<tr>
<td>pseudo-2e11-o152</td>
<td>Pattern is $2^{11} - 1$ (per 0.152 standard)</td>
</tr>
<tr>
<td>pseudo-2e15-o151</td>
<td>Pattern is $2^{15} - 1$ (per 0.151 standard)</td>
</tr>
<tr>
<td>pseudo-2e20-o151</td>
<td>Pattern is $2^{20} - 1$ (per 0.151 standard)</td>
</tr>
<tr>
<td>pseudo-2e7</td>
<td>Pattern is $2^7 - 1$</td>
</tr>
<tr>
<td>pseudo-2e9-o153</td>
<td>Pattern is $2^9 - 1$ (per 0.153 standard)</td>
</tr>
<tr>
<td>repeating-1-in-4</td>
<td>1 bit in 4 is set</td>
</tr>
<tr>
<td>repeating-1-in-8</td>
<td>1 bit in 8 is set</td>
</tr>
<tr>
<td>repeating-3-in-24</td>
<td>3 bits in 24 are set</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>all-ones-repeating</td>
<td>Repeating one bits</td>
</tr>
<tr>
<td>all-zeros-repeating</td>
<td>Repeating zero bits</td>
</tr>
<tr>
<td>alternating-double-ones-zeros</td>
<td>Alternating pairs of ones and zeros</td>
</tr>
<tr>
<td>alternating-ones-zeros</td>
<td>Alternating ones and zeros</td>
</tr>
<tr>
<td>pseudo-2e9-o153</td>
<td>Pattern is $2^9 - 1$ (per 0.153 (511 type) standard)</td>
</tr>
<tr>
<td>pseudo-2e11-o152</td>
<td>Pattern is $2^{11} - 1$ (per 0.152 and 0.153 (2047 type) standards)</td>
</tr>
<tr>
<td>pseudo-2e15-o151</td>
<td>Pattern is $2^{15} - 1$ (per 0.151 standard)</td>
</tr>
<tr>
<td>pseudo-2e20-o151</td>
<td>Pattern is $2^{20} - 1$ (per 0.151 standard)</td>
</tr>
<tr>
<td>pseudo-2e20-o153</td>
<td>Pattern is $2^{20} - 1$ (per 0.153 standard)</td>
</tr>
<tr>
<td>pseudo-2e23-o151</td>
<td>Pattern is $2^{23} - 1$ (per 0.151 standard)</td>
</tr>
<tr>
<td>repeating-1-in-4</td>
<td>1 bit in 4 is set</td>
</tr>
<tr>
<td>repeating-1-in-8</td>
<td>1 bit in 8 is set</td>
</tr>
<tr>
<td>repeating-3-in-24</td>
<td>3 bits in 24 are set</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>all-ones-repeating</td>
<td>Repeating one bits</td>
</tr>
<tr>
<td>all-zeros-repeating</td>
<td>Repeating zero bits</td>
</tr>
<tr>
<td>alternating-double-ones-zeros</td>
<td>Alternating pairs of ones and zeros</td>
</tr>
<tr>
<td>alternating-ones-zeros</td>
<td>Alternating ones and zeros</td>
</tr>
<tr>
<td>repeating-1-in-4</td>
<td>1 bit in 4 is set</td>
</tr>
<tr>
<td>repeating-1-in-8</td>
<td>1 bit in 8 is set</td>
</tr>
<tr>
<td>repeating-3-in-24</td>
<td>3 bits in 24 are set</td>
</tr>
<tr>
<td>pseudo-2e9-o153</td>
<td>Pattern is $2^9 - 1$ (per O.153 standard)</td>
</tr>
<tr>
<td>pseudo-2e11-o152</td>
<td>Pattern is $2^{11} - 1$ (per O.152 standard)</td>
</tr>
<tr>
<td>pseudo-2e15-o151</td>
<td>Pattern is $2^{15} - 1$ (per O.151 standard)</td>
</tr>
<tr>
<td>pseudo-2e20-o151</td>
<td>Pattern is $2^{20} - 1$ (per O.151 standard)</td>
</tr>
<tr>
<td>pseudo-2e20-o153</td>
<td>Pattern is $2^{20} - 1$ (per O.153 standard)</td>
</tr>
<tr>
<td>pseudo-2e23-o151</td>
<td>Pattern is $2^{23}$ (per O.151 standard)</td>
</tr>
</tbody>
</table>

Table 122 on page 1036 shows the BERT capabilities for various interface types.

**Table 122: BERT Capabilities by Interface Type**

<table>
<thead>
<tr>
<th>Interface</th>
<th>T1 BERT</th>
<th>T3 BERT</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-port T1/E1 Circuit Emulation</td>
<td>Yes (ports 0–11)</td>
<td>—</td>
<td>• Limited algorithms</td>
</tr>
<tr>
<td>4-port Channelized OC3/STM1 Circuit Emulation</td>
<td>Yes (port 0–3)</td>
<td>—</td>
<td>• Limited algorithms</td>
</tr>
<tr>
<td>E1 or T1</td>
<td>Yes (port 0–3)</td>
<td>Yes (port 0–3)</td>
<td>• Single port at a time</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Limited algorithms</td>
</tr>
<tr>
<td>E3 or T3</td>
<td>Yes (port 0–3)</td>
<td>Yes (port 0–3)</td>
<td>• Single port at a time</td>
</tr>
<tr>
<td>Channelized OC12</td>
<td>—</td>
<td>Yes (channel 0–11)</td>
<td>• Single channel at a time</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Limited algorithms</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• No bit count</td>
</tr>
<tr>
<td>Channelized STM1</td>
<td>Yes (channel 0–62)</td>
<td>—</td>
<td>• Multiple channels</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Only one algorithm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• No error insert</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• No bit count</td>
</tr>
<tr>
<td>Channelized T3 and Multichannel T3</td>
<td>Yes (channel 0–27)</td>
<td>Yes (port 0–3 on channel 0)</td>
<td>• Multiple ports and channels</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Limited algorithms for T1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• No error insert for T1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• No bit count for T1</td>
</tr>
</tbody>
</table>
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 2006

**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 123 on page 1038 provides links and commands for monitoring Fast Ethernet and Gigabit Ethernet interfaces.

Table 123: Checklist for Monitoring Fast Ethernet and Gigabit Ethernet Interfaces

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Command or Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Monitor Fast Ethernet and Gigabit Ethernet Interfaces” on page 1039</td>
<td>show interfaces terse (fe*</td>
</tr>
<tr>
<td>1. Display the Status of Fast Ethernet Interfaces on page 1039</td>
<td>show interfaces (fe-fpc/pic/port</td>
</tr>
<tr>
<td>2. Display the Status of a Specific Fast Ethernet or Gigabit Ethernet Interface on page 1042</td>
<td>show interfaces (fe-fpc/pic/port</td>
</tr>
<tr>
<td>3. Display Extensive Status Information for a Specific Fast Ethernet or Gigabit Ethernet Interface on page 1043</td>
<td>monitor interface (fe-fpc/pic/port</td>
</tr>
<tr>
<td>4. Monitor Statistics for a Fast Ethernet or Gigabit Ethernet Interface</td>
<td></td>
</tr>
<tr>
<td>5. Fiber-Optic Ethernet Interface Specifications on page 1047</td>
<td></td>
</tr>
</tbody>
</table>

Meaning You can use the above described commands to monitor and to display the configurations for Fast Ethernet and Gigabit Ethernet interfaces.

Related Documentation • Display the Status of Gigabit Ethernet Interfaces on page 1041
• Display the Status of Fast Ethernet Interfaces on page 1039

Monitoring Fast Ethernet and Gigabit Ethernet Interfaces

• Checklist for Monitoring Fast Ethernet and Gigabit Ethernet Interfaces on page 1038
• Monitor Fast Ethernet and Gigabit Ethernet Interfaces on page 1039
• Fiber-Optic Ethernet Interface Specifications on page 1047

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 123 on page 1038 provides links and commands for monitoring Fast Ethernet and Gigabit Ethernet interfaces.

Table 124: Checklist for Monitoring Fast Ethernet and Gigabit Ethernet Interfaces

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Command or Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Monitor Fast Ethernet and Gigabit Ethernet Interfaces” on page 1039</td>
<td>show interfaces terse (fe*</td>
</tr>
</tbody>
</table>
Table 124: Checklist for Monitoring Fast Ethernet and Gigabit Ethernet Interfaces (continued)

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Command or Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Display the Status of a Specific Fast Ethernet or Gigabit Ethernet Interface on page 1042</td>
<td>`show interfaces (fe-fpc/pic/port</td>
</tr>
<tr>
<td>3. Display Extensive Status Information for a Specific Fast Ethernet or Gigabit Ethernet Interface on page 1043</td>
<td>`show interfaces (fe-fpc/pic/port</td>
</tr>
<tr>
<td>4. Monitor Statistics for a Fast Ethernet or Gigabit Ethernet Interface</td>
<td>`monitor interface (fe-fpc/pic/port</td>
</tr>
<tr>
<td>5. Fiber-Optic Ethernet Interface Specifications on page 1047</td>
<td></td>
</tr>
</tbody>
</table>

**Meaning**  You can use the above described commands to monitor and to display the configurations for Fast Ethernet and Gigabit Ethernet interfaces.

**See Also**  
- Display the Status of Gigabit Ethernet Interfaces on page 1041
- Display the Status of Fast Ethernet Interfaces on page 1039

### 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 1039
2. Display the Status of Gigabit Ethernet Interfaces on page 1041
3. Display the Status of a Specific Fast Ethernet or Gigabit Ethernet Interface on page 1042
4. Display Extensive Status Information for a Specific Fast Ethernet or Gigabit Ethernet Interface on page 1043
5. Monitor Statistics for a Fast Ethernet or Gigabit Ethernet Interface on page 1046

#### 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*
```
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 125 on page 1040.

Table 125: Status of Fast Ethernet Interfaces

<table>
<thead>
<tr>
<th>Physical Interface</th>
<th>Logical Interface</th>
<th>Status Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>fe-2/1/0</td>
<td>fe-2/1/0.0</td>
<td>This interface has both the physical and logical links up and running.</td>
</tr>
<tr>
<td>Admin Up</td>
<td>Admin Up</td>
<td></td>
</tr>
<tr>
<td>Link Up</td>
<td>Link Up</td>
<td></td>
</tr>
<tr>
<td>fe-3/0/2</td>
<td>fe-3/0/2.0</td>
<td>This interface has the physical link down, the link layer down, or both down (Link Down). The logical link is also down as a result.</td>
</tr>
<tr>
<td>Admin Up</td>
<td>Admin Up</td>
<td></td>
</tr>
<tr>
<td>Link Down</td>
<td>Link Down</td>
<td></td>
</tr>
<tr>
<td>fe-4/1/0</td>
<td>fe-4/1/0.0</td>
<td>This interface is administratively disabled and the physical link is healthy (Link Up), but the logical interface is not established. The logical interface is down because the physical link is disabled.</td>
</tr>
<tr>
<td>Admin Down</td>
<td>Admin Up</td>
<td></td>
</tr>
<tr>
<td>Link Up</td>
<td>Link Down</td>
<td></td>
</tr>
<tr>
<td>fe-4/1/2</td>
<td>fe-4/1/2.0</td>
<td>This interface has both the physical and logical links down.</td>
</tr>
<tr>
<td>Admin Up</td>
<td>Admin Up</td>
<td></td>
</tr>
<tr>
<td>Link Down</td>
<td>Link Down</td>
<td></td>
</tr>
</tbody>
</table>

See Also

• Display the Status of Gigabit Ethernet Interfaces on page 1041
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:

```
user@host> show interfaces terse ge*
```

<table>
<thead>
<tr>
<th>Interface</th>
<th>Admin</th>
<th>Link</th>
<th>Proto</th>
<th>Local</th>
<th>Remote</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-2/2/0</td>
<td>down</td>
<td>down</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ge-2/2/0.0</td>
<td>up</td>
<td>down</td>
<td>inet</td>
<td>65.113.23.105/30</td>
<td></td>
</tr>
<tr>
<td>ge-2/3/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ge-2/3/0.0</td>
<td>up</td>
<td>up</td>
<td>inet</td>
<td>65.115.56.57/30</td>
<td></td>
</tr>
<tr>
<td>ge-3/1/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ge-3/1/0.0</td>
<td>up</td>
<td>up</td>
<td>inet</td>
<td>65.115.56.193/30</td>
<td></td>
</tr>
<tr>
<td>ge-3/2/0</td>
<td>up</td>
<td>down</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Meaning**

This sample output lists only the Gigabit Ethernet interfaces. It shows the status of both the physical and logical interfaces. See Table 126 on page 1041 for a description of what the output means.

**Table 126: Status of Gigabit Ethernet Interfaces**

<table>
<thead>
<tr>
<th>Physical Interface</th>
<th>Logical Interface</th>
<th>Status Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-2/2/0</td>
<td>ge-2/2/0.0</td>
<td>This interface is administratively disabled (Admin Down). Both the physical and logical links are down (Link Down).</td>
</tr>
<tr>
<td>Admin Down</td>
<td>Admin Up</td>
<td></td>
</tr>
<tr>
<td>Link Down</td>
<td>Link Down</td>
<td></td>
</tr>
<tr>
<td>ge-2/3/0</td>
<td>ge-2/3/0.0</td>
<td>This interface has both the physical and logical links up and running.</td>
</tr>
<tr>
<td>Admin Up</td>
<td>Admin Up</td>
<td></td>
</tr>
<tr>
<td>Link Up</td>
<td>Link Up</td>
<td></td>
</tr>
<tr>
<td>ge-3/2/0</td>
<td>ge-3/2/0.0</td>
<td>This interface has both the physical link and the logical interface down.</td>
</tr>
<tr>
<td>Admin Up</td>
<td>Admin Up</td>
<td></td>
</tr>
<tr>
<td>Link Down</td>
<td>Link Down</td>
<td></td>
</tr>
</tbody>
</table>

**See Also**

- Display the Status of Fast Ethernet Interfaces on page 1039
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
      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
  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
```
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 1043, 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:
    Receive    Transmit
    Total octets    439703575    177452093
    Total packets  1866532    1642916
    Unicast packets 972137    1602563
    Broadcast packets 30    2980
```
Meaning  The sample output shows where the errors might be occurring and includes autonegotiation information. See Table 127 on page 1044 for a description of errors to look for.

Table 127: Errors to Look For

<table>
<thead>
<tr>
<th>Error</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policed discards</td>
<td>Discarded frames that were not recognized or were not of interest.</td>
</tr>
<tr>
<td>L2 channel errors</td>
<td>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.</td>
</tr>
<tr>
<td>MTU</td>
<td>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.</td>
</tr>
<tr>
<td>Input DA rejects</td>
<td>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.</td>
</tr>
</tbody>
</table>
Table 127: Errors to Look For (continued)

<table>
<thead>
<tr>
<th>Error</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input SA rejects</td>
<td>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.</td>
</tr>
</tbody>
</table>

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 1064 for an explanation of Fast Ethernet and Gigabit Ethernet alarms.

Table 128 on page 1045 lists and describes some MAC statistics errors to look for.

Table 128: MAC Statistics Errors

<table>
<thead>
<tr>
<th>Error</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRC/Align errors</td>
<td>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 (FCS Error) or a bad FCS with a non-integral number of octets (Alignment Error).</td>
</tr>
<tr>
<td>MAC control frames</td>
<td>The number of MAC control frames.</td>
</tr>
<tr>
<td>MAC pause frames</td>
<td>The number of MAC control frames with pause operational code.</td>
</tr>
<tr>
<td>Jabber frames</td>
<td>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. 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.</td>
</tr>
<tr>
<td>Fragment frames</td>
<td>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. 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.</td>
</tr>
</tbody>
</table>

Autonegotiation is the process that connected Ethernet interfaces use to communicate the information necessary to interoperate. Table 129 on page 1045 explains the autonegotiation information of the show interface interface-name extensive command output.

Table 129: Autonegotiation Information

<table>
<thead>
<tr>
<th>Autonegotiation Field Information</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negotiation status: Incomplete</td>
<td>The Negotiation status field shows Incomplete when the Ethernet interface has the speed or link mode configured.</td>
</tr>
<tr>
<td>Negotiation status: No autonegotiation</td>
<td>The Negotiation status field shows No autonegotiation when the remote Ethernet interface has the speed or link mode configured, or does not perform autonegotiation.</td>
</tr>
</tbody>
</table>
Table 129: Autonegotiation Information (continued)

<table>
<thead>
<tr>
<th>Autonegotiation Field Information</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negotiation status: Complete</td>
<td>The Negotiation status field shows Complete and the Link partner field shows OK when the Ethernet interface is connected to a device that performs autonegotiation and the autonegotiation process completes successfully.</td>
</tr>
<tr>
<td>Link partner status: OK</td>
<td>The Link partner field shows Full-duplex or Half-duplex depending on the capability of the attached Ethernet device.</td>
</tr>
<tr>
<td>Flow control: Symmetric/asymmetric</td>
<td>The Flow control field displays the types of flow control supported by the remote Ethernet device.</td>
</tr>
</tbody>
</table>

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:

```
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: Current Delta
Input bytes: 282556864218 (14208 bps) [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
Aged packets: 0
Active alarms: None
Active defects: None
Input MAC/Filter statistics:
  Unicast packets 464751787
  Packet error count 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 cliterminal` 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 1047 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 1047 for the optical specifications.

**Fiber-Optic Ethernet Interface Specifications**

*Table 130 on page 1047* shows the specifications for fiber-optic interfaces for Juniper Networks routers.

<table>
<thead>
<tr>
<th>Fiber-Optic Ethernet Interface</th>
<th>Length</th>
<th>Wavelength</th>
<th>Average Launch Power</th>
<th>Receiver Saturation</th>
<th>Receiver Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gigabit Ethernet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duplex SC connector</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 130: Fiber-Optic Ethernet Interface Specifications (continued)

<table>
<thead>
<tr>
<th>Fiber-Optic Ethernet Interface</th>
<th>Length</th>
<th>Wavelength</th>
<th>Average Launch Power</th>
<th>Receiver Saturation</th>
<th>Receiver Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>LH optical interface</td>
<td>49.5-mile 70-km reach on 8.2-micrometer SMF</td>
<td>1480 to 1580 nm</td>
<td>-3 to +2 dBm</td>
<td>-3 dBm</td>
<td>-23 dBm (BER 10^-12) for SMF</td>
</tr>
<tr>
<td>LX optical interface</td>
<td>6.2-mile 10-km reach on 9/125-micrometer SMF</td>
<td>1270 to 1355 nm</td>
<td>-11 to -3 dBm</td>
<td>-3 dBm</td>
<td>-19 dBm</td>
</tr>
<tr>
<td></td>
<td>1804.5-ft 550-m reach on 62.5/125- and 50/125-micrometer MMF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SX optical interface</td>
<td>656-ft 200-m reach on 62.5/125-micrometer MMF</td>
<td>830 to 860 nm</td>
<td>-9.5 to -4 dBm</td>
<td>-3 dBm</td>
<td>-17 dBm</td>
</tr>
<tr>
<td></td>
<td>1640-ft 500-m reach on 50/125-micrometer MMF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fast Ethernet 8-Port</td>
<td>FX optical interface with MT-RJ connector</td>
<td>1270 to 1380 nm</td>
<td>-20 to -14 dBm</td>
<td>-14 dBm</td>
<td>-34 dBm</td>
</tr>
<tr>
<td></td>
<td>1.24-mile 2-km reach on 62.5/125-micrometer MMF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

See Also
- Ethernet Interfaces Feature Guide for Routing Devices
- Understanding Fiber-Optic Cable Signal Loss, Attenuation, and Dispersion
- Calculating Power Budget and Power Margin for Fiber-Optic Cables

Performing Loopback Testing for Fast Ethernet and Gigabit Ethernet Interfaces

- Checklist for Using Loopback Testing for Fast Ethernet and Gigabit Ethernet Interfaces on page 1049
- Diagnose a Suspected Hardware Problem with a Fast Ethernet or Gigabit Ethernet Interface on page 1050
- Create a Loopback on page 1050
- Verify That the Fast Ethernet or Gigabit Ethernet Interface Is Up on page 1053
- Configure a Static Address Resolution Protocol Table Entry on page 1056
- Clear Fast Ethernet or Gigabit Ethernet Interface Statistics on page 1060
- Ping the Fast Ethernet or Gigabit Ethernet Interface on page 1060
- Check for Fast Ethernet or Gigabit Ethernet Interface Error Statistics on page 1061
- Diagnose a Suspected Circuit Problem on page 1063
**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 131 on page 1049 provides links and commands for using loopback testing for Fast Ethernet and Gigabit Ethernet interfaces.

**Table 131: Checklist for Using Loopback Testing for Fast Ethernet and Gigabit Ethernet Interfaces**

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Command or Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Diagnose a Suspected Hardware Problem with a Fast Ethernet or Gigabit Ethernet Interface” on page 1050</td>
<td></td>
</tr>
<tr>
<td>1. Create a Loopback on page 1050</td>
<td></td>
</tr>
<tr>
<td>a. Create a Physical Loopback for a Fiber-Optic Interface on page 1050</td>
<td>Connect the transmit port to the receive port.</td>
</tr>
<tr>
<td>b. Create a Loopback Plug for an RJ-45 Ethernet Interface on page 1051</td>
<td>Cross pin 1 (TX+) and pin 3 (RX+) together, and pin 2 (TX-) and pin 6 (RX-) together.</td>
</tr>
<tr>
<td>c. Configure a Local Loopback on page 1052</td>
<td>[edit interfaces interface-name (fastether-options</td>
</tr>
<tr>
<td>2. Verify That the Fast Ethernet or Gigabit Ethernet Interface Is Up on page 1053</td>
<td>show interfaces (fe-fpc/pic/port</td>
</tr>
<tr>
<td>3. Configure a Static Address Resolution Protocol Table Entry on page 1056</td>
<td>show interfaces ge-fpc/pic/port</td>
</tr>
<tr>
<td></td>
<td>[edit interfaces interface-name unit logical-unit-number family inet address address] set arp ip-address mac mac-address show commit run show arp no-resolve</td>
</tr>
<tr>
<td>4. Clear Fast Ethernet or Gigabit Ethernet Interface Statistics on page 1060</td>
<td>clear interfaces statistics fe-fpc/pic/port</td>
</tr>
<tr>
<td>5. Ping the Fast Ethernet or Gigabit Ethernet Interface on page 1060</td>
<td>ping remote-IP-address bypass-routing interface (fe-fpc/pic/port</td>
</tr>
<tr>
<td>6. Check for Fast Ethernet or Gigabit Ethernet Interface Error Statistics on page 1061</td>
<td>show interfaces (fe-fpc/pic/port</td>
</tr>
<tr>
<td>“Diagnose a Suspected Circuit Problem” on page 1063</td>
<td>Perform Steps 2 through 8 from “Diagnose a Suspected Hardware Problem with a Fast Ethernet or Gigabit Ethernet Interface” on page 1050.</td>
</tr>
</tbody>
</table>
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 1050
- Verify That the Fast Ethernet or Gigabit Ethernet Interface Is Up on page 1053
- Configure a Static Address Resolution Protocol Table Entry on page 1056
- Clear Fast Ethernet or Gigabit Ethernet Interface Statistics on page 1060
- Check for Fast Ethernet or Gigabit Ethernet Interface Error Statistics on page 1061

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 1050
2. Create a Loopback Plug for an RJ-45 Ethernet Interface on page 1051
3. Configure a Local Loopback on page 1052

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 58 on page 1051* illustrates how to create a loopback plug for an RJ-45 Ethernet interface.

*Figure 58: RJ-45 Ethernet Loopback Plug*

![RJ-45 Ethernet Loopback Plug](image)

**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.

**See Also**

- Configure a Local Loopback on page 1052
- Verify That the Fast Ethernet or Gigabit Ethernet Interface Is Up on page 1053
- Configure a Static Address Resolution Protocol Table Entry on page 1056
Configure a Local Loopback

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 | gigether-options)]` hierarchy level, places the interface into local loopback mode.

NOTE: Remember to delete the loopback statement after completing the test.

See Also • Create a Loopback Plug for an RJ-45 Ethernet Interface on page 1051
Verify That the Fast Ethernet or Gigabit Ethernet Interface Is Up on page 1053
Configure a Static Address Resolution Protocol Table Entry on page 1056

See Also
Verify That the Fast Ethernet or Gigabit Ethernet Interface Is Up on page 1053
Configure a Static Address Resolution Protocol Table Entry on page 1056
Clear Fast Ethernet or Gigabit Ethernet Interface Statistics on page 1060
Ping the Fast Ethernet or Gigabit Ethernet Interface on page 1060
Check for Fast Ethernet or Gigabit Ethernet Interface Error Statistics on page 1061

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
  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

<table>
<thead>
<tr>
<th>Queue counters</th>
<th>Queued packets</th>
<th>Transmitted packets</th>
<th>Dropped packets</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 best-effort</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1 expedited-fo</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2 assured-forw</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3 network-cont</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th></th>
<th>Receive</th>
<th>Transmit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total octets</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total packets</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Unicast packets</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Broadcast packets</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Multicast packets</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CRC/Align errors</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>FIFO errors</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MAC control frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MAC pause frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Oversized frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Jabber frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fragment frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>VLAN tagged frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Code violations</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Filter statistics:

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input packet count</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input packet rejects</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Input DA rejects</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Input SA rejects</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Output packet count</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Output packet pad count</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Output packet error count</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>CAM destination filters: 0, CAM source filters: 0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Direction</th>
<th>CoS transmit queue</th>
<th>Bandwidth</th>
<th>Buffer Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Limit</td>
<td>%</td>
<td>bps</td>
</tr>
<tr>
<td></td>
<td>0 best-effort</td>
<td>95</td>
<td>950000000</td>
</tr>
<tr>
<td></td>
<td>3 network-control</td>
<td>5</td>
<td>50000000</td>
</tr>
</tbody>
</table>

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 132 on page 1056 presents problem situations and actions for a physical link that is down.
Table 132: Problems and Solutions for a Physical Link That Is Down

<table>
<thead>
<tr>
<th>Problem</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable mismatch</td>
<td>Verify that the fiber connection is correct.</td>
</tr>
<tr>
<td>Damaged and/or dirty cable</td>
<td>Verify that the fiber can successfully loop a known good port of the same type.</td>
</tr>
<tr>
<td>Too much or too little optical attenuation</td>
<td>Verify that the attenuation is correct per the PIC optical specifications.</td>
</tr>
<tr>
<td>The transmit port is not transmitting within the dBm optical range per the specifications</td>
<td>Verify that the Tx power of the optics is within range of the PIC optical specification.</td>
</tr>
<tr>
<td>Mismatch between the cable type and the port</td>
<td>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.)</td>
</tr>
</tbody>
</table>

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
   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:

<table>
<thead>
<tr>
<th>Type</th>
<th>Input bytes</th>
<th>Output bytes</th>
<th>Input packets</th>
<th>Output packets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>125500</td>
<td>125482</td>
<td>1281</td>
<td>1281</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

IPv6 transit statistics:

<table>
<thead>
<tr>
<th>Type</th>
<th>Input bytes</th>
<th>Output bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Dropped traffic statistics due to STP State:

<table>
<thead>
<tr>
<th>Type</th>
<th>Input bytes</th>
<th>Output bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Queue number</th>
<th>Queued packets</th>
<th>Transmitted packets</th>
<th>Dropped packets</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 best-effort</td>
<td>1260</td>
<td>1260</td>
<td>0</td>
</tr>
<tr>
<td>1 expedited-fo</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2 assured-forw</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3 network-cont</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Queue number: Mapped forwarding classes

<table>
<thead>
<tr>
<th>Queue number</th>
<th>Mapped forwarding classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 best-effort</td>
<td></td>
</tr>
<tr>
<td>1 expedited-forwarding</td>
<td></td>
</tr>
<tr>
<td>2 assured-forwarding</td>
<td></td>
</tr>
<tr>
<td>3 network-control</td>
<td></td>
</tr>
</tbody>
</table>

Active alarms: None

Active defects: None

MAC statistics:

<table>
<thead>
<tr>
<th>Type</th>
<th>Receive</th>
<th>Transmit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total octets</td>
<td>130624</td>
<td>130624</td>
</tr>
<tr>
<td>Total packets</td>
<td>1281</td>
<td>1281</td>
</tr>
<tr>
<td>Unicast packets</td>
<td>1280</td>
<td>1280</td>
</tr>
<tr>
<td>Broadcast packets</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Multicast packets</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CRC/Align errors</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>FIFO errors</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MAC control frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MAC pause frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Oversized frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Jabber frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fragment frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>VLAN tagged frames</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
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 50000000 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 Ox4004000 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 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: Sendbcast-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
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
4 5 00 00054 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
4 5 00 00054 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
4 5 00 00054 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
4 5 00 00054 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
4 5 00 00054 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
4 5 00 00054 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:
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:2e:2e, Hardware address: 00:1f:12:fe:2e: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:

<table>
<thead>
<tr>
<th></th>
<th>Receive</th>
<th>Transmit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total octets</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total packets</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Unicast packets</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Broadcast packets</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Multicast packets</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CRC/Align errors</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>FIFO errors</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MAC control frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MAC pause frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Oversized frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Jabber frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fragment frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>VLAN tagged frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Code violations</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Filter statistics:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Input packet count</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Input packet rejects</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Input DA rejects</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Input SA rejects</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Output packet count</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Output packet pad count</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Output packet error count</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>CAM destination filters</td>
<td>0, CAM source filters: 0</td>
<td></td>
</tr>
</tbody>
</table>

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   | Priority
  0 best-effort    | 95       | 950000000 | 95       | 0      | low    |
  3 network-control | 5       | 500000000 | 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 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 1050. 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 1064
- Display the Fast Ethernet or Gigabit Ethernet Interface LINK Alarm on page 1064
- Fast Ethernet and Gigabit Ethernet Counters on page 1066

**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 133 on page 1064 provides links and commands for locating LINK alarm and major counters for Fast Ethernet and Gigabit Ethernet interfaces.

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Command or Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Display the Fast Ethernet or Gigabit Ethernet Interface LINK Alarm” on page 1064</td>
<td>show interfaces (fe-fpc/pic/port</td>
</tr>
<tr>
<td>“Fast Ethernet and Gigabit Ethernet Counters” on page 1066</td>
<td></td>
</tr>
</tbody>
</table>

**See Also**

- *Ethernet Interfaces Feature Guide for Routing Devices*

**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:

```
user@host> show interfaces (fe-fpc/pic/port | ge-fpc/pic/port) extensive
```
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:            Receive            Transmit
  Total octets          439703575     177452093
  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            0
  Jabber frames           0            0
  Fragment frames         0            0
  VLAN tagged frames      0            0
  Code violations         0            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
```
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 1049 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. |

See Also

- Checklist for Locating Fast Ethernet and Gigabit Ethernet Alarms and Counters on page 1064
- Fast Ethernet and Gigabit Ethernet Counters on page 1066
- Ethernet Interfaces Feature Guide for Routing Devices

Fast Ethernet and Gigabit Ethernet Counters

| Problem | Description: Table 134 on page 1066 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. |

<p>| Table 134: Major Fast Ethernet and Gigabit Ethernet Counters |
|---|---|---|
| Counter | Description | Reason for Increment |
| Input Errors: | | |
| Errors | The sum of the incoming frame aborts and frame check sequence (FCS) errors. | |</p>
<table>
<thead>
<tr>
<th>Counter</th>
<th>Description</th>
<th>Reason for Increment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policed discard</td>
<td>The frames discarded by the incoming packet match code.</td>
<td>The frames were discarded because they were not recognized or of interest. Usually, this field reports protocols that the Junos OS does not handle.</td>
</tr>
<tr>
<td>Drops</td>
<td>The number of packets dropped by the output queue of the I/O Manager application-specific integrated circuit (ASIC).</td>
<td>If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's random early detection (RED) mechanism.</td>
</tr>
<tr>
<td>L3 incompletes</td>
<td>The number of packets discarded due to the packets failing Layer 3 header checks.</td>
<td>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.</td>
</tr>
<tr>
<td>L2 channel errors</td>
<td>The errors that occur when the software could not find a valid logical interface (such as fe-1/2/3.0) for an incoming frame.</td>
<td>This error increments when, for example, a lookup for a virtual LAN (VLAN) fails.</td>
</tr>
<tr>
<td>L2 mismatch timeouts</td>
<td>The count of malformed or short packets.</td>
<td>The malformed or short packets cause the incoming packet handler to discard the frame and be unreadable.</td>
</tr>
<tr>
<td>FIFO errors</td>
<td>The number of first in, first out (FIFO) errors in the receive direction as reported by the ASIC on the Physical Interface Card (PIC).</td>
<td>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.</td>
</tr>
</tbody>
</table>

**Output Errors**

<table>
<thead>
<tr>
<th>Errors</th>
<th>The sum of outgoing frame aborts and FCS errors.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Collisions</td>
<td>The number of Ethernet collisions.</td>
<td>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.</td>
</tr>
<tr>
<td>Drops</td>
<td>The number of packets dropped by the output queue of the I/O Manager ASIC.</td>
<td>If the interface is saturated, this number increments once for every packet that is dropped by the ASIC's RED mechanism.</td>
</tr>
<tr>
<td>Aged packets</td>
<td>The number of packets that remained in shared packet SDRAM for so long that the system automatically purged them.</td>
<td>The value in this field should never increment. If it increments, it is probably a software bug or broken hardware.</td>
</tr>
<tr>
<td>HS link FCS errors, FIFO errors</td>
<td>The number of errors on the high-speed links between the ASICs responsible for handling the router interfaces.</td>
<td>The value in this field should always be 0. If it increments, either the FPC or the PIC is broken.</td>
</tr>
</tbody>
</table>
### Table 134: Major Fast Ethernet and Gigabit Ethernet Counters (continued)

<table>
<thead>
<tr>
<th>Counter</th>
<th>Description</th>
<th>Reason for Increment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Miscellaneous Counters</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Input DA rejects</strong></td>
<td>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.</td>
<td>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).</td>
</tr>
<tr>
<td><strong>Output packet pad count</strong></td>
<td>The number of packets that the filter padded to the minimum Ethernet size (60 bytes) before giving the packet to the MAC hardware.</td>
<td>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.</td>
</tr>
<tr>
<td><strong>Output packet error count</strong></td>
<td>Number of packets with an indicated error that the filter was given to transmit.</td>
<td>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.</td>
</tr>
<tr>
<td><strong>CAM destination filters, CAM source filters</strong></td>
<td>The number of entries in the content-addressable memory (CAM) dedicated to destination and source MAC address filters.</td>
<td>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.</td>
</tr>
</tbody>
</table>

### See Also
- Checklist for Locating Fast Ethernet and Gigabit Ethernet Alarms and Counters on page 1064
- Ethernet Interfaces Feature Guide for Routing Devices
- Understanding Interfaces on ACX Series Universal Metro Routers
- ACX2000 and ACX2100 Routers Hardware and CLI Terminology Mapping

### 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 “To resolve the issue” on page 1069 section for recovery options.

1. 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
- DPCs Supported on MX240, MX480, and MX960 Routers
- T1600 PICs Supported
PART 5

Configuration Statements and Operational Commands

- Configuration Statements (OTN) on page 1073
- Configuration Statements (OAM-CFM) on page 1129
- Configuration Statements on page 1195
- Operational Commands on page 1629
Configuration Statements (OTN)

- alarm (optics-options) on page 1074
- backward-frr-enable on page 1075
- ber-threshold-clear on page 1077
- ber-threshold-signal-degrade on page 1080
- bypass on page 1083
- bytes (otn-options) on page 1084
- fec on page 1085
- fixed-stuff-bytes on page 1087
- high-polarization on page 1088
- interval on page 1089
- is-ma on page 1091
- laser-enable on page 1092
- line-loopback on page 1093
- local-loopback on page 1094
- monitor-end-point on page 1095
- no-odu-backward-frr-enable on page 1096
- no-odu-signal-degrade-monitor-enable on page 1097
- number-of-frames on page 1098
- oc192 on page 1098
- odu-delay-management on page 1099
- odu-backward-frr-enable on page 1100
- odu-signal-degrade on page 1101
- odu-signal-degrade-monitor-enable on page 1102
- odu-ttim-action-enable on page 1103
- otu-ttim-action-enable on page 1104
- otu4 on page 1105
- pass-through on page 1106
- prbs on page 1107
alarm (optics-options)

Syntax

```
alarm low-light—alarm {
    (link-down | syslog);
}
```

Hierarchy Level

[edit interfaces interface-name optics-options]

Release Information

Statement introduced in Junos OS Release 10.0.
Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 18.3R1 for PTX10K-LC1104 on the PTX10008 and PTX10016 routers.

Description

Specify the action to take if the receiving opticssignal is below the optics low-light alarm threshold.

Options

- link-down—Drop the 10-Gigabit Ethernet link and marks link as down.
- syslog—Write the optics information to the system log.

Required Privilege Level

interface—to view this statement in the configuration.
interface-control—to add this statement to the configuration.

Related Documentation

- Configuring 10-Gigabit Ethernet Link Down Notification for Optics Options Alarm or Warning on page 450
- 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
**backward-frr-enable**

**Syntax**

(backward-frr-enable | no-backward-frr-enable);

**Hierarchy Level**

[edit interfaces interface-name otn-options preemptive-fast-reroute]

**Release Information**

Statement introduced in Junos OS Release 13.2 for PTX Series routers.

**Description**

Enable or disable backward fast reroute status insertion.

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 `signal-degrade-monitor-enable` statement, notification of signal degradation and rerouting of traffic occurs in less time than that required through a Layer 3 protocol.

**NOTE:** When you configure pre-FEC BER signal degrade monitoring, we recommend that you configure both the `signal-degrade-monitor-enable` and `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. Include the `ber-threshold-signal-degrade value`, `ber-threshold-clear value`, and `interval value` statements at the [edit interfaces interface-name otn-options signal-degrade] hierarchy level to configure the BER thresholds and time interval. See “Understanding Pre-FEC BER Monitoring and BER Thresholds” on page 582 for more information about pre-FEC BER monitoring and determining BER threshold settings.

**Default**

By default, backward fast reroute insertion is disabled.

**Options**

- `backward-frr-enable`—Enable backward fast reroute status insertion.
- `no-backward-frr-enable`—Do not enable backward fast reroute status insertion.

**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 582
- 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
• Configuring 100-Gigabit DWDM OTN PICs on page 588
ber-threshold-clear

Syntax
ber-threshold-clear value;

Hierarchy Level
[edit interfaces interface-name otn-options signal-degrade]
[edit interfaces interface-name otn-options odu-signal-degrade]

Release Information
Statement introduced in Junos OS Release 13.2 for PTX Series routers.
Statement introduced in Junos OS Release 15.1F6 for MPC5E, MIC6-100G-CFP2 on MPC6E
on MX240, MX480, MX960, MX2010, and MX2020 routers.

Description
Specify bit error rate (BER) threshold to clear the interface alarm for signal degradation.

You can configure the BER clear threshold to customize the BER that will clear 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 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.

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 582 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 135 on page 1078 shows the default values for pre-FEC BER and ODU BER signal
degradede threshold values for different PICs. If the BER signal degrade threshold is not
configured, the default value is used.
Table 135: Default Clear Threshold Values

<table>
<thead>
<tr>
<th>PIC or MPC</th>
<th>Default Pre-FEC BER Clear Threshold Value</th>
<th>Default ODU BER Clear Threshold Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1-PTX-2-100G-WDM</td>
<td>3.0E−3</td>
<td>Not supported</td>
</tr>
<tr>
<td>P2-100GE-OTN</td>
<td>3.0E−3</td>
<td>1.0E−9</td>
</tr>
<tr>
<td>P1-PTX-24-10G-W-SFPP</td>
<td>3.0E−3</td>
<td>Not supported</td>
</tr>
<tr>
<td>MIC6-100G-CFP2</td>
<td>1.0E−6</td>
<td>1.0E−9</td>
</tr>
<tr>
<td>MPC5E</td>
<td>1.0E−6</td>
<td>1.0E−9</td>
</tr>
</tbody>
</table>

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 xE-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 135 on page 1078 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 582.

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 1.0E–n where n > 0, and the valid range of n is from 1 through 10.

Required Privilege Level

Related Documentation

• Understanding Pre-FEC BER Monitoring and BER Thresholds on page 582
• 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
• Configuring 100-Gigabit DWDM OTN PICs on page 588
### ber-threshold-signal-degrade

**Syntax**

```
ber-threshold-signal-degrade value;
```

**Hierarchy Level**

```
[edit interfaces interface-name otn-options signal-degrade]
[edit interfaces interface-name otn-options odu-signal-degrade]
```

**Release Information**

Statement introduced in Junos OS Release 13.2 for PTX Series routers.
Statement introduced in Junos OS Release 15.1F6 for MPC5E, MIC6-100G-CFP2 on MPC6E on MX240, MX480, MX960, MX2010, and MX2020 routers.

**Description**

Specify the bit error rate (BER) threshold to raise an interface alarm for signal degradation.

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 582 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 136 on page 1081 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 136: Default Signal Degrade Threshold Values

<table>
<thead>
<tr>
<th>PIC or MPC</th>
<th>Default Pre-FEC BER Signal Degrade Threshold Value</th>
<th>Default ODU BER Signal Degrade Threshold Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1-PTX-2-100G-WDM</td>
<td>7.5E−3</td>
<td>Not supported</td>
</tr>
<tr>
<td>P2-100GE-OTN</td>
<td>7.5E−3</td>
<td>1.0E−6</td>
</tr>
<tr>
<td>P1-PTX-24-10G-W-SFPP</td>
<td>7.5E−3</td>
<td>Not supported</td>
</tr>
<tr>
<td>MIC6-100G-CFP2</td>
<td>1.14E−5</td>
<td>1.0E−6</td>
</tr>
<tr>
<td>MPC5E</td>
<td>1.14E−5</td>
<td>1.0E−6</td>
</tr>
</tbody>
</table>

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 \(x E^n\), 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 136 on page 1081.

---

**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 \(1.0E-n\) 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 582.

---

**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 582
- 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
- Configuring 100-Gigabit DWDM OTN PICs on page 588
### bypass

**Syntax**

(bypass | no-bypass);

**Hierarchy Level**

[edit interfaces interface-name otn-options odu-delay-management ]

**Release Information**

Statement introduced in Junos OS Release 13.2 for PTX Series routers.

**Description**

Pass or do not pass the delay measurement (DM) value through a node.

**Default**

If you omit the bypass statement, the default behavior is to disable ODU delay management options.

By default, do not pass the DM value through a node.

**Options**

- **bypass**—Pass the DM value through a node.
- **no-bypass**—Do not pass the DM value through a node.

**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 574
- Configuring 100-Gigabit DWDM OTN PICs on page 588
### bytes (otn-options)

<table>
<thead>
<tr>
<th><strong>Syntax</strong></th>
<th>bytes transmit-payload-type value;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hierarchy Level</strong></td>
<td>[edit interfaces interface-name otn-options]</td>
</tr>
<tr>
<td><strong>Release Information</strong></td>
<td>Statement introduced in Junos OS Release 13.2 for PTX Series routers. Statement introduced in Junos OS Release 18.3R1 for PTX10K-LC1104 on the PTX10008 and PTX10016 routers.</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Specify the transmit payload type on OTN header bytes.</td>
</tr>
</tbody>
</table>
| **Options** | value—Transmit payload type.  
  Range:  0 through 255 bytes |
| **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 574  
  Configuring 100-Gigabit DWDM OTN PICs on page 588 |
### fec

**Syntax (M Series, MX Series, PTX Series)**

```
fec (efec | gfec | gfec-sdfec | hgfec | sd-fec | ufec | none);
```

**Syntax (ACX6360)**

```
fec ( sdfec | sdfec15 | none);
```

**Hierarchy Level (M Series, MX Series, PTX Series)**

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

**Hierarchy Level (ACX6360)**

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

**Release Information**

Statement introduced in Junos OS Release 9.4. Statement and **gfec-sdfec** option introduced in Junos OS Release 13.2 for PTX Series routers, with P1-PTX-2-100G-WDM PIC.


Options **efec**, **gfec**, and **ufec** introduced in Junos OS Release 14.1 for PTX Series routers, with P1-PTX-24-10G-W-SFPP.

Option **hgfec** introduced in Junos OS Release 15.1F5 for MX Series Routers with MIC3-100G-DWDM MIC.

Option **sdfec** introduced in Junos OS Release 15.1F5 for MX Series Routers with MIC3-100G-DWDM MIC.

Option **sdfec** introduced in Junos OS Release 15.1F6 for PTX Series Routers with PTX-5-100G-WDM PIC.

Statement introduced in Junos OS Release 18.3R1 for PTX10K-LC1104 on the PTX10008 and PTX10016 routers.

Statement introduced in Junos OS Release 18.3R1 for ACX6360 routers.

**Description**

Enable forward error correction (FEC) mode.

**Default**

If you do not specify a mode, the default mode is **gfec**. On PTX Series routers with P1-PTX-2-100G-WDM, the default value is **gfec-sdfec**. On PTX Series routers with PTX-5-100G-WDM and on MX Series routers with MIC3-100G-DWDM, the default value is **sdfec**.

**Options**

- **efec**—(M Series, MX Series routers and PTX Series routers only) G.975.1.I.4 enhanced forward error correction (EFEC) is configured to detect and correct bit errors. This mode is supported only on 10G ports and not supported on the 40G and 100G ports.

- **gfec**—(M series, MX Series routers and PTX Series routers only) G.709 generic forward error correction (GFEC) mode is configured to detect and correct bit errors.
gfec-sdfec—(PTX Series routers only) GFEC and soft-decision forward error correction (SD-FEC) modes are configured to detect and correct bit errors.

hgfec—(MX Series routers only) High gain forward error correction mode is configured to detect and correct bit errors.

sdfec—(MX Series routers, PTX Series routers, and ACX6360 routers only) Sky-Compatible Soft-decision forward error correction mode is configured to detect and correct bit errors.

sdfec15—(ACX6360 routers only) Soft Decision Forward Error Correction with 15 percent overhead is configured to detect and correct bit errors.

none—(M Series and MX Series routers only) FEC mode is not configured.

---

**NOTE:** On MX Series routers with MIC3-100G-DWDM and PTX Series routers with PTX-5-100G-WDM, none option is not supported. The fec mode must be enabled on the MIC3-100G-DWDM MIC and the PTX-5-100G-WDM PIC.

ufec—(MX Series routers and PTX Series routers only) G.975.1I.7 Ultra Forward Error Correction (UFEC) mode is configured to detect and correct bit errors. This mode is supported only on 10G ports and not supported on the 40G and 100G ports.

---

**Required Privilege**

**Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- 10-Gigabit Ethernet OTN Options Configuration Overview on page 563
- 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
- Configuring 100-Gigabit DWDM OTN PICs on page 588
- Supported Forward Error Correction Modes on MX Series Routers on page 586
- Supported Forward Error Correction Modes on PTX Series Routers on page 587
- Understanding Pre-FEC BER Monitoring and BER Thresholds on page 582
- Supported Forward Error Correction Modes on ACX6360 Router on page 587
**fixed-stuff-bytes**

**Syntax**

(fixed-stuff-bytes | no-fixed-stuff-bytes);

**Hierarchy Level**

[edit interfaces interface-name otn-options rate]

**Release Information**
Statement introduced in Junos OS Release 9.4.

**Description**
Enable or disable fixed stuff bytes.

**Default**
By default, no fixed stuff bytes are set.

**Options**
- **fixed-stuff-bytes**—Fixed stuff bytes 11.0957 Gbps.
- **no-fixed-stuff-bytes**—No fixed stuff bytes 11.0491 Gbps.

**Required Privilege Level**
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**
- 10-Gigabit Ethernet OTN Options Configuration Overview on page 563
- 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
- Configuring 100-Gigabit DWDM OTN PICs on page 588
**high-polarization**

**Syntax**

```
high-polarization;
```

**Hierarchy Level**

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

**Release Information**

Statement introduced in Junos OS Release 18.2R1 for ACX6360 routers.

**Description**

Enable the physical port to rapidly track the state of polarization changes. Enabling this statement reduces the optical signal to noise ratio (OSNR) by few tenths of dB.

**Default**

By default, the `high-polarization` statement is disabled.

**Required Privilege Level**

- system—To view this statement in the configuration.
- system-control—To add this statement to the configuration.

**Related Documentation**

- Supported Optics Options on ACX6360 Routers on page 579
interval

Syntax  
interval value;

Hierarchy Level  
[edit interfaces interface-name otn-options signal-degrade]
[edit interfaces interface-name otn-options odu-signal-degrade]

Release Information  
Statement introduced in Junos OS Release 13.2 for PTX Series routers.
Statement introduced in Junos OS Release 15.1F6 for MPC5E, MIC6-100G-CFP2 on MPC6E on MX240, MX480, MX960, MX2010, and MX2020 routers.

Description  
Specify the interval for which the BER must stay above the signal degradation threshold—as configured in the ber-threshold-signal-degrade value statement—for the alarm to raised. After an alarm is raised, if the BER returns below the clear threshold—as configured in the ber-threshold-clear value 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 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.

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 582 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.

For the P2-10G-40G-QSFPP PIC, the time interval is supported in multiples of 100 ms. For example, when you configure the interval as 10 ms, then it is rounded off to the nearest multiple of 100 ms.

Range: 1 ms through 1000 ms.
Default: 100 ms.

NOTE: For the P2-100GE-OTN PIC, the default value is 10 ms.

Related Documentation
- 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
- Configuring 100-Gigabit DWDM OTN PICs on page 588
is-ma

Syntax  (is-ma | no-is-ma);

Hierarchy Level  [edit interfaces interface-name otn-options]

Release Information  Statement introduced in Junos OS Release 13.2 for PTX Series routers.

Description  Specify whether masked alarms are enabled or disabled.

Default  If you omit the is-ma statement, masked alarms are disabled.

Options  is-ma—Enable masked alarms.

no-is-ma—Do not enable masked alarms.

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 574

• Configuring 100-Gigabit DWDM OTN PICs on page 588
# laser-enable

| Syntax         | (laser-enable | no-laser-enable); |
|----------------|----------------|
| Hierarchy Level| [edit interfaces interface-name otn-options] |

**Release Information**  
Statement introduced in Junos OS Release 9.4.  
Statement introduced in Junos OS Release 13.2 for PTX Series routers.  
Statement introduced in Junos OS Release 18.3R1 for PTX10K-LC1104 on the PTX10008 and PTX10016 routers.

**Description**  
Specify whether lasers are enabled or disabled.

**Default**  
If you omit the laser-enable statement, lasers are disabled.

**Options**  
- **laser-enable**—Enable lasers.  
- **no-laser-enable**—Do not enable lasers.

**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 574](#)  
- [Configuring 100-Gigabit DWDM OTN PICs on page 588](#)
line-loopback

Syntax  (line-loopback-enable | no-line-loopback);

Hierarchy Level  [edit interfaces interface-name otn-options]

Statement introduced in Junos OS Release 13.2 for PTX Series routers.
Statement introduced in Junos OS Release 18.3R1 for PTX10K-LC1104 on the PTX10008
and PTX10016 routers.

Description  Specify whether line-loopback is enabled or disabled.

Default  If you omit the line-loopback-enable statement, line-loopback is disabled.

Options  line-loopback-enable—Enable line-loopback.

no-line-loopback—Disable line-loopback.

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 574
• Configuring 100-Gigabit DWDM OTN PICs on page 588
**local-loopback**

**Syntax**  
(local-loopback-enable | no-local-loopback);

**Hierarchy Level**  
[edit interfaces interface-name otn-options]

**Release Information**  
Statement introduced in Junos OS Release 13.2 for PTX Series routers.

**Description**  
Specify whether local-loopback is enabled or disabled.

**Default**  
If you omit the local-loopback-enable statement, local-loopback is disabled.

**Options**  
- **local-loopback-enable**—Enable local-loopback.
- **no-local-loopback**—Disable local-loopback.

**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 574](#)
- [Configuring 100-Gigabit DWDM OTN PICs on page 588](#)
**monitor-end-point**

**Syntax**

```
(monitor-end-point | no-monitor-end-point);
```

**Hierarchy Level**

```
[edit interfaces interface-name otn-options odu-delay-management]
```

**Release Information**

Statement introduced in Junos OS Release 13.2 for PTX Series routers.

**Description**

Originate or do not originate the connection monitor end point.

**Default**

By default, do not originate the connection monitor end point.

**Options**

- `monitor-end-point`—Originate the connection monitor end point.
- `no-monitor-end-point`—Do not originate the connection monitor end point.

**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 574
- Configuring 100-Gigabit DWDM OTN PICs on page 588
no-odu-backward-frr-enable

Syntax

no-odu-backward-frr-enable;

Hierarchy Level

[edit interfaces interface-name otn-options preemptive-fast-reroute]

Release Information

Statement introduced in Junos OS Release 14.1R2 for P2-100GE-OTN PIC in PTX5000 routers.
Statement introduced in Junos OS Release 14.2 for P2-100GE-OTN PIC in PTX5000 routers.
Statement introduced in Junos OS Release 15.1F6 for MPC5E, MIC6-100G-CFP2 on MPC6E on MX240, MX480, MX960, MX2010, and MX2020 routers.

Description

Disable preemptive fast reroute (FRR) ODU backward FRR insertion.

Default

By default, FRR ODU backward FRR insertion is disabled.

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 574
• Configuring 100-Gigabit DWDM OTN PICs on page 588
no-odu-signal-degrade-monitor-enable

**Syntax**

```
no-odu-signal-degrade-monitor-enable;
```

**Hierarchy Level**

```
[edit interfaces interface-name otn-options preemptive-fast-reroute]
```

**Release Information**

Statement introduced in Junos OS Release 14.1R2 for P2-100GE-OTN PIC in PTX5000 routers.
Statement introduced in Junos OS Release 14.2 for P2-100GE-OTN PIC in PTX5000 routers.
Statement introduced in Junos OS Release 15.1F6 for MPC5E, MIC6-100G-CFP2 on MPC6E on MX240, MX480, MX960, MX2010, and MX2020 routers.

**Description**

Disable monitoring of signal degradation of ODU BER in the received OTN frames.

**Default**

By default, FRR signal degrade monitoring disabled.

**Required Privilege**

- `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 574
- Configuring 100-Gigabit DWDM OTN PICs on page 588
**number-of-frames**

**Syntax**

```
number-of-frames value;
```

**Hierarchy Level**

```
[edit interfaces interface-name otn-options odu-delay-management]
```

**Release Information**

Statement introduced in Junos OS Release 13.2 for PTX Series routers.

**Description**

Specify the number of consequent frames to declare a delay measurement (DM) session completed.

**Options**

`value`—Number of consequent frames to declare DM completed.

**Range:** 0 through 255 frames.

**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 574
- Configuring 100-Gigabit DWDM OTN PICs on page 588

**oc192**

**Syntax**

```
oc192;
```

**Hierarchy Level**

```
[edit interfaces interface-name otn-options rate]
```

**Release Information**

Statement introduced in Junos OS Release 13.3 for MX Series routers.

**Description**

Set the line rate or speed of the OTN signal to optical channel transport unit 2 (OTU2).

**Options**

`oc192`—OTU2 line rate or 10 Gbps

**Required Privilege Level**

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**

- 10-Gigabit Ethernet OTN Options Configuration Overview on page 563
- Configuring 100-Gigabit DWDM OTN PICs on page 588
**odu-delay-management**

**Syntax**

```plaintext
odu-delay-management {
  (bypass | no-bypass);
  (monitor-end-point | no-monitor-end-point);
  number-of-frames value;
  (no-start-measurement | start-measurement;
}
```

**Hierarchy Level**

```plaintext
[edit interfaces interface-name otn-options]
```

**Release Information**

Statement introduced in Junos OS Release 13.2 for PTX Series routers.
Statement introduced in Junos OS Release 18.3R1 for PTX10K-LC1104 on the PTX10008 and PTX10016 routers.

**Description**

Specify Optical Channel Data Unit (ODU) delay management options.

**Default**

If you omit the `odu-delay-management` statement, the ODU delay management options are disabled.

**Options**

The remaining statements are explained separately. See CLI Explorer.

**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 574
- Configuring 100-Gigabit DWDM OTN PICs on page 588
### odu-backward-frr-enable

<table>
<thead>
<tr>
<th>Syntax</th>
<th>odu-backward-frr-enable;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchy Level</td>
<td>[edit interfaces interface-name otn-options preemptive-fast-reroute]</td>
</tr>
</tbody>
</table>
| Release Information | Statement introduced in Junos OS Release 14.1R2 for P2-100GE-OTN PIC in PTX5000 routers.  
Statement introduced in Junos OS Release 14.2 for P2-100GE-OTN PIC in PTX5000 routers.  
Statement introduced in Junos OS Release 15.1F6 for MPC5E, MIC6-100G-CFP2 on MPC6E on MX240, MX480, MX960, MX2010, and MX2020 routers. |
| Description | Insert the ODU status into the transmitted OTN frames and monitor the received OTN frames for the ODU BER status. |
| Default | By default, FRR ODU backward FRR insertion is disabled. |
| 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 574  
• Configuring 100-Gigabit DWDM OTN PICs on page 588 |


**odu-signal-degrade**

**Syntax**

odu-signal-degrade {
  ber-threshold-clear;
  ber-threshold-signal-degrade;
  interval
}

**Hierarchy Level**

[edit interfaces interface-name otn-options]

**Release Information**

Statement introduced in Junos OS Release 14.1R2 for P2-100GE-OTNPIC in PTX5000 routers.
Statement introduced in Junos OS Release 14.2 for P2-100GE-OTNPIC in PTX5000 routers.
Statement introduced in Junos OS Release 15.1F6 for MPC5E, MIC6-100G-CFP2 on MPC6E on MX240, MX480, MX960, MX2010, and MX2020 routers.
Statement introduced in Junos OS Release 18.3R1 for PTX10K-LC1104 on the PTX10008 and PTX10016 routers.

**Description**

Specify optical channel data unit (ODU) signal degradation threshold-related values.

**Default**

If you omit the **odu-signal-degrade** statement, the default threshold values are used.

The following are the default threshold values for optical channel data unit (ODU) signal degradation for the P2-100GE-OTNPIC:

- ber-threshold-clear—1E-09
- ber-threshold-signal-degrade—1E-06
- interval—10 ms

The following are the default threshold values for optical channel data unit (ODU) signal degradation for the MPC5E and the MIC6-100G-CFP2 MIC:

- ber-threshold-clear—1.14E-5
- ber-threshold-signal-degrade—1.0E-6
- interval—10 ms

**Options**

The remaining statements are explained separately. See CLI Explorer.

**Required Privilege Level**

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.
odu-signal-degrade-monitor-enable

Syntax  
odu-signal-degrade-monitor-enable;

Hierarchy Level  
[edit interfaces interface-name otn-options preemptive-fast-reroute]

Release Information  
Statement introduced in Junos OS Release 14.1R2 for P2-100GE-OTN PIC in PTX5000 routers.
Statement introduced in Junos OS Release 14.2 for P2-100GE-OTN PIC in PTX5000 routers.
Statement introduced in Junos OS Release 15.1F6 for MPC5E, MIC6-100G-CFP2 on MPC6E on MX240, MX480, MX960, MX2010, and MX2020 routers.

Description  
Enable monitoring of signal degradation of ODU BER in the received OTN frames.

Default  
By default, FRR signal degrade monitoring disabled.

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 574  
• Configuring 100-Gigabit DWDM OTN PICs on page 588
**odu-ttim-action-enable**

**Syntax**

(odu-ttim-action-enable | no-odu-ttim-action-enable);

**Hierarchy Level**

[edit interfaces interface-name otn-options]

**Release Information**

Statement introduced in Junos OS Release 13.2 for PTX Series routers.

**Description**

Specify whether consequent action for Optical Channel Data Unit (ODU) TTIM is enabled or disabled.

**Default**

If you omit the odu-ttim-action-enable statement, consequent action for ODU TTIM is disabled.

**Options**

- **odu-ttim-action-enable**—Enable consequent action for ODU TTIM.
- **no-odu-ttim-action-enable**—Disable consequent action for ODU TTIM.

**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 574
- Configuring 100-Gigabit DWDM OTN PICs on page 588
### otu-ttim-action-enable

| Syntax          | (otu-ttim-action-enable | no-otu-ttim-action-enable); |
|-----------------|--------------------------|
| Hierarchy Level | [edit interfaces interface-name otn-options] |
| Release Information | Statement introduced in Junos OS Release 13.2 for PTX Series routers. |
| Description     | Specify whether consequent action for Optical Channel Transport Unit (OTU) TTIM is enabled or disabled. |
| Default         | If you omit the otu-ttim-action-enable statement, consequent action for OTU TTIM is disabled. |
| Options         | otu-ttim-action-enable—Enable consequent action for OTU TTIM. |
|                 | no-otu-ttim-action-enable—Disable consequent action for OTU TTIM. |
| 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 574 |
|                 | • Configuring 100-Gigabit DWDM OTN PIGs on page 588 |
### otu4

**Syntax**

```
ottu4;
```

**Hierarchy Level**

```
[edit interfaces interface-name otn-options rate]
```

**Release Information**

Statement introduced in Junos OS Release 13.2 for PTX Series routers.
Statement introduced in Junos OS Release 13.3 for MX Series routers.

**Description**

Sets the line rate or speed of the OTN signal to optical channel transport unit 4 (OTU4).

**Default**

By default, the rate is OTU4 on PTX Series routers.

**Options**

- `ottu4`—OTU4 line rate or 100 Gbps

**Required Privilege**

- `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 574
- Configuring 100-Gigabit DWDM OTN PICs on page 588
**pass-through**

| Syntax          | (pass-through | no-pass-through); |
|-----------------|-----------------|
| Hierarchy Level | [edit interfaces interface-name otn-options rate] |
| Description     | Enable or disable OTN pass-through mode. |
| Default         | By default, OTN pass-through mode is disabled. |
| Options         | no-pass-through—Do not enable OTN pass-through mode. |
|                 | pass-through—Enable OTN pass-through mode. |
| 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 574 |
|                 | Configuring 100-Gigabit DWDM OTN PICs on page 588 |
**prbs**

| Syntax | (prbs | no-prbs); |
| --- | --- |
| **Hierarchy Level** | [edit interfaces interface-name otn-options] |
| **Release Information** | Statement introduced in Junos OS Release 13.2 for PTX Series routers. Statement introduced in Junos OS Release 18.3R1 for PTX10K-LC1104 on the PTX10008 and PTX10016 routers. |
| **Description** | Specify whether OTN payload Pseudo-Random Binary Sequence (PBRS) is enabled or disabled. |
| **Default** | By default, OTN payload prbs is disabled. |
| **Options** | **prbs**—Enable OTN payload PBRS.  
**no-prbs**—Disable OTN payload PBRS. |
| **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 574  
• Configuring 100-Gigabit DWDM OTN PICs on page 588 |
preemptive-fast-reroute

Syntax

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);
}

Hierarchy Level

[edit interfaces interface-name otn-options]

Release Information

Statement introduced in Junos OS Release 13.2 for PTX Series routers.
Statement introduced in Junos OS Release 13.3 for MX Series routers.
Statement introduced in Junos OS Release 18.3R1 for PTX10K-LC1104 on the PTX10008 and PTX10016 routers.

Description

Enable or disable preemptive fast reroute options.

Default

By default, backward fast reroute insertion and signal degradation monitoring are disabled.

Options

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- 10-Gigabit Ethernet OTN Options Configuration Overview on page 563
- 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
- Configuring 100-Gigabit DWDM OTN PICs on page 588
rate

Syntax

rate {
    (fixed-stuff-bytes | no-fixed-stuff-bytes);
    otu4; oc192;
    (pass-through | no-pass-through);
}

Hierarchy Level

[edit interfaces interface-name otn-options]

Release Information


Description

Specify the line rate or speed of the OTN signals.

Options

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.

Related Documentation

- 10-Gigabit Ethernet OTN Options Configuration Overview on page 563
- 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
- Configuring 100-Gigabit DWDM OTN PICs on page 588
remote-loop-enable

Syntax  
(remote-loop-enable | no-remote-loop-enable);

Hierarchy Level  
[edit interfaces interface-name otn-options odu-delay-management]

Release Information  
Statement introduced in Junos OS Release 17.1 for 100-Gigabit OTN DWDM PIC with CFP2 on PTX3000 and PTX5000 routers. Statement introduced in Junos OS Release 17.1 for 100-Gigabit OTN DWDM MIC with CFP2-ACO on MX240, MX480, MX960, MX2010, and MX2020 routers with MPC3E and MPC3E-NG.

Description  
Enable the remote interface to loop back the delay measurement pattern to the local interface. Delay is measured by transmitting a known pattern (delay measurement pattern) in a selected bit of the delay measurement (DM) field and measuring the number of frames that are missed when the delay measurement pattern is received at the transmitting end (local interface).

NOTE: Do not enable remote loopback on both ends (local and remote). If you enable remote loopback on both interfaces, the delay measurement pattern is looped back continuously between the two interfaces.

Default  
Delay measurement is disabled by default.

Options  
remote-loop-enable—Enables loopback of the delay measurement pattern at the remote interface.

no-remote-loop-enable—Disables loopback of the delay measurement pattern at the remote interface.

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 574  
• 100-Gigabit DWDM OTN MIC with CFP2-ACO  
• 100-Gigabit DWDM OTN PIC with CFP2-ACO (PTX Series)  
• Configuring OTN Interfaces on MIC3-100G-DWDM MIC on page 623  
• Configuring OTN Interfaces on PTX-5-100G-WDM PIC on page 631
• Disabling ODU Path Delay Measurement on OTN Networks for Performance Monitoring on page 658
• Enabling ODU Path Delay Measurement on OTN Networks for Performance Monitoring on page 656
• Understanding ODU Path Delay Measurement on OTN Networks for Performance Monitoring on page 654
• Understanding the MIC3-100G-DWDM MIC on page 619
• Understanding the PTX-5-100G-WDM PIC on page 627

signal-degrade

Syntax

```
signal-degrade {
  ber-threshold-clear value;
  ber-threshold-signal-degrade value;
  interval value;
}
```

Hierarchy Level

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

Release Information


Description

Specify bit error rate (BER) signal degradation thresholds and time interval for raising and clearing alarms for optical transport network (OTN) links.

Default

If you omit the signal-degrade statement, the default threshold values are used.

Options

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

• 10-Gigabit Ethernet OTN Options Configuration Overview on page 563
• 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
• Configuring 100-Gigabit DWDM OTN PICs on page 588
**signal-degrade-monitor-enable**

**Syntax**

```
(signal-degrade-monitor-enable | no-signal-degrade-monitor-enable);
```

**Hierarchy Level**

```
[edit interfaces interface-name otn-options preemptive-fast-reroute]
```

**Release Information**

Statement introduced in Junos OS Release 13.2 for PTX Series routers.

**Description**

Enable or disable pre-forward error correction (FEC) bit error rate (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 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 `backward-frr-enable` statement at the same hierarchy level.

**NOTE:** When you configure pre-FEC BER signal degrade monitoring, we recommend that you configure both the `signal-degrade-monitor-enable` and `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. Include the `ber-threshold-signal-degrade value`, `ber-threshold-clear value`, and `interval value` statements at the `[edit interfaces interface-name otn-options signal-degrade]` hierarchy level to configure the BER thresholds and time interval. See “Understanding Pre-FEC BER Monitoring and BER Thresholds” on page 582 for more information about pre-FEC BER monitoring and determining BER threshold settings.

**Default**

By default, pre-FEC BER signal degrade monitoring is disabled.

**Options**

- `signal-degrade-monitor-enable`—Enable pre-FEC BER signal degrade monitoring.
- `no-signal-degrade-monitor-enable`—Do not enable pre-FEC BER signal degrade monitoring.
### start-measurement

| Syntax       | (no-start-measurement | start-measurement); |
|--------------|------------------------|

| Hierarchy Level | [edit interfaces interface-name otn-options odu-delay-management] |

<table>
<thead>
<tr>
<th>Release Information</th>
<th>Statement introduced in Junos OS Release 13.2 for PTX Series routers.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Start or do not start a delay measurement (DM) session.</th>
</tr>
</thead>
</table>

| Default | By default, do not start a DM session. |

| Options | no-start-measurement—Do not start a DM session. |

| start-measurement—Start a DM session. |

### 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 582
- 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
- Configuring 100-Gigabit DWDM OTN PICs on page 588
tca

Syntax  
tca tca-identifier (enable-tca | no-enable-tca) (threshold number | threshold-24hrs number)

Hierarchy Level  
[edit interfaces interface-name optics-options]

[edit interfaces interface-name otn-options]

Release Information  
Statement introduced in Junos OS Release 14.2 on the PTX Series.
Statement introduced in Junos OS Release 18.3R1 for PTX10K-LC1104 on the PTX10008 and PTX10016 routers.

Description  
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.

Enable threshold crossing alerts (TCAs) for the following:

- Optical channel data unit (ODU)
- Optical channel transport unit (OTU)
- Laser power
- Laser temperature

Default  
By default, TCAs are not enabled.

Options  
tca-identifier —At the otn-options hierarchy level, it can be one of the following:

- odu-tca-bbe—ODU background block error threshold-crossing defect trigger
- odu-tca-bbe-fe—ODU far-end background block error 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
• **otu-tca-bbe**—OTU background block error threshold-crossing defect trigger
• **otu-tca-bbe-fe**—OTU far-end background block error 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-fec-ber**—OTU forward error correction bit error rate 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
• **fec-ber**—Optics Errored Seconds Threshold crossing defect trigger
• **fec-corrected-errors-high-tca**—FEC Corrected Error High Threshold crossing defect trigger
• **fec-uncorrected-words-high-tca**—FEC Uncorrected Words High Threshold crossing defect trigger
• **laser-frequency-error-high-tca**—Laser frequency error high TCA
• **laser-frequency-error-low-tca**—Laser frequency error low TCA
• **pam-histogram-high-tca**—PAM Histogram high TCA
• **residual-isil-high-tca**—Residual ISI high TCA
• **residual-isil-low-tca**—Residual ISI low TCA
• **rx-power-high-tca**—Rx power high threshold setting trigger
• **rx-power-low-tca**—Rx power low threshold setting trigger
• **snr-low-tca**—SNR low TCA
• **tec-current-high-tca**—TEC Current high TCA
• **tec-current-low-tca**—TEC Current low TCA
• **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.

transport-monitoring

Syntax transport-monitoring;

Hierarchy Level [edit interfaces]

Release Information Statement introduced in Junos OS Release 14.2 for PTX5000 and PTX3000 routers.

Description Monitor the performance and state of packet transport for OTN and optics modules. The following statistics are monitored:

- Packet transport for ninety-six 15-minute intervals for the current 24 hours.
- Cumulative data of the current 24 hours.
- Cumulative data of the previous 24 hours.

If this statement is configured, transport monitoring related information is shown in the output of show interface transport command and corresponding MIBs are available. If this option is disabled, an error is shown in the output and corresponding MIBs are not available.

Required Privilege Level system—To view this statement in the configuration.

system-control—To add this statement to the configuration.

Related Documentation • show interfaces transport pm on page 2201
trigger

Syntax  

```
trigger trigger-identifier (hold-time hold-time-value | ignore);
```

Hierarchy Level  

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

Release Information  

Statement introduced in Junos OS Release 9.4.  
Statement introduced in Junos OS Release 13.2 for PTX Series routers.  
Statement introduced in Junos OS Release 18.3R1 for PTX10K-LC1104 on the PTX10008 and PTX10016 routers.

Description  

Specify defect triggers.

Default  

By default, triggers are ignored.

Options  

```
trigger-identifier—(For M Series, MX Series, SRX Series, and T 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-wavelength-lock—Optical channel Wavelength Lock defect trigger.
- odu-ais—Optical channel data unit (ODU) Alarm Indication Signal defect trigger.
- odu-bbe-th—ODU Background Block Error Threshold defect trigger.
- odu-bdi—ODU Backward Defect Indication defect trigger.
- odu-bei—(MX Series routers only) ODU Backward Error Indication defect trigger.
- odu-es-th—ODU Errored Seconds Threshold defect trigger.
- odu-iae—(MX Series routers only) ODU Incoming Alignment Error defect trigger.
- odu-lck—ODU Locked defect trigger.
- odu-oci—ODU Open Connection Indication defect trigger.
- odu-sd—ODU Signal Degradation defect trigger.
- odu-ses-th—ODU Severely Errored Seconds Threshold defect trigger.
- odu-tca-es—(MX Series routers only) ODU Errored Seconds Threshold crossing defect trigger.
- odu-tca-ses—(MX Series routers only) ODU Severely Errored Seconds Threshold crossing defect trigger.
```
- **odu-tca-uas**—(MX Series routers only) ODU Unavailable Seconds Threshold crossing defect trigger.
- **odu-ttim**—ODU Trail Trace Identifier Mismatch defect trigger.
- **opu-ptim**—(MX Series routers only) Payload Type Identifier Mismatch defect trigger.
- **odu-uas-th**—ODU Unavailable Seconds Threshold defect trigger.
- **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 Degradedefect trigger.
- **otu-fec-exe**—OTU FEC Excessive Error defect trigger.
- **otu-iae**—OTU Incoming Alignment defect trigger.
- **otu-sd**—OTU Signal Degradedefect 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 Degradation 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 Degradation defect trigger.
- **otu-fec-exe**—OTU FEC Excessive Error defect trigger.
- **otu-iae**—OTU Incoming Alignment 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].

**Required Privilege Level**
- **interface**—To view this statement in the configuration.
- **interface-control**—To add this statement to the configuration.

**Related Documentation**
- 10-Gigabit Ethernet OTN Options Configuration Overview on page 563
- 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
- Configuring 100-Gigabit DWDM OTN PICs on page 588
**tti**

**Syntax**

```
tti tti-identifier;
```

**Hierarchy Level**

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

**Release Information**

Statement introduced in Junos OS Release 9.4.
Statement introduced in Junos OS Release 13.2 for PTX Series routers.
Statement introduced in Junos OS Release 13.3 for MX Series routers.
Statement introduced in Junos OS Release 18.3R1 for PTX10K-LC1104 on the PTX10008 and PTX10016 routers.

**Description**

Specify trace identifier options.

**Options**

`tti-identifier`—Trace identifier. It can be one of the following:

- `odu-dapi`—Optical Channel Data Unit (ODU) Destination Access Point Identifier.
- `odu-expected-receive-dapi`—ODU Expected Receive Destination Access Point Identifier.
- `odu-sapi`—ODU Source Access Point Identifier.
- `otu-dapi`—Optical Channel Transport Unit (OTU) Destination Access Point Identifier.
- `otu-expected-receive-dapi`—OTU Expected Receive Destination Access Point Identifier.
- `otu-sapi`—OTU Source Access Point Identifier.

**Required Privilege Level**

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**

- 10-Gigabit Ethernet OTN Options Configuration Overview on page 563
- 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
- Configuring 100-Gigabit DWDM OTN PICs on page 588
### tx-power

**Syntax**

```
tx-power dbm;
```

**Hierarchy Level**

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

**Release Information**

Statement introduced in Junos OS Release 13.2 for PTX Series routers. Statement introduced in Junos OS Release 18.3R1 for PTX10K-LC1104 on the PTX10008 and PTX10016 routers.

**Description**

Transmit laser output power (dBm).

**Default**

If you don’t specify a value, the default transmit laser output power is –2 dBm.

**Options**

- `dbm`—Transmit power value.

**Required Privilege Level**

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**

- Ethernet DWDM Interface Wavelength Overview on page 564
- `optics-options` on page 1444
- 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
### warning

**Syntax**

```plaintext
warning low-light-warning {
  (link-down | syslog);
}
```

**Hierarchy Level**

[edit interfaces interface-name optics-options]

**Release Information**

Statement introduced in Junos OS Release 10.0.
Statement introduced in Junos OS Release 12.1 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for PTX Series routers.
Statement introduced in Junos OS Release 18.3R1 for PTX10K-LC1104 on the PTX10008 and PTX10016 routers.

**Description**

Specifies the action to take if the receiving optics signal is below the optics low-light warning threshold.

**Options**

- `link-down`—Drop the 10-Gigabit Ethernet link and marks link as down.
- `syslog`—Write the optics information to the system log.

**Required Privilege Level**

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**

- Configuring 10-Gigabit Ethernet Link Down Notification for Optics Options Alarm or Warning on page 450
- `optics-options` on page 1444
- 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
**wavelength**

**Syntax**  
```  
wavelength nm;  
```

**Hierarchy Level**  
```  
[edit interfaces interface-name optics-options]  
```

**Release Information**  
Statement introduced before Junos OS Release 7.4.  
Statement introduced in Junos OS Release 12.1 for EX Series switches.  
Statement introduced in Junos OS Release 13.2 for PTX Series routers.

**Description**  
For 10-Gigabit or 100-Gigabit Ethernet DWDM interfaces only, configure full C-band ITU-Grid tunable optics.

**Options**  
`nm`—Wavelength value. It can be one of the following:

- 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

**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.
- 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

**Required Privilege Level**
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**
- Ethernet DWDM Interface Wavelength Overview on page 564
- Configuring the 10-Gigabit or 100-Gigabit Ethernet DWDM Interface Wavelength on page 564
- show interfaces diagnostics optics (Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit Ethernet, 100-Gigabit Ethernet, and Virtual Chassis Port) on page 2006
CHAPTER 39

Configuration Statements (OAM-CFM)

- action-profile (Applying to CFM) on page 1131
- action-profile (Defining for CFM) on page 1132
- action-profile (MEP) on page 1133
- ais-trigger-condition on page 1134
- all-defects on page 1135
- auto-discovery on page 1135
- avg-fd-twoway-threshold on page 1136
- avg-ifdv-twoway-threshold on page 1137
- avg-flr-forward-threshold on page 1138
- avg-flr-backward-threshold on page 1139
- calculation-weight on page 1140
- clear-action (CFM) on page 1141
- continuity-check on page 1142
- convey-loss-threshold on page 1143
- cross-connect-ccm on page 1143
- cycle-time on page 1144
- data-tlv-size on page 1145
- default-actions on page 1146
- delay on page 1147
- delegate-server-processing on page 1148
- delay-variation on page 1149
- detect-loc on page 1150
- direction on page 1151
- enhanced-cfm-mode on page 1152
- erroneous-ccm on page 1153
- event (CFM) on page 1154
- flap-trap-monitor on page 1155
- hardware-assisted-timestamping on page 1156
- hardware-assisted-keepalives on page 1157
- hold-interval (OAM) on page 1158
- instance on page 1159
- interface-down on page 1159
- interface-status-tlv on page 1160
- interface-status-send-rdi on page 1161
- interval on page 1162
- interval (CFM MEP) on page 1163
- iteration-count on page 1164
- iteration-period on page 1165
- level on page 1166
- level (CFM MEP) on page 1167
- linktrace on page 1167
- log-and-generate-ais on page 1168
- loss-threshold on page 1169
- lowest-priority-defect on page 1170
- maintenance-association on page 1171
- maintenance-domain on page 1172
- measurement-interval on page 1174
- measurement-type on page 1175
- mep on page 1176
- mip-half-function on page 1177
- name-format on page 1178
- path-database-size on page 1179
- performance-monitoring on page 1180
- policer (CFM Global) on page 1181
- policer (CFM Session) on page 1182
- port-status-tlv on page 1183
- priority (Protocols OAM) on page 1184
- priority (CFM MEP) on page 1185
- priority (OAM Connectivity-Fault Management) on page 1186
- protocol (Server MEP) on page 1187
- protect-maintenance-association (OAM) on page 1188
- receive-ais on page 1188
- remote-maintenance-association (OAM) on page 1189
- remote-mep on page 1190
- sendid-tlv on page 1191
action-profile (Applying to CFM)

Syntax

```
action-profile profile-name;
```

Hierarchy Level

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
domain-name maintenance-association ma-name mep mep-id remote-mep remote-mep]
```

Release Information

Statement introduced in Junos OS Release 8.4.

Description

Identify the action profile to use.

Options

```
profile-name—Name of the action profile to use.
```

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Related Documentation

- Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 745
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. See CLI Explorer.

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 757
- default-actions on page 1146
- event (CFM) on page 1154
- interface-down on page 1159
action-profile (MEP)

Syntax

```
action-profile action-profile-name;
```

Hierarchy Level

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain md-name maintenance-association ma-name mep mep-id]
```

Release Information

Statement introduced in Junos OS Release 14.2.

Description

Attach the configured action profile to the MEP depending on the hierarchy level.

Options

- **action-profile-name**—Name of the action profile that is configured for the CFM MEP and the server MEP.

Required Privilege

- 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 938
- Configuring ETH-AIS on a CFM MEP on page 943
### ais-trigger-condition

**Syntax**

```plaintext
ais-trigger-condition {
  adjacency-loss;
  all-defects;
  cross-connect-ccm;
  erroneous-ccm;
  receive-ais;
}
```

**Hierarchy Level**

```plaintext
[edit protocols oam ethernet connectivity-fault-management action-profile action-profile-name event]
```

**Release Information**

Statement introduced in Junos OS Release 14.2.

**Description**

Configure the defect conditions that generate an alarm indication signal (AIS).

**Options**

The remaining statements are explained separately. See [CLI Explorer](#).

**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 938
- Configuring ETH-AIS on a CFM MEP on page 943
all-defects

Syntax

all-defects;

Hierarchy Level

[edit protocols oam ethernet connectivity-fault-management action-profile action-profile-name event ais-trigger-condition]

Release Information

Statement introduced in Junos OS Release 14.2.

Description

Configure the defect condition that raises an alarm indication signal when any or all possible defects occur in the maintenance domain level.

Required Privilege

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 938

• Configuring ETH-AIS on a CFM MEP on page 943

auto-discovery

Syntax

auto-discovery;

Hierarchy Level

[edit protocols oam ethernet connectivity-fault-management maintenance-domain domain-name maintenance-association ma-name mep mep-id]

Release Information

Statement introduced in Junos OS Release 8.4.

Description

Enable the MEP to accept continuity check messages from all remote MEPs.

Required Privilege

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Related Documentation

• Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 745
**avg-fd-twoway-threshold**

**Syntax**

```
avg-fd-twoway-threshold avg-fd-twoway-threshold-value
flap-trap-monitor seconds;
```

**Hierarchy Level**

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles profile-name]
```

**Release Information**

Statement introduced in Junos OS Release 15.1 for MX Series routers.

**Description**

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.

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.

**Options**

- **avg-fd-twoway-threshold-value**—Threshold value for average frame delay, in microseconds, for two-way ETH-DM.
  - Range: 1 through 4294967295 microseconds

- **flap-trap-monitor seconds**—Duration in seconds, for summarizing flap occurrences and send out a single jnxSoamPm ThresholdFlapAlarm notification to the network management system (NMS).
  - Range: 1 through 360 seconds

**Required Privilege**

- **Level**
  - Configure—To enter configuration mode.
  - Control—To modify any configuration.

**Related Documentation**

- flap-trap-monitor on page 1155
- Configuring an Iterator Profile on page 886
- Configuring an Iterator Profile on a Switch (CLI Procedure)
avg-ifdv-twoway-threshold

Syntax

```
avg-ifdv-twoway-threshold avg-ifdv-twoway-threshold-value; {
flap-trap-monitor seconds; }
```

Hierarchy Level

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles profile-name]
```

Release Information

Statement introduced in Junos OS Release 15.1 for MX Series routers.

Description

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.

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.

Options

```
avg-ifdv-twoway-threshold-value—Threshold value for average frame delay variation, in microseconds, for two-way ETH-DM.
Range: 1 through 4294967295 microseconds
```

```
flap-trap-monitor seconds—Duration in seconds, for summarizing flap occurrences and send out a single jnxSoamPm ThresholdFlapAlarm notification to the network management system (NMS).
Range: 1 through 360 seconds
```

Required Privilege Level

```
configure—To enter configuration mode.
control—To modify any configuration.
```

Related Documentation

- `flap-trap-monitor on page 1155`
- `Configuring an Iterator Profile on page 886`
- `Configuring an Iterator Profile on a Switch (CLI Procedure)`
**avg-flr-forward-threshold**

**Syntax**

```
avg-flr-forward-threshold avg-flr-forward-threshold-value;
flap-trap-monitor seconds; }
```

**Hierarchy Level**

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles profile-name]
```

**Release Information**

Statement introduced in Junos OS Release 15.1 for MX Series routers.

**Description**

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.

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.

**Options**

- `avg-flr-forward-threshold-value`—Threshold value for average frame loss ratio in the forward or upstream direction, in milli-percent, for ETH-SLM and ETH-LM.
  - **Range:** 1 through 100000 milli-percent

- `flap-trap-monitor seconds`—Duration in seconds, for summarizing flap occurrences and send out a single jnxSoamPm ThresholdFlapAlarm notification to the network management system (NMS).
  - **Range:** 1 through 360 seconds

**Required Privilege Level**

- `configure`—To enter configuration mode.
- `control`—To modify any configuration.

**Related Documentation**

- [flap-trap-monitor on page 1155](#)
- [Configuring an Iterator Profile on page 886](#)
- [Configuring an Iterator Profile on a Switch (CLI Procedure)](#)
**avg-flr-backward-threshold**

**Syntax**
```
avg-flr-backward-threshold avg-flr-backward-threshold-value;[
    flap-trap-monitor seconds; ]
```

**Hierarchy Level**
```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
    sla-iterator-profiles profile-name]
```

**Release Information**
Statement introduced in Junos OS Release 15.1 for MX Series routers.

**Description**
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.

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.

**Options**
- `avg-flr-backward-threshold-value`—Threshold value for average frame loss ratio in the backward or downstream direction, in milli-percent, for ETH-SLM and ETH-LM.
  - **Range:** 1 through 100000 milli-percent
- `flap-trap-monitor seconds`—Duration in seconds, for summarizing flap occurrences and send out a single jnxSoamPm ThresholdFlapAlarm notification to the network management system (NMS).
  - **Range:** 1 through 360 seconds

**Required Privilege Level**
- **configure**—To enter configuration mode.
- **control**—To modify any configuration.

**Related Documentation**
- [flap-trap-monitor on page 1155](#)
- [Configuring an Iterator Profile on page 886](#)
- [Configuring an Iterator Profile on a Switch (CLI Procedure)](#)
calculation-weight

Syntax

```
calculation-weight {
    delay delay-value;
    delay-variation delay-variation-value;
}
```

Hierarchy Level

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles profile-name]
```

Release Information

Statement introduced in Junos OS Release 11.1.
Statement introduced in Junos OS Release 11.4 for EX Series switches.

Description

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. See CLI Explorer.

Required Privilege Level

Configure—To enter configuration mode.
Control—To modify any configuration.

Related Documentation

- Configuring an Iterator Profile on page 886
- Configuring an Iterator Profile on a Switch (CLI Procedure)
- delay on page 1147
- delay-variation on page 1149
clear-action (CFM)

Syntax

```plaintext
clear-action {
  interface-down peer-interface;
}
```

Hierarchy Level

```
[edit protocols oam ethernet connectivity-fault-management action-profile profile-name ]
```

Release Information

Statement introduced in Junos OS Release 11.4.

Description

Clear the action or actions to be taken when the connectivity fault management event occurs. You cannot configure multiple actions at this time. Only one action can be configured. This limitation affects both the `action` and `clear-action` statements.

Options

- `peer-interface`—Name of the peer interface.

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 757
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 Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Related Documentation

• Configuring Continuity Check Protocol Parameters for Fault Detection on page 744
**convey-loss-threshold**

**Syntax**

convey-loss-threshold;

**Hierarchy Level**

[edit protocols oam ethernet connectivity-fault-management maintenance-domain domain-name maintenance-association ma-name continuity-check]

**Description**

Enable loss-threshold-tlv transmission.

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 maintenance endpoint (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. You can 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 statement is not specified, continuity check messages transmit this TLV only when a unified ISSU is in progress.

**Required Privilege**

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

**cross-connect-ccm**

**Syntax**

cross-connect-ccm;

**Hierarchy Level**

[edit protocols oam ethernet connectivity-fault-management action-profile action-profile-name event ais-trigger-condition]

**Release Information**

Statement introduced in Junos OS Release 14.2.

**Description**

Configure the defect condition that raises an alarm indication signal when any cross-connect continuity check messages (CCMs) are received by the MEP.

**Required Privilege**

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 938
- Configuring ETH-AIS on a CFM MEP on page 943
cycle-time

Syntax

```
cycle-time cycle-time-value;
```

Hierarchy Level

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles profile-name]
```

Release Information

Statement introduced in Junos OS Release 11.1.
Statement introduced in Junos OS Release 11.4 for EX Series switches.

Description

Configure the time (in milliseconds) taken between back-to-back transmissions of SLA frames for a single connection.

Options

- `cycle-time-value`—Cycle time value in milliseconds.
  - Range: 10 through 3,600,000
  - Default: 1000

Required Privilege

- **Level**
  - Configure—To enter configuration mode.
  - Control—To modify any configuration.

Related Documentation

- Configuring an Iterator Profile on page 886
- Configuring an Iterator Profile on a Switch (CLI Procedure)
**data-tlv-size**

**Syntax**

```
data-tlv-size size;
```

**Hierarchy Level**

```
[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]
```

**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**

`size`—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.
- Control—To modify any configuration.

**Related Documentation**

- sla-iterator-profile on page 1193
- Configuring a Remote MEP with an Iterator Profile on page 897
## default-actions

**Syntax**
```
default-actions {
  interface-down;
}
```

**Hierarchy Level**
```
[edit protocols oam ethernet connectivity-fault-management action-profile profile-name]
```

**Release Information**
Statement introduced in Junos OS Release 8.4.

**Description**
Define the action to be taken when connectivity to the remote MEP is lost.

**Default**
If no action is configured, no action is taken.

**Options**
- **interface-down**—When a remote MEP connectivity failure is detected, bring the interface down.

**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 757
## delay

**Syntax**

```
delay delay-value;
```

**Hierarchy Level**

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles profile-name calculation-weight]
```

**Release Information**

Statement introduced in Junos OS Release 11.1.
Statement introduced in Junos OS Release 11.4 for EX Series switches.

**Description**

Configure the calculation weight for delay.

**Options**

- `delay-value`—Calculation weight for delay.

**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.
- Control—To modify any configuration.

**Related Documentation**

- Configuring an Iterator Profile on page 886
- Configuring an Iterator Profile on a Switch (CLI Procedure)
- calculation-weight on page 1140
### delegate-server-processing

<table>
<thead>
<tr>
<th><strong>Syntax</strong></th>
<th>delegate-server-processing;</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Hierarchy Level</strong></th>
<th>[edit protocols oam ethernet connectivity-fault-management performance-monitoring]</th>
</tr>
</thead>
</table>

**Release Information**

Statement introduced in Junos OS Release 11.1.

**Description**

For Ethernet interfaces on MX Series routers, enable server-side processing for two-way delay measurement and loss measurement.

By default, the processing is done by the Routing Engine.

**Required Privilege**

- **trace**—To view this statement in the configuration.
- **trace-control**—To add this statement to the configuration.

**Related Documentation**

- Ethernet Frame Delay Measurements Overview on page 854
## delay-variation

**Syntax**
```
delay-variation delay-variation-value;
```

**Hierarchy Level**
```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles profile-name calculation-weight]
```

**Release Information**
Statement introduced in Junos OS Release 11.1.
Statement introduced in Junos OS Release 11.4 for EX Series switches.

**Description**
Configure the calculation weight for delay variation.

**Options**
- **delay-variation-value**—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.
- Control—To modify any configuration.

**Related Documentation**
- Configuring an Iterator Profile on page 886
- Configuring an Iterator Profile on a Switch (CLI Procedure)
- calculation-weight on page 1140
### detect-loc

**Syntax**

```plaintext
detect-loc;
```

**Hierarchy Level**

```plaintext
[edit protocols oam ethernet connectivity-fault-management maintenance-domain]
  md-name maintenance-association ma-name mep mep-id remote-mep mep-id]

[edit protocols oam ethernet link-fault-management interface interface-name]
```

**Release Information**

Statement introduced in Junos OS Release 14.2.

**Description**

Specify whether Ethernet OAM continuity checks are performed for an individual remote maintenance end point (MEP).

When you configure the `detect-loc` statement at `[edit protocols oam ethernet link-fault-management interface interface-name]` hierarchy level, a loss-of-continuity (LOC) defect is raised when the peer is not found within a period that is equal to 3 times the current keepalive pdu interval. When an LOC defect is raised, a syslog error message is generated.

**NOTE:** When you configure the `detect-loc` statement at the `[edit protocols oam ethernet link-fault-management interface interface-name]` hierarchy level, any action-profile configured to bring down the interface is executed when an LOC defect is detected. However, the action-profile is not executed if you have not configured `detect-loc` statement the `detect-loc` statement at the `[edit protocols oam ethernet link-fault-management interface interface-name]` hierarchy level.

To view the current LOC status of an interface, execute the `show oam ethernet link-fault-management` command.

**Default**

The MEP does not generate LOC defect messages by default.

**Required Privilege**

- **Level**: interface—To view this statement in the configuration.
  - interface-control—To add this statement to the configuration.

**Related Documentation**

- Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 745
- remote-mep on page 1190
direction

direction (up | down);

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management maintenance-domain
domain-name maintenance-association ma-name mep mep-id]

Release Information Statement introduced in Junos OS Release 8.4.

Description Configure the direction of the MEP.

Options up—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.

NOTE: The up direction for MEP is not supported on T Series routers.

down—Down MEP CCMs are transmitted only out the interface configured on this MEP.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
• Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 745
• IEEE 802.1ag OAM Connectivity Fault Management Overview on page 728
enhanced-cfm-mode

Syntax

```
enhanced-cfm-mode enhanced-cfm-mode;
```

Hierarchy Level

```
[edit logical-systems name protocols oam ethernet connectivity-fault-management],
[edit protocols oam ethernet connectivity-fault-management]
```

Release Information

Statement introduced in Junos OS Release 17.2R1 for MX Series routers.

Description

Enables enhanced CFM mode. When you enable enhanced CFM mode, Junos OS supports 32,000 maintenance association end points (MEPs) and maintenance intermediate points (MIPs) each per chassis for bridge, VPLS, L2VPN, and CCC domains. To support enhanced CFM mode, configure the network services mode on the router as `enhanced-ip`.

NOTE: After enabling CFM mode, restart CFM for the changes to take effect. If you do not restart CFM, CFM automatically restarts after 1 minute.

Required Privilege Level

Routing

Related Documentation

- [Enabling Enhanced Connectivity Fault Management Mode](#) on page 799
### erroneous-ccm

<table>
<thead>
<tr>
<th>Syntax</th>
<th>erroneous-ccm;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchy Level</td>
<td>[edit protocols oam ethernet connectivity-fault-management action-profile action-profile-name event ais-trigger-condition]</td>
</tr>
<tr>
<td>Description</td>
<td>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.</td>
</tr>
<tr>
<td>Required Privilege Level</td>
<td>interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.</td>
</tr>
<tr>
<td>Related Documentation</td>
<td>• Ethernet Alarm Indication Signal (ETH-AIS) Function Overview on page 938 • Configuring ETH-AIS on a CFM MEP on page 943</td>
</tr>
</tbody>
</table>
event (CFM)

Syntax

```plaintext
event {
  adjacency-loss;
  interface-status-tlv [lower-layer-down down];
  port-status-tlv blocked;
  rdi;
}
```

Hierarchy Level

[edit protocols oam ethernet connectivity-fault-management action-profile]

Release Information

Statement introduced in Junos OS Release 10.1

Description

Configure threshold values for connectivity fault management events in an action profile.

Options

- adjacency-loss—Connectivity is lost.
- interface-status-tlv [lower-layer-down down]—Values that need to be monitored in interface status TLV.
- port-status-tlv—Values that need to be monitored in port status TLV.
- rdi—RDI received from some MEP.

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 757
- interface-status-tlv on page 1160
- port-status-tlv on page 1183
### flap-trap-monitor

**Syntax**

```
flap-trap-monitor seconds;
```

**Hierarchy Level**

```
[edit logical-systems name protocols oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles],
[edit protocols oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles]
[edit logical-systems name protocols oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles profile-name avg-fd-twoway-threshold],
[edit protocols oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles profile-name avg-ifdv-twoway-threshold],
[edit logical-systems name protocols oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles profile-name avg-flr-forward-threshold],
[edit protocols oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles profile-name avg-flr-forward-threshold],
[edit logical-systems name protocols oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles profile-name avg-flr-backward-threshold],
[edit protocols oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles profile-name avg-flr-backward-threshold],
```

**Release Information**

Statement introduced in Junos OS Release 17.2R1 for MX Series routers.

**Description**

Enables damping of jnxSoamPmThresholdCrossingAlarm traps sent to the network management system (NMS) by summarizing the flap occurrences over a period of time and sends a single jnxSoamPmThresholdFlapAlarm notification to the NMS. You can enable damping at the global level for the iterator or you can enable damping at the individual threshold type of an iterator. You can specify the duration of time for summarizing flap occurrences.

**Options**

`seconds`—Duration in seconds, for summarizing flap occurrences and send out a single jnxSoamPmThresholdFlapAlarm notification to the NMS.

Range: 1 through 360 seconds

**Required Privilege Level**

routing

**Related Documentation**

- avg-fd-twoway-threshold on page 1136
- avg-ifdv-twoway-threshold on page 1137
- avg-flr-backward-threshold on page 1139
- avg-flr-forward-threshold on page 1138
hardware-assisted-timestamping

Syntax  

```
hardware-assisted-timestamping;
```

Hierarchy Level  

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring]
```

Release Information  
Statement introduced in Junos OS Release 9.5.

Description  
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.

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.

Required Privilege Level  
```
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.
```

Related Documentation  
• Ethernet Frame Delay Measurements Overview on page 854
• Guidelines for Configuring Routers to Support an ETH-DM Session on page 900
• Enabling the Hardware-Assisted Timestamping Option on page 911
**hardware-assisted-keepalives**

**Syntax**

```
hardware-assisted-keepalives [enable | disable];
```

**Hierarchy Level**

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring]
```

**Release Information**

Statement introduced in Junos OS Release 14.2R1.

**Description**

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 of CCMs. Inline transmission of CCMs is also known as Inline-KA.

By default, CCMs are transmitted by the CPU of the MPC and not by 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.

**NOTE:** Starting in Junos OS Release 16.1R1, the inline support for 1s interval is supported on MPC1 to MPC7 (except MPC3 and MPC4) line cards.

**Default**

Inline transmission is disabled by default.

**Options**

- **enable**—Enable inline transmission of CCMs.

**NOTE:** Inline transmission of CCMs is not enabled when there is a CFM session already established. To enable inline transmission, you must first deactivate the CFM session using the `deactivate` command and then reactivate the CFM session using the `activate` command.

- **disable**—Disable inline transmission of CCMs.

**NOTE:** After disabling inline transmission of CCMs, you must reboot the router for the changes to take effect.
hold-interval (OAM)

Syntax

```
hold-interval minutes;
```

Hierarchy Level

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
domain-name maintenance-association ma-name continuity-check]
```

Release Information


Description

The time to wait in minutes before flushing the maintenance association end point (MEP) database, if no updates occur. The configurable range is 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.

Options

```
minutes—Time to wait, in minutes.
```

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Continuity Check Protocol Parameters Overview on page 743
- Configuring Continuity Check Protocol Parameters for Fault Detection on page 744
instance

Syntax

```plaintext
instance vpls-instance-name;
```

Hierarchy Level

```plaintext
[edit protocols oam ethernet connectivity-fault-management maintenance-domain name]
```

Release Information

Statement introduced in Junos OS Release 9.4.

Description

Specify the VPLS instance of the default maintenance domain.

Required Privilege

- Level
  - interface—to view this statement in the configuration.
  - interface-control—to add this statement to the configuration.

Related Documentation

- Configuring Maintenance Intermediate Points (MIPs) on page 736
- maintenance-domain on page 1172

interface-down

Syntax

```plaintext
interface-down;
```

Hierarchy Level

```plaintext
[edit protocols oam ethernet connectivity-fault-management action-profile profile-name default-actions]
```

Release Information

Statement introduced in Junos OS Release 8.5.

Description

Bring the interface down when a remote MEP connectivity failure is detected.

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 757
**interface-status-tlv**

<table>
<thead>
<tr>
<th>Syntax</th>
<th>interface-status-tlv [ down lower-layer-down ];</th>
</tr>
</thead>
</table>

**Hierarchy Level**

```
[edit protocols oam ethernet connectivity-fault-management action-profile profile-name event]
[edit protocols oam ethernet connectivity-fault-management maintenance-domain domain-name maintenance-association ma-name continuity-check]
```

**Release Information**


**Description**

Defines an action-profile consisting of various events and the action. Based on values of `interface-status-tlv` in the received CCM packets, specific action such as `interface-down` can be taken using action-profile options.

**Options**

- **down**—When the incoming CCM packet contains interface status TLV with value down, the action will be triggered for this action-profile.
- **lower-layer-down**—When the incoming CCM packet contains interface status TLV with value lower-layer-down, the action will be triggered for this action-profile.

**Required Privilege Level**

- interface—to view this statement in the configuration.
- interface-control—to add this statement to the configuration.

**Related Documentation**

- Configuring Remote MEP Action Profile Support on page 778
interface-status-send-rdi

Syntax

```plaintext
interface-status-send-rdi interface-status-send-rdi;
```

Hierarchy Level

```plaintext
[edit logical-systems name protocols oam ethernet connectivity-fault-management maintenance-domain name maintenance-association name continuity-check], [edit protocols oam ethernet connectivity-fault-management maintenance-domain name maintenance-association name continuity-check]
```

Release Information

Statement introduced in Junos OS Release 17.3R1 for MX Series Routers.

Description

Configure CFM to propagate the status of the provider edge device via the remote defect indication (RDI) bit in the CC messages when the interface is down. When the status of the EVPN provider edge device is standby, the EVPN VPWS service is notified and it sets the interface status to CCC-down. When the interface status is CCC-down, it indicates that the provider edge service is down. When you enable CFM monitoring, CFM propagates the status of the provider edge device via the remote defect indication (RDI) bit in the CC messages. Thus, the customer edge device is aware that the provider edge device is down.

Usually, when the interface goes down, CFM propagates the status of the provider edge device via the interface status TLV. If the customer edge device does not support the interface status TLV, you can use the RDI bit to propagate the status of the provider edge device.

Required Privilege Level

routing—To view this statement in the configuration.

Related Documentation

- [interface-status-tlv on page 1160](#)
- [Configuring Port Status TLV and Interface Status TLV on page 768](#)
- [Understanding CFM Monitoring between CE and PE Devices on page 800](#)
**interval**

**Syntax**

```
interval (100ms | 10m | 10ms | 10s | 1m | 1s);
```

**Hierarchy Level**

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
domain-name maintenance-association ma-name continuity-check]
```

**Release Information**

Statement introduced in Junos OS Release 8.4.
Option 10ms introduced in Junos OS Release 9.1.
Third-party interoperability during a unified in-service software upgrade (ISSU) introduced in Junos OS Release 17.1.

**Description**

Configure the interval between successive transmissions of continuity check messages (CCMs) as part of the connectivity fault detection strategy. When the receiving maintenance association end point (MEP) does not receive a CCM at the configured interval, the `loss-threshold` statement determines how many CCMs can be lost before the sending MEP is marked as down. The `hold-interval` statement then determines the frequency at which the database of MEPs in the maintenance association (MA) is flushed in the absence of updates.

During a unified in-service software upgrade (ISSU), Junos OS connectivity fault management (CFM) works when the peer device is not a Juniper Networks router. Interoperating with the router of another vendor, the Juniper Networks router retains session information and continues to transmit CCM (continuity check message) PDUs during the unified ISSU upgrade. For this feature to work, you must enable Packet Forwarding Engine keepalives with the `hardware-assisted-keepalives` statement, and configure the interval between CCMs to be 1 second with `interval` statement.

---

**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 by default. You can disable PPM only on the Packet Forwarding Engine. To disable PPM on the Packet Forwarding Engine, use the `no-delegate-processing` statement at the `[edit routing-options ppm]` hierarchy level.

---

**NOTE:** A continuity check interval of 10 milliseconds is not supported for CFM sessions over a label-switched interface (LSI).

**Options**

- `100ms`—100 milliseconds.
- `10m`—10 minutes.
10ms—10 milliseconds.
10s—10 seconds.
1m—1 minute.
1s—1 second.
Default: 1m

**Required Privilege**
- Interface—To view this statement in the configuration.
- Interface-control—To add this statement to the configuration.

**Related Documentation**
- Continuity Check Protocol Parameters Overview on page 743
- Configuring Continuity Check Protocol Parameters for Fault Detection on page 744
- Configuring Connectivity Fault Management for Interoperability During Unified In-Service Software Upgrades on page 932

### Interval (CFM MEP)

**Syntax**
```
interval (1m | 1s);
```

**Hierarchy Level**
```
[edit protocols oam ethernet connectivity-fault-management action-profile action-profile-name]
```

**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**
- 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 938
- Configuring ETH-AIS on a CFM MEP on page 943
### iteration-count

<table>
<thead>
<tr>
<th><strong>Syntax</strong></th>
<th>iteration-count count-value;</th>
</tr>
</thead>
</table>

**Hierarchy Level**

```
[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]
```

**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**

- **count-value**—Number of iterations for which the connection should partake in the iterator for acquiring SLA measurements.
  - **Range:** 1 through 65,535
  - **Default:** 0 (or infinite iterations)

**Required Privilege**

- **Level**
  - Configure—To enter configuration mode.
  - Control—To modify any configuration.

**Related Documentation**

- sla-iterator-profile on page 1193
- Configuring a Remote MEP with an Iterator Profile on page 897
iteration-period

Syntax

iteration-period iteration-period-value;

Hierarchy Level

[edit protocols oam ethernet connectivity-fault-management performance-monitoring sla-iterator-profiles profile-name]

Release Information

Statement introduced in Junos OS Release 11.1.
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

iteration-period-value—Maximum number of cycles per iteration.

Range: 1 through 2000
Default: 2000

Required Privilege

Configure—To enter configuration mode.
Control—To modify any configuration.

Related Documentation

• Configuring an Iterator Profile on page 886
• Configuring an Iterator Profile on a Switch (CLI Procedure)
level

Syntax

level number;

Hierarchy Level

[edit protocols oam ethernet connectivity-fault-management maintenance-domain domain-name]

Release Information

Statement introduced in Junos OS Release 8.4.
Statement introduced in junos os release 12.1X48 for PTX Series Packet Transport Routers.

Description

A number used in connectivity fault management (CFM) messages to identify the maintenance association. The number is embedded in each of the CFM frames. CFM messages within a given level are processed by maintenance end points (MEPs) at the same level. For example, the operator domain can be level 0, the provider domain can be level 3, and the customer domain can be level 7.

Options

number—A number used to identify the maintenance domain to which the CFM message belongs.

Range: 0 through 7

Required Privilege

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 735
**level (CFM MEP)**

**Syntax**
level value;

**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 server maintenance domain level for the MEP.

**Options**
value—Maintenance domain level.

**Range:** 1 through 7

**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 938
- Configuring ETH-AIS on a CFM MEP on page 943

**linktrace**

**Syntax**
linktrace {
    age (30m | 10m | 1m | 30s | 10s);
    path-database-size path-database-size;
}

**Hierarchy Level**
[edit protocols oam ethernet connectivity-fault-management]

**Release Information**
Statement introduced in Junos OS Release 8.5.

**Description**
Configure connectivity fault management linktrace parameters.

**Required Privilege Level**
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

**Related Documentation**
- Configuring Linktrace Protocol in CFM on page 758
log-and-generate-ais

Syntax
log-and-generate-ais {
    interval (1m | 1s);
    level level;
    priority level;
}

Hierarchy Level
[edit protocols oam ethernet connectivity-fault-management action-profile
action-profile-name action]

Release Information
Statement introduced in Junos OS Release 14.2.

Description
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.

Options
The other 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 Alarm Indication Signal (ETH-AIS) Function Overview on page 938
- Configuring ETH-AIS on a CFM MEP on page 943
loss-threshold

Syntax  
loss-threshold number;

Hierarchy Level  
[edit protocols oam ethernet connectivity-fault-management maintenance-domain domain-name maintenance-association ma-name continuity-check]

Release Information  
Statement introduced in Junos OS Release 8.4.  
Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers.

Description  
Specify the number of continuity check messages lost before marking the remote MEP as down. The value can be from 3 to 256 protocol data units (PDUs). The default value is 3 PDUs.

Options  
number—The number of continuity check messages that can be lost before the remote MEP is considered down.

Required Privilege

Level  
interface—To view this statement in the configuration.  
interface-control—To add this statement to the configuration.

Related Documentation  
• Continuity Check Protocol Parameters Overview on page 743  
• Configuring Continuity Check Protocol Parameters for Fault Detection on page 744
**lowest-priority-defect**

**Syntax**

`lowest-priority-defect (all-defects | err-xcon | mac-rem-err-xcon | no-defect | rem-err-xcon | xcon)`

**Hierarchy Level**

`[edit protocols oam ethernet connectivity-fault-management maintenance-domain domain-name maintenance-association ma-name mep mep-id]`

**Release Information**

Statement introduced in Junos OS Release 10.0.

**Description**

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.

**Options**

Specify one of the following lowest priority defect options:

- **all-defects**—Allows all defects.
- **err-xcon**—Allows only erroneous CCM and cross-connect CCM defects.
- **mac-rem-err-xcon**—Allows only MAC, not receiving CCM, erroneous CCM, and cross-connect defects.
- **no-defect**—Allows no defects.
- **rem-err-xcon**—Allows only not receiving CCM, erroneous CCM, and cross-connect CCM defects.
- **xcon**—Allows only cross-connect CCM defects.

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- *Configuring the Maintenance End Point Lowest Priority Defect*
maintenance-association

Syntax

```java
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 {
    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;
      }
    }
  }
}
```

Hierarchy Level

[edit protocols oam ethernet connectivity-fault-management maintenance-domain domain-name]

Release Information

Statement introduced in Junos OS Release 8.4.
Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers.

Description

Configure the name of the maintenance association in IEEE-compliant format.

Options

- **ma-name**—The name of the maintenance association within the maintenance domain.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege

- interface—to view this statement in the configuration.
- interface-control—to add this statement to the configuration.

Related Documentation

- Creating a Maintenance Association on page 742
- Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 745
## maintenance-domain

**Syntax**

```plaintext
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. See CLI Explorer.

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 735
- Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 745
**measurement-interval**

**Syntax**  
measurement-interval (5|15|30|60)

**Hierarchy Level**  
[edit protocols oam ethernet cfm performance-monitoring]
[edit protocols oam ethernet cfm performance-monitoring sla-iterator-profiles profile-name]

**Release Information**

**Description**  
Configure measurement interval to be used for a performance monitoring session. You must configure the measurement-interval at the [edit protocols oam ethernet cfm performance-monitoring] hierarchy level, which is a global level parameter. You can override the configured value by specifying a measurement-interval for the iterator profile at the [edit protocols oam ethernet cfm performance-monitoring sla-iterator-profiles profile-name] hierarchy level.

---

**NOTE:** When you configure when MEF-36-compliant performance monitoring, you must also configure an enhanced-sla-iterator at the [edit protocols oam ethernet cfm performance-monitoring] hierarchy level.

**Default**  
15 minutes

**Required Privilege**  
configure—To enter configuration mode.
control—To modify any configuration.

**Related Documentation**  
- IEEE 802.1ag OAM Connectivity Fault Management Overview on page 728
- Junos OS Support for Performance Monitoring Compliant with Technical Specification MEF 36 on page 733
measurement-type

**Syntax**

```
measurement-type (loss | statistical-loss-measurement | two-way-delay);
```

**Hierarchy Level**

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring
  sla-iterator-profiles profile-name]
```

**Release Information**

Statement introduced in Junos OS Release 11.1.
The **statistical-loss-measurement** option introduced in Junos OS Release 11.2.

**Description**

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.

**Options**

- **loss**—Use Y.1731-compliant line module (LM) frames to measure frame loss.

  - **statistical-loss-measurement**—Use Y.1731-compliant two-way data module (DM) frames to statistically measure frame loss.

  - **two-way-delay**—Use Y.1731-compliant two-way DM frames to measure frame loss.

**Required Privilege Level**

- Configure—To enter configuration mode.
- Control—To modify any configuration.

**Related Documentation**

- Configuring an Iterator Profile on page 886
**mep**

**Syntax**

```
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;
    }
  }
]
```

**Hierarchy Level**
```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain md-name maintenance-association ma-name]
```

**Release Information**
Statement introduced in Junos OS Release 8.4.

**Description**
The numeric identifier of the maintenance association end point (MEP) within the maintenance association.

**Options**
```
mep mep-id—Specify the numeric identifier of the MEP.
```

**Range**: 1 through 8191

The remaining statements are explained separately. See [CLI Explorer](https://www.juniper.net/documentation/en_US/junos_18.4-R1.0/index.html).

**Required Privilege**
```
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 938
- Configuring ETH-AIS on a CFM MEP on page 943
- Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 745
**mip-half-function**

**Syntax**

```
mip-half-function (none | default | explicit);
```

**Hierarchy Level**

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain md-name],
[edit protocols oam ethernet connectivity-fault-management maintenance-association ma-name]
```

**Release Information**


**Description**

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.

**Options**

- **none**—Specify to not use the mip-half-function.
- **default**—Specify to use the default mip-half-function.
- **explicit**—Specify an explicit mip-half-function.

**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 735
- maintenance-domain on page 1172
name-format

Syntax
name-format (character-string | none | dns | mac+2oct);

Hierarchy Level
[edit protocols oam ethernet connectivity-fault-management maintenance-domain domain-name]

Release Information
Statement introduced in Junos OS Release 8.4.
Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers.

Description
Specify the format of the maintenance domain name.

Options
- character-string—The name is an ASCII character string.
- none—The maintenance domain name is not used.
- dns—The name is in domain name service (DNS) format. For example: www.juniper.net.
- mac+2oct—Name is the MAC address plus a two-octet maintenance association identifier. For example: 08:00:22:33:44:55.100.

Default: character-string

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 Association on page 742
- Creating a Maintenance Domain on page 735
# path-database-size

<table>
<thead>
<tr>
<th>Syntax</th>
<th><code>path-database-size path-database-size;</code></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchy Level</td>
<td>[edit protocols oam ethernet connectivity-fault-management linktrace]</td>
</tr>
<tr>
<td>Release Information</td>
<td>Statement introduced in Junos OS Release 8.5.</td>
</tr>
<tr>
<td>Description</td>
<td>Number of linktrace reply entries to be stored per linktrace request.</td>
</tr>
</tbody>
</table>
| Options      | **path-database-size**—Database size.  
                 **Range:** 1 through 255  
                 **Default:** 64 |
| Required Privilege Level | interface—To view this statement in the configuration.  
                              interface-control—To add this statement to the configuration. |
| Related Documentation | • Configuring Linktrace Protocol in CFM on page 758 |
performance-monitoring

Syntax

```
performance-monitoring {
  delegate-server-processing;
  hardware-assisted-timestamping;
  hardware-assisted-keepalives;
  sla-iterator-profiles {
    profile-name {
      avg-fd-twoway-threshold;
      avg-iffv-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. See CLI Explorer.

Required Privilege Level

Configure—To enter configuration mode.

Control—To modify any configuration.

Related Documentation

- Ethernet Frame Delay Measurements Overview on page 854
- Guidelines for Configuring Routers to Support an ETH-DM Session on page 900
- Enabling the Hardware-Assisted Timestamping Option on page 911
## policer (CFM Global)

### Syntax

```c
policer {
  all cfm-policer-name;
  continuity-check cfm-policer-name;
  other cfm-policer-name;
}
```

### Hierarchy Level

```bash
[edit protocols oam ethernet connectivity-fault-management]
```

### Release Information

Statement introduced in Junos OS Release 10.0.

### Description

Specify a policer at the global level to police the CFM traffic belonging to all sessions.

### Options

- **continuity-check cfm-policer-name**—Police all continuity check packets with the policer specified.
- **other cfm-policer-name**—Police all non-continuity check packets with the policer specified.
- **all cfm-policer-name**—Police all CFM packets with policer specified. If the all option is used, then you cannot specify above two options.

### Required Privilege

- **interface**—To view this statement in the configuration.
- **interface-control**—To add this statement to the configuration.

### Related Documentation

- Configuring Rate Limiting of Ethernet OAM Messages on page 787
- policer (CFM Session) on page 1182
**policer (CFM Session)**

**Syntax**

```plaintext
policer {
  all cfm-policer-name;
  continuity-check cfm-policer-name;
  other cfm-policer-name;
}
```

**Hierarchy Level**

```plaintext
[edit protocols oam ethernet connectivity-fault-management maintenance-domain name level number maintenance-association name]
```

**Release Information**

Statement introduced in Junos OS Release 10.0.

**Description**

Specify a separate policer to rate-limit packets specific to that session.

**Options**

- `continuity-check cfm-policer-name`—Police continuity check packets belonging to this session.
- `other cfm-policer-name`—Police all non-continuity check packets belonging to this session.
- `all cfm-policer-name`—Police all CFM packets belonging to this session. If the `all` option is used, then you cannot specify the above two options.

**Required Privilege**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- Configuring Rate Limiting of Ethernet OAM Messages on page 787
- `policer (CFM Global)` on page 1181
**port-status-tlv**

**Syntax**  
port-status-tlv blocked;

**Hierarchy Level**  
[edit protocols oam ethernet connectivity-fault-management action-profile tlv-action event]  
[edit protocols oam ethernet connectivity-fault-management maintenance-domain domain-name maintenance-association ma-name continuity-check]

**Release Information**  

**Description**  
Define an action-profile consisting of various events and the action. Based on values of port-status-tlv in the received CCM packets, specific action such as interface-down can be taken using action-profile options.

**Options**  
blocked—When the incoming CCM packet contains port status TLV with value blocked, the action will be triggered for this action-profile.

**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 757  
- Configuring Remote MEP Action Profile Support on page 778
priority (Protocols OAM)

Syntax

```plaintext
priority priority-value;
```

Hierarchy Level

```
[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-namesla-iterator-profile]
```

Release Information

Statement introduced in Junos OS Release 11.1.

Description

Configure the priority of the iterator profile, which is the `vlan-pcp` value that is sent in the Y.1731 data frames.

Options

`priority-value`—Priority value, which is the `vlan-pcp` value that is sent in the Y.1731 data frames.

- **Range:** 0 through 7
- **Default:** 0

Required Privilege

- **Level:**
  - Configure—To enter configuration mode.
  - Control—To modify any configuration.

Related Documentation

- sla-iterator-profile on page 1193
- Configuring a Remote MEP with an Iterator Profile on page 897
priority (CFM MEP)

Syntax

\[ priority value; \]

Hierarchy Level

[edit protocols oam ethernet connectivity-fault-management action-profile
action-profile-name action log-generate-ais]

Release Information

Statement introduced in Junos OS Release 14.2.

Description

Configure the 802.1p priority of the AIS packet.

Options

value—Priority level.

Range: 0 through 7

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 938
- Configuring ETH-AIS on a CFM MEP on page 943
priority (OAM Connectivity-Fault Management)

Syntax
priority number;

Hierarchy Level
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  md-name maintenance-association ma-name mep mep-id]

For EX Series Switches:
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  domain-name maintenance-association ma-name mep mep-id]

Release Information
Statement introduced in Junos OS Release 8.4.

Description
IEEE 802.1p priority bits used by the continuity check messages.

Options
number—Configure the IEEE 802.1p priority bits to be used in the VLAN header of the CFM packets.

Range: 0 through 7

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
- Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 745
**protocol (Server MEP)**

**Syntax**

```plaintext
protocol (l2circuit | l2vpn | ethernet) {
  interface interface-name;
}
```

**Hierarchy Level**

[edit protocols oam ethernet connectivity-fault-management]

**Release Information**

Statement introduced in Junos OS Release 14.2.

**Description**

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.

**Options**

- **l2circuit**—Configure the protocol for the server MEP as Layer 2 circuit.
- **l2vpn**—Configure the protocol for the server MEP as Layer 2 VPN.
- **ethernet**—Configure the protocol for the server MEP as Ethernet.

  ```plaintext
  interface interface-name—The interface that is to be associated with the protocol that needs monitoring for ETH-AIS.
  ```

**Required Privilege**

- 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 938
- Configuring ETH-AIS on a CFM MEP on page 943
**protect-maintenance-association (OAM)**

Syntax

```plaintext
protect-maintenance-association protect-ma-name;
```

Hierarchy Level

```plaintext
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
domain-name maintenance-association ma-name ]
```

Release Information

Statement introduced in Junos OS Release 11.4

Description

Configure the name of the protect transport path for the maintenance-association.

Options

- `protect-ma-name`—The name of the protect transport path.

Required Privilege

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

Related Documentation

- Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 745

---

**receive-ais**

Syntax

```plaintext
receive-ais;
```

Hierarchy Level

```plaintext
[edit protocols oam ethernet connectivity-fault-management action-profile
action-profile-name event ais-trigger-condition]
```

Release Information

Statement introduced in Junos OS Release 14.2.

Description

Send a message to the peer MEPs when an AIS message is received by a peer MEP at its own maintenance level.

Required Privilege

- `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 938
- Configuring ETH-AIS on a CFM MEP on page 943
## remote-maintenance-association (OAM)

<table>
<thead>
<tr>
<th>Syntax</th>
<th><code>remote-maintenance-association remote-ma-name;</code></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchy Level</td>
<td><code>[edit protocols oam ethernet connectivity-fault-management maintenance-domain domain-name maintenance-association ma-name]</code></td>
</tr>
<tr>
<td>Release Information</td>
<td>Statement introduced in Junos OS Release 11.4.</td>
</tr>
<tr>
<td>Description</td>
<td>Configure the name of the remote maintenance association.</td>
</tr>
<tr>
<td>Options</td>
<td><code>remote-ma-name</code>—Name of the remote maintenance association.</td>
</tr>
<tr>
<td>Required Privilege Level</td>
<td>interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.</td>
</tr>
<tr>
<td>Related Documentation</td>
<td>Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 745</td>
</tr>
</tbody>
</table>
remote-mep

Syntax

```
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;
```

Hierarchy Level

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain 
  md-name maintenance-association ma-name mep mep-id]
```

Release Information

Statement introduced in Junos OS Release 8.4.

Description

Configure the numeric identifier of the remote maintenance association end point (MEP) within the maintenance association.

Options

**mep-id**—Numeric identifier of the MEP.

Range: 1 through 8191

The remaining statements are explained separately. See CLI Explorer.

Required Privilege

**Level**

- Configure—To enter configuration mode.
- Control—To modify any configuration.

Related Documentation

- Configuring a MEP to Generate and Respond to CFM Protocol Messages on page 745
- detect-loc on page 1150
sendid-tlv

Syntax

```plaintext
sendid-tlv {
    send-chassis-tlv;
}
```

Hierarchy Level

```
[edit protocols oam ethernet connectivity-fault-management]
[edit protocols oam ethernet connectivity-fault-management maintenance-domain]
  maintenance-domain-name maintenance-association maintenance-association-name
  continuity-check]
```

Release Information

Statement introduced in Junos OS Release 16.1R2.

Description

Configures Junos OS to send the sender ID TLV along with the packets. The sender ID TLV is an optional TLV that is sent in continuity check messages (CCMs), loopback messages, and Link Trace Messages (LTMs), as specified in the IEEE 802.1ag standard. TLVs (type, length, and value) are described in the IEEE 802.1ag standard for Connectivity Fault Management (CFM) as a method of encoding variable-length and optional information in a protocol data unit (PDU).

Required Privilege Level

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

Related Documentation

- Junos OS Support for Chassis ID TLV on page 734
short-name-format

Syntax  
short-name-format (character-string | vlan | 2octet | rfc-2685-vpn-id);

Hierarchy Level  
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
domain-name maintenance-association ma-name]

Release Information  

Description  
Specify the name format of the maintenance association name.

Options  
character-string—The name is an ASCII character string.

    vlan—The primary VLAN identifier.

    2octet—A number in the range 0 through 65,535.

    rfc-2685-vpn-id—A VPN identifier that complies with RFC 2685.

Default: character-string

NOTE: The PTX Series Packet Transport Routers support the vlan and 2octet options only.

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 Association on page 742
sla-iterator-profile

Syntax

```
sla-iterator-profile profile-name {
  data-tlv-size size;
  iteration-count count-value;
  priority priority-value;
}
```

Hierarchy Level

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain md-name maintenance-association ma-name mep mep-id remote-mep remote-mep-id]
```

Release Information

Statement introduced in Junos OS Release 11.1.

Description

Configure a remote MEP with an iterator profile and specify the options.

Y.1731 performance monitoring (PM) over Aggregated Ethernet Interfaces is not supported on EX4300 switches.

Options

- `profile-name`—Name of the iterator profile configured for a remote MEP. For more information about configuring a remote MEP with an iterator profile, see "Configuring a Remote MEP with an Iterator Profile" on page 897.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

- Configure—To enter configuration mode.
- Control—To modify any configuration.

Related Documentation

- Configuring an Iterator Profile on page 886
- Configuring a Remote MEP with an Iterator Profile on page 897
- Verifying the Configuration of an Iterator Profile on page 889
- Managing Iterator Statistics on page 892
- sla-iterator-profiles on page 1194
sla-iterator-profiles

Syntax

```
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;
        flap-trap-monitor seconds
        iteration-period iteration-period-value;
        measurement-type (loss | statistical-frame-loss | two-way-delay);
    }
}
```

Hierarchy Level

```
[edit protocols oam ethernet connectivity-fault-management performance-monitoring]
```

Release Information

- Statement introduced in Junos OS Release 11.1.

Description

Configure an iterator application and specify the iterator profile options.

Options

- **profile-name**—Name of the iterator profile. For more information about configuring the iterator profile, see “Configuring an Iterator Profile” on page 886.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

- Configure—To enter configuration mode.
- Control—To modify any configuration.

Related Documentation

- Configuring an Iterator Profile on page 886
- Configuring a Remote MEP with an Iterator Profile on page 897
- Verifying the Configuration of an Iterator Profile on page 889
- Managing Iterator Statistics on page 892
CHAPTER 40

Configuration Statements

- 802.3ad on page 1205
- accept-source-mac on page 1206
- access-concentrator on page 1208
- account-layer2-overhead (PIC Level) on page 1209
- action (OAM) on page 1209
- action-profile on page 1210
- adaptive on page 1212
- address on page 1213
- adjacency-loss on page 1215
- advertisement-interval on page 1216
- age on page 1217
- agent-specifier on page 1218
- aggregate (Gigabit Ethernet CoS Policer) on page 1219
- aggregated-devices on page 1220
- aggregated-ether-options on page 1222
- alarms on page 1223
- allow-remote-loopback on page 1224
- apply-action-profile on page 1224
- arp (Interfaces) on page 1225
- asynchronous-notification on page 1229
- authentication-access-control (MX Series in Enhanced LAN Mode) on page 1230
- authentication-profile-name on page 1231
- authenticator on page 1232
- auto-negotiation on page 1233
- auto-reconnect on page 1235
- bandwidth-limit (Policer for Gigabit Ethernet Interfaces) on page 1236
- bridge-domain on page 1237
- bridge-domains on page 1238
• bfd-liveness-detection (LAG) on page 1240
• burst-size-limit (Policer for Gigabit Ethernet Interfaces) on page 1242
• cak (MX Series) on page 1243
• captive-portal (MX Series in Enhanced LAN Mode) on page 1244
• captive-portal-custom-options (MX Series in Enhanced LAN Mode) on page 1245
• centralized on page 1247
• cipher-suite (MACsec) on page 1248
• ckn (MX Series) on page 1250
• classifier on page 1251
• clear on page 1251
• client on page 1252
• community-vlans (MX Series) on page 1253
• compatibility-version on page 1254
• connectivity-association (MACsec Interfaces for MX Series) on page 1255
• connectivity-association (MX Series) on page 1256
• connectivity-fault-management on page 1258
• control-channel on page 1260
• data-channel on page 1261
• delay (PPPoE Service Name Tables) on page 1262
• destination (IPCP) on page 1263
• device-count on page 1264
• direction (MX Series) on page 1265
• disable on page 1266
• disable (Link Protection) on page 1267
• disable (802.1X for MX Series in Enhanced LAN Mode) on page 1267
• distribution-list on page 1268
• dot1p-priority on page 1269
• dot1x on page 1270
• dot1x (MX Series in Enhanced LAN Mode) on page 1271
• domain-id on page 1272
• drop (PPPoE Service Name Tables) on page 1273
• dynamic-profile (PPPoE Service Name Tables) on page 1274
• east-interface on page 1275
• egress-policer-overhead on page 1276
• encapsulation (Logical Interface) on page 1277
• encapsulation on page 1281
• encryption (MACsec for MX Series) on page 1289
• enhanced-convergence on page 1290
  • ether-options on page 1291
  • ethernet (Chassis) on page 1292
  • ethernet (Protocols OAM) on page 1293
  • ethernet-policer-profile on page 1299
  • ethernet-ring on page 1301
  • ethernet-switch-profile on page 1302
  • evcs on page 1304
  • evc-protocol cfm on page 1305
  • event (LFM) on page 1306
  • event-thresholds on page 1307
  • exclude-protocol (MX Series) on page 1308
  • exercise on page 1309
  • failover-delay on page 1309
  • family on page 1310
  • fast-aps-switch on page 1315
  • fastether-options on page 1316
  • flexible-vlan-tagging on page 1317
  • flow-control on page 1318
  • fnp on page 1319
  • force switch on page 1320
  • force-up on page 1320
  • forwarding-class (Gigabit Ethernet IQ Classifier) on page 1321
  • forwarding-mode (100-Gigabit Ethernet) on page 1322
  • forwarding-mode (PTX Series Packet Transport Routers) on page 1323
  • frame-error on page 1324
  • frame-period on page 1325
  • frame-period-summary on page 1326
  • framing (10-Gigabit Ethernet Interfaces) on page 1327
  • gigether-options on page 1329
  • gratuitous-arp-reply on page 1330
  • guest-vlan (MX Series in Enhanced LAN Mode) on page 1331
  • guard-interval on page 1332
  • hold-interval (Protection Group) on page 1333
  • hold-multiplier on page 1334
  • hold-time up on page 1335
  • iccp on page 1336
- id (MACsec for MX Series) on page 1337
- ieee802.1p on page 1338
- igmp-snooping on page 1339
- ignore-l3-incompletes on page 1343
- include-sci (MACsec for MX Series) on page 1343
- ingress-policer-overhead on page 1344
- ingress-rate-limit on page 1346
- inner-tag-protocol-id on page 1347
- inner-vlan-id on page 1348
- inline on page 1349
- input-policer on page 1350
- input-priority-map on page 1351
- input-three-color on page 1352
- input-vlan-map (Aggregated Ethernet) on page 1353
- input-vlan-map on page 1354
- interface on page 1355
- interface (IEEE 802.1x) on page 1356
- interface (OAM Link-Fault Management) on page 1358
- interface (Static MAC Bypass) on page 1359
- interfaces (MACsec for MX Series) on page 1360
- interface-group on page 1361
- interface-group-down on page 1362
- interface-none on page 1362
- isolated-vlan (MX Series) on page 1363
- key (MACsec for MX Series) on page 1364
- key-server-priority (MACsec for MX Series) on page 1365
- lacp (802.3ad) on page 1366
- lacp (Aggregated Ethernet) on page 1367
- layer2-policer on page 1369
- link-adjacency-loss on page 1370
- link-discovery on page 1370
- link-degrade-monitor on page 1371
- link-down on page 1372
- link-event-rate on page 1372
- link-fault-management on page 1373
- link-mode on page 1375
- link-protection on page 1377
Chapter 40: Configuration Statements

- link-protection (non-LACP) on page 1378
- link-speed (Aggregated Ethernet) on page 1379
- link-speed (Aggregated SONET/SDH) on page 1381
- lldp on page 1382
- lldp-configuration-notification-interval on page 1383
- trap-notification on page 1384
- lmi (Ethernet OAM) on page 1385
- load-balance on page 1386
- load-balance-stateful (Aggregated Ethernet Interfaces) on page 1387
- load-type (Aggregated Ethernet Interfaces) on page 1388
- lockout on page 1389
- logical-interface-policer on page 1390
- loopback (Aggregated Ethernet, Fast Ethernet, and Gigabit Ethernet) on page 1392
- loopback (Local and Remote) on page 1393
- loopback-tracking on page 1394
- loss-priority on page 1394
- mac on page 1395
- mac (IRB) on page 1396
- mac-address (Accept Source Mac) on page 1397
- mac-address (MACsec) on page 1398
- mac-learn-enable on page 1399
- mac-radius (MX Series in Enhanced LAN Mode) on page 1400
- mac-validate on page 1401
- macsec (MX Series) on page 1402
- major-ring-name on page 1403
- manual switch on page 1403
- master-only on page 1404
- max-sessions (PPPoE Service Name Tables) on page 1405
- max-sessions-vsa-ignore (Static and Dynamic Subscribers) on page 1406
- maximum-links on page 1407
- maximum-requests on page 1408
- maximum-requests (MX Series in Enhanced LAN Mode) on page 1409
- mc-ae on page 1410
- minimum-bandwidth (aggregated Ethernet) on page 1413
- minimum-links on page 1414
- mixed-rate-mode on page 1415
- mka (MX Series) on page 1416
• must-secure (MX Series) on page 1417
• mtu on page 1418
• multicast-router-interface (IGMP Snooping) on page 1422
• multi-chassis-protection on page 1423
• negotiate-address on page 1424
• negotiation-options on page 1425
• no-adaptive on page 1425
• no-allow-link-events on page 1426
• no-encryption (MACsec for MX Series) on page 1427
• no-auto-mdix on page 1428
• no-gratuitous-arp-request on page 1429
• no-keepalives on page 1430
• no-mac-table-binding (802.1X for MX Series in Enhanced LAN Mode) on page 1431
• no-native-vlan-insert on page 1432
• no-pre-classifier on page 1433
• no-reauthentication (MX Series in Enhanced LAN Mode) on page 1434
• no-send-pads-ac-info on page 1435
• no-send-pads-error on page 1436
• non-revertive (Interfaces) on page 1436
• non-revertive on page 1437
• non-vc-mode on page 1437
• node-id on page 1438
• offset (MX Series) on page 1439
• oam on page 1441
• optics-options on page 1444
• otn-options on page 1445
• output-policer on page 1447
• output-priority-map on page 1448
• output-three-color on page 1449
• output-vlan-map (Aggregated Ethernet) on page 1450
• output-vlan-map on page 1451
• pado-advertise on page 1452
• passive-monitor-mode on page 1453
• pdu-interval on page 1454
• pdu-threshold on page 1455
• per-flow (Aggregated Ethernet Interfaces) on page 1456
• peer on page 1457
• periodic on page 1458
• policer (CFM Firewall) on page 1459
• policer (CoS) on page 1460
• policer (MAC) on page 1461
• pop on page 1462
• pop-pop on page 1463
• pop-swap on page 1464
• port-description-type on page 1465
• port-id (MACsec for MX Series) on page 1466
• port-priority on page 1467
• port-id-subtype on page 1468
• pp0 (Dynamic PPPoE) on page 1470
• ppm (Ethernet Switching) on page 1472
• pppoe-options on page 1473
• pppoe-underlying-options (Static and Dynamic Subscribers) on page 1474
• preferred-source-address on page 1475
• pre-shared-key (MX Series) on page 1476
• premium (Output Priority Map) on page 1477
• premium (Policer) on page 1478
• propagate-tc on page 1478
• protection-group on page 1479
• protocols on page 1481
• protocol-down on page 1482
• ptopo-configuration-maximum-hold-time on page 1482
• ptopo-configuration-trap-interval on page 1483
• push on page 1484
• push-push on page 1485
• premium (Output Priority Map) on page 1486
• premium (Policer) on page 1487
• proxy on page 1488
• proxy-arp on page 1489
• push on page 1490
• push-push on page 1491
• quiet-period on page 1492
• quiet-period (MX Series in Enhanced LAN Mode) on page 1493
• reauthentication on page 1494
• reauthentication (MX Series in Enhanced LAN Mode) on page 1495
• rebalance (Aggregated Ethernet Interfaces) on page 1495
• receive-options-packets on page 1496
• receive-ttl-exceeded on page 1496
• recovery on page 1497
• remote on page 1498
• remote-loopback on page 1499
• replay-window-size (MX Series) on page 1500
• replay-protect (MX Series) on page 1501
• restore-interval on page 1502
• retries on page 1503
• retries (MX Series in Enhanced LAN Mode) on page 1504
• revertive on page 1505
• ring-id on page 1506
• ring-protection-link-end on page 1507
• ring-protection-link-owner on page 1508
• routing-instance on page 1509
• routing-instance (PPPoE Service Name Tables) on page 1510
• rx-enable on page 1511
• rx-max-duration on page 1512
• sa-multicast (100-Gigabit Ethernet) on page 1513
• sa-multicast (PTX Series Packet Transport Routers) on page 1514
• secure-authentication (MX Series in Enhanced LAN Mode) on page 1515
• secure-channel on page 1516
• security-association on page 1517
• send-critical-event on page 1518
• server on page 1518
• server-fail on page 1519
• server-reject-vlan (MX Series in Enhanced LAN Mode) on page 1520
• server-timeout on page 1521
• server-timeout (MX Series in Enhanced LAN Mode) on page 1522
• service (PPPoE) on page 1523
• service-name on page 1524
• service-name-table on page 1525
• service-name-tables on page 1526
• session-expiry (MX Series in Enhanced LAN Mode) on page 1527
• source-address-filter on page 1528
• source-filtering on page 1529
• speed (Ethernet) on page 1530
• speed (MX Series DPC) on page 1536
• stacked-vlan-tagging on page 1537
• static (Protocols 802.1X) on page 1538
• static-interface on page 1539
• supplicant on page 1540
• supplicant (MX Series in Enhanced LAN Mode) on page 1541
• supplicant-timeout on page 1542
• supplicant-timeout (MX Series in Enhanced LAN Mode) on page 1543
• swap on page 1544
• swap-by-poppush on page 1545
• swap-push on page 1545
• swap-swap on page 1546
• switch-options on page 1547
• switch-port on page 1548
• symbol-period on page 1549
• syslog (OAM Action) on page 1550
• system-id on page 1551
• system-priority on page 1552
• tag-protocol-id (TPIDs Expected to Be Sent or Received) on page 1553
• tag-protocol-id (TPID to Rewrite) on page 1554
• targeted-options (Grouping Subscribers by Bandwidth Usage) on page 1555
• targeted-options (Manual Targeting) on page 1557
• targeted-distribution on page 1558
• targeted-options on page 1559
• terminate (PPPoE Service Name Tables) on page 1560
• thresholds on page 1561
• traceoptions on page 1563
• traceoptions (Individual Interfaces) on page 1566
• traceoptions (LACP) on page 1573
• traceoptions (MACsec) on page 1575
• traceoptions (MACsec Interfaces) on page 1577
• traceoptions (PPPoE) on page 1579
• traceoptions (802.1X and Captive Portal for MX Series in Enhanced LAN Mode) on page 1582
• transmit-delay on page 1584
• transmit-interval (MACsec for MX Series) on page 1585
• transmit-period on page 1586
• transmit-period (MX Series in Enhanced LAN Mode) on page 1587
• tx-duration on page 1588
• tx-enable on page 1589
• uac-policy (MX Series in Enhanced LAN Mode) on page 1590
• underlying-interface on page 1591
• unit on page 1592
• unnumbered-address (Dynamic Profiles) on page 1599
• unnumbered-address (PPP) on page 1601
• version-3 on page 1602
• virtual-control-channel on page 1603
• virtual-switch on page 1603
• vlan-assignment on page 1604
• vlan-id (VLAN ID to Be Bound to a Logical Interface) on page 1605
• vlan-id on page 1606
• vlan-id-list (Ethernet VLAN Circuit) on page 1611
• vlan-id-list (Interface in Bridge Domain) on page 1613
• vlan-id-range on page 1614
• vlan-rewrite on page 1615
• vlan-rule (100-Gigabit Ethernet Type 4 PIC with CFP) on page 1616
• vlan-steering (100-Gigabit Ethernet Type 4 PIC with CFP) on page 1617
• vlan-tagging on page 1618
• vlan-tags on page 1620
• vlan-tags (Dual-Tagged Logical Interface) on page 1621
• vlan-tags (Stacked VLAN Tags) on page 1623
• wait-to-block-interval on page 1625
• west-interface on page 1626
802.3ad

Syntax

```plaintext
802.3ad {
  primary | backup;
  ae interface-number ;
  lacp {
    port-priority priority-number;
  }
  link-index index-number
  distribution-list distribution-list-number
}
```

Hierarchy Level

[edit interfaces interface-name fastether-options],
[edit interfaces interface-name gigether-options]

Release Information

Statement introduced before Junos OS Release 7.4. 
primary and backup options added in Junos OS Release 8.3.

Description

Specify aggregated Ethernet logical interface number.

Options

bundle—Join an aggregated Ethernet interface.

```plaintext
ae interface-number—Aggregated Ethernet logical interface number. For MX Series routers running Junos release 14.2R3 and later you can configure a maximum of 1000 aggregated interfaces. On MX2010 and MX2020 routers you can configure a maximum of 800 aggregated interfaces.
```

```plaintext
primary | backup—For link protection configurations, specify the link as primary link or backup link for egress traffic.
```

```plaintext
lacp—Configure Link Aggregation Control Protocol. Specify the port priority in the range 0 through 65535. Default port-priority is 127.
```

```plaintext
link-index—Specify the desired child link index within the aggregated Ethernet Interface. Index number of the logical interface reflects its initialization sequence.
```

```plaintext
distribution-list—For targeted distribution, specify the distribution list to which the interface belongs.
```

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring an Aggregated Ethernet Interface on page 110
- Configuring Aggregated Ethernet Link Protection on page 152
accept-source-mac

Syntax

```plaintext
accept-source-mac {
  mac-address mac-address {
    policer {
      input cos-policer-name;
      output cos-policer-name;
    }
  }
}
```

Hierarchy Level

[edit interfaces interface-name unit logical-unit-number],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1X48 for PTX Packet Transport Routers.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description

For Gigabit Ethernet intelligent queuing (IQ) interfaces only, accept traffic from and to the specified remote media access control (MAC) address.

The `accept-source-mac` statement is equivalent to the `source-address-filter` 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 `accept-source-mac` statement.

On untagged Gigabit Ethernet interfaces, you should not configure the `source-address-filter` statement and the `accept-source-mac` statement simultaneously. On tagged Gigabit Ethernet interfaces, you should not configure the `source-address-filter` statement and the `accept-source-mac` statement with an identical MAC address specified in both filters.

The remaining statements are explained separately. See CLI Explorer.

---

**NOTE:** The `policer` statement is not supported on PTX Series Packet Transport Routers.

---

**NOTE:** On QFX platforms, if you configure source MAC addresses for an interface using the `static-mac` or `persistent-learning` statements and later configure a different MAC address for the same interface using the `accept-source-mac` 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.
Required Privilege Level

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

Related Documentation

- Configuring MAC Address Filtering on page 676
- Configuring MAC Address Filtering on PTX Series Packet Transport Routers on page 16
- source-filtering on page 1529
access-concentrator

Syntax

```
access-concentrator name;
```

Hierarchy Level

```
[edit dynamic-profiles profile-name interfaces demux0 unit logical-unit-number family pppoe],
[edit dynamic-profiles profile-name interfaces interface-name unit logical-unit-number family pppoe],
[edit interfaces interface-name unit logical-unit-number family pppoe],
[edit interfaces interface-name unit logical-unit-number pppoe-options],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number family pppoe],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number pppoe-options],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number pppoe-underlying-options]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Support at the [edit interfaces interface-name unit logical-unit-number pppoe-underlying-options] and [edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number pppoe-underlying-options] hierarchy levels introduced in Junos OS Release 10.1.
Support at the [edit ... family pppoe] hierarchies introduced in Junos OS Release 11.2.

Description

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.

Options

- `name`—Name of the access concentrator.

Required Privilege Level

- interface—to view this statement in the configuration.
- interface-control—to add this statement to the configuration.

Related Documentation

- Identifying the Access Concentrator on page 374
- Configuring the PPPoE Family for an Underlying Interface
- Configuring Dynamic PPPoE Subscriber Interfaces
- PPPoE Overview on page 368
account-layer2-overhead (PIC Level)

Syntax
account-layer2-overhead;

Hierarchy Level
[edit chassis fpc slot-number pic pic-number]

Release Information
Statement introduced in Junos OS Release 13.2.

Description
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.

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
- Accounting of the Layer 2 Overhead Attribute in Interface Statistics on page 665
- Configuring Layer 2 Overhead Accounting in Interface Statistics on page 668
- Verifying the Accounting of Layer 2 Overhead in Interface Statistics on page 669

action (OAM)

Syntax
action {
  link-down;
  send-critical-event;
  syslog;
}

Hierarchy Level
[edit protocols oam ethernet link-fault-management action-profile]

Release Information
Statement introduced in Junos OS Release 8.5.

Description
Define the action or actions to be taken when the OAM fault event occurs.

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
- Specifying the Actions to Be Taken for Link-Fault Management Events on page 832
**action-profile**

**List of Syntax**

Syntax: T, M, MX and ACX Series Routers, SRX Series Firewalls and EX Series Switches on page 1210
Syntax: EX Series Switches and NFX Series Devices on page 1210

```
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;
  }
}
```

```
action-profile profile-name;
action {
  syslog;
  link-down;
}
event {
  link-adjacency-loss;
  link-event-rate {
    frame-error count;
    frame-period count;
    frame-period-summary count;
    symbol-period count;
  }
}
```

**Hierarchy Level**

[edit protocols oam ethernet link-fault-management]

**Release Information**

Statement introduced in Junos OS Release 8.5 for T, M, MX and ACX Series Routers, SRX Series Firewalls, and EX Series Switches.
Statement introduced in Junos OS Release 9.4 for EX Series switches and NFX Series devices.

**Description**

Configure an Ethernet OAM link fault management (LFM) action profile by specifying a profile name.
The remaining statements are explained separately. See CLI Explorer.

**Options**

- **profile-name**—Name of the action profile.

The remaining statements are explained separately. See CLI Explorer.

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.
- routing—To view this statement in the configuration.
- routing-control—To add this statement to the configuration.

**Related Documentation**

- Configuring an OAM Action Profile on page 830
- Configuring Ethernet OAM Link Fault Management

adaptive

Syntax

```python
adaptive {
    pps;
    scan-interval multiple;
    tolerance tolerance-percentage;
}
```

Hierarchy Level

```
[edit interfaces ae
aggregated-ether-options load-balance]
```

Release Information

- Statement introduced in Junos OS Release 13.2R3 for MX Series Routers.
- Statement introduced in Junos OS Release 15.1X53-D10 for the QFX Series.

Description

Correct a genuine traffic imbalance by using a feedback mechanism to distribute the traffic across the links of an aggregated Ethernet bundle.

Options

- **pps**—(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.
  - **scan-interval multiple**—(PTX Series only) Scan interval, as a multiple of a 30-second interval.
    - **Range**: 1 through 5
    - **Default**: 1
  - **tolerance tolerance-percentage**—(MX Series and PTX Series) Limit to the variance in the packet traffic flow to the aggregated Ethernet links in a percentage.
    - **Range**: 1 through 100 percent
    - **Default**: 20 percent

Required Privilege Level

- interface - To view this statement in the configuration.
- interface-control - To add this statement to the configuration.

Related Documentation

- Understanding Aggregated Ethernet Load Balancing on page 169
- Example: Configuring Aggregated Ethernet Load Balancing on page 173
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 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 peak rate sustained rate burst length | vbr peak rate sustained rate burst length);  
    queue-length number;  
  }  
  vci vpi-identifier.vci-identifier;  
]  
primary;  
preferred;  
virtual-gateway-address  
(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.

**Description**

Configure the interface address.

**NOTE:** If you configure the same address on multiple interfaces in the same routing instance, Junos OS uses only the first configuration, and 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:

```plaintext
interfaces {
    xe-0/0/0 {
        unit 0 {
            family inet {
                address 192.168.1.1/8;
            }
        }
    }
    xe-0/0/1 {
        unit 0 {
            family inet {
                address 192.168.1.1/8;
            }
        }
    }
}
```

For more information on configuring the same address on multiple interfaces, see *Configuring the Interface Address*.

- 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.
Options  

**address**—Address of the interface.

The remaining statements are explained separately. Search for a statement in CLI Explorer or click a linked statement in the Syntax section for details.

---

**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.

**Related Documentation**

- Configuring the Protocol Family
- family
- negotiate-address on page 1424
- unnumbered-address (Ethernet)

---

**adjacency-loss**

**Syntax**

adjacency-loss;

**Hierarchy Level**

[edit protocols oam ethernet connectivity-fault-management action-profile action-profile-name event ais-trigger-condition]

**Release Information**

Statement introduced in Junos OS Release 14.2.

**Description**

Configure the defect condition that raises an alarm indication signal when physical connectivity is lost between peer MEPs.

**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 938
- Configuring ETH-AIS on a CFM MEP on page 943
**advertisement-interval**

**Syntax**

advertisement-interval seconds;

**Hierarchy Level**

[edit protocols lldp],
[edit routing-instances routing-instance-name protocols lldp]

**Release Information**

Statement introduced in Junos OS Release 9.6 for MX Series and T Series routers.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

**Description**

Configure an interval for LLDP advertisement.

For switches configured for Link Layer Discovery Protocol, configure the frequency at which LLDP advertisements are sent.

The `advertisement-interval` value must be greater than or equal to four times the `transmit-delay` value, or an error will be returned when you attempt to commit the configuration.

**NOTE:** The default value of `transmit-delay` is 2 seconds. If you configure the `advertisement-interval` as less than 8 seconds and you do not configure a value for `transmit-delay`, the default value of `transmit-delay` is automatically changed to 1 second in order to satisfy the requirement that the `advertisement-interval` value must be greater than or equal to four times the `transmit-delay` value.

**Default**

Disabled.

**Options**

`seconds`—Interval between LLDP advertisement.

**Required Privilege Level**

routing—to view this statement in the configuration.

routing-control—to add this statement to the configuration.

**Related Documentation**

- Configuring LLDP on page 356
- show lldp
- Configuring LLDP (CLI Procedure)
- Understanding LLDP and LLDP-MED on EX Series Switches
- transmit-delay
- Understanding LLDP

age

Syntax

```mermaid
age (30m | 10m | 1m | 30s | 10s);
```

Hierarchy Level

```mermaid
[edit protocols oam ethernet connectivity-fault-management linktrace]
```

Release Information

Statement introduced in Junos OS Release 8.5.

Description

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.

Default

10 minutes

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Linktrace Protocol in CFM on page 758
agent-specifier

Syntax

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;
  }
}

Hierarchy Level

[edit protocols pppoe service-name-tables table-name service service-name]

Release Information

Statement introduced in Junos OS Release 10.0. drop, delay, terminate, dynamic-profile, routing-instance, and static-interface options introduced in Junos OS Release 10.2.

Description

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, empty service, or any 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, empty, and any service entries in the service name table.

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.

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 remote-id-string 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.

Default

The default action is terminate.

Options

aci circuit-id-string—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.

ari remote-id-string—Identifier for the subscriber associated with the DSLAM interface that initiated the service request. This is a string of up to 63 characters.
The remaining statements are explained separately. Search for a statement in CLI Explorer or click a linked statement in the Syntax section for details.

**Required Privilege Level**
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**
- Configuring PPoE Service Name Tables
- Assigning an ACI/ARI Pair to a Service Name and Configuring the Action Taken When the Client Request Includes ACI/ARI Information

### aggregate (Gigabit Ethernet CoS Policer)

**Syntax**

```
aggregate {
    bandwidth-limit bps;
    burst-size-limit bytes;
}
```

**Hierarchy Level**

```
[edit interfaces interface-name gigether-options ethernet-switch-profile ethernet-policer-profile policer cos-policer-name]
```

**Release Information**

Statement introduced before Junos OS Release 7.4.

**Description**

Define a policer to apply to nonpremium traffic.

The remaining statements are explained separately. See CLI Explorer.

**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 671
- premium (Hierarchical Policer)
- ieee802.1p on page 1338
aggregated-devices

Syntax

```
aggregated-devices {
  ethernet {
    device-count number;
    lacp {
      link-protection {
        non-revertive;
      }
      system-priority;
    }
  }
  sonet {
    device-count number;
  }
  maximum-links maximum-links-limit;
}
```

Hierarchy Level

```
[edit chassis]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Support for LACP link protection and system priority introduced in Junos OS Release 9.3.

Description

Configure properties for aggregated devices on the router. Aggregate Ethernet links are logical interfaces defined on the device that bundle together multiple physical interfaces into a single interface for the use of redundancy and bandwidth aggregation. When interconnecting devices you can create aggregate ethernet interfaces to bundle together multiple physical ethernet links to increase bandwidth and redundancy between devices.

Link aggregation enables you to group Ethernet interfaces to form a single link layer interface. Link Aggregation Control Protocol (LACP) is supported in chassis cluster deployments, where aggregated Ethernet interfaces and redundant Ethernet interfaces are supported simultaneously.

You must first configure the system to enable configuring the Aggregated Ethernet (ae) Interfaces. By default, Juniper devices do not have any aggregated ethernet interfaces created. To configure the device to support a given number of ae interfaces, you must define it on a per chassis basis using the `set chassis aggregated-devices devices {1-32}` in configuration mode. The number of devices you define will be the number of aggregated ethernet interfaces that the system will create which can be configured just like any other ethernet interface. Also you can view the interfaces created by using the `show interface terse` command. Once you have defined the number of aggregated ethernet devices on the chassis you can then continue to configure the LAG members on a per ethernet interface basis.

Options

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 Junos OS for Supporting Aggregated Devices on page 133
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);
    }
  }
}
Hierarchy Level  
[edit interfaces aex]

Release Information  
Statement introduced before Junos OS Release 7.4.

Description  
Configure aggregated Ethernet-specific interface properties.

The remaining statements are explained separately. See CLI Explorer.

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

alarms

Syntax  
alarms;

Hierarchy Level  
[edit interfaces interface-name optics-options]

Release Information  
Statement introduced in JUNOS Release 10.1.

Description  
For 10-Gigabit Ethernet DPCs, configure the DPC to drop the interface link when the receive power falls below the alarm threshold.

Required Privilege  
Level  
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

Related Documentation  
- Ethernet DWDM Interface Wavelength Overview on page 564
allow-remote-loopback

Syntax
allow-remote-loopback;

Hierarchy Level
[edit protocols oam link-fault-management interface interface-name negotiation-options]

Release Information
Statement introduced in Junos OS Release 8.4.

Description
Enable the remote loopback on IQ2 and IQ2-E Gigabit Ethernet interfaces, and Ethernet interfaces on the MX Series routers and EX Series switches.

Required Privilege
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

Related Documentation
- Enabling Remote Loopback Support on the Local Interface on page 838

apply-action-profile

Syntax
apply-action-profile profile-name;

Hierarchy Level
[edit protocols oam ethernet link-fault-management interface]

Release Information
Statement introduced in Junos OS Release 8.5.

Description
Apply the specified action profile to the interface for link-fault management.

Required Privilege
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

Related Documentation
- Applying an Action Profile on page 836
arp (Interfaces)

Syntax

```
arp ip-address (mac | multicast-mac) mac-address publish;
```

```
arp {
    aging-timer minutes;
    gratuitous-arp-delayseconds;
    gratuitous-arp-on-ifup;
    interfaces {
        interface-name {
            aging-timer minutes;
        }
    }
    passive-learning;
purging;
}
```

Syntax (EX Series)

```
arp {
    aging-timer minutes;
}
```

Hierarchy Level

```
[edit system]
```

```
[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]
```

NOTE: The `edit logical-systems` hierarchy is not available on QFabric systems.

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
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

For Ethernet, Fast Ethernet, and Gigabit Ethernet interfaces only, configure Address Resolution Protocol (ARP) table entries, mapping IP addresses to MAC addresses. You can enable backup VRRP routers to learn ARP requests for VRRP-IP to VRRP-MAC address translation. You can also set the time interval between ARP updates.

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...

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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.

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.

NOTE: For EX-Series switches, set only the time interval between ARP updates.
Options

**ip-address**—IP address to map to the MAC address. The IP address specified must be part of the subnet defined in the enclosing address statement.

**mac mac-address**—MAC address to map to the IP address. Specify the MAC address as six hexadecimal bytes in one of the following formats: `nnnn.nnnn.nnnn` or `nnn.nn.nnn.nn.nn`. For example, `0000.5e00.5355` or `00:00:5e:00:53:55`.

**multicast-mac mac-address**—Multicast MAC address to map to the IP address. Specify the multicast MAC address as six hexadecimal bytes in one of the following formats: `nnnn.nnnn.nnnn` or `nnn.nn.nnn.nn.nn.nn`. For example, `0000.5e00.5355` or `00:00:5e:00:53:55`.

**publish**—(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.

---

**NOTE:** For unicast MAC addresses only, if you include the publish option, the router or switch replies to proxy ARP requests.

---

**aging-timer**—Time interval in minutes between ARP updates. In environments where the number of ARP entries to update is high (for example, on routers only, metro Ethernet environments), increasing the time between updates can improve system performance.

**gratuitous-arp-delay**—(T Series only) Configure a delay for gratuitous ARP requests at the system level. By default, Junos OS sends gratuitous ARP requests immediately after network-related configuration changes are made on an interface (for example, a VLAN ID, MAC address, or IP address change). This might lead to the Packet Forwarding Engine dropping some initial request packets if the configuration updates have not been fully processed. To avoid such request packets being dropped, you can configure a delay in gratuitous ARP requests.

**Values:**

- **seconds**—Configure the ARP request delay in seconds. We recommend configuring a value in the range of 3 through 6 seconds.

**gratuitous-arp-on-ifup**—(ACX Series, SRX Series, T Series only) Add this statement to the [edit system arp] hierarchy to configure Junos OS to automatically issue a gratuitous ARP announcement when an interface is online.

**interfaces**—(T Series only) Specify the ARP aging timer in minutes for a logical interface of family type inet.

**Values:**

- **aging-timer minutes**—Time between ARP updates, in minutes.
- **Default:** 20
- **Range:** 1 through 6,00,000
**passive-learning**—(M Series, MX Series, PTX Series, SRX Series, T Series only) Configure backup VRRP routers or switches to learn the ARP mappings (IP-to-MAC address) for hosts sending the requests. By default, the backup VRRP router drops these requests; therefore, if the master router fails, the backup router must learn all entries present in the ARP cache of the master router. Configuring passive learning reduces transition delay when the backup router is activated. Learning of ARP mappings (IP-to-MAC address) by backup VRRP routers or switches for hosts sending the requests is disabled unless this statement is configured.

**purging**—(M Series, MX Series, PTX Series, SRX Series, T Series only) Purge obsolete ARP entries from the cache when an interface or link goes offline.

**Required Privilege Level**
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.
- system—To view this statement in the configuration.
- system-control—To add this statement to the configuration.

**Related Documentation**
- Configuring Static ARP Table Entries For Mapping IP Addresses to MAC Addresses on page 390
- Configuring Junos OS ARP Learning and Aging Options for Mapping IPv4 Network Addresses to MAC Addresses
- Junos OS Network Interfaces Library for Routing Devices
- Junos OS System Basics Configuration Guide
- Adjusting the ARP Aging Timer
asynchronous-notification

Syntax
(asynchronous-notification | no-asynchronous-notification);

Hierarchy Level
[edit interfaces ge-fpc/pic/port gigether-options ]

Release Information
Statement introduced in Junos OS Release 8.3.
Statement introduced in Junos OS Release 12.2 for ACX Series Universal Metro Routers.

Description
(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.

(M120 and M320 routers) For all 10-Gigabit Ethernet PIC interfaces, configure support for notification of link down alarm generation and transfer.

- asynchronous-notification—Support notification of link down alarm generation and transfer.
- no-asynchronous-notification—Prohibit notification of link down alarm generation and transfer.

Default
Support for notification of link down alarm generation and transfer is not enabled.

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
- Gigabit Ethernet Notification of Link Down Alarm Overview on page 449
- Configuring Gigabit Ethernet Notification of Link Down Alarm on page 450
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 remaining statements are explained separately. See CLI Explorer.

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 Level
routing—To view this statement in the configuration.
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 Level
interface—To view this statement in the configuration.
interface control—To add this statement to the configuration.

Related Documentation
- IEEE 802.1x Port-Based Network Access Control Overview on page 35
- authenticator on page 1232
- dot1x on page 1270
authenticator

Syntax authenticator {
    authentication-profile-name access-profile-name;
    interface interface-id {
        maximum-requests integer;
        quiet-period seconds;
        reauthentication (disable | interval seconds);
        retries integer;
        server-timeout seconds;
        supplicant (single);
        supplicant-timeout seconds;
        transmit-period seconds;
    }
}

Hierarchy Level [edit protocols dot1x]

Release Information Statement introduced in Junos OS Release 9.3.

Description Specify an authentication profile for user or client authentication and configure the Ethernet interface for 802.1x protocol operation.

Options authentication-profile-name access-profile-name—Specifies the RADIUS authentication profile for user or client authentication.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level protocols—To view this statement in the configuration.
protocols-control—To add this statement to the configuration.

Related Documentation
- IEEE 802.1x Port-Based Network Access Control Overview on page 35
- authentication-profile-name on page 1231
- dot1x on page 1270
auto-negotiation

Syntax
(auto-negotiation | no-auto-negotiation) <remote-fault (local-interface-online | local-interface-offline)>;

Hierarchy Level
[edit interfaces interface-name ether-options],
[edit interfaces interface-name gigether-options],
[edit interfaces ge-pim/0/0 switch-options switch-port port-number]

Release Information
Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.2 for ACX Series Universal Metro Routers.

Description
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.
NOTE: On ACX Series routers, when you configure fiber interfaces (fiber media mode) to operate at 1 Gbps, autonegotiation is enabled by default to negotiate the speed and duplex settings. You can disable autonegotiation by using the (no-auto-negotiation) statement, and commit the configuration. In the fiber media mode. In copper interfaces (copper media mode), autonegotiation is enabled by default. To disable autonegotiation, you need to explicitly configure the link speed to 10 or 100 Mbps, set no-auto-negotiation, and commit the configuration.

Default
Autonegotiation is automatically enabled. No explicit action is taken after the autonegotiation is complete or if the negotiation fails.

Options
remote-fault (local-interface-online | local-interface-offline)—(Optional) For M Series, MX Series, T Series, TX Matrix routers, and ACX Series routers only, manually configure remote fault on an interface.

Default: local-interface-online

Required Privilege
Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
• Gigabit Ethernet Autonegotiation Overview on page 683
• Configuring Gigabit Ethernet Interfaces (CLI Procedure)
• Configuring Gigabit Ethernet Interfaces for EX Series Switches with ELS support
# auto-reconnect

**Syntax**

```plaintext
auto-reconnect seconds;
```

**Hierarchy Level**

```plaintext
[edit interfaces interface-name unit logical-unit-number pppoe-options],
[edit logical-systems logical-system-name interfaces interface-name
unit logical-unit-number pppoe-options]
```

**Release Information**

Statement introduced before Junos OS Release 7.4.

**Description**

PPP over Ethernet interfaces, configure the amount of time to wait before reconnecting after a session has terminated.

**Options**

- **seconds** — Time to wait before reconnecting after a session has terminated.
  - **Range:** 0 through 4,294,967,295 seconds
  - **Default:** 0 (never)

**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 Automatic Reconnect Wait Timer on page 374
- Junos OS Interfaces and Routing Configuration Guide
bandwidth-limit (Policer for Gigabit Ethernet Interfaces)

<table>
<thead>
<tr>
<th>Syntax</th>
<th>bandwidth-limit bps;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchy Level</td>
<td>[edit interfaces interface-name gigether-options ethernet-switch-profile ethernet-policer-profile policer cos-policer-name aggregate], [edit interfaces interface-name gigether-options ethernet-switch-profile ethernet-policer-profile policer cos-policer-name premium]</td>
</tr>
<tr>
<td>Release Information</td>
<td>Statement introduced before Junos OS Release 7.4.</td>
</tr>
<tr>
<td>Description</td>
<td>Define a policer to apply to nonpremium traffic.</td>
</tr>
<tr>
<td>Options</td>
<td>bps—Bandwidth limit, in bits per second. Specify 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). Range: 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.</td>
</tr>
<tr>
<td>Required Privilege Level</td>
<td>interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.</td>
</tr>
<tr>
<td>Related Documentation</td>
<td>• Configuring Gigabit Ethernet Policers on page 671 • burst-size-limit (Policer for Gigabit Ethernet Interfaces) on page 1242</td>
</tr>
</tbody>
</table>
**bridge-domain**

**Syntax**

```
bridge-domain name;
    vlan-id [ vlan-identifiers ];
```

**Hierarchy Level**

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
    maintenance-domain-name],
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
    maintenance-domain-name virtual-switch virtual-switch-name]
```

**Release Information**

Statement introduced in Junos OS Release 9.4.

**Description**

(MX Series routers only) Specify the OAM Ethernet CFM maintenance domain bridge domain.

**Options**

- `name`—Specify the name of the bridge domain.
- `vlan-identifiers`—Specify one or more VLAN identifiers.

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- Configuring Maintenance Intermediate Points (MIPs) on page 736
- maintenance-domain on page 1172
**bridge-domains**

**Syntax**

```
bridge-domains {
  bridge-domain-name {
    bridge-options {
      ...bridge-options-configuration...
    }
  
  } 
  domain-type bridge;
  interface interface-name;
  no-irb-layer-2-copy;
  no-local-switching;
  routing-interface routing-interface-name;
  vlan-id (all | none | number);
  vlan-id-list [vlan-id-numbers];
  vlan-tags outer number inner number;
  bridge-options {
    interface interface-name {
      mac-pinning
      static-mac mac-address;
    }
    interface-mac-limit limit;
    mac-statistics;
    mac-table-size limit;
    no-mac-learning;
  }
}
```

**Hierarchy Level**

- [edit]
- [edit logical-systems logical-system-name routing-instances routing-instance-name]
- [edit routing-instances routing-instance-name]

**Release Information**

Statement introduced in Junos OS Release 8.4.
Support for logical systems added in Junos OS Release 9.6.
Support for the `no-irb-layer-2-copy` statement added in Junos OS Release 10.2.

**Description**

(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.

On MX Series routers, Integrated routing and bridging (IRB) is not supported on Pseudowire Subscriber (PS) Logical Interface. Hence you cannot add IRB to bridge domain with PS interface, that is, you cannot configure IRB and PS interface in the same bridge domain. Note that adding IRB to a bridge-domain having PS interface causes kernel crash and continuous reboot of the router until the configuration is rolled back.

**Options**

- `bridge-domain-name`—Name of the bridge domain.
NOTE: You cannot use the slash (/) character as part of the bridge domain name. If you do, the configuration will not commit.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level
- routing—To view this statement in the configuration.
- routing-control—To add this statement to the configuration.

Related Documentation
- Configuring a Bridge Domain
- Configuring a Layer 2 Virtual Switch
bfd-liveness-detection (LAG)

Syntax

```plaintext
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 or the AE interface address of the source of the BFD session.

NOTE: Beginning with Release 16.1R2, Junos OS checks and validates the configured micro BFD local-address against the interface or loopback IP address before the configuration commit. Junos OS performs this
check on both IPv4 and IPv6 micro BFD address configurations, and if they do not match, the commit fails.

**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 or the AE interface 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).

**NOTE:** The version option is not supported on the QFX Series.

**Default:** automatic

The remaining statements are explained separately. See CLI Explorer.

**Required Privilege Level**

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.
Related Documentation • authentication
  • detection-time
  • transmit-interval
  • Configuring Independent Micro BFD Sessions for LAG
  • Example: Configuring Independent Micro BFD Sessions for LAG on page 198
  • Understanding Independent Micro BFD Sessions for LAG on page 195

burst-size-limit (Policer for Gigabit Ethernet Interfaces)

Syntax burst-size-limit bytes;

Hierarchy Level [edit interfaces interface-name gigether-options ethernet-switch-profile ethernet-policer-profile policer cos-policer-name aggregate],
[edit interfaces interface-name gigether-options ethernet-switch-profile ethernet-policer-profile policer cos-policer-name premium]

Release Information Statement introduced before Junos OS Release 7.4.

Description Define a policer to apply to nonpremium traffic.

Options bytes—Burst length.
  Range: 1500 through 100,000,000 bytes

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 671
  • bandwidth-limit (Policer for Gigabit Ethernet Interfaces) on page 1236
**cak (MX Series)**

**Syntax**

```
cak hexadecimal-number;
```

**Hierarchy Level**

```
[edit security macsec connectivity-association connectivity-association-name pre-shared-key]
```

**Release Information**

Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers. Statement introduced in Junos OS Release 17.3R1 for MX10003 Universal Routing Platforms.

**Description**

Specifies the connectivity association key (CAK) for a pre-shared key.

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.

**Default**

No CAK exists, by default.

**Options**

`hexadecimal-number`—The key name, in hexadecimal format.

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.

On MX10003 router, to maximize the security, it is recommended to configure CAK of even length.

- If you configure CAK of length that is less than 32 hexadecimal digits and if cipher-suite is gcm-aes-128/gcm-aes-256 and less than 64 hexadecimal digits, then the following warning message is displayed: warning: To maximize security, recommend configuring all 32 digits of pre-shared-key cak or warning: To maximize security, recommend configuring all 64 digits of pre-shared-key cak

- On MX10003 router, if you configure the length of CAK to an odd value, then the following warning message is displayed: To maximize security, it is recommended to configure pre-shared-key cak of even length

**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
### captive-portal (MX Series in Enhanced LAN Mode)

| Syntax          | (captive-portal | no-captive-portal); |
|-----------------|------------------|
| Hierarchy Level | [edit protocols authentication-access-control] |
| Release Information | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode. |
| Description     | 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. |
| Default         | Not enabled |
| Options         | captive-portal—Enable captive portal authentication.  
                 | no-captive-portal—Disable captive portal authentication. |
| Required Privilege Level | security—to view this statement in the configuration.  
                           | security-control—to add this statement to the configuration. |
captive-portal-custom-options (MX Series in Enhanced LAN Mode)

Syntax

```plaintext
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;
}
```

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

Specify the design elements of a captive portal login page.

Options

- **banner-message**—The first screen displayed before the captive portal login page is displayed—for example, a disclaimer message.
  - **Range:** 1–2047 characters

- **footer-bgcolor** —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).
  - **Values:** # symbol followed by six characters.

- **footer-message**—Text message displayed in the footer bar across the bottom of the captive portal login page.
  - **Range:** 1–2047 characters
  - **Default:** Copyright ©2010, Juniper Networks Inc.

- **footer-text-color** — Color of the text in the footer.
  - **Default:** The default color is white.

- **form-header-bgcolor** —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.
  - **Values:** # symbol followed by six characters.

- **form-header-message**—Text message displayed in the header bar across the top of the form area of the captive portal login page.
**Range:** 1–255 characters  
**Default:** Captive Portal User Authentication

**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.

**Required Privilege**  
**Level**

routing—To view this statement in the configuration.  
routing–control—To add this statement to the configuration.
### centralized

<table>
<thead>
<tr>
<th>Syntax</th>
<th><code>centralized;</code></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchy Level</td>
<td><code>[edit protocols lACP ppm]</code></td>
</tr>
<tr>
<td>Description</td>
<td>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. 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 <code>no-delegate-processing</code> statement in the <code>[edit routing-options ppm]</code> hierarchy.</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Default</th>
<th>Distributed PPM processing is enabled for all packets that use PPM.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required Privilege Level</td>
<td>routing—To view this statement in the configuration. routing-control—To add this statement to the configuration.</td>
</tr>
</tbody>
</table>
| Related Documentation | - inline on page 1349  
- Configuring Distributed Periodic Packet Management on an EX Series Switch (CLI Procedure)  
- Configuring Aggregated Ethernet LACP (CLI Procedure)  
- Configuring Distributed Periodic Packet Management  
- Configuring Link Aggregation |
cipher-suite (MACsec)

Syntax

cipher-suite encryption-algorithm-name;

Hierarchy Level

[edit security macsec connectivity-association connectivity-association-name]

Release Information

Statement introduced in Junos OS Release 16.2R1 for MX240, MX480, MX960, MX2020, and MX2010 routers.
Statement introduced in Junos OS Release 17.2R1 for QFX Series switches.
Statement introduced in Junos OS Release 17.3R1 for JNP-MIC1-MACSEC MIC on MX10003 routers.
Statement introduced in Junos OS Release 18.2R1 for EX Series switches.

Description

Specify the set of ciphers used to encrypt traffic on an Ethernet link that is secured with Media Access Control Security (MACsec). 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. The configured cipher suites should be the same between MACsec peers.

MACsec utilizes the Galois/Counter Mode Advanced Encryption Standard (GCM-AES). The default cipher suite used for MACsec is GCM-AES-128, with a maximum key length of 128 bits. MACsec also supports GCM-AES-256, with a maximum key length of 256 bits.

GCM–AES–128 and GCM–AES–256 use a 32-bit packet number as part of the initial value that has to be unique for every packet sent with a given secure association key (SAK). When the permutations of the 32-bit packet number are exhausted, the SAK must be refreshed. The frequency of SAK refreshes can be reduced by using a cipher suite with Extended Packet Numbering (XPN), which increases the size of the packet number to 64-bits. Both GCM-AES-128 and GCM-AES-256 are available with XPN.

NOTE: When enabling MACsec on et interfaces, use either the GCM-AES-XPN-128 or GCM-AES-XPN-256 cipher suite.

NOTE: On EX4300-48MP switches, the XPN cipher suites are not supported on multi-rate ports.

Default

If the cipher-suite statement is not configured, the default cipher suite used for encryption is GCM-AES-128.

Options

gcm-aes-128—GCM-AES-128 has a maximum key size of 128 bits.
gcm-aes-xpn-128—GCM-AES-XPN-128 has a maximum key size of 128 bits and extended packet number.

gcm-aes-256—GCM-AES-256 has a maximum key size of 256 bits.

gcm-aes-xpn-256—GCM-AES-XPN-256 has a maximum key size of 256 bits and extended packet number.

Required Privilege
Level
admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Documentation
• Configuring MACsec on EX, SRX and Fusion Devices
• Configuring Media Access Control Security (MACsec) on MX Series Routers
ckn (MX Series)

**Syntax**

```
ckn hexadecimal-number;
```

**Hierarchy Level**

```
[edit security macsec connectivity-association
  connectivity-association-name pre-shared-key]
```

**Release Information**

Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers. Statement introduced in Junos OS Release 17.3R1 for MX10003 Universal Routing Platforms.

**Description**

Specifies the connectivity association key name (CKN) for a pre-shared key.

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.

**Default**

No CKN exists, by default.

**Options**

- `hexadecimal-number`—The key name, in hexadecimal format.

  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.

  - On MX10003 router, if you configure the length of CKN to the value less than 64 hexadecimal digits, then the following warning message is displayed:

    `warning: To maximize security, recommend configuring all 64 digits of pre-shared-key ckn`

  - On MX10003 router, if you configure the length of CKN to an odd value, then the commit will not be successful and the following error message is displayed:

    `error: ckn: 'abcde': Must be an even-length string up to 64 hexadecimal digits (0-9, a-f, A-F)`

**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*
**classifier**

**Syntax**
```
classifier {
    per-unit-scheduler {
        forwarding-class class-name {
            loss-priority (high | low);
        }
    }
}
```

**Hierarchy Level**
```
[edit interfaces interface-name gigether-options ethernet-switch-profile ethernet-policer-profile output-priority-map]
```

**Release Information**
Statement introduced before Junos OS Release 7.4.

**Description**
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.

The remaining statements are explained separately. See CLI Explorer.

**Required Privilege**
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**
- Specifying an Output Priority Map on page 674
- input-priority-map on page 1351

**clear**

**Syntax**
```
request protection-group ethernet-aps clear md <md> ma <ma>
```

**Hierarchy Level**
```
[edit protocols protection-group ethernet-aps]
```

**Description**
Clears the lockout, force switch, manual switch, exercise, and wait-to-restore (WTR) states.

**Required Privilege**
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**
- Ethernet Automatic Protection Switching Overview on page 229
## client

<table>
<thead>
<tr>
<th>Syntax</th>
<th>client;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchy Level</td>
<td>[edit interfaces pp0 unit logical-unit-number pppoe-options], [edit logical-systems logical-system-name interfaces pp0 unit logical-unit-number pppoe-options]</td>
</tr>
<tr>
<td>Release Information</td>
<td>Statement introduced in Junos OS Release 8.5.</td>
</tr>
<tr>
<td>Description</td>
<td>Configure the router to operate in the PPPoE client mode.</td>
</tr>
<tr>
<td>Required Privilege Level</td>
<td>interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.</td>
</tr>
<tr>
<td>Related Documentation</td>
<td>• Configuring the PPPoE Client Mode on page 375</td>
</tr>
</tbody>
</table>
community-vlans (MX Series)

Syntax

community-vlans [ number number-number ];

Hierarchy Level

[edit bridge-domains bridge-domain-name ],
[edit logical-systems logical-system-name routing-instances routing-instance-name bridge-domains bridge-domain-name bridge-options],
[edit logical-systems logical-system-name routing-instances routing-instance-name bridge-domains bridge-domain-name ],
[edit routing-instances routing-instance-name bridge-domains bridge-domain-name ],

Release Information

Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers.

Description

Configure the specified community VLAN to be a secondary VLAN of the specified primary VLAN. A community 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.

Options

number—Individual VLAN IDs separated by a space.

Required Privilege Level

system—To view this statement in the configuration.

system-control—To add this statement to the configuration.

Related Documentation
compatibility-version

Syntax

compatibility-version;

Hierarchy Level

[edit protocols protection-group ethernet-ring ring-name]

Release Information

Statement introduced in Junos OS Release 14.2.

Description

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.

Options

• 1—Use ITU-T Recommendation G.8032/Y.1344 compatible mode version 1.
• 2—Use ITU-T Recommendation G.8032/Y.1344 compatible mode version 2.

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 237
• Configuring Ethernet Ring Protection Switching on Switches (CLI Procedure)
connectivity-association (MACsec Interfaces for MX Series)

**Syntax**

```
connectivity-association connectivity-association-name;
```

**Hierarchy Level**

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

**Release Information**

Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

**Description**

Applies a connectivity association to an interface, which enables Media Access Control Security (MACsec) on that interface.

**Default**

No connectivity associations are associated with any interfaces.

**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]

**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
connectivity-association (MX Series)

Syntax  

```plaintext
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**

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*
connectivity-fault-management

Syntax

```plaintext
connectivity-fault-management {  
  action-profile profile-name {   
    action {   
      interface-down;   
      log-and-generate-ais {   
        interval (1m | 1s);   
        level value;   
        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;   
  }   
  linktrace {   
    age (30m | 10m | 1m | 30s | 10s);   
    path-database-size path-database-size;   
  }   
  expected-defect {   
    rx-enable;   
    rx-max-duration seconds;   
    tx-enable;   
    tx-duration seconds;   
  }   
  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;
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]

Release Information Statement introduced in Junos OS Release 8.4.
For Ethernet interfaces on M7i and M10i routers with Enhanced CFEB (CFEB-E), and on M20, M3020, 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. See CLI Explorer.

**Required Privilege**

**Level**

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

**Related Documentation**

- IEEE 802.1ag OAM Connectivity Fault Management Overview on page 728

---

**control-channel**

**Syntax**

```
control-channel channel-name {
  vlan vlan-id;
  interface name interface-name
}
```

**Hierarchy Level**

```
[edit protocols protection-group ethernet-ring name (east-interface | west-interface)]
```

**Release Information**

Statement introduced in Junos OS Release 9.4.

Statement introduced in Junos OS Release 12.1 for EX Series switches.


**Description**

Configure the Ethernet RPS control channel logical interface to carry the RAPS PDU. The related physical interface is the physical ring port.

**Options**

- **vlan vlan-id**—If the control channel logical interface is a trunk port, then a dedicated `vlan vlan-id` defines the dedicated VLAN channel to carry the RAPS traffic. Only configure the `vlan-id` when the control channel logical interface is the trunk port.

- **interface name interface-name**—Interface name of the control channel.

**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 237

- 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 on Switches (CLI Procedure)
### data-channel

| Syntax          | data-channel {  
|                |   vlan number;  
<table>
<thead>
<tr>
<th></th>
<th>}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchy Level</td>
<td>[edit protocols protection-group ethernet-ring ring-name]</td>
</tr>
</tbody>
</table>
| Release Information | Statement introduced in Junos OS Release 10.2.  
|                  | Statement introduced in Junos OS Release 12.1 for EX Series switches.  
| Description     | For Ethernet ring protection, configure a data channel to define a set of VLAN IDs that belong to a ring instance.  
|                  | 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. |
| Options         | vlan number—Specify (by VLAN ID) one or more VLANs that belong to a ring instance. |
| 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 Using Ring Instances for Load Balancing on page 991  
|                  | • Example: Configuring Load Balancing Within Ethernet Ring Protection for MX Series Routers on page 999  
|                  | • Example: Configuring Ethernet Ring Protection Switching on QFX Series and EX Series Switches Supporting ELS  
|                  | • Configuring Ethernet Ring Protection Switching on Switches (CLI Procedure) |
**delay (PPPoE Service Name Tables)**

**Syntax**
```
delay seconds;
```

**Hierarchy Level**
```
[edit protocols pppoe service-name-tables table-name service service-name],
[edit protocols pppoe service-name-tables table-name service-name agent-specifier
aci circuit-id-string ari remote-id-string ]
```

**Release Information**
Statement introduced in Junos OS Release 10.0.
Support at [edit protocols pppoe service-name-tables table-name service service-name
agent-specifier aci circuit-id-string ari remote-id-string ] hierarchy level introduced in Junos
OS Release 10.2.

**Description**
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

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.

**Options**

- **seconds**—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.
  **Range:** 1 through 120 seconds

**Required Privilege**

- **interface**—To view this statement in the configuration.
- **interface-control**—To add this statement to the configuration.

**Related Documentation**
- [Configuring PPPoE Service Name Tables](#)
**destination (IPCP)**

**Syntax**
```
destination address destination-profile profile-name;
```

**Hierarchy Level**
```
[edit interfaces interface-name unit logical-unit-number family inet unnumbered-address interface-name],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number family inet unnumbered-address interface-name]
```

**Release Information**
Statement introduced before Junos OS Release 7.4.

**Description**
For unnumbered interfaces with PPP encapsulation, specify the IP address of the remote interface.

**Options**
```
address—IP address of the remote interface.
```

The remaining statement is explained separately. See CLI Explorer.

**Required Privilege Level**
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

**Related Documentation**
- Configuring IPCP Options for Interfaces with PPP Encapsulation
- address on page 1213
- negotiate-address on page 1424
- Junos OS Administration Library
### device-count

<table>
<thead>
<tr>
<th>Syntax</th>
<th>device-count number;</th>
</tr>
</thead>
</table>

**Hierarchy Level**

[edit chassis aggregated-devices ethernet]
[edit chassis aggregated-devices sonet]

**Release Information**

Statement introduced before Junos OS Release 7.4.
Statement functionality updated in Junos OS Release 14.2, as described below.

**Description**

Configure the number of aggregated logical devices available to the router.

Starting in Junos release 14.2, for MX series routers, aggregated 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.)

**Options**

- **number**—Set the number of aggregated logical devices that will be available for configuration.

  **NOTE:** 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.

  For Junos OS Evolved, you can specify up to 512 aggregated Ethernet devices.

  **Range:** 1 - 496. The upper limit for this value is system specific.
  **Range:** 1 - 512 for Junos OS Evolved.

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- Configuring Junos OS for Supporting Aggregated Devices on page 133
- Configuring Aggregated SONET/SDH Interfaces
**direction (MX Series)**

| Syntax       | direction (inbound | outbound); |
|--------------|------------------|

| Hierarchy Level | [edit security macsec connectivity-association connectivity-association-name secure-channel secure-channel-name] |

| Release Information | Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers. |

| Description | Configure whether the secure channel applies MACsec security to traffic entering or leaving an interface. |

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.

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.

| Default | This statement does not have a default value. |

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.

| Options | inbound—Enable MACsec security on traffic entering the interface that has applied the secure channel. |

| | outbound—Enable MACsec security on traffic leaving the interface that has applied the secure channel. |

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 |
### disable

**Syntax**
```
disable;
```

**Hierarchy Level**
- [edit protocols lldp],
- [edit protocols lldp interface (all | interface-name)],
- [edit routing-instances routing-instance-name protocols lldp],
- [edit routing-instances routing-instance-name protocols lldp interface (all | interface-name)]

**Release Information**

**Description**
Disable LLDP globally or on an interface.

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*.

**Required Privilege Level**
- routing—To view this statement in the configuration.
- routing-control—To add this statement to the configuration.

**Related Documentation**
- [Configuring LLDP](#) on page 356
**disable (Link Protection)**

**Syntax**
```bash
disable;
```

**Hierarchy Level**
```
[edit interfaces aeX aggregated-ether-options lACP link-protection]
```

**Release Information**
- Statement introduced in Junos OS Release 9.3.
- Statement introduced in Junos OS Release 11.4 for EX Series switches.
- Statement introduced in Junos OS Release 15.1F4 for PTX Series routers.

**Description**
Disable LACP link protection on the interface.

**Required Privilege**
- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**
- Configuring LACP for Aggregated Ethernet Interfaces
- Configuring LACP Link Protection of Aggregated Ethernet Interfaces for Switches

**disable (802.1X for MX Series in Enhanced LAN Mode)**

**Syntax**
```bash
disable;
```

**Hierarchy Level**
```
[edit protocols authentication-access-control interface (all | [interface-names]) dot1x]
```

**Release Information**
- Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.

**Description**
Disable 802.1X authentication on a specified interface or all interfaces.

**Default**
802.1X authentication is disabled on all interfaces.

**Required Privilege**
- `routing`—To view this statement in the configuration.
- `routing-control`—To add this statement to the configuration.
**distribution-list**

**Syntax**

distribution-list distribution-list-number;

**Hierarchy Level**

[edit interfaces interface name gigether-options 802.3ad ]
[edit dynamic-profiles name interfaces name gigether-options 802.3ad]
[edit dynamic-profiles name logical-systems name interfaces name gigether-options 802.3ad]

**Release Information**

Statement introduced in Junos OS Release 16.1R1.

**Description**

Specify a distribution list to a Gigabit Ethernet interface to carry traffic. You can then configure the distribution list as a primary list or a backup list for the members of an aggregated Ethernet bundle.

Example:

```
[edit]
user@router# set interfaces ge-0/0/3 gigether-options 802.3ad distribution-list dl1
```

**Required Privilege Level**

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

**Related Documentation**

- Targeted Distribution of Static Logical interfaces Across Aggregated Ethernet Member Links on page 217
- targeted-options on page 1559
- targeted-distribution on page 1558
**Syntax**

dot1p-priority *number*;

**Hierarchy Level**

[edit protocols protection-group ethernet-ring *ring-name*]

**Release Information**

Statement introduced in Junos OS Release 14.2.

**Description**

Specify the IEEE 802.1p priority to be used in the transmitted RAPS protocol data units.

**Options**

*number*—802.1p priority number.

**Range:** 0 through 7

**Default:** 0

**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 237
- Configuring Ethernet Ring Protection Switching on Switches (CLI Procedure)
## dot1x

**Syntax**

```
dot1x {
    authenticator {
        authentication-profile-name access-profile-name;
        interface interface-id {
            maximum-requests integer;
            quiet-period seconds;
            reauthentication (disable | interval seconds);
            retries integer;
            server-timeout seconds;
            supplicant (single);
            supplicant-timeout seconds;
            transmit-period seconds;
        }
    }
}
```

**Hierarchy Level**

[edit protocols]

**Release Information**

Statement introduced in Junos OS Release 9.3.

**Description**

For the MX Series only, specifies settings for using 802.1x Port-Based Network Access Control.

The remaining statements are explained separately. See CLI Explorer.

**Required Privilege Level**

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**

- [IEEE 802.1x Port-Based Network Access Control Overview on page 35](#)
- [authenticator on page 1232](#)
- [authentication-profile-name on page 1231](#)
- [interface (IEEE 802.1x) on page 1356](#)
dot1x (MX Series in Enhanced LAN Mode)

Syntax

```
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;
}
```

Hierarchy Level

```
[edit protocols authentication-access-control interface (all | [interface-names ])]
```

Release Information

Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.

Description

Configure 802.1X authentication for Port-Based Network Access Control. 802.1X authentication is supported on interfaces that are members of private VLANs (PVLANs).

The remaining statements are explained separately. See CLI Explorer.

Default

802.1X is disabled.

Required Privilege

- routing—To view this statement in the configuration.
- routing-control—To add this statement to the configuration.
**domain-id**

**Syntax**
```
domain-id domain-id;
```

**Hierarchy Level**
```
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols (ospf | ospf3)],
[edit routing-instances routing-instance-name protocols (ospf | ospf3)]
```

**Release Information**
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.

**Description**
Specify a domain ID for a route. The domain ID identifies the OSPF domain from which the route originated.

**Options**
- **domain-id**—You can specify either an IP address or an IP address and a local identifier using the following format: `ip-address:local-identifier`. If you do not specify a local identifier with the IP address, the identifier is assumed to have a value of 0.
- **Default:** 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.

**Required Privilege**
- **Level**
  - routing—To view this statement in the configuration.
  - routing-control—To add this statement to the configuration.

**Related Documentation**
- [Configuring Routing Between PE and CE Routers in Layer 3 VPNs](#)
## drop (PPPoE Service Name Tables)

**Syntax**

```
drop;
```

**Hierarchy Level**

```
[edit protocols pppoe service-name-tables table-name service service-name],
[edit protocols pppoe service-name-tables table-name service service-name agent-specifier aci circuit-id-string ari remote-id-string]
```

**Release Information**


**Description**

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.

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- Configuring PPPoE Service Name Tables
**dynamic-profile (PPPoE Service Name Tables)**

**Syntax**

```
dynamic-profile profile-name;
```

**Hierarchy Level**

```
[edit protocols pppoe service-name-tables table-name service service-name],
[edit protocols pppoe service-name-tables table-name service service-name agent-specifier aci circuit-id-string ari remote-id-string]
```

**Release Information**

Statement introduced in Junos OS Release 10.2.

**Description**

Specify a dynamic profile to instantiate a dynamic PPPoE interface. You can associate a dynamic profile with a named service entry, empty service entry, or any 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.

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.

If you include the `dynamic-profile` statement at the `[edit protocols pppoe service-name-tables table-name service service-name agent-specifier aci circuit-id-string ari remote-id-string]` hierarchy level, you cannot also include the `static-interface` statement at this level. The `dynamic-profile` and `static-interface` statements are mutually exclusive for ACI/ARI pair configurations.

**Options**

- `profile-name`—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.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**

- Configuring PPPoE Service Name Tables
- Assigning a Dynamic Profile and Routing Instance to a Service Name or ACI/ARI Pair for Dynamic PPPoE Interface Creation
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.

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 remaining statements are explained separately. See CLI Explorer.

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 237
- Ethernet Ring Protection Using Ring Instances for Load Balancing on page 991
- west-interface on page 1626


- ethernet-ring on page 1301
- 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 on Switches (CLI Procedure)

### egress-policer-overhead

**Syntax**

```plaintext
egress-policer-overhead bytes;
```

**Hierarchy Level**

```
[edit chassis fpc slot-number pic pic-number]
```

**Release Information**

Statement introduced before Junos OS Release 11.1.

**Description**

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 shaping overhead bytes added to output traffic on the line card.

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).

**Options**

- **bytes**—Number of bytes added to a packet exiting an interface.
  
  **Range:** 0–255 bytes
  
  **Default:** 0

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- egress-shaping-overhead
- Policer Overhead to Account for Rate Shaping Overview
- Example: Configuring Policer Overhead to Account for Rate Shaping
- Configuring a Policer Overhead
- CoS on Enhanced IQ2 PICs Overview
encapsulation (Logical Interface)

Syntax


Hierarchy Level

[edit interfaces interface-name unit logical-unit-number],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number],
[edit interfaces risq number unit logical-unit-number]
[edit protocols evpn]

Release Information

Statement introduced in Junos OS Release 12.2 for the ACX Series Universal Metro Routers. Only the atm-ccc-cell-relay and atm-ccc-vc-mux options are supported on ACX Series routers.
Statement introduced in Junos OS Release 17.3R1 for QFX10000 Series switches (ethernet-ccc and vlan-ccc options only).

Description

Configure a logical link-layer encapsulation type. Not all encapsulation types are supported on the switches. See the switch CLI.

Options

atm-ccc-cell-relay—Use ATM cell-relay encapsulation.
atm-ccc-vc-mux—Use ATM virtual circuit (VC) multiplex encapsulation on CCC circuits. When you use this encapsulation type, you can configure the ccc family only.
atm-cisco-nlpid—Use Cisco ATM network layer protocol identifier (NLPID) encapsulation. When you use this encapsulation type, you can configure the inet family only.
atm-mlppp-llc—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.
atm-nlpid—Use ATM NLPID encapsulation. When you use this encapsulation type, you can configure the inet family only.
atm-ppp-llc—(ATM2 IQ interfaces and MX Series routers with MPC/MIC interfaces using the ATM MIC with SFP only) Use PPP over AAL5 LLC encapsulation.
atm-ppp-vc-mux—(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.

atm-snap—(All interfaces including MX Series routers with MPC/MIC interfaces using the ATM MIC with SFP) Use ATM subnetwork attachment point (SNAP) encapsulation.

atm-tcc-snap—Use ATM SNAP encapsulation on translational cross-connect (TCC) circuits.

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 router over a time-division multiplexing (TDM) link. This encapsulation type enables the PE router 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**—Use PPP over Ethernet encapsulation to configure an underlying Ethernet interface for a dynamic PPPoE logical interface on M120 and M320 routers with Intelligent Queuing 2 (IQ2) PICs, and on MX Series routers with MPCs.
**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.

**vxlan**—Use VXLAN data plane encapsulation for EVPN.

**Required Privilege Level**  
interface—to view this statement in the configuration.  
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 the CCC Encapsulation for LSP Tunnel Cross-Connects  
- Circuit and Translational Cross-Connects Overview  
- Identifying the Access Concentrator on page 374  
- Configuring ATM Interface Encapsulation  
- Configuring VLAN and Extended VLAN Encapsulation on page 275  
- 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  
- Understanding CoS on ATM IMA Pseudowire Interfaces Overview  
- Configuring Policing on an ATM IMA Pseudowire
## encapsulation

### List of Syntax

<table>
<thead>
<tr>
<th>Syntax for Physical Interfaces: M Series, MX Series, QFX Series, T Series, PTX Series</th>
<th>Syntax for Physical Interfaces: SRX Series on page 1281</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax for Logical Interfaces: SRX Series on page 1281</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Syntax for Physical Interfaces: M Series, MX Series, QFX Series, T Series, PTX Series</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Syntax for Physical Interfaces: SRX Series</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Syntax for Logical Interfaces: SRX Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>encapsulation ( dix</td>
</tr>
</tbody>
</table>

### Physical Interfaces: M Series, MX Series, QFX Series, T Series, PTX Series

- [edit interfaces interface-name],
- [edit interfaces rlsq number:number]

### Logical Interfaces

- [edit interfaces interface-name unit logical-unit-number ]

### Release Information

- Statement introduced before Junos OS Release 7.4.
- Statement introduced in Junos OS Release 9.5.
- Statement introduced in Junos OS Release 11.1 for EX Series switches.
- Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers (flexible-ethernet-services, ethernet-ccc, and ethernet-tcc options only).

### Description

For M Series, MX Series, QFX Series, T Series, PTX Series, specify the physical link-layer encapsulation type.

For SRX Series, specify logical link layer encapsulation.

### NOTE:

Not all encapsulation types are supported on the switches. See the switch CLI.
Default  **ppp**—Use serial PPP encapsulation.
Physical Interface Options and Logical Interface Options

For physical interfaces:

NOTE: Frame Relay, ATM, PPP, SONET, and SATSOP options are not supported on EX Series switches.

- **atm-ccc-cell-relay**—Use ATM cell-relay encapsulation.
- **atm-pvc**—Defined in RFC 2684, *Multiprotocol Encapsulation over ATM Adaptation Layer 5*. When you configure physical ATM interfaces with ATM PVC encapsulation, an RFC 2684-compliant ATM Adaptation Layer 5 (AAL5) tunnel is set up to route the ATM cells over a Multiprotocol Label Switching (MPLS) path that is typically established between two MPLS-capable routers using the Label Distribution Protocol (LDP).
- **cisco-hdlc**—Use Cisco-compatible High-Level Data Link Control (HDLC) framing. E1, E3, SONET/SDH, T1, and T3 interfaces can use Cisco HDLC encapsulation. Two related versions are supported:
  - CCC version (**cisco-hdlc-ccc**)—The logical interface does not require an encapsulation statement. When you use this encapsulation type, you can configure the ccc family only.
  - TCC version (**cisco-hdlc-tcc**)—Similar to CCC and has the same configuration restrictions, but used for circuits with different media on either side of the connection.
- **cisco-hdlc-ccc**—Use Cisco-compatible HDLC framing on CCC circuits.
- **cisco-hdlc-tcc**—Use Cisco-compatible HDLC framing on TCC circuits for connecting different media.
- **ethernet-bridge**—Use Ethernet bridge encapsulation on Ethernet interfaces that have bridging enabled and that must accept all packets.
- **ethernet-over-atm**—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 BPU 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 ENET/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. When you use this encapsulation type, you can configure the ccc family only.

• **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. Extended VLAN CCC encapsulation supports TPIDs 0x8100, 0x9100, and 0x9901. When you use this encapsulation type, you can configure the ccc family only. 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), and for Gigabit Ethernet interfaces, 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 is defined in RFC 1490, *Multiprotocol Interconnect over Frame Relay*. E1, E3, link services, SONET/SDH, T1, T3, and voice services interfaces can use Frame Relay encapsulation.

- **frame-relay-ccc**—Use Frame Relay encapsulation on CCC circuits. This encapsulation is same as standard Frame Relay for DLCIs 0 through 511. DLCIs 512 through 1022 are dedicated to CCC. The logical interface must also have frame-relay-ccc encapsulation. 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 the Cisco Frame Relay. IETF frame relay encapsulation identifies the payload format using NLPID and SNAP formats. Cisco-compatible Frame Relay encapsulation uses the Ethernet type to identify the type of payload.

  **NOTE:** When the encapsulation type is set to Cisco-compatible Frame Relay encapsulation, ensure that the LMI type is set to ANSI or Q933-A.

- **frame-relay-ether-type-tcc**—Use Frame Relay ether type TCC for Cisco-compatible Frame Relay on TCC circuits to connect different media. This encapsulation is Cisco-compatible Frame Relay for DLCIs 0 through 511. DLCIs 512 through 1022 are dedicated to TCC.
- **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. The connection between the two CE routers can be either user-to-network interface (UNI) or network-to-network interface (NNI); this is completely transparent to the PE routers. When you use this encapsulation type, you can configure the ccc family only.

- **frame-relay-tcc**—This encapsulation is similar to Frame Relay CCC and has the same configuration restrictions, but used for circuits with different media on either side of the connection.

- **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. This encapsulation is defined in RFC 1661, *The Point-to-Point Protocol (PPP) for the Transmission of Multiprotocol Datagrams over Point-to-Point Links*. PPP is the default encapsulation type for physical interfaces. E1, E3, SONET/SDH, T1, and T3 interfaces can use 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 CCC encapsulation supports TPID 0x8100 only. 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. 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.

For logical interfaces:

• **frame-relay**—Configure a Frame Relay encapsulation when the physical interface has multiple logical units, and the units are either point to point or multipoint.

• **multilink-frame-relay-uni-nni**—Link services interfaces functioning as FRF.16 bundles can use Multilink Frame Relay UNI NNI encapsulation.

• **ppp**—For normal mode (when the device is using only one ISDN B-channel per call). Point-to-Point Protocol is for communication between two computers using a serial interface.

• **ppp-over-ether**—This encapsulation is used for underlying interfaces of pp0 interfaces.

**Required Privilege**

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.
• Understanding Physical Encapsulation on an Interface
• 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 275
• Configuring VLAN and Extended VLAN Encapsulation on page 275
• 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
• Configuring an MPLS-Based Layer 2 VPN (CLI Procedure)
encryption (MACsec for MX Series)

Syntax

```
encryption;
```

Hierarchy Level

```
[edit security macsec connectivity-association
connectivity-association-name secure-channel
secure-channel-name]
```

Release Information

Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

Description

Enable MACsec encryption within a secure channel.

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.

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.

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 no-encryption configuration statement.

Default

MACsec encryption is disabled when MACsec is configured using static SAK security mode, by default.

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
## enhanced-convergence

### Syntax

```plaintext
enhanced-convergence;
```

### Hierarchy Level

```plaintext
[edit interfaces aeX aggregated-ether-options mc-ae]
[edit interfaces irb unit unit-number]
```

### Release Information

Statement introduced in Junos OS Release 15.1R1.
Statement introduced in Junos OS Release 15.1X53-D60 for the QFX Series.

### Description

**NOTE:** On EX9200 and QFX10000 switches, enhanced convergence is applicable for unicast traffic only—for example, when a MAC address is learned over an MC-AE interface, or an ARP entry is resolved over an MC-AE interface.

Improves Layer 2 and Layer 3 convergence time when a multichassis aggregated Ethernet (MC-AE) link goes down or comes up in a bridge domain or VLAN. Convergence time is improved because the traffic on the MC-AE interface is switched to the interchassis link (ICL) without waiting for a MAC address update.

If you have configured an IRB interface over an MC-AE interface that has enhanced convergences enabled, then you must configure enhanced convergence on the IRB interface as well. Enhanced convergence must be enabled for both Layer 2 and Layer 3 interfaces.

### Required Privilege

- **interface**—To view this statement in the configuration.
- **interface-control**—To add this statement to the configuration.

### Related Documentation

- Configuring Multichassis Link Aggregation on MX Series Routers
- Configuring Multichassis Link Aggregation
ether-options

**Syntax**

```plaintext
erther-options {  
802.3ad {  
aex;  
  (backup | primary);  
lACP {  
    force-up;  
    port-priority  
  }  
}  
(auto-negotiation | no-auto-negotiation);  
eternet-switch-profile {  
tag-protocol-id;  
}  
(flow-control | no-flow-control);  
IEEE-802-3az-EEE;  
link-mode mode;  
(loopback | no-loopback);  
speed (speed | auto-negotiation);  
}
```

**Hierarchy Level**

[edit interfaces interface-name],  
[edit interfaces interface-range range]

**Release Information**

Statement introduced in Junos OS Release 9.0 for EX Series switches.  
Statement introduced in Junos OS Release 12.3R2.

**Description**

Configure Ethernet properties for a Gigabit Ethernet interface or a 10-Gigabit Ethernet interface.

The remaining statements are explained separately. See [CLI Explorer](#).

**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 Interfaces (CLI Procedure)  
- Configuring Gigabit Ethernet Interfaces for EX Series Switches with ELS support  
- Configuring Gigabit Ethernet Interfaces (J-Web Procedure)  
- Configuring LACP Link Protection of Aggregated Ethernet Interfaces for Switches  
- Configuring Q-in-Q Tunneling on EX Series Switches with ELS Support  
- Junos OS Ethernet Interfaces Configuration Guide
### ethernet (Chassis)

**Syntax**

```
ethernet {
  device-count number;
  lacp {
    link-protection {
      non-revertive;
    }
    system-priority;
  }
}
```

**Hierarchy Level**

[edit chassis aggregated-devices]

**Release Information**

- Statement introduced before Junos OS Release 7.4.
- Statement introduced in Junos OS Release 11.4 for EX Series switches.

**Description**

Configure properties for Ethernet aggregated devices on the router.

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- Configuring Junos OS for Supporting Aggregated Devices on page 133
- Configuring LACP Link Protection of Aggregated Ethernet Interfaces for Switches
## ethernet (Protocols OAM)

### List of Syntax

Syntax: MX, T, ACX Series Routers, SRX Firewalls, M320 and EX Series Switches on page 1293
Syntax: EX Series Switches and NFX Series Devices on page 1296

```yaml
ethernet {
  connectivity-fault-management {
    action-profile profile-name {
      default-actions {
        interface-down;
      }
    }
    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;
          }
        }
      }
    }
    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);
  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;
    }
  }
}
}
evcs evc-id {
  evc-protocol cfm management-domain domain-id (management-association association-id | vpls (routing-instance instance-id));
  remote-uni-count count;
  multipoint-to-multipoint;
}
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;
}

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;
}
}
}
Syntax: EX Series
Switches and NFX
Series Devices

ethernet {
  connectivity-fault-management {
    action-profile profile-name {
      action {
        interface-down;
      }
      default-actions {
        interface-down;
      }
      event {
        adjacency-loss;
      }
    }
    esp-traceoptions {
      file filename <files number> <no-stamp> <replace> <size size> <world-readable | no-world-readable>;
      flag (all |error | esp | interface | krt | lib |normal |task |timer);
    }
    linktrace {
      age (30m | 10m | 1m | 30s | 10s);
      path-database-size path-database-size;
    }
    maintenance-domain domain-name {
      level number;
      mip-half-function (none | default |explicit);
      name-format (character-string | none | dns | mac+2oct);
      maintenance-association ma-name {
        continuity-check {
          hold-interval minutes;
          interface-status-tlv;
          interval (10m | 10s | 1m | 1s | 100ms);
          loss-threshold number;
          port-status-tlv;
        }
        mep mep-id {
          auto-discovery;
          direction down;
          interface interface-name;
          priority
          remote-mep mep-id {
            action-profile profile-name;
            sla-iterator-profile profile-name {
              data-tlv-size size;
              iteration-count count-value;
              priority priority-value;
            }
          }
        }
      }
      short-name-format (character-string | vlan | 2octet | rfc-2685-vpn-id);
    }
  }
  performance-monitoring {
    sla-iterator-profiles {
      profile-name {
        calculation-weight {
delay delay-value;
delay-variation delay-variation-value;
}
cycle-time cycle-time-value;
iteration-period iteration-period-value;
measurement-type two-way-delay;
passive;
}
}
}
traceoptions {
    file filename <files number> <match regex> <size size> <world-readable | no-world-readable>;
    flag flag;
    no-remote-trace;
}
}
link-fault-management {
    action-profile profile-name;
    action {
        syslog;
        link-down;
    }
    event {
        link-adjacency-loss;
        link-event-rate {
            frame-error count;
            frame-period count;
            frame-period-summary count;
            symbol-period count;
        }
    }
}
interface interface-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;
    }
}
}
traceoptions {
    file filename <files number> <match regex> <size size> <world-readable | no-world-readable>;
    flag flag;
    no-remote-trace;
}
Hierarchy Level [edit protocols oam]

Release Information Statement introduced in Junos OS Release 8.2 for MX, T, ACX Series routers, SRX firewalls, M320 and EX Series switches.
Statement introduced in Junos OS Release 9.4 for EX Series switches and NFX Series devices.
connectivity-fault-management introduced in Junos OS Release 10.2 for EX Series switches.

Description Provide IEEE 802.3ah Operation, Administration, and Maintenance (OAM) support for Ethernet interfaces or configure connectivity fault management (CFM) for IEEE 802.1ag Operation, Administration, and Management (OAM) support.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.
- routing—To view this statement in the configuration.
- routing-control—To add this statement to the configuration.

Related Documentation
- Enabling IEEE 802.3ah OAM Support on page 823
- Example: Configuring Ethernet OAM Link Fault Management
ethernet-policer-profile

Syntax

```
ethernet-policer-profile {
  input-priority-map {
    ieee8021p 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 remaining statements are explained separately. See CLI Explorer.

Required Privilege

**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 671


### ethernet-ring

**Syntax**

```plaintext
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.  

**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. See [CLI Explorer](#).

**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 237
- 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 on Switches (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;
      }
    }
    storm-control storm-control-profile;
    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 Metro 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.

---

1302  
Copyright © 2019, Juniper Networks, Inc.
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 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. See CLI Explorer.

NOTE: When you gather interfaces into a bridge domain, the no-mac-learn-enable statement at the [edit interfaces interface-name gigether-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.

Default If the ethernet-switch-profile 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.

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 671
- Configuring MAC Address Filtering on page 676
- Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview on page 691
- Configuring Q-in-Q Tunneling on EX Series Switches with ELS Support
evcs

Syntax

```
evcs evc-id {
  evc-protocol cfm;
  remote-uni-count count;
  multipoint-to-multipoint;
}
```

Hierarchy Level

```
[edit protocols oam ethernet]
```

Release Information

Statement introduced in Junos OS Release 9.5.

Description

On MX Series routers with ge, xe, or ae interfaces, configure an OAM Ethernet virtual connection.

Options

- `remote-uni-count count`—(Optional) Specify the number of remote UNIs in the EVC configuration, the default is 1.

- `multipoint-to-multipoint`—(Optional) Specify multiple points in the EVC configuration, the default is point-to-point if `remote-uni-count` is 1.

Remaining options 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 Ethernet Local Management Interface on page 759
- lmi (Ethernet OAM) on page 1385
evc-protocol cfm

Syntax

```
evc-protocol cfm {
  maintenance-association association-name | vpls routing-instance routing-id;
  maintenance-domain domain-id;
  mep-id mep-id;
}
```

Hierarchy Level

```
[edit protocols oam ethernet evcs]
```

Release Information

Statement introduced in Junos OS Release 9.5.

```
meq-id mep-id 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

- `management-domain domain-id`—(Optional) For CFM, specify the CFM management domain.
- `management-association association-id`—(Optional) For CFM, specify the CFM management association.
- `routing-instance instance-id`—(Optional) For VPLS, specify the VPLS routing instance.
- `mep-id mep-id`—(Required for CFM) Identifier for the maintenance association endpoint

**NOTE:** This option is available on MX Series routers only.

```
Range: 1 through 8191
```

Required Privilege

```
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 759
- lmi (Ethernet OAM) on page 1385
event (LFM)

List of Syntax

Syntax: MX, M, T, ACX Series Routers, SRX Firewalls and EX Series Switches on page 1306
Syntax: EX Series Switches and NFX Series Devices on page 1306

Syntax: MX, M, T, ACX Series Routers, SRX Firewalls and EX Series Switches

```
event {
  link-adjacency-loss;
  link-event-rate {
    frame-error count;
    frame-period count;
    frame-period-summary count;
    symbol-period count;
  }
  protocol-down;
}
```

Syntax: EX Series Switches and NFX Series Devices

```
event {
  link-adjacency-loss;
  link-event-rate {
    frame-error count;
    frame-period count;
    frame-period-summary count;
    symbol-period count;
  }
}
```

Hierarchy Level

[edit protocols oam ethernet link-fault-management action-profile]

Release Information

Statement introduced in Junos OS Release 8.5 for MX, M, T, ACX Series routers, SRX Series firewalls and EX Series switches.
Statement introduced in Junos OS Release 9.4 for EX Series switches and NFX devices.

Description

Configure link events in an action profile for Ethernet OAM link fault management (LFM).

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Monitoring Protocol Status on page 834
- Configuring Ethernet OAM Link Fault Management
### event-thresholds

**Syntax**
```
event-thresholds {
  frame-error count;
  frame-period count;
  frame-period-summary count;
  symbol-period count;
}
```

**Hierarchy Level**
```
[edit protocols oam link-fault-management interface interface-name]
```

**Release Information**
Statement introduced in Junos OS Release 8.4.

**Description**
Configure threshold limit values for link events in periodic OAM PDUs.
The remaining statements are explained separately. See CLI Explorer.

**Required Privilege**
- **interface**—To view this statement in the configuration.
- **interface-control**—To add this statement to the configuration.

**Related Documentation**
- Configuring Threshold Values for Local Fault Events on an Interface on page 827
**exclude-protocol (MX Series)**

<table>
<thead>
<tr>
<th>Syntax</th>
<th>exclude-protocol protocol-name;</th>
</tr>
</thead>
</table>

**Hierarchy Level**

[edit security macsec connectivity-association connectivity-association-name]

**Release Information**

Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

**Description**

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.

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.

**Default**

Disabled.

All packets are secured on a link when MACsec is enabled, with the exception of all types of Spanning Tree Protocol (STP) packets.

**Options**

*protocol-name*—Specifies the name of the protocol that should not be MACsec-secured.

Options include:

- cdp—Cisco Discovery Protocol.
- lacp—Link Aggregation Control Protocol.
- lldp—Link Level Discovery Protocol.

**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
## exercise

**Syntax**
```
request protection-group ethernet-aps exercise md <md> ma <ma>
```

**Hierarchy Level**
```
[edit protocols protection-group ethernet-aps]
```

**Description**
This configuration statement is used to test if APS is operating correctly, it does not interrupt regular APS operations.

**Required Privilege Level**
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**
- Ethernet Automatic Protection Switching Overview on page 229

## failover-delay

**Syntax**
```
failover-delay milliseconds;
```

**Hierarchy Level**
```
[edit protocols vrrp]
```

**Release Information**
Statement introduced in Junos OS Release 9.4.

**Description**
Configure the failover delay for VRRP and VRRP for IPv6 operations.

**Options**
- `milliseconds`—Specify the failover delay time, in milliseconds.
  - **Range:** 50 through 2000

**Required Privilege Level**
- routing—To view this statement in the configuration.
- routing-control—To add this statement to the configuration.

**Related Documentation**
- Configuring VRRP and VRRP for IPv6 on page 364
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;
nd6-stale-time seconds;
negotiate-address;
no-neighbor-learn;
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> <filter [aci]>;
(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 dcli 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;
vrp-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 interface-name unit logical-unit-number],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number]

Release Information Statement introduced before Junos OS Release 7.4.
Option max-sessions-vsa-ignore introduced in Junos OS Release 11.4.

Description Configure protocol family information for the logical interface.

NOTE: Not all subordinate statements 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. You can optionally configure this protocol family for the logical interface on which you configure VPLS.

- **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. You can configure this protocol family for the logical interface of CCC physical interfaces. When you use this encapsulation type, you can configure the **ccc** family only.

- **inet**—Internet Protocol version 4 suite. You must configure this protocol family for the logical interface to support IP protocol traffic, including Open Shortest Path First (OSPF), Border Gateway Protocol (BGP), Internet Control Message Protocol (ICMP), and Internet Protocol Control Protocol (IPCP).

- **inet6**—Internet Protocol version 6 suite. You must configure this protocol family for the logical interface to support IPv6 protocol traffic, including Routing Information Protocol for IPv6 (RIPng), Intermediate System-to-Intermediate System (IS-IS), BGP, and Virtual Router Redundancy Protocol for IPv6 (VRRP).

- **iso**—International Organization for Standardization Open Systems Interconnection (ISO OSI) protocol suite. You must configure this protocol family for the logical interface to support IS-IS traffic.

- **mlfr-end-to-end**—Multilink Frame Relay FRF.15. You must configure this protocol or multilink Point-to-Point Protocol (MLPPP) for the logical interface to support multilink bundling.

- **mlfr-uni-nni**—Multilink Frame Relay FRF.16. You must configure this protocol or **mlfr-end-to-end** for the logical interface to support link services and voice services bundling.

- **multilink-ppp**—Multilink Point-to-Point Protocol. You must configure this protocol (or **mlfr-end-to-end**) for the logical interface to support multilink bundling.

- **mpls**—Multiprotocol Label Switching (MPLS). You must configure this protocol family for the logical interface to participate in an MPLS path.

- **pppoe**—Point-to-Point Protocol over Ethernet

- **tcc**—Translational cross-connect protocol suite. You can configure this protocol family for the logical interface of TCC physical interfaces.
• **tnp**—Trivial Network Protocol. This protocol is used to communicate between the Routing Engine and the router’s packet forwarding components. The Junos OS automatically configures this protocol family on the router’s internal interfaces only, as discussed in *Understanding Internal Ethernet Interfaces*.

• **vpls**—(M Series and T Series routers only) Virtual private LAN service. You can optionally configure this protocol family for the logical interface on which you configure VPLS. VPLS provides an Ethernet-based point-to-multipoint Layer 2 VPN to connect customer edge (CE) routers across an MPLS backbone. When you configure a VPLS encapsulation type, the `family vpls` statement is assumed by default.

    MX Series routers support dynamic profiles for VPLS pseudowires, VLAN identifier translation, and automatic bridge domain configuration.

    For more information about VPLS, see the *Junos OS VPNs Library for Routing Devices*.

The remaining statements are explained separately. See **CLI Explorer**.

### Required Privilege Levels

- **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

Syntax

```
fast-aps-switch;
```

Hierarchy Level

```
[edit interfaces interface-name sonet-options aps]
```

Release Information

Statement introduced in Junos OS Release 12.1.

Description

(M320 routers with Channelized OC3/STM1 Circuit Emulation PIC with SFP only, EX Series switches, and MX series routers with Channelized OC3/STM1 Circuit Emulation PIC with SFP only using container interfaces) Reduce the Automatic Protection Switching (APS) switchover time in Layer 2 circuits.

NOTE:

- The fast APS switching feature is supported only within a single chassis on a MX series router using a container interface.
- 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.

Required Privilege

Level

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

Related Documentation

- `Reducing APS Switchover Time in Layer 2 Circuits`
fastether-options

Syntax

```text
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 remaining statements are explained separately. See CLI Explorer.

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
flexible-vlan-tagging

Syntax

```
flexible-vlan-tagging;
```

Hierarchy Level

```
[edit interfaces aex],
[edit interfaces ge-fpc/pic/port],
[edit interfaces et-fpc/pic/port],
[edit interfaces ps0],
[edit interfaces xe-fpc/pic/port]
```

Release Information

Statement introduced in Junos OS Release 8.1.
Support for aggregated Ethernet added in Junos OS Release 9.0.
Statement introduced in Junos OS Release 12.1x48 for PTX Series Packet Transport Routers.
Statement introduced in Junos OS Release 13.2X50-D15 for EX Series switches.
Statement introduced in Junos OS Release 13.2X51-D20 for the QFX Series.

Description

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.

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 and QFX Series switches.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Enabling VLAN Tagging on page 263
- Configuring Flexible VLAN Tagging on PTX Series Packet Transport Routers on page 267
- Configuring Double-Tagged VLANs on Layer 3 Logical Interfaces
flow-control

Syntax  (flow-control | no-flow-control);

Hierarchy Level  [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],
    [edit interfaces interface-name multiservice-options],
    [edit interfaces interface-range name aggregated-ether-options],
    [edit interfaces interface-range name ether-options]

Release Information  Statement introduced before Junos OS Release 7.4.
    Statement introduced in Junos OS Release 9.0 in EX Series switches.
    Statement introduced in Junos OS Release 12.2 for ACX Series Universal Metro Routers.

Description  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.

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.

Default  Flow control is enabled.

NOTE: Flow control is enabled by default only on physical interfaces and it is disabled by default on aggregated Ethernet interfaces.

Required Privilege Level  interface—To view this statement in the configuration.
    interface-control—To add this statement to the configuration.

Related Documentation  • Configuring Flow Control on page 12
    • Configuring Gigabit Ethernet Interfaces (CLI Procedure)
    • Configuring Gigabit Ethernet Interfaces for EX Series Switches with ELS support
### fnp

**Syntax**

```plaintext
fnp {
    interval <100ms | 1s | 10s | 1m | 10m>;;
    loss-threshold number
    interface interface name {
        domain-id domain-id
    }
}
```

**Hierarchy Level**

```
[edit protocols oam ethernet]
```

**Release Information**

Command introduced in Junos OS Release 11.4.

**Description**

On routers with ge, xe, or ae interfaces, configure an OAM Ethernet failure notification protocol.

**Options**

- `interval number`—Specifies the time between the transmission of FNP messages.
- `loss-threshold number`—FNP messages that can be lost before the FNP message is considered aged out and flushed.
- `interface interface-name`—Name of the Ethernet interface.
- `domain-id number`—Domain ID of the access network.

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- Ethernet Failure Notification Protocol Overview on page 866
- Configuring the Failure Notification Protocol on page 937
**force switch**

**Syntax**

```
request protection-group ethernet-aps force-switch md <md> ma <ma>
```

**Hierarchy Level**

```
[edit protocols protection-group ethernet-aps]
```

**Description**

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.

**Required Privilege**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- Ethernet Automatic Protection Switching Overview on page 229

---

**force-up**

**Syntax**

```
force-up;
```

**Hierarchy Level**

```
[edit interfaces interface-name aggregated-ethernet-options lacp]
```

**Release Information**

Statement introduced in Junos OS Release 14.2 for MX Series routers.

```
NOTE: For EX9200 switches, you must configure force-up on physical interfaces of both MC-LAG peers for this feature to work properly.
```

**Description**

Configure the peer interface (in MC-LAG) to remain up even with limited LACP capability.

**Required Privilege**

- interface— To view this statement in the configuration.
- interface-control— To add this statement to the configuration.

**Related Documentation**

- Forcing MC-LAG Links or Interfaces with Limited LACP Capability to Be Up
forwarding-class (Gigabit Ethernet IQ Classifier)

Syntax

```
forwarding-class class-name {
    loss-priority (high | low);
}
```

Hierarchy Level

```
[edit interfaces interface-name gigether-options ethernet-switch-profile ethernet-policer-profile output-priority-map classifier premium]
```

Release Information

Statement introduced before Junos OS Release 7.4.

Description

For Gigabit Ethernet IQ interfaces only, define forwarding class name and option values.

Options

- `class-name`—Name of forwarding class.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

Related Documentation

- Specifying an Output Priority Map on page 674
- `input-priority-map` on page 1351
- `forwarding-class` statement in the Class of Service Feature Guide (Routers and EX9200 Switches)
forwarding-mode (100-Gigabit Ethernet)

Syntax

```plaintext
forwarding-mode {
    (sa-multicast | ...the following vlan-steering statement...);
    vlan-steering {
        vlan-rule (high-low | odd-even);
    }
}
```

Hierarchy Level

[edit chassis fpc slot pic slot]

Release Information

Statement introduced in Junos OS Release 10.4.
Statement introduced in Junos OS Release 12.1 for MX Series routers.

Description

Configure the interoperation mode for 100-Gigabit Ethernet PIC or the 100-Gigabit Ethernet MIC.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring VLAN Steering Mode for 100-Gigabit Ethernet Type 4 PIC with CFP on page 466
- Configuring 100-Gigabit Ethernet MICs to Interoperate with Type 4 100-Gigabit Ethernet PICs (PD-1CE-CFP-FPC4) Using SA Multicast Mode
- Interoperability Between the 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and PF-1CGE-CFP on page 473
- Configuring the Interoperability Between the 100-Gigabit Ethernet PICs PF-1CGE-CFP and PD-1CE-CFP-FPC4 on page 475
- sa-multicast (100-Gigabit Ethernet) on page 1513
- vlan-rule (100-Gigabit Ethernet Type 4 PIC with CFP) on page 1616
- vlan-steering (100-Gigabit Ethernet Type 4 PIC with CFP) on page 1617
### forwarding-mode (PTX Series Packet Transport Routers)

| Syntax | forwarding-mode {  
|        |   sa-multicast  
<table>
<thead>
<tr>
<th></th>
<th>}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchy Level</td>
<td>[edit chassis fpc slot pic slot port port-number]</td>
</tr>
</tbody>
</table>
| Description | Configure interoperability between 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and P1-PTX-2-100GE-CFP.  
|            | The remaining statement is explained separately. See CLI Explorer. |
| Required Privilege Level | interface—to view this statement in the configuration.  
|            | interface-control—to add this statement to the configuration. |
| Related Documentation | • Configuring the Interoperability Between the 100-Gigabit Ethernet PICs P1-PTX-2-100GE-CFP and PD-1CE-CFP-FPC4 on page 478  
|            | • Interoperability Between the 100-Gigabit Ethernet PICs PD-1CE-CFP-FPC4 and PF-1CGE-CFP on page 473  
|            | • Configuring the Interoperability Between the 100-Gigabit Ethernet PICs PF-1CGE-CFP and PD-1CE-CFP-FPC4 on page 475 |
frame-error

Syntax
frame-error count;

Hierarchy Level
[edit protocols oam ethernet link-fault-management action-profile event link-event-rate],
[edit protocols oam link-fault-management interface interface-name event-thresholds]

Release Information
Statement introduced in Junos OS Release 8.4.

Description
Threshold for sending frame error events or taking the action specified in the action profile.

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.

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.

Options
**count**—Threshold count for frame error events.

**Range:** 0 through 100

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
- Configuring Threshold Values for Local Fault Events on an Interface on page 827
- Configuring Threshold Values for Fault Events in an Action Profile on page 835
### frame-period

**Syntax**

```plaintext
frame-period count;
```

**Hierarchy Level**

[edit protocols oam ethernet link-fault-management action-profile event link-event-rate],
[edit protocols oam link-fault-management interface interface-name event-thresholds]

**Release Information**

Statement introduced in Junos OS Release 8.4.

**Description**

Threshold for sending frame period error events or taking the action specified in the action profile.

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.

**Options**

- **count**—Threshold count for frame period error events.
  - **Range:** 0 through 100

**Required Privilege Level**

- **interface**—To view this statement in the configuration.
- **interface-control**—To add this statement to the configuration.

**Related Documentation**

- [Configuring Threshold Values for Local Fault Events on an Interface on page 827](#)
- [Configuring Threshold Values for Fault Events in an Action Profile on page 835](#)
**frame-period-summary**

**Syntax**

frame-period-summary count;

**Hierarchy Level**

[edit protocols oam ethernet link-fault-management action-profile event link-event-rate],
[edit protocols oam link-fault-management interface interface-name event-thresholds]

**Release Information**

Statement introduced in Junos OS Release 8.4.

**Description**

Threshold for sending frame period summary error events or taking the action specified in the action profile.

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.

**Options**

`count`—Threshold count for frame period summary error events.

*Range:* 0 through 100

**Required Privilege Level**

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

**Related Documentation**

- Configuring Threshold Values for Local Fault Events on an Interface on page 827
- Configuring Threshold Values for Fault Events in an Action Profile on page 835
framing (10-Gigabit Ethernet Interfaces)

Syntax
framing (lan-phy | wan-phy);

Hierarchy Level
[edit interfaces xe-fpc/pic/port]

[edit interfaces et-fpc/pic/port] (PTX Series Packet Transport Routers and MX Series Routers)

Release Information
Statement introduced in Junos OS Release 8.0.
Statement introduced in Junos OS Release 12.3R2 for PTX Series Packet Transport Routers.

Description
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.
- In Junos OS Releases 17.4R2, 17.4R3, and later, on the following MPCs or routers, you cannot configure wan-phy mode at 10-Gbps, 40-Gbps, and 100-Gbps on a per-port basis:
  - MPC7E-10G, MPC7E-MRATE, MX2K-MPC8E, and MX2K-MPC9E
  - MPC10003
  - MX204 router
  - JNP10K-LC2101 MPC

Default
Operates in LAN PHY mode.
Options

- **lan-phy**—10GBASE-R interface framing format that bypasses the WIS sublayer to directly stream block-encoded Ethernet frames on a 10-Gigabit Ethernet serial interface.

- **wan-phy**—10GBASE-W interface framing format that allows 10-Gigabit Ethernet wide area links to use fiber-optic cables and SONET devices.

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- [10-Gigabit Ethernet Framing Overview on page 445](#)
- *Configuring SONET Options for 10-Gigabit Ethernet Interfaces*
gigether-options

Syntax

```
gigether-options {
  802.3ad {
    ae (primary | backup);
    lacp {
      port-priority;
    }
  }
  (asynchronous-notification | no-asynchronous-notification);
  (auto-negotiation | no-auto-negotiation) remote-fault <local-interface-online | local-interface-offline>;
  fec {
    (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;
      }
    }
  }
```
Hierarchy Level: [edit interfaces interface-name]

Release Information: Statement introduced before Junos OS Release 7.4.

Description: Configure Gigabit Ethernet specific interface properties.

The remaining statements are explained separately. See CLI Explorer.

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
- gigether-options (ACX Series)

gratuitous-arp-reply

Syntax: (gratuitous-arp-reply | no-gratuitous-arp-reply);

Hierarchy Level: [edit interfaces interface-name]
[edit interfaces interface-range interface-range-name]

Release Information: Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 in EX Series switches.
Statement introduced in Junos OS Release 12.2 for ACX Series Universal Metro Routers.

Description: For Ethernet interfaces, enable updating of the Address Resolution Protocol (ARP) cache for gratuitous ARPs.

Default: Updating of the ARP cache is disabled on all Ethernet interfaces.

Required Privilege Level:
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

Related Documentation:
- Configuring Gratuitous ARP on page 20
- no-gratuitous-arp-request on page 1429
**guest-vlan (MX Series in Enhanced LAN Mode)**

**Syntax**

```
guest-vlan (vlan-id | vlan-name);
```

**Hierarchy Level**

```[edit protocols authentication-access-control interface (all | [interface-names]) dot1x]```

**Release Information**
Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.

**Description**
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.

**Default**
None

**Options**

- `vlan-id`—VLAN tag identifier of the guest VLAN.
- `vlan-name`—Name of the guest VLAN.

**Required Privilege Level**

- `routing`—To view this statement in the configuration.
- `routing-control`—To add this statement to the configuration.
guard-interval

Syntax  
```
guard-interval number;
```

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.

Description
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.

Options
- `number`—Guard timer interval, in milliseconds.
  - Range: 10 through 2000 ms
  - Default: 500 ms

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 237
- 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 on Switches (CLI Procedure)
## hold-interval (Protection Group)

**Syntax**

```
hold-interval number;
```

**Hierarchy Level**

```
[edit protocols protection-group ethernet-ring name]
```

**Release Information**

Statement introduced in Junos OS Release 9.4.

**Description**

Specify the hold-off timer interval for all rings in 100 millisecond (ms) increments.

**Options**

- **number**—Hold-timer interval, in milliseconds.
  - **Range:** 0 through 10,000 ms
  - **Default:** 100 ms

**Required Privilege**

- 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 237
- Example: Configuring Ethernet Ring Protection Switching on QFX Series and EX Series Switches Supporting ELS
**hold-multiplier**

**Syntax**

```plaintext
hold-multiplier number;
```

**Hierarchy Level**

- [edit protocols lldp]
- [edit routing-instances routing-instance-name protocols lldp]

**Release Information**


**Description**

Configure a value for the LLDP hold multiplier.

Hold timer interval in seconds to cache learned LLDP information before discarding.

**Options**

- **number**—Advertisement interval multiplier for LLDP cache discard.
  - **Default:** 4 (giving 120 second LLDP cache lifetime with other defaults)
  - **Range:** 2 through 10

**Required Privilege Level**

- **routing**—To view this statement in the configuration.
- **routing-control**—To add this statement to the configuration.

**Related Documentation**

- Configuring LLDP on page 356
hold-time up

Syntax
hold-time up timer-value;

Hierarchy Level
[edit interfaces ae x aggregated-ether-options lacp],

Release Information
Statement introduced in Junos OS Release 14.2R3.

Description
Specifies the time period for which the Link Aggregation Control Protocol (LACP) maintains the state of a child (member) link as expired or default.

When a child link goes from the current state to the expired state, the LACP monitors the reception of protocol data units (PDUs) on the child link for the configured hold-up time interval and does not allow the child link to transition back to the current state. This configuration thus prevents excessive flapping of a child link on an aggregated Ethernet interface.

The configured hold-up timer value is applicable to all the child links within a link aggregated (LAG) interface. By default, this feature is disabled.

Options
timer-value—Hold-up interval in seconds.

Range: 1 to 6000 seconds

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
• Configuring LACP for Aggregated Ethernet Interfaces on page 143
• Configuring Aggregated Ethernet LACP (CLI Procedure)
iccp

Syntax

```yaml
iccp [
  traceoptions; [
    file <filename> <files number> <match regular-expression> <microsecond-stamp> <size size> <world-readable | no-world-readable>;
    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;
]
```

Hierarchy Level

```
[edit protocols iccp]
[edit logical-systems logical-system-name protocols iccp]
```

Release Information


Description

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.

Default

If you do not include this statement, no ICCP protocol tracing operations are performed.

Options

- **traceoptions**—Set Interchassis Control Protocol (ICCP) tracing options.
- **local-ip-address**—Specify the source address where the ICCP packet is routed.
- **session-establishment-hold-time**—Specify if the chassis takes over as the master at the ICCP session.
- **authentication-key**—Specify TCP Message Digest 5 (MD5) option for an ICCP TCP session.
- **peer ip-address**—Specify the IP address of the peer that hosts an MC-LAG. You must configure ICCP for both peers that host the MC-LAG.
- **redundancy-group-id-list**—Specify the redundancy groups between two ICCP peers.
- **liveness-detection**—Specify Bidirectional Forwarding Detection (BFD) protocol options.
id (MACsec for MX Series)

**Syntax**
```
id {
    mac-address mac-address;
    port-id port-id-number;
}
```

**Hierarchy Level**
```
[edit security macsec connectivity-association connectivity-association-name secure-channel secure-channel-name]
```

**Release Information**
Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

**Description**
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.

**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 ICCP for MC-LAG
- Configuring Media Access Control Security (MACsec) on MX Series Routers
**ieee802.1p**

**Syntax**

```
ieee802.1p premium [ values ];
```

**Hierarchy Level**

```
[edit interfaces interface-name gigether-options ethernet-switch-profile ethernet-policer-profile input-priority-map]
[edit interfaces/interface-name ether-options ethernet-switch-profile ethernet-policer-profile input-priority-map]
```

**Release Information**


**Description**

For Gigabit Ethernet IQ and 10-Gigabit Ethernet interfaces only, configure premium priority values for IEEE 802.1p input traffic.

**Options**

`values`—Define IEEE 802.1p priority values to be treated as premium.

**Range:** 0 through 7

**Required Privilege Level**

`interface`—To view this statement in the configuration.

`interface-control`—To add this statement to the configuration.

**Related Documentation**

- [Specifying an Input Priority Map on page 673](#)
igmp-snooping

List of Syntax
Syntax (EX Series, QFX Series, and NFX Series) on page 1339
Syntax (MX Series) on page 1339
Syntax (SRX Series) on page 1341

Syntax (EX Series, QFX Series, and NFX Series)

```plaintext
igmp-snooping {
  traceoptions {
    file "filename" <files number> <size size> <world-readable | no-world-readable> <match regex>;
    flag flag (detail | disable | receive | send);
  }
  vlan (vlan-name | all) {
    data-forwarding {
      receiver {
        install;
        mode (proxy | transparent);
        (source-list | source-vlans) vlan-list;
        translate;
      }
      source {
        groups group-prefix;
      }
    }
    disable;
    immediate-leave;
    interface interface-name {
      group-limit limit;
      host-only-interface;
      immediate-leave;
      multicast-router-interface;
      static {
        group multicast-ip-address;
      }
    }
    l2-querier {
      source-address ip-address;
    }
    proxy {
      source-address ip-address;
    }
    query-interval seconds;
    query-last-member-interval seconds;
    query-response-interval seconds;
    robust-count number;
    version number;
  }
}
```

Syntax (MX Series)

```plaintext
igmp-snooping {
  immediate-leave;
  interface interface-name {
```

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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;
}
Syntax (SRX Series)

```
igmp-snooping {
  vlan (all | vlan-name) {
    immediate-leave;
    interface interface-name {
      group-limit range;
      host-only-interface;
      multicast-router-interface;
      immediate-leave;
      static {
        group multicast-ip-address {
          source ip-address;
        }
      }
    }
  }
  l2-querier {
    source-address ip-address;
  }
  proxy {
    source-address ip-address;
  }
  qualified-vlan vlan-id;
  query-interval number;
  query-last-member-interval number;
  query-response-interval number;
  robust-count number;
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier>;
  }
}
```

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.
Statement introduced in Junos OS Release 18.1R1 for SRX1500 devices.
Statement introduced in Junos OS Release 9.1 for EX Series switches.
Statement introduced in Junos OS Release 13.2 for the QFX Series.
**Description**  Configure IGMP snooping to constrain multicast traffic to only the ports that have receivers attached. IGMP snooping enables the device to selectively send out multicast packets on only the ports that need them. Without IGMP snooping, the device floods the packets on every port. The device listens for the exchange of IGMP messages by the device and the end hosts. In this way, the device builds an IGMP snooping table that has a list of all the ports that have requested a particular multicast group. The factory default configuration enables IGMP snooping on all VLANs.

**NOTE:** IGMP snooping must be disabled on the device before enabling ISSU.

**NOTE:** Starting with Junos OS Release 18.1R1, QFX5110 switches support IGMP snooping in an EVPN-VXLAN multihoming environment, but in this environment you must enable IGMP snooping on all VLANs associated with any configured VXLANs. You cannot selectively enable IGMP snooping only on those VLANs that might have interested listeners, because all the VXLANs share VXLAN tunnel endpoints (VTEPs) between the same multihoming peers and must have the same settings.

**Default**  IGMP snooping is disabled on the device.

**Options**  The remaining statements are explained separately. See CLI Explorer.

**Required Privilege Level**
- routing—To view this statement in the configuration.
- routing-control—To add this statement to the configuration.

**Related Documentation**
- IGMP Snooping in MC-LAG Active-Active Mode
- Example: Configuring IGMP Snooping on SRX Series Devices
- IGMP Snooping Overview
- Example: Preserving Bandwidth with IGMP Snooping in an EVPN-VXLAN Environment
### Ignore-L3-Incompletes

**Syntax**
```plaintext
generate-l3-incompletes;
```

**Hierarchy Level**
```
[edit interfaces interface-name fastether-options],
[edit interfaces interface-name gigether-options]
```

**Release Information**
Statement introduced in Junos OS Release 9.0.
Statement introduced in Junos OS Release 12.2 for ACX Series Universal Metro Routers.

**Description**
Ignore the counting of Layer 3 incomplete errors on Fast Ethernet, Gigabit Ethernet, and 10-Gigabit Ethernet interfaces.

**Required Privilege Level**
- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**
- Ignoring Layer 3 Incomplete Errors on page 20

### Include-SCI (MACsec for MX Series)

**Syntax**
```plaintext
include-sci;
```

**Hierarchy Level**
```
[edit security macsec connectivity-association connectivity-association-name]
```

**Release Information**
Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

**Description**
Specifies that the SCI tag should be appended to each packet on a link that has enabled MACsec.

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.

**Default**
SCI tagging is not enabled by default.

**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
**ingress-policer-overhead**

**Syntax**

```plaintext
ingress-policer-overhead bytes;
```

**Hierarchy Level**

```plaintext
[edit chassis fpc slot-number pic pic-number]
```

**Release Information**

Statement introduced before Junos OS Release 11.1. Statement introduced in Junos OS Release 15.1X49-D30 for vSRX.

**Description**

Add the configured number of bytes to the length of a packet entering the interface.

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.

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.

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.

---

**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.

```plaintext
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**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- `ingress-shaping-overhead`
- `Policer Overhead to Account for Rate Shaping Overview`
- `Example: Configuring Policier Overhead to Account for Rate Shaping`
- `Configuring a Policier Overhead`
- `CoS on Enhanced IQ2 PICs Overview`
### ingress-rate-limit

<table>
<thead>
<tr>
<th>Syntax</th>
<th><code>ingress-rate-limit rate;</code></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchy Level</td>
<td><code>[edit interfaces interface-name fastether-options]</code></td>
</tr>
<tr>
<td>Release Information</td>
<td>Statement introduced before Junos OS Release 7.4.</td>
</tr>
<tr>
<td>Description</td>
<td>Perform port-based rate limiting on ingress traffic arriving on Fast Ethernet 8-port, 12-port, and 48-port PICs.</td>
</tr>
<tr>
<td>Options</td>
<td><strong>rate</strong>—Traffic rate, in megabits per second (Mbps).&lt;br&gt;<strong>Range:</strong> 1 through 100 Mbps</td>
</tr>
<tr>
<td>Required Privilege Level</td>
<td>interface—To view this statement in the configuration.&lt;br&gt;interface-control—To add this statement to the configuration.</td>
</tr>
<tr>
<td>Related Documentation</td>
<td>• Configuring the Ingress Rate Limit on page 11</td>
</tr>
</tbody>
</table>
inner-tag-protocol-id

**Syntax**

```plaintext
inner-tag-protocol-id tpid;
```

**Hierarchy Level**

- `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`

**Release Information**

Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

**Description**

Configure the IEEE 802.1Q TPID value to rewrite for the inner tag.

All TPIDs you include in input and output VLAN maps must be among those you specify at the `edit interfaces interface-name gilether-options ethernet-switch-profile tag-protocol-id [ tpid ]` hierarchy level.

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.

**Default**

If the `inner-tag-protocol-id` statement is not configured, the TPID value is 0x8100.

**Required Privilege Level**

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**

- Configuring Inner and Outer TPIDs and VLAN IDs on page 698
### inner-vlan-id

<table>
<thead>
<tr>
<th>Syntax</th>
<th>inner-vlan-id number;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchy Level</td>
<td>[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]</td>
</tr>
<tr>
<td>Description</td>
<td>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. You cannot include the inner-vlan-id statement with the swap statement, swap-push statement, push-push statement or push-swap statement and the inner-vlan-id statement at the [edit interfaces interface-name unit logical-unit-number output-vlan-map] 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 inner-vlan-id statement you include at the [edit interfaces interface-name unit logical-unit-number] hierarchy level.</td>
</tr>
<tr>
<td>Options</td>
<td>number—VLAN ID number. Range: 0 through 4094</td>
</tr>
<tr>
<td>Required Privilege Level</td>
<td>interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.</td>
</tr>
<tr>
<td>Related Documentation</td>
<td>• Configuring Inner and Outer TPIDs and VLAN IDs on page 698</td>
</tr>
</tbody>
</table>
inline

Syntax  inline;

Hierarchy Level  [edit protocols lacp ppm]

Release Information  Statement introduced in Junos OS Release 19.1R1 for MX Series routers with MPC line cards.

Description  (MX Series routers with MPC line cards only) To enable the inline Link Aggregation Control Protocol (LACP) PDU transmission processing.

This statement disables the default distributed periodic packet management (PPM) processing for Link Aggregation Control Protocol (LACP) packets and run all Link Aggregation Control Protocol (LACP) PDU transmission processing inline. The inline option can be used in scenarios where the line card CPU is under heavy load and cannot schedule the PPM processing for LACP packets. PPM, by default, delegates the transmission of PDUs to the PPMAN process on the PFE/line card. But when the inline option is configured, it delegates the transmission of LCAP PDUs even further away from the line card CPU and into the forwarding chipset.

For example, in a system with both MPCs and DPCs, upon configuration of [protocols lacp ppm inline], the PDUs are sent inline on the MPCs and performed by periodic packet management (PPM) on DPCs.

BEST PRACTICE: We recommend to retain the default and disable distributed PPM or enable inline processing only if Juniper Networks Customer Service advises you to do so. You should disable distributed PPM or enable inline processing only if you have a compelling reason to disable it.

Refer Disabling or Enabling Inline Periodic Packet Management for LACP Packets for more details.

Default  Distributed PPM processing is enabled for all packets that use PPM.

Required Privilege Level  routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation  • centralized on page 1247
  • Disabling or Enabling Inline Periodic Packet Management for LACP Packets
  • Configuring Link Aggregation
  • Configuring Aggregated Ethernet LACP (CLI Procedure)
**input-policer**

**Syntax**

```
input-policer policer-name;
```

**Hierarchy Level**

```
[edit interfaces interface-name unit logical-unit-number layer2-policer]
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number layer2-policer]
```

**Release Information**

Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

**Description**

Apply a single-rate two-color policer to the Layer 2 input traffic at the logical interface. The `input-policer` and `input-three-color` statements are mutually exclusive.

**Options**

- `policer-name`—Name of the single-rate two-color policer that you define at the `[edit firewall]` hierarchy level.

**Usage Guidelines**

See *Applying Layer 2 Policers to Gigabit Ethernet Interfaces*.

**Required Privilege Level**

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**

- *Two-Color and Three-Color Policers at Layer 2*
- *Applying Layer 2 Policers to Gigabit Ethernet Interfaces*
  - Example: Configuring Gigabit Ethernet Policers on page 676
  - `input-three-color` on page 1352
  - `layer2-policer` on page 1369
  - `logical-interface-policer` on page 1390
  - `output-policer` on page 1447
  - `output-three-color` on page 1449
## input-priority-map

### Syntax
```
input-priority-map {
    ieee802.1p premium [ values ];
}
```

### Hierarchy Level
```
[edit interfaces interface-name gigether-options ethernet-switch-profile ethernet-policer-profile]
[edit interfaces interface-name ether-options ethernet-switch-profile ethernet-policer-profile]
```

### Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 13.2 for the QFX Series.

### Description
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.

The remaining statements are explained separately. See CLI Explorer.

### Required Privilege Level
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

### Related Documentation
- Specifying an Input Priority Map on page 673
- output-priority-map on page 1448
**input-three-color**

**Syntax**

```
input-three-color policer-name;
```

**Hierarchy Level**

- [edit interfaces interface-name unit logical-unit-number layer2-policer]
- [edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number layer2-policer]

**Release Information**

Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

**Description**

Apply a single-rate or two-rate three-color policer to the Layer 2 input traffic at the logical interface. The `input-three-color` and `input-policer` statements are mutually exclusive.

**Options**

- `policer-name`—Name of the single-rate or two-rate three-color policer.

**Usage Guidelines**

See Applying Layer 2 Policers to Gigabit Ethernet Interfaces.

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- Two-Color and Three-Color Policers at Layer 2
- Applying Layer 2 Policers to Gigabit Ethernet Interfaces
  - Example: Configuring Gigabit Ethernet Policers on page 676
- input-policer on page 1350
- layer2-policer on page 1369
- logical-interface-policer on page 1390
- output-policer on page 1447
- output-three-color on page 1449
input-vlan-map (Aggregated Ethernet)

Syntax

```plaintext
input-vlan-map {
    (pop | push | swap);
    tag-protocol-id tpid;
    vlan-id number;
}
```

Hierarchy Level

- edit interfaces interface-name unit logical-unit-number
- edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number

Release Information

Statement introduced in Junos OS Release 8.2. Starting in Junos OS Release 17.3R1, input-vlan-map for outer vlan is supported for L2 circuit over aggregated Ethernet interfaces for QFX10000 Series switches.

Description

Define the rewrite profile to be applied to incoming frames on this logical interface. On MX Series routers, this statement only applies to aggregated Ethernet interfaces using Gigabit Ethernet IQ, 10-Gigabit Ethernet IQ2 and IQ2-E interfaces and 100-Gigabit Ethernet Type 5 PIC with CFP.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

Related Documentation

- Stacking a VLAN Tag on page 701
- output-vlan-map (Aggregated Ethernet) on page 1450
**input-vlan-map**

**Syntax**

```
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;
}
```

**Hierarchy Level**

[edit interfaces interface-name unit logical-unit-number],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number]

**Release Information**

Statement introduced before Junos OS Release 7.4.

*pop-pop, pop-swap, push-push, swap-push, and swap-swap* statements introduced in Junos OS Release 8.1.

Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Statement introduced in Junos OS Release 13.2X50-D15 for EX Series switches.

Statement introduced in Junos OS Release 13.2X51-D20 for the QFX Series.

**Description**

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.

The remaining statements are explained separately. See CLI Explorer.

**NOTE:** Connectivity fault management (CFM) sessions for all interfaces in which input-vlan-map is configured are supported only if the interface also has an explicit configuration for output-vlan-map as output-vlan-map pop.; See output-vlan-map. 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.

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- Stacking a VLAN Tag on page 701
- output-vlan-map on page 1451
- Configuring Q-in-Q Tunneling on EX Series Switches with ELS Support
interface

Syntax

```
interface (all | interface-name) {
  disable;
}
```

Hierarchy Level

[edit protocols lldp],
[edit routing-instances routing-instance-name protocols lldp]

Release Information


Description

Specify an LLDP interface.

Options

`interface-name`—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

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Related Documentation

- Configuring LLDP on page 356
interface (IEEE 802.1x)

Syntax

```
interface interface-id {
  maximum-requests integer;
  quiet-period seconds;
  reauthentication (disable | interval seconds);
  retries integer;
  server-timeout seconds;
  supplicant (single);
  supplicant-timeout seconds;
  transmit-period seconds;
}
```

Hierarchy Level

```
[edit protocols dot1x authenticator]
```

Release Information
Statement introduced in Junos OS Release 9.3.

Description
Use this statement to configure the 802.1x Port-Based Network Access Control protocol-specific Ethernet interface options.

Default
The default values are provided for the options below on the respective statement pages.

Options

- **maximum-requests**—Specify the maximum number of retransmission times for an EAPOL Request packet to the client before it times out the authentication session.

- **quiet-period**—Specify the number of seconds the port remains in the wait state following a failed authentication exchange with the client, before reattempting the authentication.

- **reauthentication**—Includes two options:
  - **disable**—Periodic reauthentication of the client is disabled.
  - **interval**—Specify the periodic reauthentication time interval.

- **retries**—Specify the number of tries after which the port remains in the wait state for quiet-period seconds before reattempting the authentication.

- **server-timeout**—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.

- **supplicant (single)**—Specify supplicant single mode. See the usage guidelines to configure other modes.

- **supplicant-timeout**—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.
transmit-period—Specify the number of seconds the port waits before retransmitting the initial EAPOL PDUs to the client.

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- IEEE 802.1x Port-Based Network Access Control Overview on page 35
- authenticator on page 1232
- dot1x on page 1270
interface (OAM Link-Fault Management)

List of Syntax

Syntax: T, M, MX and ACX Series Routers, SRX Series Firewalls and EX Series Switches on page 1358
Syntax: EX Series Switches and NFX Series Devices on page 1358

Syntax: T, M, MX and ACX Series Routers, SRX Series Firewalls and EX Series Switches

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;
  }
}

Syntax: EX Series Switches and NFX Series Devices

interface interface-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 for T, M, MX and ACX Series Routers, SRX Series firewalls and EX Series switches.
Statement introduced in Junos OS Release 9.4 for EX Series switches and NFX Series devices.
**Description** Configure Ethernet OAM link fault management (LFM) for all interfaces or for specific interfaces.

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 Level**
- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.
- `routing`—To view this statement in the configuration.
- `routing-control`—To add this statement to the configuration.

**Related Documentation**
- Enabling IEEE 802.3ah OAM Support on page 823
- Example: Configuring Ethernet OAM Link Fault Management
- Configuring Ethernet OAM Link Fault Management

---

**interface (Static MAC Bypass)**

**Syntax** `interface [interface-names];`

**Hierarchy Level** `[edit protocols authentication-access-control]`

**Release Information** Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.

**Description** Configure interfaces on which the specified MAC addresses are allowed to bypass RADIUS authentication and allowed to connect to the LAN without authentication.

**Options** `interface-names`—List of interfaces.

**Required Privilege Level**
- `routing`—To view this statement in the configuration.
- `routing-control`—To add this statement to the configuration.

**Related Documentation**
interfaces (MACsec for MX Series)

Syntax

```
interfaces interface-name {
    connectivity-association connectivity-association-name;
}
```

Hierarchy Level

[edit security macsec]

Release Information

Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

Description

Applies the specified connectivity association to the specified interface to enable MACsec.

One connectivity association can be applied to multiple interfaces.

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.

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.

NOTE: Starting in Junos OS Release 16.1R2, when Media Access Control Security (MACsec) is enabled on an interface, the interface flow control capability is enabled by default, regardless of the configuration that you set using the (flow-control | no-flow-control) statement at the [edit interfaces interface-name gigether-options] hierarchy level. When MACsec is disabled, interface flow control is restored to the configuration that you set using the flow-control statement at the [edit interfaces] hierarchy level. When MACsec is enabled, additional header bytes are added to the packet by the MACsec PHY. With line rate traffic, when MACsec is enabled and flow control is disabled, the pause frames sent by the MACsec PHY are terminated by the MIC's MAC (enhanced 20-port Gigabit Ethernet MICs on MX Series routers) and not transferred to the Packet Forwarding Engine, causing framing errors. Therefore, when MACsec is enabled on an interface, flow control is also automatically enabled on such an interface.

Default

Interfaces are not associated with any connectivity associations, by default.
**interface-group**

**Syntax**

```
interface-group {
  interface-device-name
  unit-list
}
```

**Hierarchy Level**

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
  md-name maintenance-association ma-name mep mep-id remote-mep mep-id ]
```

**Release Information**

Statement introduced in Junos OS Release 18.1R1.

**Description**

Mark the interface group down for the action profile configured with the action `interface-group-down`. Provides information for the interface-group on which the configured action will be taken when the configured event occur for a specific remote MEP ID.

**Options**

- `interface-device-name`—Name of the interface device. Only Ethernet devices are allowed. The device interface name includes `ge, ae, xe and et`.
- `unit-list`—One or more logical interface unit numbers.
  - **Range:** A string in the range `<0-16385>` or `<0-16385>-<0-16385>`. For example, `unit-list[12 23-33 44]`

**Required Privilege Level**

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**

- Configuring Media Access Control Security (MACsec) on MX Series Routers
- Configuring a CFM Action Profile to Bring Down a Group of Logical Interfaces on page 1024
- `interface-group-down` on page 1362
interface-group-down

Syntax  interface-group-down

Hierarchy Level  [edit protocols oam ethernet connectivity-fault-management action-profile action-profile-name action]

Release Information  Statement introduced in Junos OS Release 18.1R1.

Description  Mark the interface group down.

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 Bring Down a Group of Logical Interfaces on page 1024
• interface-group on page 1361

interface-none

Syntax  interface-none;

Hierarchy Level  [edit protocols protection-group ethernet-ring ring-name east-interface]
[edit protocols protection-group ethernet-ring ring-name west-interface]

Description  Designates port as not used for Ethernet ring protection.

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 237
• Ethernet Ring Protection Using Ring Instances for Load Balancing on page 991
• Example: Configuring Ethernet Ring Protection Switching on EX Series Switches
• Configuring Ethernet Ring Protection Switching on Switches (CLI Procedure)
## isolated-vlan (MX Series)

**Syntax**

isolated-vlan vlan-id;

**Hierarchy Level**

```plaintext
[edit bridge-domains bridge-domain-name ],
[edit logical-systems logical-system-name routing-instances routing-instance-name bridge-domains bridge-domain-name bridge-options],
[edit logical-systems logical-system-name routing-instances routing-instance-name bridge-domains bridge-domain-name ],
[edit routing-instances routing-instance-name bridge-domains bridge-domain-name ],
```

**Release Information**

Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers.

**Description**

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.

**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 that you specify using the isolated-vlan state is treated as an isolated port.

**Options**

- `vlan-id`—Individual VLAN IDs separated by a space.

**Required Privilege**

- `system`—To view this statement in the configuration.
- `system-control`—To add this statement to the configuration.
key (MACsec for MX Series)

Syntax

```
key key-string;
```

Hierarchy Level

```
[edit security macsec connectivity-association
  connectivity-association-name secure-channel
  secure-channel-name security-association security-association-number]
```

Release Information

Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

Description

Specifies the static security key to exchange to enable MACsec using static secure association key (SAK) security mode.

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.

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.

Default

This statement does not have a default value.

Options

```
key-string — Specifies the key to exchange with the other end of the link on the secure channel. The key-string is a 32-digit hexadecimal string that is created by the user.
```

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
key-server-priority (MACsec for MX Series)

**Syntax**

```plaintext
key-server-priority priority-number;
```

**Hierarchy Level**

```plaintext
[edit security macsec connectivity-association
connectivity-association-name mka]
```

**Release Information**

Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

**Description**

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.

The switch with the lower `priority-number` is selected as the key server.

If the `priority-number` 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.

**Default**

The default key server priority number is 16.

**Options**

`priority-number`—Specifies the MKA server election priority number.

The `priority-number` can be any number between 0 and 255. The lower the number, the higher the priority.

**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
**lACP (802.3ad)**

**Syntax**

```
lACP {
    port-priority port-priority;
}
```

**Hierarchy Level**

- [edit interfaces interface-name fastether-options 802.3ad]
- [edit interfaces interface-name gigether-options 802.3ad]

**Release Information**

Statement introduced in Junos OS Release 9.3.

**Description**

Configure the Link Aggregation Control Protocol (LACP) port priority for Ethernet interfaces.

**Options**

- `port-priority`—Priority for being elected as the active port to collect and distribute traffic. A smaller value indicates a higher priority for selection.
  
  **Range:** 0 through 65,535
  
  **Default:** 127

**Required Privilege Level**

- interface—to view this statement in the configuration.
- interface-control—to add this statement to the configuration.

**Related Documentation**

- Configuring LACP for Aggregated Ethernet Interfaces on page 143
- port-priority on page 1467
### lACP (Aggregated Ethernet)

**Syntax (T, PTX, MX Series)**

```yaml
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;
}
```

**Hierarchy Level (PTX, MX Series)**

```yaml
[edit interfaces aeX aggregated-ether-options]
[edit logical-systems logical-system-name interfaces aeX aggregated-ether-options]
```

**Release Information**

- Statement introduced before Junos OS Release 7.4.
- Statement introduced in Junos OS Release 15.1F4 for PTX Series routers.
- `fast-failover` option introduced in Junos OS Release 12.2.
- Support for logical systems introduced in Junos OS Release 14.1.

**Description**

Configure the Link Aggregation Control Protocol (LACP) for aggregated Ethernet interfaces only.

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 configure 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 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 `accept-data` statement is configured.
If you do not specify LACP as either active or passive, LACP remains passive.

**Options**
- **active**—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. See [CLI Explorer](#).

**Required Privilege**
- **interface**—To view this statement in the configuration.
- **interface-control**—To add this statement to the configuration.

**Related Documentation**
- Configuring LACP for Aggregated Ethernet Interfaces on page 143
layer2-policer

Syntax

layer2-policer {
  input-policer policer-name;
  input-three-color policer-name;
  output-policer policer-name;
  output-three-color policer-name;
}

Hierarchy Level

[edit interfaces interface-name unit logical-unit-number],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number],

Release Information

Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description

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:

- Two-color
- Single-rate tricolor marking (srTCM)
- Two-rate tricolor marking (trTCM)

Two-color and tricolor policers are configured at the [edit firewall] hierarchy level.

Options

input-policer policer-name—Two-color input policer to associate with the interface. This statement is mutually exclusive with the input-three-color statement.

input-three-color policer-name—Tricolor input policer to associate with the interface. This statement is mutually exclusive with the input-policer statement.

output-policer policer-name—Two-color output policer to associate with the interface. This statement is mutually exclusive with the output-three-color statement.

output-three-color policer-name—Tricolor output policer to associate with the interface. This statement is mutually exclusive with the output-policer statement.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Applying Layer 2 Policers to Gigabit Ethernet Interfaces
- Configuring Gigabit Ethernet Two-Color and Tricolor Policers on page 678
### link-adjacency-loss

**Syntax**
```
link-adjacency-loss;
```

**Hierarchy Level**
```
[edit protocols oam ethernet link-fault-management action-profile event]
```

**Release Information**
Statement introduced in Junos OS Release 8.5.

**Description**
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 `action` statement.

**Required Privilege**
- **Level**
  - `interface`—To view this statement in the configuration.
  - `interface-control`—To add this statement to the configuration.

**Related Documentation**
- Monitoring the Loss of Link Adjacency on page 833

### link-discovery

**Syntax**
```
link-discovery (active | passive);
```

**Hierarchy Level**
```
[edit protocols oam ethernet link-fault-management interface interface-name]
```

**Release Information**
Statement introduced in Junos OS Release 8.2.

**Description**
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.

**Options**
- `(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.

**Required Privilege**
- **Level**
  - `interface`—To view this statement in the configuration.
  - `interface-control`—To add this statement to the configuration.

**Related Documentation**
- Configuring Link Discovery on page 824
link-degrade-monitor

Syntax

```
link-degrade-monitor {
  actions media-based;
  recovery {
    (auto | manual);
    timer timer;
  }
  thresholds {
    clear clear-value;
    interval interval-value;
    set set-value;
    warning-clear warning-clear-value;
    warning-set warning-set-value;
  }
}
```

Hierarchy Level

[edit interfaces interfaces-name]

Release Information

Statement introduced in Junos OS Release 15.1.

Description

Configure link degrade monitoring on an interface and specify the corrective action to be triggered when a link degrade event is detected. Deleting the configuration disables the feature. When configured, the feature monitors the quality of physical links on Ethernet interfaces (10-Gigabit, 40-Gigabit, and 100-Gigabit) and triggers the user-configured action when the link's bit error rate (BER) value breaches the preconfigured threshold. This feature can detect a BER value as low as $10^{-13}$ to $10^{-5}$.

Options

- **actions media-based**—Action to be taken when a link degrade event is detected. A media-based action brings down the physical link at both local and remote ends of the interface, and stops BER monitoring at the local end until an autorecovery is triggered.

  The remaining statements are described separately.

Required Privilege

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

Related Documentation

- Link Degrade Monitoring Overview on page 399
- thresholds on page 1561
- recovery on page 1497
- request interface link-degrade-recover on page 1671
link-down

**Syntax**

```
link-down;
```

**Hierarchy Level**

```
[edit protocols oam ethernet link-fault-management ]
```

**Release Information**

Statement introduced in Junos OS Release 8.5.

**Description**

Mark the interface down for transit traffic.

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- Specifying the Actions to Be Taken for Link-Fault Management Events on page 832

link-event-rate

**Syntax**

```
link-event-rate {
    frame-error count;
    frame-period count;
    frame-period-summary count;
    symbol-period count;
}
```

**Hierarchy Level**

```
[edit protocols oam ethernet link-fault-management action-profile event]
```

**Release Information**

Statement introduced in Junos OS Release 8.5.

**Description**

Configure the number of link-fault management events per second.

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- Configuring Threshold Values for Fault Events in an Action Profile on page 835
**link-fault-management**

**Syntax**

```plaintext
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. See CLI Explorer.
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 823
link-mode

Syntax  

```
link-mode mode (automatic | full-duplex | half-duplex);
```

Hierarchy Level  

```
[edit interfaces interface-name],
[edit interfaces interface-name ether-options],
[edit interfaces ge-pim/0/0 switch-options switch-port port-number]
```

Release Information  

Statement introduced before Junos OS Release 7.4.  
Statement introduced in Junos OS Release 9.0 for EX Series switches.  
Statement introduced in Junos OS Release 12.2 for ACX Series Universal Metro Routers.

Description  

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 or switch’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 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.
- Starting with Junos OS release 17.4R1 and later, the link-mode configuration is not supported for 10-Gigabit Ethernet interfaces.
- Starting in Junos OS release 18.4R1, half-duplex mode is supported on SRX340 and SRX345 devices.
Required Privilege Level

- interface—to view this statement in the configuration.
- interface-control—to add this statement to the configuration.

Related Documentation

- Configuring the Link Characteristics on Ethernet Interfaces on page 13
- Understanding Management Ethernet Interfaces
- Configuring Gigabit Ethernet Interfaces (CLI Procedure)
- Configuring Gigabit Ethernet Interfaces for EX Series Switches with ELS support
### link-protection

**Syntax**
```
link-protection {
  disable;
  (revertive | non-revertive);
}
```

**Hierarchy Level**
- [edit interfaces ae aggregated-ether-options]
- [edit interfaces ae aggregated-ether-options lacp]

**Release Information**
- Statement introduced in Junos OS Release 8.3.
- Statement introduced in Junos OS Release 9.0 for EX Series switches.
- Statement introduced in Junos OS Release 15.1F4 for PTX Series routers.
- Support for `disable`, `revertive`, and `non-revertive` statements added in Junos OS Release 9.3.

**Description**
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 `primary` and `backup` statements at the `[edit interfaces ge-fpc/pic/port g ether-options 802.3ad ae x]` hierarchy level or the `[edit interfaces fe-fpc/pic/port fast ether-options 802.3ad ae x]` hierarchy level.

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.

For Junos OS link protection, specify `link-protection` at the following hierarchy levels:

- `[edit interfaces ge-fpc/pic/port ether-options 802.3ad ae x]`
- `[edit interfaces xe-fpc/pic/port ether-options 802.3ad ae x]` hierarchy level or at the `[edit interfaces xe-fpc/pic/port ether-options 802.3ad ae x]` hierarchy level.

To disable link protection, use the `delete interface ae aggregate-ether-options link-protection` statement at the `[edit interfaces ae aggregated-ether-options]` hierarchy level or the `[edit interfaces ae aggregated-ether-options lacp]` hierarchy level.

**Options**
The remaining statements are explained separately. See CLI Explorer.

**Required Privilege Level**
- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**
- Configuring Aggregated Ethernet Link Protection on page 152
- Configuring LACP Link Protection of Aggregated Ethernet Interfaces for Switches
link-protection (non-LACP)

Syntax

```
link–protection {
  link–protection–revertive;
}
```

Hierarchy Level

[edit interfaces ae aggregated-ether-options]

Release Information

Statement introduced in Junos OS Release 17.3R1.

Description

User can specify the `link–protection–revertive` statement in the link protection configuration at the aggregated Ethernet interface level to set revertive mode. In revertive mode, adding a higher-priority link to the aggregated Ethernet bundle results in recalculation of the priorities and traffic will switch from the currently active link to the newly added, higher-priority link. Recalculation of priorities is performed only while link event such as addition\deletion and UP/Down operation on link, that is, configuration of this option will not result in any recalculation immediately until next link-event occurs.

In addition to enabling static 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 `primary` and `backup` statements at the [edit interfaces ge-fpc/pic/port gigether-options 802.3ad aex] hierarchy level or the [edit interfaces fe-fpc/pic/port fastether-options 802.3ad aex] hierarchy level.

For static link protection, specify `link-protection` at the following hierarchy levels:

- [edit interfaces ge-fpc/pic/port ether-options 802.3ad aex]
- [edit interfaces xe-fpc/pic/port ether-options 802.3ad aex] hierarchy level or at the [edit interfaces xe-fpc/pic/port ether-options 802.3ad aex] hierarchy level.

To disable static link protection, use the `delete interface ae aggregate-ether-options link-protection` statement at the [edit interfaces aex aggregated-ether-options] hierarchy level.

Options

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Aggregated Ethernet Link Protection on page 152
# link-speed (Aggregated Ethernet)

**Syntax**

```
link-speed speed;
```

**Hierarchy Level (EX Series)**

[edit interfaces aex aggregated-ether-options],
[edit interfaces interface-range name aggregated-ether-options],
[edit interfaces interface-range name aggregated-sonet-options]

**Release Information**

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
mixed option added in Junos OS Release 15.1F3 and 16.1R2 for PTX5000 routers and 15.1F6 and 16.1R2 for PTX3000 routers.

**Description**

For aggregated Ethernet interfaces only, set the required link speed.

**Options**

`speed`—For aggregated Ethernet links, you can specify `speed` 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 links 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.

Aggregated Ethernet links on T Series, MX Series, PTX Series routers, and QFX5100, QFX10002, QFX10008, and QFX10016 switches 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.

**mixed**—Enables bundling of different Ethernet rate links in the same Aggregated Ethernet interface.

**Required Privilege Level**

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**

- Aggregated Ethernet Interfaces Overview on page 104
- Configuring Aggregated Ethernet Link Speed on page 138
- Configuring Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles on page 127
- Configuring Aggregated Ethernet Links (CLI Procedure)
- Example: Configuring Aggregated Ethernet High-Speed Uplinks Between an EX4200 Virtual Chassis Access Switch and an EX4200 Virtual Chassis Distribution Switch
**link-speed (Aggregated SONET/SDH)**

**Syntax**

```plaintext
link-speed (speed | mixed);
```

**Hierarchy Level**

```
[edit interfaces asx aggregated-sonet-options]
```

**Release Information**

Statement introduced before Junos OS Release 7.4.

*mixed* option added in Release 8.0.

**Description**

For aggregated SONET/SDH interfaces only, set the required link speed.

**Options**

- **speed**—Aggregated SONET/SDH links can have one of the following speed values.
  - *oc3*—Links are OC3c or STM1c.
  - *oc12*—Links are OC12c or STM4c.
  - *oc48*—Links are OC48c or STM16c.
  - *oc192*—Links are OC192c or STM64c.
  - *oc768*—Links are OC768c or STM256c.

- **mixed**—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.

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- Configuring Aggregated Ethernet Link Speed on page 138
- Configuring Aggregated SONET/SDH Interfaces
lldp

Syntax

```
lldp {
    advertisement-interval seconds;
    disable;
    hold-multiplier number;
    interface (all | interface-name) {
        disable;
    }
    lldp-configuration-notification-interval seconds;
    management-address ip-management-address;
    mau-type
    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 maximum-file-size> <world-readable | no-world-readable>;
        flag flag <disable>;
    }
    transmit-delay seconds;
}
```

Hierarchy Level

[edit protocols],
[edit routing-instances routing-instance-name protocols]

Release Information


Description

Specify LLDP configuration parameters.

Options

The remaining statements are explained separately. See CLI Explorer.

Required Privilege

- routing—To view this statement in the configuration.
- routing-control—To add this statement to the configuration.

Related Documentation

- Configuring LLDP on page 356
lldp-configuration-notification-interval

Syntax  
lldp-configuration-notification-interval seconds;

Hierarchy Level  
[edit protocols lldp]  
[edit routing-instances routing-instance-name protocols lldp]

Release Information  
Statement introduced in Junos OS Release 9.6 for EX Series switches.  
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description  
Specify how often SNMP trap notifications are generated as a result of LLDP database changes.

Default  
SNMP trap notifications of LLDP database changes are disabled.

Options  
seconds—Time for the period of SNMP trap notifications about the LLDP database. This feature is disabled by default.  
Range: 5 through 3600

Required Privilege Level  
routing—To view this statement in the configuration.  
routing-control—To add this statement to the configuration.

Related Documentation  
- Configuring LLDP on page 356  
- show lldp
**trap-notification**

**Syntax**

```
trap-notification (enable|disable);
```

**Hierarchy Level**

```
[edit protocols lldp interface (all | interface-name)]
```

**Release Information**

Statement introduced in Junos OS Release 15.1R7-S3 for EX3300, EX4200, EX4500, EX4550, EX6200, EX8200 switches.

**Description**

Enables or disables the lldp/ptopo traps for the specific interface or all the interfaces.

**Default**

Trap notifications of lldp/ptopo are disabled.

- To configure LLDP/PTOPO traps on all interfaces:
  
  ```
  [edit protocols lldp]
  user@switch# set interface all trap-notification enable
  ```

- To configure LLDP/PTOPO on a specific interface:
  
  ```
  [edit protocols lldp]
  user@switch# set interface interface-name trap-notification enable
  ```

**Options**

- `enable`—Enables LLDP/PTOPO trap notifications.
- `disable`—Disables LLDP/PTOPO trap notifications.

**Required Privilege Level**

- `routing`—To view this statement in the configuration.
- `routing-control`—To add this statement to the configuration.

**Related Documentation**

- Configuring LLDP on page 356
- lldp-configuration-notification-interval on page 1383
- `show lldp`
**Imi (Ethernet OAM)**

**Syntax**
```plaintext
Imi {
  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.
load-balance

Syntax

```plaintext
load-balance {
  adaptive{
    pps;
    scan-interval multiple;
    tolerance percentage;
  }
  no-adaptive;
  per-packet;
}
```

Hierarchy Level

```
[edit interfaces ae
  aggregated-ether-options]
```

Release Information

Statement introduced in Junos OS Release 13.3.

Description

Load-balances the received traffic across all the available paths of aggregated Ethernet bundles for better link utilization.

Options

- **adaptive**—(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.
- **no-adaptive**—(MX Series and PTX Series) Disables the adaptive load-balancing solution configured to distribute traffic by using a feedback mechanism.
- **per-packet**—(MX Series only) Randomly sprays packets to the aggregate next hops in a round-robin manner to avoid traffic imbalance.

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 759
- evcs on page 1304
- Understanding Aggregated Ethernet Load Balancing on page 169
- Example: Configuring Aggregated Ethernet Load Balancing on page 173
load-balance-stateful (Aggregated Ethernet Interfaces)

Syntax

```text
load-balance-stateful {
    per-flow;
    rebalance interval;
    load-type (low | medium | large);
}
```

Hierarchy Level

```text
[edit interfaces aeX unit logical-unit-number forwarding-options]
```

Release Information

Statement introduced in Junos OS Release 13.2R1.

Description

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.

Options

```text
stateful—Define the stateful load-distribution mechanism for traffic flows on aggregated Ethernet interfaces.
```

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Stateful Load Balancing on Aggregated Ethernet Interfaces on page 192
load-type (Aggregated Ethernet Interfaces)

Syntax

load-type (low | medium | large);

Hierarchy Level

[edit interfaces aeX unit logical-unit-number forwarding-options load-balance-stateful]

Release Information

Statement introduced in Junos OS Release 13.2R1.

Description

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.

Options

- **low**—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).
- **medium**—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).
- **large**—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).

Required Privilege

- interface—to view this statement in the configuration.
- interface-control—to add this statement to the configuration.

Related Documentation

- Configuring Stateful Load Balancing on Aggregated Ethernet Interfaces on page 192
### lockout

**Syntax**

```
request protection-group ethernet-aps lockout md <md> ma <ma>
```

**Hierarchy Level**

```
[edit protocols protection-group ethernet-aps]
```

**Description**

Configure a lockout of the protection path, forcing the use of the working path and locking out the protect path regardless of anything else.

**Required Privilege Level**

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**

- [Ethernet Automatic Protection Switching Overview on page 229](#)
**logical-interface-policer**

**Syntax**

```
logical-interface-policer;
```

**Hierarchy Level**

```
[edit dynamic-profiles profile-name firewall policer policer-name],
[edit dynamic-profiles profile-name firewall three-color-policer name],
[edit firewall atm-policer atm-policer-name],
[edit firewall policer policer-name],
[edit firewall policer policer-template-name],
[edit firewall three-color-policer policer-name],
[edit logical-systems logical-system-name firewall policer policer-name],
[edit logical-systems logical-system-name firewall three-color-policer name]
```

**Release Information**

Statement introduced before Junos OS Release 7.4.
Support at the [edit firewall three-color-policer policer-name] hierarchy level introduced in Junos OS Release 8.2.
Logical systems support introduced in Junos OS Release 9.3.
Support at the [edit dynamic-profiles ... policer policer-name] and [edit dynamic-profiles ... three-color-policer name] hierarchy levels introduced in Junos OS Release 11.4.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.
Support for PTX series routers with third-generation FPCs added in Junos OS Release 18.3R1.

**Description**

Configure a logical interface policer. For PTX series routers running Junos OS Release 18.3R1 or later, you can use this command to configure separate firewall filters for different family address types (IPv4 and IPv6) that share the same interface, and configure the same policer as an action for the filter.

To configure the aggregate policer, configure the firewall policer you want to use as logical-interface-policer. And at the firewall family family-name filter filter-name hierarchy level where you will reference the policer, make the policer an interface-specific firewall filter action.

The sample configuration shows the relationship.

```
firewall {
    policer Shared_Policer {
        logical-interface-policer;
        if-exceeding {
            bandwidth-limit 100m;
            burst-size-limit 500k;
        }
        then {
            discard;
        }
    }
}
```
family inet {
    filter filter_name{
        interface-specific;
        term term_name {
            then {
                policer Shared_Policer;
                count cinet;
            }
        }
    }
}

NOTE: 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.

Required Privilege
firewall—To view this statement in the configuration.
firewall-control—To add this statement to the configuration.

Related Documentation
• Two-Color and Three-Color Logical Interface Policers
• Traffic Policer Types
• Configuring and Applying Tricolor Marking Policers
• action
• Configuring Gigabit Ethernet Two-Color and Tricolor Policers on page 678
• action
loopback (Aggregated Ethernet, Fast Ethernet, and Gigabit Ethernet)

**Syntax**

```
(loopback | no-loopback);
```

**Hierarchy Level**

- [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],
- [edit interfaces interface-range name ether-options]

For QFX Series and EX Series:

- [edit interfaces interface-name aggregated-ether-options],
- [edit interfaces interface-name ether-options],

For SRX Series Devices and vSRX:

- [edit interfaces interface-name redundant-ether-options]

**Release Information**

- Statement introduced before Junos OS Release 7.4 for MX Series.
- Statement introduced in Junos OS Release 9.0 for EX Series switches.
- Statement introduced in Junos OS Release 12.2 for ACX Series Universal Metro Routers.
- 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.
- Statement modified in Junos OS Release 9.2 for the SRX Series.

**Description**

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.

**Default**

By default, loopback is disabled.
Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
• Configuring Ethernet Loopback Capability on page 19
• Understanding Interfaces

loopback (Local and Remote)

Syntax
loopback (local | remote);

Hierarchy Level
[edit interfaces interface-name gigether-options]

Release Information
Statement introduced in Junos OS Release 15.1F3 and 16.1R2 for PTX5000 routers.
Statement introduced in Junos OS Release 15.1F6 and 16.1R2 for PTX3000 routers.

Description
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.

Options
local—Enables local loopback
remote—Enables remote loopback

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
• Configuring Ethernet Loopback Capability
### loopback-tracking

**Syntax**  

```
loopback-tracking;
```

**Hierarchy Level**  

```
[edit protocols oam ethernet link-fault-management]
```

**Release Information**  

Statement introduced in Junos OS Release 14.2.

**Description**  

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.

**Required Privilege Level**  

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**  

- IEEE 802.3ah OAM Link-Fault Management Overview on page 818
- Enabling IEEE 802.3ah OAM Support on page 823

### loss-priority

**Syntax**  

```
loss-priority (high | low);
```

**Hierarchy Level**  

```
[edit interfaces interface-name gigether-options ethernet-switch-profile ethernet-policer-profile output-priority-map classifier premium forwarding-class class-name]
```

**Release Information**  

Statement introduced before Junos OS Release 7.4.

**Description**  

Specify the packet loss priority value.

**Options**  

- **high**—Packet has high loss priority.
- **low**—Packet has low loss priority.

**Required Privilege Level**  

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**  

- Specifying an Output Priority Map on page 674
### mac

<table>
<thead>
<tr>
<th><strong>Syntax</strong></th>
<th><code>mac mac-address;</code></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hierarchy Level</strong></td>
<td><code>[edit interfaces interface-name]</code></td>
</tr>
<tr>
<td><strong>Release Information</strong></td>
<td>Statement introduced before Junos OS Release 7.4.</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Set the MAC address of the interface. Use this statement at the <code>[edit interfaces ... ps0]</code> hierarchy level to configure the MAC address for a pseudowire logical device that is used for subscriber interfaces over point-to-point MPLS pseudowires.</td>
</tr>
<tr>
<td><strong>Options</strong></td>
<td><code>mac-address</code>—MAC address. Specify the MAC address as six hexadecimal bytes in one of the following formats: <code>nnnn.nn.nn.nn</code> or <code>nnnn:nnn:nnn:nnn</code>. For example, <code>0000.5e00.5355</code> or <code>00:00:5e:00:53:55</code>.</td>
</tr>
<tr>
<td><strong>Required Privilege Level</strong></td>
<td>interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.</td>
</tr>
<tr>
<td><strong>Related Documentation</strong></td>
<td>• Configuring the MAC Address on the Management Ethernet Interface on page 29 • Configuring a Pseudowire Subscriber Logical Interface Device</td>
</tr>
</tbody>
</table>
## mac (IRB)

<table>
<thead>
<tr>
<th><strong>Syntax</strong></th>
<th><code>mac mac-address;</code></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hierarchy Level</strong></td>
<td><code>[edit interfaces irb unit logical-unit-number ]</code></td>
</tr>
<tr>
<td><strong>Release Information</strong></td>
<td>Statement introduced in Junos OS Release 13.2.</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Specify the MAC address of the IRB interface in devices that have Modular Port Concentrator (MPC) cards.</td>
</tr>
<tr>
<td><strong>Options</strong></td>
<td><strong>mac-address</strong>—Specify the MAC address as six hexadecimal bytes in one of the following hexadecimal formats: <code>nnnn:nnnn:nnnn</code> or <code>nn:nn:nn:nn:nn:nn</code>.</td>
</tr>
<tr>
<td><strong>Required Privilege Level</strong></td>
<td>interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.</td>
</tr>
<tr>
<td><strong>Related Documentation</strong></td>
<td>Example: Configuring the MAC Address of an IRB Interface on page 345</td>
</tr>
</tbody>
</table>
### mac-address (Accept Source Mac)

**Syntax**

```
mac-address mac-address policer;
```

**Hierarchy Level**

```
[edit interfaces interface-name unit logical-unit-number accept-source-mac],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number accept-source-mac]
```

#### Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.2 for ACX Series Universal Metro Routers.

#### Description

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.

#### Options

- **mac-address**—MAC address. Specify the MAC address as six hexadecimal bytes in one of the following formats: `nnnn.nnnn.nnnn` or `nnnn:nnnn:nnnn`. For example, `0011.2233.4455` or `00:11:22:33:44:55`.

- **policer**—MAC policer. For more information, see `policer (MAC)`.

#### Required Privilege

- **interface**—To view this statement in the configuration.
- **interface-control**—To add this statement to the configuration.

#### Related Documentation

- Configuring MAC Address Filtering on page 676
**mac-address (MACsec)**

**Syntax**
```
mac-address mac-address;
```

**Hierarchy Level**
```
[edit security macsec connectivity-association
connectivity-association-name secure-channel
secure-channel-name id]
```

**Release Information**
Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

**Description**
Specify a MAC address to enable MACsec using static secure association key (SAK) security mode. The `mac-address` variables must match on the sending and receiving ends of a link to enable MACsec using static SAK security mode.

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 `mac-address`.

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 `mac-address`.

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.

**Default**
No MAC address is specified in the secure channel, by default.

**Options**
- `mac-address`—The MAC address, in six groups of two hexadecimal digits.

**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](#)
**mac-learn-enable**

**Syntax**
mac-learn-enable;

**Hierarchy Level**
[edit interfaces interface-name gigether-options ethernet-switch-profile]
[edit interfaces aex aggregated-ether-options ethernet-switch-profile]

**Release Information**
Statement introduced before Junos OS Release 7.4.

**Description**
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.

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.

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.

**Required Privilege Level**
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**
- [Configuring MAC Address Filtering on page 676](#)
- [Configuring MAC Address Accounting on page 663](#)
mac-radius (MX Series in Enhanced LAN Mode)

Syntax  
```
mac-radius <flap-on-disconnect> <restrict>;
```

Hierarchy Level  
```
[edit protocols authentication-access-control interface (all | [interface-names]) dot1x]
```

Release Information  
Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.

Description  
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.

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.

To restrict authentication to MAC RADIUS only, use the restrict option. In restrictive mode, all 802.1X packets are eliminated and the attached device on the interface is considered a nonresponsive host.

Options

- **flap-on-disconnect**—(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 restrict option is also set.

- **restrict**—(Optional) Restricts authentication to MAC RADIUS only. When `mac-radius restrict` 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.

Required Privilege

- **Level**
  - routing—to view this statement in the configuration.
  - routing-control—to add this statement to the configuration.
mac-validate

Syntax

mac-validate (loose | strict);

Hierarchy Level

[edit interfaces interface-name unit logical-unit-number family family]

Release Information

Statement introduced in Junos OS Release 9.3.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description

Enable IP and MAC address validation for static Ethernet and IP demux interfaces.

Options

loose—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.

strict—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.

Required Privilege

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

• MAC Address Validation on Static Ethernet Interfaces Overview on page 255
• Configuring an IP Demultiplexing Interface
• Configuring a VLAN Demultiplexing Interface
macsec (MX Series)

Syntax

macsec {
  connectivity-association connectivity-association-name {
    cipher-suite encryption-algorithm-name;
    exclude-protocol protocol-name;
    pre-shared-key-chain macsec-pre-shared-key-chain-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;
  }
}
### major-ring-name

<table>
<thead>
<tr>
<th><strong>Syntax</strong></th>
<th>major-ring-name name;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hierarchy Level</strong></td>
<td>[edit protocols protection-group ethernet-ring ring-name]</td>
</tr>
<tr>
<td><strong>Release Information</strong></td>
<td>Statement introduced in Junos OS Release 14.2.</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Specify the name of major ring to which the sub-ring node is interconnected.</td>
</tr>
</tbody>
</table>

#### Related Documentation
- Configuring Media Access Control Security (MACsec) on MX Series Routers

### manual switch

<table>
<thead>
<tr>
<th><strong>Syntax</strong></th>
<th>request protection-group ethernet-aps manual-switch md &lt;md&gt; ma &lt;ma&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hierarchy Level</strong></td>
<td>[edit protocols protection-group ethernet-aps]</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>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.</td>
</tr>
</tbody>
</table>

#### Related Documentation
- Ethernet Automatic Protection Switching Overview on page 229
### master-only

<table>
<thead>
<tr>
<th>Syntax</th>
<th>master-only;</th>
</tr>
</thead>
</table>

| Hierarchy Level | [edit groups rex interfaces (fxp0 | em0) unit \( \text{logical-unit-number} \) family \( \text{family} \) address],  
|                 | [edit groups rex logical-systems logical-system-name interfaces fxp0 unit \( \text{logical-unit-number} \) family \( \text{family} \) address],  
|                 | [edit interfaces (fxp0 | em0) unit \( \text{logical-unit-number} \) family \( \text{family} \) address],  
|                 | [edit logical-systems logical-system-name interfaces fxp0 unit \( \text{logical-unit-number} \) family \( \text{family} \) address] |

| Release Information | Statement introduced before Junos OS Release 7.4.  
|                     | Statement introduced in Junos OS Release 11.1 for the QFX Series. |

| Description | Configure the IP address to be used when the Routing Engine is the current master. |

| Required Privilege Level | interface—To view this statement in the configuration.  
|                         | interface-control—To add this statement to the configuration. |

| Related Documentation | • Configuring a Consistent Management IP Address on page 28  
|                      | • CLI User Guide |
max-sessions (PPPoE Service Name Tables)

**Syntax**

```plaintext
max-sessions number;
```

**Hierarchy Level**

```
[edit protocols pppoe service-name-tables table-name service service-name]
```

**Release Information**

Statement introduced in Junos OS Release 10.2.

**Description**

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, empty service, or any 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.

The router uses the `max-sessions` value for a PPPoE service name table entry in conjunction with the `max-sessions` 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.

**Options**

`number`—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.

**Required Privilege Level**

- **interface**—To view this statement in the configuration.
- **interface-control**—To add this statement to the configuration.

**Related Documentation**

- Limiting the Number of Active PPPoE Sessions Established with a Specified Service Name
- Configuring PPPoE Service Name Tables
- PPPoE Maximum Session Limit Overview
- Configuring an Interface Set of Subscribers in a Dynamic Profile
- Subscriber Interfaces and PPPoE Overview
max-sessions-vsa-ignore (Static and Dynamic Subscribers)

**Syntax**

```plaintext
max-sessions-vsa-ignore;
```

**Hierarchy Level**

```
[edit dynamic-profiles profile-name interfaces demux0 unit logical-unit-number family pppoe],
[edit dynamic-profiles profile-name interfaces interface-name unit logical-unit-number family pppoe],
[edit dynamic-profiles profile-name interfaces interface-name unit logical-unit-number family pppoe-underlying-options],
[edit interfaces interface-name unit logical-unit-number family pppoe],
[edit interfaces interface-name unit logical-unit-number family pppoe-underlying-options],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number family pppoe],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number family pppoe-underlying-options]
```

**Release Information**

Statement introduced in Junos OS Release 11.4.

**Description**

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 `max-sessions` 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.

**Default**

If you do not include the `max-sessions-vsa-ignore` 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 `max-sessions` statement.

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- Limiting the Maximum Number of PPPoE Sessions on the Underlying Interface
- PPPoE Maximum Session Limit Overview
- Guidelines for Using PPPoE Maximum Session Limit from RADIUS
- Juniper Networks VSAs Supported by the AAA Service Framework
- Configuring an Interface Set of Subscribers in a Dynamic Profile
- Subscriber Interfaces and PPPoE Overview
maximun-links

Syntax  
maximun-links maximun-links-limit;

Hierarchy Level  
[edit chassis aggregated-devices]

Release Information  
Statement introduced in Junos OS Release 11.1 for T Series routers.
Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers.
Statement introduced in Junos OS Release 12.3 for MX Series routers.

Description  
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, Network Services Mode Overview.

For MX series routers and PTX series switches, the option for 64 links is only supported for Junos OS release 12.3 and later.

NOTE: This statement is not supported on the MX80, MX104, and PTX1000 routers.

Options  
maximun-links-limit—Maximum links limit for aggregated devices.
Range: 16, 32, 64

NOTE: On T-Series routers, the maximum-links supported is 32 in an aggregated Ethernet link.

Required Privilege Level  
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation  
• Network Services Mode Overview
• Configuring Junos OS for Supporting Aggregated Devices on page 133
• Configuring an Aggregated Ethernet Interface on page 110
• network-services
### maximum-requests

**Syntax**

```
maximum-requests times;
```

**Hierarchy Level**

```[edit protocols dot1x authenticator interface interface-id']```

**Release Information**

Statement introduced in Junos OS Release 9.3.

**Description**

Specify the maximum number of retransmission times of an EAPOL Request packet to the client before it times out the authentication session.

**Options**

- **times**—Specify the maximum number of retransmission times.
  - **Range:** 1 through 10 times
  - **Default:** 2 times

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- IEEE 802.1x Port-Based Network Access Control Overview on page 35
- authenticator on page 1232
- dot1x on page 1270
- interface (IEEE 802.1x) on page 1356
maximum-requests (MX Series in Enhanced LAN Mode)

Syntax

```
maximum-requests number;
```

Hierarchy Level

```
[edit protocols authentication-access-control interface (all | [interface-names]) dot1x]
```

Release Information

Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.

Description

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.

Default

Two retransmission attempts

Options

- **number**—Number of retransmission attempts.
  - **Range:** 1 through 10
  - **Default:** 2

Required Privilege

- routing—To view this statement in the configuration.
- routing-control—To add this statement to the configuration.
mc-ae

Syntax

```plaintext
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;
  revert-time revert-time;
  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 12.2 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.
- 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.
- `switchover-mode` and `revert-time` statements introduced in Junos OS Release 13.3.
- Support for logical systems introduced in Junos OS Release 14.1.

Description

Enable multichassis link aggregation groups (MC-LAG), which enables one device to form a logical LAG interface with two or more other devices.

Options

- **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.

When ICCP goes down, you can use this keyword to make a mc-lag PE to become the active PE. For example, if you want mc-lag PE1 to be Active on ICCP down, then configure this keyword in PE1. It is not recommended to configure this keyword in both the mc-lag PEs.

**NOTE:** The prefer-status-control-active statement can be configured with the status-control standby configuration to prevent the LACP MC-LAG system ID from reverting to the default LACP system ID on ICCP failure. Use this configuration only if you can ensure that ICCP will not go down unless the router or switch is down. You must also configure the hold-time down value (at the [edit interfaces interface-name] hierarchy level) for the interchassis link with the status-control standby configuration to be higher than the ICCP BFD timeout. This configuration prevents data traffic loss by ensuring that when the router or switch with the status-control active configuration goes down, the router or switch with the status-control standby configuration does not go into standby mode.

To make the prefer-status-control-active configuration work with the status-control standby configuration when an interchassis-link logical interface is configured on aggregate Ethernet interface, you must either configure the lacp periodic interval statement at the [edit interface interface-name aggregated-ether-options] hierarchy level as slow or configure the detection-time threshold statement at the [edit protocols iccp peer liveness-detection] hierarchy level as less than 3 seconds.

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.

**NOTE:** On QFX and EX Series switches, the default session establishment hold time is 300 seconds. However, the session establishment time must be at least 100 seconds higher than the init delay time. You can optionally update the session establishment time to be 340 seconds and the init delay time to be 240 seconds.
**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 should be configured as active.

**Required Privilege Level**

- **interface**—To view this statement in the configuration.
- **interface-control**—To add this statement to the configuration.
### minimum-bandwidth (aggregated Ethernet)

<table>
<thead>
<tr>
<th>Syntax</th>
<th>minimum-bandwidth bw-unit unit bw-value value;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchy Level</td>
<td>[edit interfaces aex aggregated-ether-options]</td>
</tr>
<tr>
<td>Release Information</td>
<td>Statement introduced before Junos OS Release 14.1R1 and 14.2 for MX Series.</td>
</tr>
<tr>
<td>Description</td>
<td>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.</td>
</tr>
</tbody>
</table>
| Options         | **unit**—Minimum bandwidth unit for the aggregated Ethernet bundle as bps, Gbps, Kbps, or Mbps.  
**value**—Minimum bandwidth value from 1 through 128,000.  |
| Required Privilege Level | routing—To view this statement in the configuration.  
routing-control—To add this statement to the configuration.  |
| Related Documentation | • Aggregated Ethernet Interfaces Overview on page 104  
• Understanding Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles on page 120  
• Configuring Mixed Rates and Mixed Modes on Aggregated Ethernet Bundles on page 127 |
minimum-links

Syntax (SRX, MX, T, M, EX, QFX Series, EX4600, Qfabric System)

minimum-links number;

Hierarchy Level (EX Series)

[edit interfaces ae aggregated-ether-options],
[edit interfaces ae aggregated-sonet-options],
[edit interfaces interface-name mfr-uni-nni-bundle-options],
[edit interfaces interface-name unit logical-unit-number],
[edit interfaces interface-range range aggregated-ether-options],
[edit interfaces interface-range range aggregated-sonet-options],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number]

Hierarchy Level (QFX Series)

[edit interfaces ae aggregated-ether-options]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.

Description

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.

Options

number—Number of links.

Range: 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. On EX4600, QFX Series and Q Fabric Systems, 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.

Default: 1

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

• Configuring Aggregated Ethernet Minimum Links on page 141
• Configuring Aggregated SONET/SDH Interfaces
• Configuring Aggregated Ethernet Links (CLI Procedure)
• Example: Configuring Aggregated Ethernet High-Speed Uplinks Between an EX4200 Virtual Chassis Access Switch and an EX4200 Virtual Chassis Distribution Switch
• Junos OS Services Interfaces Library for Routing Devices
• Configuring Link Aggregation

mixed-rate-mode

Syntax mixed-rate-mode;

Hierarchy Level [edit chassis fpc slot-number pic pic-number mixed-rate-mode],
[edit chassis lcc number fpc slot-number pic pic-number mixed-rate-mode] (Routing Matrix)

Release Information Statement introduced in Junos OS Release 13.3.

Description Configure the mixed-rate mode for the 24-port 10 Gigabit Ethernet PIC (PF-24XGE-SFPP) only.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
• Modes of Operation of 10-Gigabit Ethernet PICs on page 421
• Configuring Mixed-Rate Mode Operation on page 427
**mka (MX Series)**

**Syntax**
```
mka {
    must-secure;
    key-server-priority priority-number;
    transmit-interval interval;
    eapol-address (pae | provider-bridge | lldp-multicast);
}
```

**Hierarchy Level**
```
[edit security macsec connectivity-association
    connectivity-association-name]
```

**Release Information**
Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers. Option `eapol-address` introduced in Junos OS Release 18.3R1 for MX Series routers.

**Description**
Specify parameters for the MACsec Key Agreement (MKA) protocol.

**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
- eapol-address
### must-secure (MX Series)

**Syntax**

must-secure;

**Hierarchy Level**

[edit security macsec connectivity-association connectivity-association-name mka]

**Release Information**

Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

**Description**

Specifies that all traffic travelling on the MACsec-secured link must be MACsec-secured to be forwarded onward.

When the `must-secure` option is enabled, all traffic that is not MACsec-secured that is received on the interface is dropped.

When the `must-secure` option is disabled, all traffic from devices that support MACsec is MACsec-secured while traffic received from devices that do no support MACsec is forwarded through the network.

The `must-secure` 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 `must-secure` 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.

**Default**

The `must-secure` option is disabled.

**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
### mtu

#### Syntax

mtu bytes;

#### Hierarchy Level

[edit interfaces interface-name],
[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],
[edit logical-systems logical-system-name protocols l2circuit local-switching interface interface-name backup-neighbor address],
[edit logical-systems logical-system-name protocols l2circuit neighbor address interface interface-name],
[edit logical-systems logical-system-name protocols l2circuit neighbor address interface interface-name backup-neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols l2vpn interface interface-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols vpls],
[edit protocols l2circuit local-switching interface interface-name backup-neighbor address],
[edit protocols l2circuit neighbor address interface interface-name]
[edit protocols l2circuit neighbor address interface interface-name backup-neighbor address],
[edit routing-instances routing-instance-name protocols l2vpn interface interface-name],
[edit routing-instances routing-instance-name protocols vpls],
[edit logical-systems name protocols ospf area name interface ],
[edit logical-systems name routing-instances name protocols ospf area name interface],
[edit protocols ospf area name interface ],
[edit routing-instances name protocols ospf area name interface]

#### Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for Layer 2 VPNs and VPLS introduced in Junos OS Release 10.4.
Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers.
Statement introduced in Junos OS Release 12.2 for ACX Series Universal Metro Routers.
Support at the [set interfaces interface-name unit logical-unit-number family ccc] hierarchy level introduced in Junos OS Release 12.3R3 for MX Series routers.
Statement introduced in Junos OS 17.3R1 Release for MX Series Routers.

#### Description

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.

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 irb or vlan, respectively).
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.

• Starting in Release 14.2, MTU for IRB interfaces is calculated by removing the Ethernet header overhead (6(DMAC)+6(SMAC)+2(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 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), 256 through 9500 bytes (Junos OS 16.1R1 for MX Series routers)

NOTE: Starting in Junos OS Release 16.1R1, the MTU size for a media or protocol is increased from 9192 to 9500 for Ethernet interfaces on the following MX Series MPCs:

- MPC1
- MPC2
- MPC2E
- MPC3E
- MPC4E
- MPC5E
- MPC6E

Default: 1500 bytes (INET, INET6, and ISO families), 1448 bytes (MPLS), 1514 bytes (EX Series switch interfaces)

Required Privilege Level

- interface—to view this statement in the configuration.
- interface-control—to add this statement to the configuration.

Related Documentation

- Configuring the Media MTU
- Configuring the MTU for Layer 2 Interfaces
- Setting the Protocol MTU
**multicast-router-interface (IGMP Snooping)**

<table>
<thead>
<tr>
<th>Syntax</th>
<th>multicast-router-interface;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hierarchy Level</strong></td>
<td>[edit bridge-domains bridge-domain-name protocols igmp-snooping interface interface-name], [edit bridge-domains bridge-domain-name protocols igmp-snooping vlan vlan-id interface interface-name], [edit protocols igmp-snooping vlan (all</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>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.</td>
</tr>
</tbody>
</table>

**NOTE:** 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.

Configure an interface as a bridge interface toward other multicast routing devices.

**Default** Disabled. If this statement is disabled, the interface drops IGMP messages it receives. The interface can either be a host-side or multicast-routing device interface.

**Required Privilege Level** routing—To view this statement in the configuration. routing-control—To add this statement to the configuration.

**Related Documentation**
- Example: Configuring IGMP Snooping
- IGMP Snooping in MC-LAG Active-Active Mode
- host-only-interface
multi-chassis-protection

Syntax
multi-chassis-protection {
  peer a.b.c.d {
    interface interface-name;
  }
}

Hierarchy Level
[edit interfaces interface-name]

Release Information
Statement introduced in Junos OS Release 11.1.

Description
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:

If there are n + 1 logical interfaces under ae0, from ae0.0 through ae0.n, there will be n + 1 logical interfaces under ge-0/0/0 as well, from ge-0/0/0.0 through ge-0/0/0.n, and each ge-0/0/0 logical interface will be a protection link for the ae0 logical interface.

NOTE: A bridge domain cannot have MC-AE logical interfaces which belong to different redundancy groups.

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.

The remaining statements are explained separately. See CLI Explorer.

Options
- interface interface-name—Specify the interface: interface interface-name-fpc/pic/port

Required Privilege Level
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

Related Documentation
- Configuring Multichassis Link Aggregation on MX Series Routers
- Configuring Active-Active Bridging and VRRP over IRB in Multichassis Link Aggregation on MX Series Routers and QFX Series Switches
- Configuring Aggregated Ethernet Link Protection on page 152
- Example: Configuring Aggregated Ethernet Link Protection on page 154
- peer on page 1457
**negotiate-address**

**Syntax**  
negotiate-address;

**Hierarchy Level**  
[edit interfaces interface-name unit logical-unit-number family inet],  
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number family inet]

**Release Information**  
Statement introduced before Junos OS Release 7.4.

**Description**  
For interfaces with PPP encapsulation, enable the interface to be assigned an IP address by the remote end.

**Required Privilege**  
interface—To view this statement in the configuration.  
interface-control—To add this statement to the configuration.

**Related Documentation**  
- Configuring IPCP Options for Interfaces with PPP Encapsulation  
- address on page 1213  
- unnumbered-address (PPP) on page 1601  
- Junos OS Administration Library
**negotiation-options**

**Syntax**

```
negotiation-options {
  allow-remote-loopback;
  no-allow-link-events;
}
```

**Hierarchy Level**

```
[edit protocols oam link-fault-management interface interface-name]
```

**Release Information**

Statement introduced in Junos OS Release 8.4.

**Description**

Enable and disable IEEE 802.3ah Operation, Administration, and Management (OAM) features for Ethernet interfaces.

The remaining statements are explained separately. See [CLI Explorer](#).

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- [IEEE 802.3ah OAM Link-Fault Management Overview on page 818](#)

---

**no-adaptive**

**Syntax**

```
negotiation-options {
  allow-remote-loopback;
  no-allow-link-events;
}
```

**Hierarchy Level**

```
[edit protocols oam link-fault-management interface interface-name]
```

**Release Information**

Statement introduced in Junos OS Release 13.2R3.

**Description**

Configure no-adaptive on the aggregated Ethernet bundle to remove the adaptive that is configured to address the traffic imbalance.

**Required Privilege Level**

- interface - To view statement in the configuration.
- interface-control - To add this statement to the configuration.

**Related Documentation**

- [Understanding Aggregated Ethernet Load Balancing on page 169](#)
### no-allow-link-events

**Syntax**

no-allow-link-events;

**Hierarchy Level**

[edit protocols oam ethernet link-fault-management interface interface-name negotiation-options]

**Release Information**

Statement introduced in Junos OS Release 8.4.

**Description**

Disable the sending of link event TLVs.

**Required Privilege**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- Disabling the Sending of Link Event TLVs on page 828
no-encryption (MACsec for MX Series)

<table>
<thead>
<tr>
<th>Syntax</th>
<th>no-encryption;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchy Level</td>
<td>[edit security macsec connectivity-association connectivity-association-name]</td>
</tr>
<tr>
<td>Release Information</td>
<td>Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.</td>
</tr>
<tr>
<td>Description</td>
<td>Disables MACsec encryption for a connectivity association that is configured to enable MACsec using static connectivity association key (CAK) or dynamic security mode. 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. 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 encryption configuration statement.</td>
</tr>
<tr>
<td>Default</td>
<td>MACsec encryption is enabled if MACsec is enabled using static CAK or dynamic security mode.</td>
</tr>
<tr>
<td>Required Privilege Level</td>
<td>admin—To view this statement in the configuration. admin-control—To add this statement to the configuration.</td>
</tr>
<tr>
<td>Related Documentation</td>
<td>• Configuring Media Access Control Security (MACsec) on MX Series Routers</td>
</tr>
</tbody>
</table>
### no-auto-mdix

<table>
<thead>
<tr>
<th><strong>Syntax</strong></th>
<th>no-auto-mdix;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hierarchy Level</strong></td>
<td>[edit interface ge-fpc/port/pic gigether-options]</td>
</tr>
</tbody>
</table>
| **Release Information** | Statement introduced in Junos OS Release 9.5.
Statement introduced in Junos OS Release 12.2 for ACX Series Universal Metro Routers. |
| **Description** | Disable the Auto MDI/MDIX feature.
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. |
| **Default** | Auto MDI/MDIX is enabled by default. |
| **Options** | There are no options for this statement. |
| **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  
• gigether-options on page 1329. |
### no-gratuitous-arp-request

**Syntax**  
`no-gratuitous-arp-request;`

**Hierarchy Level**  
`[edit interfaces interface-name]`

**Release Information**  
Statement introduced in Junos OS Release 9.6 for EX Series switches.  
Statement introduced in Junos OS Release 12.2 for ACX Series Universal Metro Routers.

**Description**  
For Ethernet interfaces and pseudowire logical interfaces, do not respond to gratuitous ARP requests.

**Default**  
Gratuitous ARP responses are enabled on all Ethernet interfaces.

**Required Privilege Level**  
- `interface`—To view this statement in the configuration.  
- `interface-control`—To add this statement to the configuration.

**Related Documentation**  
- Configuring Gratuitous ARP on page 20
no-keepalives

Syntax

no-keepalives;

Hierarchy Level

[edit interfaces interface-name],
[edit interfaces interface-name unit logical-unit-number],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number]

Release Information

Statement introduced before Junos OS Release 7.4.

Description

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.

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:

- atm-ppp-llc—PPP over AAL5 LLC encapsulation.
- atm-ppp-vc-mux—PPP over AAL5 multiplex encapsulation.

Required Privilege

Interface—To view this statement in the configuration.

Interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Keepalives
- Disabling the Sending of PPPoE Keepalive Messages on page 378
- Configuring Frame Relay Keepalives
### no-mac-table-binding (802.1X for MX Series in Enhanced LAN Mode)

<table>
<thead>
<tr>
<th><strong>Syntax</strong></th>
<th><code>no-mac-table-binding;</code></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hierarchy Level</strong></td>
<td><code>[edit protocols authentication-access-control]</code></td>
</tr>
<tr>
<td><strong>Release Information</strong></td>
<td>Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>Not enabled</td>
</tr>
<tr>
<td><strong>Required Privilege Level</strong></td>
<td>routing—To view this statement in the configuration. routing-control—To add this statement to the configuration.</td>
</tr>
<tr>
<td><strong>Related Documentation</strong></td>
<td></td>
</tr>
</tbody>
</table>
no-native-vlan-insert

Syntax
no-native-vlan-insert;

Hierarchy Level
[edit interfaces interface-name]

Release Information
Statement introduced in Junos OS Release 17.1R1.

Description
Send traffic without the native VLAN ID (native-vlan-id) to the remote end of the network if untagged traffic is received.

If this statement is not configured, then native-vlan-id is added to untagged traffic. But if this statement is configured, then native-vlan-id is not added to untagged traffic.

NOTE:
- This feature works only on MX Series routers with MPCs/MICs. Configuring this statement on MX Series routers with DPCs results is no behavioral change. However, if you configure the statement on aggregated Ethernet (ae) interfaces with logical interfaces across MPCs/MICs and DPCs, then the MPCs/MICs and DPCs behave differently.
- In the egress direction, this feature is disrupted by VLAN normalization. Because of normalization, the egress interface cannot distinguish between untagged traffic and tagged traffic. And untagged traffic is sent out with native-vlan-id. Consider this while configuring both VLAN normalization and new native-vlan-id statement.
  
  There will be a problem with ingress firewall filter if filter term includes native-vlan-id. With no-native-vlan-insert statement configured, native-vlan-id will not be inserted to untagged traffic. So, firewall filter term will not match with untagged traffic. But if incoming traffic have VLAN ID which is equal to native-vlan-id, then firewall filter term will match and firewall will work.
- When this feature is used with AE, all sub-interfaces of AE should be in same type of FPC.

Default
By default, native-vlan-id is inserted to untagged traffic. That is, if this statement is not configured, then native-vlan-id is inserted to untagged traffic.

Required Privilege
Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.
Related Documentation

- Configuring Mixed Tagging Support for Untagged Packets
- Configuring Access Mode on a Logical Interface on page 280
- Configuring the Native VLAN Identifier on Switches With ELS Support
- Understanding Bridging and VLANs on Switches
- flexible-vlan-tagging on page 1317
- native-vlan-id
- Understanding Q-in-Q Tunneling and VLAN Translation
- Sending Untagged Traffic Without VLAN ID to Remote End on page 266

no-pre-classifier

Syntax

```plaintext
no-pre-classifier;
```

Hierarchy Level

[edit chassis fpc n pic n]

Release Information

Statement introduced in Junos OS Release 10.4.

Description

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.

NOTE: 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 no-pre-classifier statement to disable the control queue.

Default

The no-pre-classifier statement is not configured and the control queue is operational.

Required Privilege Level

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

Related Documentation

- 10-port 10-Gigabit Ethernet LAN/WAN PIC Overview on page 413
- Configuring Control Queue Disable on a 10-port 10-Gigabit Ethernet LAN/WAN PIC on page 423
# no-reauthentication (MX Series in Enhanced LAN Mode)

<table>
<thead>
<tr>
<th>Syntax</th>
<th>no-reauthentication;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchy Level</td>
<td>[edit protocols authentication-access-control interface (all</td>
</tr>
<tr>
<td>Release Information</td>
<td>Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.</td>
</tr>
<tr>
<td>Description</td>
<td>For 802.1X authentication, disables reauthentication.</td>
</tr>
<tr>
<td>Default</td>
<td>Not disabled</td>
</tr>
</tbody>
</table>
| Required Privilege Level | routing—To view this statement in the configuration.  
routeing-control—To add this statement to the configuration. |
## no-send-pads-ac-info

**Syntax**
```
no-send-pads-ac-info;
```

**Hierarchy Level**
```
[edit protocols pppoe]
```

**Release Information**
Statement introduced in Junos OS Release 12.2.

**Description**
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.

**NOTE:** 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.

**Required Privilege Level**
- **interface**—To view this statement in the configuration.
- **interface-control**—To add this statement to the configuration.

**Related Documentation**
- [Disabling the Sending of PPPoE Access Concentrator Tags in PADS Packets](#)
### no-send-pads-error

**Syntax**  
no-send-pads-error;

**Hierarchy Level**  
[edit protocols pppoe]

**Release Information**  
Statement introduced in Junos OS Release 12.3.

**Description**  
Discard PADR messages to prevent transmission of PADS control packets with AC-System-Error tags.

**Required Privilege**  
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**  
- Discarding PADR Messages to Accommodate Abnormal CPE Behavior

### non-revertive (Interfaces)

**Syntax**  
non-revertive;

**Hierarchy Level**  
[edit interfaces aeX aggregated-ether-options lACP link-protection]

**Release Information**  
- Statement introduced in Junos OS Release 9.3.
- Statement introduced in Junos OS Release 11.4 for EX Series switches.
- Statement introduced in Junos OS Release 15.1F4 for PTX Series routers.

**Description**  
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.

**Required Privilege**  
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**  
- link-protection on page 1377
- Configuring Aggregated Ethernet Link Protection on page 152
- Configuring LACP Link Protection of Aggregated Ethernet Interfaces for Switches
**non-revertive**

**Syntax**
non-revertive;

**Hierarchy Level**
[edit protocols protection-group ethernet-ring ring-name]

**Release Information**
Statement introduced in Junos OS Release 14.2.

**Description**
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.

**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 237
- Configuring Ethernet Ring Protection Switching on Switches (CLI Procedure)

---

**non-vc-mode**

**Syntax**
non-vc-mode;

**Hierarchy Level**
[edit protocols protection-group ethernet-ring ring-name]

**Release Information**
Statement introduced in Junos OS Release 14.2.

**Description**
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 non-vc-mode option should be used with care and only for open rings. Using this option for closed rings creates loops for RAPS control messages.

**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 237
- Configuring Ethernet Ring Protection Switching on Switches (CLI Procedure)
### node-id

**Syntax**
```
node-id mac-address;
```

**Hierarchy Level**
```
[edit protocols protection-group ethernet-ring ring-name]
```

**Release Information**
Statement introduced in Junos OS Release 9.4.

**Description**
For EX Series switches and QFX Series switches, node-id is not configurable.

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.

**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 237
- 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
**offset (MX Series)**

**Syntax**

```
offset (0 | 30 | 50);
```

**Hierarchy Level**

```
[edit security macsec connectivity-association connectivity-association-name]
[edit security macsec connectivity-association connectivity-association-name secure-channel secure-channel-name]
```

**Release Information**

Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

**Description**

Specifies the number of octets in an Ethernet frame that are sent in unencrypted plain-text when encryption is enabled for MACsec.

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.

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.

You configure the `offset` in the `[edit security macsec connectivity-association connectivity-association-name]` hierarchy when you are enabling MACsec using static connectivity association key (CAK) or dynamic security mode.

You configure the `offset` in the `[edit security macsec connectivity-association connectivity-association-name secure-channel secure-channel-name]` hierarchy when you are enabling MACsec using static secure association key (SAK) security mode.

**Default**

0

**Options**

0—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.

30—Specifies that the first 30 octets of each Ethernet frame are unencrypted.

---

**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
Syntax

```
oam {
  ethernet {
    connectivity-fault-management {
      action-profile profile-name {
        default-actions {
          interface-down;
        }
      }
    }
    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);
        }
      }
    }
  }
  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;
    }
}
<table>
<thead>
<tr>
<th><strong>Hierarchy Level</strong></th>
<th>[edit protocols]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>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.  The remaining statements are explained separately. See CLI Explorer.</td>
</tr>
<tr>
<td><strong>Required Privilege</strong></td>
<td>interface—To view this statement in the configuration.  interface-control—To add this statement to the configuration.</td>
</tr>
<tr>
<td><strong>Related Documentation</strong></td>
<td>• IEEE 802.3ah OAM Link-Fault Management Overview on page 818</td>
</tr>
</tbody>
</table>
optics-options

Syntax

```plaintext
optics-options {
  alarm low-light-alarm {
    (link-down | syslog);
  }
  tca tca-identifier (enable-tca | no-enable-tca) (threshold number | threshold-24hrs number);
  tx-power dbm;
  warning low-light-warning {
    (link-down | syslog);
  }
  wavelength nm;
}
```

Hierarchy Level

[edit interfaces interface-name]

Release Information

Statement introduced before Junos OS Release 7.4.
- `alarm` option and `warning` options introduced in Junos OS Release 10.0.
- Statement introduced in Junos OS Release 12.1 for EX Series switches.
- Statement and `tx-power` option introduced in Junos OS Release 13.2 for PTX Series routers.
- `tca` option introduced in Junos OS Release 14.2 for PTX Series routers.
- Statement introduced in Junos OS Release 18.3R1 for PTX10K-LC1104 on the PTX10008 and PTX10016 routers.
- Statement introduced in Junos OS Release 18.3R1 for ACX6360 routers.

Description

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.

On the PTX Series routers, when an interface is configured in 8QAM mode, you must configure both the optics from an AC400 module with the same optics-options for the links to come up.

Options

The remaining statements are explained separately. See CLI Explorer.

Required Privilege

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

Related Documentation

- Ethernet DWDM Interface Wavelength Overview on page 564
- 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
- Supported Forward Error Correction Modes on ACX6360 Router on page 587
otn-options

Syntax

```plaintext
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.

oc192 statement introduced in Junos OS Release 13.3R3 for MX Series routers.


tca option introduced in Junos OS Release 14.2 for PTX Series routers.

bytes, line-loopback, local-loopback, preemptive-fast-reroute, tca, trigger, prbs, and tti statements introduced in 18.3R1 for ACX6360 routers.

<table>
<thead>
<tr>
<th>Description</th>
<th>Specify the Ethernet optical transport network (OTN) interface and options.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Options</td>
<td>The remaining statements are explained separately. See CLI Explorer.</td>
</tr>
<tr>
<td>Required Privilege Level</td>
<td>interfaces—To view this statement in the configuration.</td>
</tr>
<tr>
<td></td>
<td>interfaces-control—To add this statement to the configuration.</td>
</tr>
<tr>
<td>Related Documentation</td>
<td>• 10-Gigabit Ethernet OTN Options Configuration Overview on page 563</td>
</tr>
<tr>
<td></td>
<td>• 100-Gigabit Ethernet OTN Options Configuration Overview on page 574</td>
</tr>
<tr>
<td></td>
<td>• Configuring 100-Gigabit DWDM OTN PICs on page 588</td>
</tr>
</tbody>
</table>
## output-policer

<table>
<thead>
<tr>
<th>Syntax</th>
<th>output-policer policer-name;</th>
</tr>
</thead>
</table>

### Hierarchy Level

```
[edit interfaces interface-name unit logical-unit-number layer2-policer],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number layer2-policer]
```

### Release Information

Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

### Description

Apply a single-rate two-color policer to the Layer 2 output traffic at the logical interface. The `output-policer` and `output-three-color` statements are mutually exclusive.

### Options

- **policer-name**—Name of the single-rate two-color policer that you define at the [edit firewall] hierarchy level.

### Required Privilege Level

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

### Related Documentation

- Two-Color and Three-Color Policers at Layer 2
- Applying Layer 2 Policers to Gigabit Ethernet Interfaces
  - Example: Configuring Gigabit Ethernet Policers on page 676
  - input-policer on page 1350
  - input-three-color on page 1352
  - layer2-policer on page 1369
  - logical-interface-policer on page 1390
  - output-three-color on page 1449
output-priority-map

Syntax

```
output-priority-map {
    classifier {
        premium {
            forwarding-class class-name {
                loss-priority (high | low);
            }
        }
    }
}
```

Hierarchy Level

- [edit interfaces interface-name gigether-options ethernet-switch-profile ethernet-policer-profile]
- [edit interfaces interface-name ether-options ethernet-switch-profile ethernet-policer-profile]

Release Information

- Statement introduced before Junos OS Release 7.4.
- Statement introduced in Junos OS Release 13.2 for the QFX Series.

Description

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.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

Related Documentation

- Specifying an Output Priority Map on page 674
- input-priority-map on page 1351
output-three-color

Syntax

```
output-three-color policer-name;
```

Hierarchy Level

```
[edit interfaces interface-name unit logical-unit-number layer2-policer]
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number layer2-policer]
```

Release Information

Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description

Apply a single-rate or two-rate three-color policer to the Layer 2 output traffic at the logical interface. The `output-three-color` and `output-policer` statements are mutually exclusive.

Options

- `policer-name`—Name of the single-rate or two-rate three-color policer.

Required Privilege

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

Related Documentation

- Two-Color and Three-Color Policers at Layer 2
- Applying Layer 2 Policers to Gigabit Ethernet Interfaces
  - Example: Configuring Gigabit Ethernet Policers on page 676
- input-three-color on page 1352
- input-policer on page 1350
- layer2-policer on page 1369
- logical-interface-policer on page 1390
- output-policer on page 1447
output-vlan-map (Aggregated Ethernet)

Syntax

```
output-vlan-map {
  (pop | push | swap);
  tag-protocol-id tpid;
  vlan-id number;
}
```

Hierarchy Level

- [edit interfaces interface-name unit logical-unit-number],
- [edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number]

Release Information

Statement introduced in Junos OS Release 8.2. Starting in Junos OS Release 17.3R1, input-vlan-map for outer vlan is supported for L2 circuit over aggregated Ethernet interfaces for QFX10000 Series switches.

Description

Define the rewrite profile to be applied to outgoing frames on this logical interface. On MX Series routers, this statement only applies to aggregated Ethernet interfaces using Gigabit Ethernet IQ, 10-Gigabit Ethernet IQ2 and IQ2-E interfaces and 100-Gigabit Ethernet Type 5 PIC with CFP.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

Related Documentation

- Stacking and Rewriting Gigabit Ethernet VLAN Tags on page 692
- input-vlan-map (Aggregated Ethernet) on page 1353
## output-vlan-map

**Syntax**

```plaintext
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;
}
```

**Hierarchy Level**

- `[/edit interfaces interface-name unit logical-unit-number]`
- `[/edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number]`

**Release Information**

Statement introduced before Junos OS Release 7.4.


Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

**Description**

For EX Series switches, defines the rewrite operation to be applied to outgoing frames.

For MX Series routers and NFX Series devices' Gigabit Ethernet IQ and 10-Port 10-Gigabit Ethernet SFPP interfaces only, defines the rewrite operation to be applied to outgoing frames on this logical interface.

The remaining statements are explained separately. See CLI Explorer.

**Required Privilege**

- **Level**
  - interface—To view this statement in the configuration.
  - interface-control—To add this statement to the configuration.

**Related Documentation**

- Stacking and Rewriting Gigabit Ethernet VLAN Tags on page 692
- input-vlan-map on page 1354
**pado-advertise**

**Syntax**
pado-advertise;

**Hierarchy Level**
[edit protocols pppoe]

**Release Information**
Statement introduced in Junos OS Release 10.2.

**Description**
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.

---

**Required Privilege Level**
- **interface**—To view this statement in the configuration.
- **interface-control**—To add this statement to the configuration.

**Related Documentation**
- Configuring PPPoE Service Name Tables
- Enabling Advertisement of Named Services in PADO Control Packets
passive-monitor-mode

Syntax

```
passive-monitor-mode;
```

Hierarchy Level

```
[edit interfaces interface-name],
[edit interfaces interface-name unit logical-unit-number],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number]
```

Release Information

Statement introduced before Junos OS Release 7.4.

Description

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.

This statement is supported on ATM, Ethernet, and SONET/SDH interfaces. For more information, see ATM Interfaces Feature Guide for Routing Devices.

For ATM and Ethernet interfaces, you can include this statement on the physical interface only.

For SONET/SDH interfaces, you can include this statement on the logical interface only.

Required Privilege Level

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

Related Documentation

- Enabling Passive Monitoring on ATM Interfaces
- Passive Monitoring on Ethernet Interfaces Overview on page 31
- Enabling Packet Flow Monitoring on SONET/SDH Interfaces
- multiservice-options
- Junos OS Services Interfaces Library for Routing Devices
pdu-interval

Syntax

```
pdu-interval interval;
```

Hierarchy Level

```
[edit protocols oam ethernet link-fault-management interface interface-name]
```

Release Information

Statement introduced in Junos OS Release 8.2 for MX, M, T, ACX, Series routers, SRX Series firewalls, and EX Series Switches.
Statement introduced in Junos OS Release 9.4 for EX Series switches.

Description

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.

Options

- **interval**—Periodic OAM PDU sending interval.
  - **Range:** For MX, M, T, ACX, Series routers, SRX Series firewalls and EX Series switches – 100 through 1000 milliseconds
  - **Default:** For EX Series switches – 1000 milliseconds

Required Privilege Level

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.
- routing—To view this statement in the configuration.
- routing-control—To add this statement to the configuration.

Related Documentation

- Configuring the OAM PDU Interval on page 825
- Example: Configuring Ethernet OAM Link Fault Management
- Configuring Ethernet OAM Link Fault Management
pdu-threshold

Syntax

pdu-threshold threshold-value;

Hierarchy Level

[edit protocols oam ethernet link-fault-management interface interface-name]

Release Information

Statement introduced in Junos OS Release 8.2 for T, M, MX and ACX Series routers, SRX Series firewalls and EX Series switches.
Statement introduced in Junos OS Release 9.4 for EX Series switches and NFX Series devices.

Description

Configure how many protocol data units (PDUs) are missed before declaring the peer lost in Ethernet OAM link fault management (LFM) for all interfaces or for specific interfaces.

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.

Options

threshold-value—The number of PDUs missed before declaring the peer lost.
Range: 3 through 10 PDUs
Default: 3 PDUs

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

• Configuring the OAM PDU Threshold on page 826
• Configuring Ethernet OAM Link Fault Management
**per-flow (Aggregated Ethernet Interfaces)**

**Syntax**

```
per-flow;
```

**Hierarchy Level**

```
[edit interfaces aeX unit logical-unit-number forwarding-options load-balance-stateful]
```

**Release Information**

Statement introduced in Junos OS Release 13.2R1.

**Description**

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. When multiple flows are transmitted out of an 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.

**Options**

- **per-flow**—Enable the stateful load-distribution mechanism per traffic flow on an aggregated Ethernet interface.

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- Configuring Stateful Load Balancing on Aggregated Ethernet Interfaces on page 192
## peer

<table>
<thead>
<tr>
<th>Syntax</th>
<th>peer a.b.c.d [  Interface interface-name;  ]</th>
</tr>
</thead>
</table>

| Hierarchy Level    | [edit interfaces interface-name multi-chassis-protection] |

### Release Information
Statement introduced in Junos OS Release 11.1.

### Description
For MX Series routers with multichassis aggregated Ethernet (MC-AE) interfaces, use the `multi-chassis-protection` 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 `peer` statement. You must also specify the peer’s physical interface.

### Options
- **a.b.c.d**—Specify the IP address of the peer.
- **interface interface-name**—Specify the peer’s physical interface: `interface interface-name-fpc/pic/port`

### Required Privilege Level
- **interface**—To view this statement in the configuration.
- **interface-control**—To add this statement to the configuration.

### Related Documentation
- Configuring Multichassis Link Aggregation on MX Series Routers
- Configuring Active-Active Bridging and VRRP over IRB in Multichassis Link Aggregation on MX Series Routers and QFX Series Switches
- Configuring Aggregated Ethernet Link Protection on page 152
- Example: Configuring Aggregated Ethernet Link Protection on page 154
- `multi-chassis-protection` on page 1423
### periodic

| List of Syntax | Syntax (EX Series) on page 1458  
| Syntax (QFX Series) on page 1458 |
| Syntax (EX Series) | periodic interval; |
| Syntax (QFX Series) | periodic (fast | slow); |

**Hierarchy Level (EX Series)**

- [edit interfaces ae
  aggregated-ether-options lacp],
- [edit interfaces interface-range name aggregated-ether-options lacp]

**Hierarchy Level (QFX Series)**

- [edit interfaces ae
  aggregated-ether-options lacp]

**Release Information**

Statement introduced before Junos OS Release 7.4.  
Statement introduced in Junos OS Release 9.0 for EX Series switches.  
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.  
Statement introduced in Junos OS Release 15.1F4 for PTX Series routers.

**Description**

For aggregated Ethernet interfaces only, configure the interval for periodic transmission of LACP packets.

**Options**

`interval`—Interval for periodic transmission of LACP packets.

- **fast**—Transmit packets every second.
- **slow**—Transmit packets every 30 seconds.

Default: fast

**Required Privilege Level**

- interface—To view this statement in the configuration.  
- interface-control—To add this statement to the configuration.

**Related Documentation**

- Configuring LACP for Aggregated Ethernet Interfaces on page 143  
- Configuring Aggregated Ethernet LACP (CLI Procedure)  
- Example: Configuring Aggregated Ethernet High-Speed Uplinks Between an EX4200 Virtual Chassis Access Switch and an EX4200 Virtual Chassis Distribution Switch  
- Configuring Aggregated Ethernet LACP (CLI Procedure)  
- Understanding Aggregated Ethernet Interfaces and LACP for Switches  
- Junos OS Network Interfaces Library for Routing Devices
policer (CFM Firewall)

Syntax

```
policer cfm-policer {
  if-exceeding {
    bandwidth-limit 8k;
    burst-size-limit 2k;
  }
  then discard;
}
```

Hierarchy Level

[edit firewall]

Release Information

Statement introduced in Junos OS Release 10.0.

Description

Attach an explicit policer to CFM sessions.

Required Privilege

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Rate Limiting of Ethernet OAM Messages on page 787
- policer (CFM Global) on page 1181
- policer (CFM Session) on page 1182
## policer (CoS)

**Syntax**
```
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 ethernet-policer-profile] 
```

**Release Information**
Statement introduced before Junos OS Release 7.4.

**Description**
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).

**Options**
- **cos-policer-name**—Name of one policer to specify the premium bandwidth and burst-size limits, and the aggregate bandwidth and burst-size limits.

  The remaining statements are explained separately. See [CLI Explorer](#).

**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 671
### policer (MAC)

**Syntax**

```plaintext
policer {
  input cos-policer-name;
  output cos-policer-name;
}
```

**Hierarchy Level**

```plaintext
[edit interfaces interface-name unit logical-unit-number accept-source-mac mac-address mac-address],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number accept-source-mac mac-address]
```

**Release Information**

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

**Description**

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.

**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.

**Options**

- **input cos-policer-name**—Name of one policer to specify the premium bandwidth and aggregate bandwidth.
- **output cos-policer-name**—Name of one policer to specify the premium bandwidth and aggregate bandwidth.

**Required Privilege Level**

- **interface**—To view this statement in the configuration.
- **interface-control**—To add this statement to the configuration.

**Related Documentation**

- Configuring MAC Address Filtering on page 676
### pop

#### Syntax

<table>
<thead>
<tr>
<th>Syntax</th>
</tr>
</thead>
<tbody>
<tr>
<td>pop;</td>
</tr>
</tbody>
</table>

#### Hierarchy Level

- [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]

#### Release Information

- Statement introduced before Junos OS Release 7.4.
- Statement introduced in Junos OS Release 12.3R2 for EX Series switches.
- Statement introduced in Junos OS Release 13.2X51-D20 for the QFX Series.

#### Description

**NOTE:** On EX4300 switches, `pop` is not supported at the `[edit interfaces interface-name unit logical-unit-number input-vlan-map]` hierarchy level.

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.

#### Required Privilege Level

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

#### Related Documentation

- [Removing a VLAN Tag on page 703](#)
- [Configuring Q-in-Q Tunneling on EX Series Switches with ELS Support](#)
### Syntax

```
pop-pop;
```

### Hierarchy Level

```
[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]
```

### Release Information

Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

### Description

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.

### Required Privilege

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>interface</td>
<td>To view this statement in the configuration.</td>
</tr>
<tr>
<td>interface-control</td>
<td>To add this statement to the configuration.</td>
</tr>
</tbody>
</table>

### Related Documentation

- Removing the Outer and Inner VLAN Tags on page 703
### pop-swap

**Syntax**

```
pop-swap;
```

**Hierarchy Level**

```
[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]
```

**Release Information**

Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

**Description**

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.

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.

**Required Privilege Level**

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**

- Removing the Outer VLAN Tag and Rewriting the Inner VLAN Tag on page 704
**port-description-type**

**Syntax**
```
port-description-type {
    interface-alias;
    interface-description;
}
```

**Hierarchy Level**
```
[edit protocols lldp]
[edit routing-instances routing-instance-name protocols lldp]
```

**Release Information**
Statement introduced in Junos OS Release 13.3R5, 14.2R2, 14.1R4, and 12.3R9.

**Description**
For Link Layer Discovery Protocol, configure the value to be used for port description TLV.

**Options**
- **interface-alias**—Use the `ifAlias` MIB object value to generate the port description TLV.
- **interface-description**—Use the `ifDescr` MIB object value to generate the port description TLV.

**Default:** By default, **interface-alias** is used for generation of port description TLV. The **interface-alias** value is same as description of an interface configured by statement `set interface name description description`.

---

**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.

---

**Required Privilege Level**
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

**Related Documentation**
- lldp on page 1382
- show lldp on page 2219
- show lldp neighbors on page 2225
**port-id (MACsec for MX Series)**

**Syntax**

```plaintext
port-id port-id-number;
```

**Hierarchy Level**

```plaintext
[edit security macsec connectivity-association
    connectivity-association-name secure-channel
    secure-channel-name id]
```

**Release Information**

Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

**Description**

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.

Once the port numbers match, MACsec is enabled for all traffic on the connection.

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.

**Default**

No port ID is specified.

**Options**

- `port-id-number`—The port ID number.

**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*
**port-priority**

**Syntax**

```
port-priority priority;
```

**Hierarchy Level**

```
[edit interfaces interface-name gigether-options 802.3ad lacp]
```

**Release Information**

Statement introduced in Junos OS Release 9.3.
Statement introduced in Junos OS Release 11.4 for EX Series switches.
Statement introduced in Junos OS Release 15.1F4 for PTX Series routers.

**Description**

Define LACP port priority at the interface level.

**Options**

`priority`—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.

- **Range**: 0 through 65535
- **Default**: 127

**Required Privilege**

- **Level**: interface—To view this statement in the configuration.
- **Level**: interface-control—To add this statement to the configuration.

**Related Documentation**

- Configuring LACP Link Protection of Aggregated Ethernet Interfaces for Switches
- Configuring Aggregated Ethernet LACP (CLI Procedure)
**port-id-subtype**

**Syntax**

```plaintext
port-id-subtype {
  interface-name;
  locally-assigned;
}
```

**Hierarchy Level**

[edit protocols lldp]
[edit routing-instances routing-instance-name protocols lldp]

**Release Information**

Statement introduced in Junos OS Release 12.3R1

**Description**

For Link Layer Discovery Protocol, configure the port ID type, length, and value (TLV).

**Options**

`interface-name`—Use the interface name to generate the port ID TLV.

**Default:** 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:** For QFX5200 switches, the default value used to generate port ID TLV in LLDP messages is interface name, not SNMP index.

---

**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 instance `lldpLocPortId` depends on the 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 command `set port-id-subtype interface-name`, then the value of the MIB variable `lldpLocPortId` instance is the interface name and not the SNMP index.
Required Privilege Level

- **routing**—To view this statement in the configuration.
- **routing-control**—To add this statement to the configuration.

Related Documentation

- [lldp on page 1382](#)
- [Configuring LLDP on page 356](#)
- [show lldp neighbors on page 2225](#)
pp0 (Dynamic PPPoE)

Syntax

```plaintext
pp0 {
  unit logical-unit-number {
    keepalives interval seconds;
    no-keepalives;
    pppoe-options {
      underlying-interface interface-name;
      server;
    }
  }
  ppp-options {
    aaa-options aaa-options-name;
    authentication [ authentication-protocols ];
    chap {
      challenge-length minimum minimum-length maximum maximum-length;
    }
    ignore-magic-number-mismatch;
    initiate-ncp (ip | ipv6 | dual-stack-passive)
    ipcp-suggest-dns-option;
    mru size;
    mtu (size | use-lower-layer);
    on-demand-ip-address;
    pap;
    peer-ip-address-optional;
  }
  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;
      }
    }
  }
}
```

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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. Search for a statement in CLI Explorer or click a linked statement in the Syntax section for details.

Required Privilege Level  
interface—To view this statement in the configuration.  
interface-control—To add this statement to the configuration.

Related Documentation  
- Configuring a PPPoE Dynamic Profile  
- Configuring Dynamic Authentication for PPP Subscribers  
- For information about creating static PPPoE interfaces, see Configuring PPPoE on page 371
ppm (Ethernet Switching)

Syntax

```
ppm {
    centralized;
}
```

Hierarchy Level

[edit protocols lacp]

Release Information

- Statement introduced in Junos OS Release 9.4 for MX Series routers.
- Statement introduced in Junos OS Release 10.2 for EX Series switches.
- Statement introduced in Junos OS Release 11.3 for the QFX Series.
- Statement introduced in Junos OS Release 12.1 for T Series devices.
- Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Configure PPM processing options for Link Aggregation Control Protocol (LACP) packets.

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 `no-delegate-processing` configuration statement in the [edit routing-options ppm] statement hierarchy.

Default

Distributed PPM processing is enabled for all packets that use PPM.

Required Privilege Level

- routing—To view this statement in the configuration.
- routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Distributed Periodic Packet Management on an EX Series Switch (CLI Procedure)
- Configuring Distributed Periodic Packet Management
**pppoе-options**

**Syntax**

```
pppoе-options {
  access-concentrator name;
  auto-reconnect seconds;
  (client | server);
  service-name name;
  underlying-interface interface-name;
  ppp-max-payload ppp-max-payload
}
```

**Hierarchy Level**

```
[edit interfaces pp0 unit logical-unit-number],
[edit logical-systems logical-system-name interfaces pp0 unit logical-unit-number]
[set interface ppp interface unit logical-unit-number ppp-max-payload ppp-max-payload],
```

**Release Information**

Statement introduced before Junos OS Release 7.4.
Client Statement introduced in Junos OS Release 8.5.
Server Statement introduced in Junos OS Release 8.5.
Client Statement introduced in Junos OS Release 15.1X49-D100.

**Description**

Configure PPP over Ethernet-specific interface properties.

The remaining statements are explained separately. Search for a statement in CLI Explorer or click a linked statement in the Syntax section for details.

The maximum payload allowed on an Ethernet frame is 1500 bytes. For a PPPoE interface, the PPPoE header uses 6 bytes and the PPP protocol ID uses 2 bytes. This restricts the maximum MTU size on a PPPoE interface to 1492 bytes, which can cause frequent fragmentation and reassembly of larger PPP packets received over the PPPoE interface. To prevent frequent fragmentation and reassembly for PPP packets over Ethernet, you can configure the maximum transmission unit (MTU) and MRU sizes for PPP subscribers.

For PPPoE subscribers, the PPP MRU or PPP MTU size can be greater than 1492 bytes if the PPP-Max-Payload tag is received in the PPPoE Active Discovery Request (PADR) packets.

The PPP-Max-Payload option allows you to override the default behavior of the PPPoE client by providing a maximum size that the PPP payload can support in both sending and receiving directions. The PPPoE server might allow the negotiation of an MRU larger than 1492 octets and the ability to use an MTU larger than 1500 octets.

It is important to set an appropriate value for the MTU size of the physical interface before setting ppp-max-payload. The value of mtu must be greater than the value of ppp-max-payload.

To enable Jumbo frames refer *Understanding Jumbo Frames Support for Ethernet Interfaces*. 
**pppoe-underlying-options (Static and Dynamic Subscribers)**

**Syntax**
```plaintext
pppoe-underlying-options {
    access-concentrator name;
    dynamic-profile profile-name;
    direct-connect
duplicate-protection;
max-sessions number;
max-sessions-vsa-ignore;
service-name-table table-name;
short-cycle-protection <lockout-time-min minimum-seconds> <lockout-time-max maximum-seconds> <filter [aci]>;
}
```

**Hierarchy Level**
```
[edit interfaces interface-name unit logical-unit-number],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number]
```

**Release Information**
Statement introduced in Junos OS Release 10.0.

**Description**
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 (`ppp-over-ether`) encapsulation.

The remaining statements are explained separately. Search for a statement in CLI Explorer or click a linked statement in the Syntax section for details.

**Required Privilege Level**
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**
- Configuring PPPoE on page 371 (for static interfaces)
- Configuring an Underlying Interface for Dynamic PPPoE Subscriber Interfaces
- Assigning a Service Name Table to a PPPoE Underlying Interface
preferred-source-address

Syntax

preferred-source-address address;

Hierarchy Level

[edit dynamic-profiles interfaces interface-name unit logical-unit-number family family unnumbered-address interface-name],
[edit dynamic-profiles profile-name interfaces demux0 unit logical-unit-number family family],

Release Information

Statement introduced in Junos OS Release 9.2.
Support for the $junos-preferred-source-address and $junos-preferred-source-ipv6-address predefined variables introduced in Junos OS Release 9.6.

Description

For unnumbered Ethernet interfaces configured with a loopback interface as the donor interface, specify one of the loopback interface's secondary addresses as the preferred source address for the unnumbered Ethernet interface. Configuring the preferred source address enables you to use an IP address other than the primary IP address on some of the unnumbered Ethernet interfaces in your network. To configure the preferred source address dynamically, instead of using this statement, you must include the $junos-preferred-source-address predefined variable for IPv4 (family inet) addresses or the $junos-preferred-source-ipv6-address predefined variable for IPv6 (family inet6) addresses.

Configuration of a preferred source address for unnumbered Ethernet interfaces is supported for IPv4 and IPv6 address families.

NOTE: When you specify a static logical interface for the unnumbered interface in a dynamic profile that includes the $junos-routing-instance predefined variable, you must not configure a preferred source address, whether with the $junos-preferred-source-address predefined variable, the $junos-preferred-source-ipv6-address predefined variable, or the preferred-source-address statement. Configuring the preferred source address in this circumstance causes a commit failure.

Options

address—Secondary IP address of the donor loopback interface. Alternatively, use the $junos-preferred-source-address or the $junos-preferred-source-ipv6-address predefined variable to dynamically apply a preferred source address to the unnumbered Ethernet interface.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

• Configuring an Unnumbered Interface
**pre-shared-key (MX Series)**

**Syntax**
```plaintext
pre-shared-key {
    cak hexadecimal-number;
    ckn hexadecimal-number;
}
```

**Hierarchy Level**
```
[edit security macsec connectivity-association connectivity-association-name]
```

**Release Information**
Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

**Description**
Specifies the pre-shared key used to enable MACsec using static connectivity association key (CAK) security mode.

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.

**Default**
No pre-shared keys exist, by default.

**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
premium (Output Priority Map)

Syntax

```plaintext
premium {
  forwarding-class class-name {
    loss-priority (high | low);
  }
}
```

Hierarchy Level

```
[edit interfaces interface-name gigether-options ethernet-switch-profile ethernet-policer-profile output-priority-map classifier]
```

Release Information

Statement introduced before Junos OS Release 7.4.

Description

For Gigabit Ethernet IQ interfaces only, define the classifier for egress premium traffic.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

- **interface**—To view this statement in the configuration.
- **interface-control**—To add this statement to the configuration.

Related Documentation

- Specifying an Output Priority Map on page 674
- `input-priority-map` on page 1351
**premium (Policer)**

**Syntax**

```null
premium {
    bandwidth-limit bps;
    burst-size-limit bytes;
}
```

**Hierarchy Level**

```null
[edit interfaces interface-name gigether-options ethernet-switch-profile ethernet-policer-profile policer cos-policer-name]
```

**Release Information**

Statement introduced before Junos OS Release 7.4.

**Description**

Define a policer to apply to nonpremium traffic.

The remaining statements are explained separately. See CLI Explorer.

**Required Privilege**

- 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 671
- aggregate (Gigabit Ethernet CoS Policer) on page 1219
- ieee802.1p on page 1338

---

**propagate-tc**

**Syntax**

```null
propagate-tc;
```

**Hierarchy Level**

```null
[edit protocols protection-group ethernet-ring ring-name]
```

**Release Information**

Statement introduced in Junos OS Release 14.2.

**Description**

Enable topology change propagation from a sub-ring to an interconnected major-ring. By default, topology change propagation is disabled.

**Required Privilege**

- 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 237
- Configuring Ethernet Ring Protection Switching on Switches (CLI Procedure)
### protection-group

**Syntax**

```plaintext
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);
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
}
}
data-channel {
```
```yaml
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;
traceoptions {
  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.
Statement introduced in Junos OS Release 12.1 for EX Series switches.

**Description**
Configure Ethernet ring protection switching.

The statements are explained separately. All statements apply to MX Series routers. EX Series switches do not assign node-id and use control-vlan instead of control-channel.

**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 237
- Ethernet Ring Protection Using Ring Instances for Load Balancing on page 991
- Example: Configuring Load Balancing Within Ethernet Ring Protection for MX Series Routers on page 999
- Configuring Ethernet Ring Protection Switching on Switches (CLI Procedure)
- 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

### protocols

**Syntax**
```
protocols [inet iso mpls];
```

**Hierarchy Level**
```
[edit interfaces interface-name unit logical-unit-number family tcc]
```

**Release Information**
Statement introduced in Junos OS Release 8.3.

**Description**
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.

**NOTE:** Some platform and FPC combinations can not pass TCC encapsulated ISO traffic. See Platforms/FPCs That Cannot Forward TCC Encapsulated ISO Traffic for details.

**Required Privilege Level**
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**
- Configuring IS-IS or MPLS Traffic for TCC Interfaces
- Platforms/FPCs That Cannot Forward TCC Encapsulated ISO Traffic
**protocol-down**

**Syntax**

```
protocol-down;
```

**Hierarchy Level**

```
[edit protocols oam ethernet link-fault-management action-profile event]
```

**Release Information**

Statement introduced in Junos OS Release 8.5.

**Description**

Upper layer indication of protocol down event. When the `protocol-down` statement is included, the protocol down event triggers the action specified under the `action` statement.

**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 830

**ptopo-configuration-maximum-hold-time**

**Syntax**

```
ptopo-configuration-maximum-hold-time seconds;
```

**Hierarchy Level**

```
[edit protocols lldp],
[edit routing-instances routing-instance-name protocols lldp]
```

**Release Information**


**Description**

Configure a time to maintain dynamic topology entries.

**Options**

`seconds`—Time to maintain interval dynamic topology entries.

- **Default:** 300
- **Range:** 1 through 2147483647

**Required Privilege Level**

- `routing`—To view this statement in the configuration.
- `routing-control`—To add this statement to the configuration.

**Related Documentation**

- Configuring LLDP on page 356
# ptopo-configuration-trap-interval

## Syntax

```
ptopo-configuration-trap-interval seconds;
```

## Hierarchy Level

```
[edit protocols lldp],
[edit routing-instances routing-instance-name protocols lldp]
```

## Release Information


## Description

Configure a time for the period of SNMP trap notifications to the Master Agent to wait regarding changes in topology global statistics.

## Options

- **seconds**—Time for the period of SNMP trap notifications about global statistics. This feature is disabled by default.
  
  **Range:** 0 through 3600

## Required Privilege Level

- routing—To view this statement in the configuration.
- routing-control—To add this statement to the configuration.

## Related Documentation

- Configuring LLDP on page 356
push

Syntax

```
push;
```

Hierarchy Level

```
[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]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.
Statement introduced in Junos OS Release 13.2X51-D20 for the QFX Series.

Description

NOTE: On EX4300 switches, push is not supported at the [edit interfaces interface-name unit logical-unit-number output-vlan-map] hierarchy level.

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.

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.

If you include the push statement in the configuration, you must also include the pop statement at the [edit interfaces interface-name unit logical-unit-number output-vlan-map] hierarchy level.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Stacking a VLAN Tag on page 701
- Configuring Q-in-Q Tunneling on EX Series Switches with ELS Support
### push-push

<table>
<thead>
<tr>
<th>Syntax</th>
<th>push-push;</th>
</tr>
</thead>
</table>

#### Hierarchy Level

- [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]

#### Release Information

Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

#### Description

Specify the VLAN rewrite operation to push two VLAN tags in front of the frame.

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.

#### Required Privilege

- **Level**
  - interface—To view this statement in the configuration.
  - interface-control—To add this statement to the configuration.

#### Related Documentation

- [Stacking Two VLAN Tags on page 702](#)
**premium (Output Priority Map)**

**Syntax**
```
premium {
  forwarding-class class-name {
    loss-priority (high | low);
  }
}
```

**Hierarchy Level**
```
[edit interfaces interface-name gigether-options ethernet-switch-profile ethernet-policer-profile output-priority-map classifier]
```

**Release Information**
Statement introduced before Junos OS Release 7.4.

**Description**
For Gigabit Ethernet IQ interfaces only, define the classifier for egress premium traffic. The remaining statements are explained separately. See CLI Explorer.

**Required Privilege Level**
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**
- Specifying an Output Priority Map on page 674
- input-priority-map on page 1351
premium (Policer)

Syntax

```
premium {
    bandwidth-limit bps;
    burst-size-limit bytes;
}
```

Hierarchy Level

```
[edit interfaces interface-name gigether-options ethernet-switch-profile ethernet-policer-profile policer cos-policer-name]
```

Release Information

Statement introduced before Junos OS Release 7.4.

Description

Define a policer to apply to nonpremium traffic.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege

- 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 671
- aggregate (Gigabit Ethernet CoS Policier) on page 1219
- ieee802.1p on page 1338
proxy

Syntax

proxy inet-address address;

Hierarchy Level

[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]

Release Information

Statement introduced before Junos OS Release 7.4.

Description

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.

Options

inet-address—Configure the IP address of the neighbor to the TCC router.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

• Configuring Translation Cross-Connect Interface Switching on page 396
• Example: Configuring an Ethernet TCC or Extended VLAN TCC
• remote on page 1498
• Junos OS VPNs Library for Routing Devices
proxy-arp

Syntax  proxy-arp (restricted | unrestricted);

Hierarchy Level  [edit interfaces interface-name unit logical-unit-number],
                 [edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number]

Release Information  Statement introduced before Junos OS Release 7.4.
                      Statement introduced in Junos OS Release 9.6 for EX Series switches.
                      restricted added in Junos OS Release 10.0 for EX Series switches.
                      Statement introduced in Junos OS Release 12.2 for the QFX Series.

Description  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.

NOTE:  You must configure the IP address and the inet family for the interface when you enable proxy ARP.

Default  Proxy ARP is not enabled. The router or switch responds to an ARP request only if the
destination IP address is its own.

Options  • none—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.

         • restricted—(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.

         • unrestricted—(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.

Default:  unrestricted

Required Privilege Level  interface—To view this statement in the configuration.
                         interface-control—To add this statement to the configuration.

Related Documentation  • Configuring Restricted and Unrestricted Proxy ARP on page 387
                         • Configuring Proxy ARP on Switches
                         • Example: Configuring Proxy ARP on an EX Series Switch
                         • Configuring Gratuitous ARP on page 20
**push**

**Syntax**

```plaintext
push;
```

**Hierarchy Level**

```
[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]
```

**Release Information**

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.
Statement introduced in Junos OS Release 13.2X51-D20 for the QFX Series.

**Description**

NOTE: On EX4300 switches, push is not supported at the [edit interfaces interface-name unit logical-unit-number output-vlan-map] hierarchy level.

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.

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.

If you include the push statement in the configuration, you must also include the pop statement at the [edit interfaces interface-name unit logical-unit-number output-vlan-map] hierarchy level.

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- Stacking a VLAN Tag on page 701
- Configuring Q-in-Q Tunneling on EX Series Switches with ELS Support
### push-push

**Syntax**

```
push-push;
```

**Hierarchy Level**

```
[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]
```

**Release Information**

Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

**Description**

Specify the VLAN rewrite operation to push two VLAN tags in front of the frame.

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.

**Required Privilege Level**

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**

- [Stacking Two VLAN Tags on page 702](#)
**quiet-period**

**Syntax**

```plaintext
quiet-period seconds;
```

**Hierarchy Level**

```plaintext
[edit protocols dot1x authenticator interface interface-id]
```

**Release Information**

Statement introduced in Junos OS Release 9.3.

**Description**

Specify the number of seconds the port remains in the wait state following a failed authentication exchange with the client, before reattempting authentication.

**Options**

`seconds`—Specify the number of seconds the port remains in the wait state following a failed authentication exchange with the client, before reattempting authentication.

- **Range:** 0 through 65,535 seconds
- **Default:** 60 seconds

**Required Privilege Level**

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**

- IEEE 802.1x Port-Based Network Access Control Overview on page 35
- authenticator on page 1232
- dot1x on page 1270
- interface (IEEE 802.1x) on page 1356
quiet-period (MX Series in Enhanced LAN Mode)

Syntax
quiet-period seconds;

Hierarchy Level
[edit protocols authentication-access-control interface (all | [interface-names)])

Release Information
Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.

Description
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.

Default
60 seconds

Options
seconds—Number of seconds the interface remains in the wait state.
Range: 0 through 65,535 seconds
Default: 60 seconds

Required Privilege
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.
reauthentication

Syntax

reauthentication (disable | interval seconds);

Hierarchy Level

[edit protocols dot1x authenticator interface interface-id]

Release Information

Statement introduced in Junos OS Release 9.3.

Description

Set or disable the periodic reauthentication of the client.

Options

• disable—Disable the periodic reauthentication of the client.
  • interval seconds—Specify the periodic reauthentication time interval.

Range: 1 through 65,535 seconds

Default: 3600 seconds

Required Privilege

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Related Documentation

• IEEE 802.1x Port-Based Network Access Control Overview on page 35
• dot1x on page 1270
• interface (IEEE 802.1x) on page 1356
• quiet-period on page 1492
reauthentication (MX Series in Enhanced LAN Mode)

**Syntax**

reauthentication interval;

**Hierarchy Level**

[edit protocols authentication-access-control interface (all | [interface-names]) dot1x]

**Release Information**

Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.

**Description**

For 802.1X authentication, specify the number of seconds before an authentication session times out.

**Options**

interval—Sets the periodic reauthentication time interval in seconds.

*Range:* 1 through 4,294,967,296 seconds

*Default:* 3600 seconds

**Required Privilege Level**

routing—to view this statement in the configuration.

routing-control—to add this statement to the configuration.

rebalance (Aggregated Ethernet Interfaces)

**Syntax**

rebalance interval

**Hierarchy Level**

[edit interfaces aeX unit logical-unit-number forwarding-options load-balance-stateful per-flow]

**Release Information**

Statement introduced in Junos OS Release 13.2R1.

**Description**

Configure periodic rebalancing of traffic flows of an aggregated Ethernet bundle by clearing the load balance state at a specified interval.

**Options**

interval—Number of minutes after which the load-balancing state must be cleared for the specified interface.

*Range:* 1 through 1000 flows per minute

**Required Privilege Level**

interface—to view this statement in the configuration.

interface-control—to add this statement to the configuration.

**Related Documentation**

- Configuring Stateful Load Balancing on Aggregated Ethernet Interfaces on page 192
receive-options-packets

Syntax

receive-options-packets;

Hierarchy Level

[edit interfaces interface-name unit logical-unit-number family inet],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number family inet]

Release Information

Statement introduced before Junos OS Release 7.4.

Description

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.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

• Enabling Passive Monitoring on ATM Interfaces
• Enabling Packet Flow Monitoring on SONET/SDH Interfaces

receive-ttl-exceeded

Syntax

receive-ttl-exceeded;

Hierarchy Level

[edit interfaces interface-name unit logical-unit-number family inet],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number family inet]

Release Information

Statement introduced before Junos OS Release 7.4.

Description

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.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

• Enabling Passive Monitoring on ATM Interfaces
• Enabling Packet Flow Monitoring on SONET/SDH Interfaces
recovery

Syntax

recovery {
  (auto | manual);
  timer timer-value;
}

Hierarchy Level

[edit interfaces interfaces-name link-degrade-monitor]

Release Information

Statement introduced in Junos OS Release 15.1.

Description

Configure the mechanism to be used to recover a degraded link. The recovery options supported are auto and manual.

Options

auto—Recover a degraded link automatically. Use this option with the media-based action when there are no Layer 2 or Layer 3 protocols configured on the interface. If this option is configured, the degraded link is monitored at user-configured intervals; and if the link quality is found to have improved (if bit error rate hits the clear threshold), the link is automatically recovered. With this configuration, you must configure a timer value.

manual—Recover a degraded link manually. Use this option with the media-based action configuration when Layer 2 and Layer 3 protocols are configured on the interface. If this option is configured, you need to use the request interface link-degrade-recover interface-name statement to recover the link.

NOTE: The manual recovery option is recommended for user deployments that have static route configurations causing the remote end of the link to start forwarding packets (as soon as the physical link is up) while autorecovery is in progress.

timer timer-value—Specify the interval value (in seconds) after which autorecovery of the degraded link must be triggered. This option is applicable if you configure the autorecovery option. The interval period starts from the time the link is degraded. The default interval is 1800 seconds. The autorecovery attempt is repeated until the link is recovered or the link monitoring feature is disabled through configuration.

NOTE: During autorecovery, you might notice link flaps at the remote end of the link.
remote

Syntax
remote {
  (inet-address address | mac-address address);
}

Hierarchy Level
[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]

Release Information
Statement introduced before Junos OS Release 7.4.

Description
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.

Options
mac-address—Configure the MAC address of the remote site.
inet-address—Configure the IP address of the remote site.

Related Documentation
- Configuring Translation Cross-Connect Interface Switching on page 396
- Example: Configuring an Ethernet TCC or Extended VLAN TCC
- proxy on page 1488
- Junos OS VPNs Library for Routing Devices
**remote-loopback**

**Syntax**

remote-loopback;

**Hierarchy Level**

```
[edit protocols oam link-fault-management interface interface-name]
```

**Release Information**

Statement introduced in Junos OS Release 8.2.

**Description**

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.

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- Setting a Remote Interface into Loopback Mode on page 837
replay-window-size (MX Series)

Syntax

```
replay-window-size number-of-packets;
```

Hierarchy Level

```
[edit security macsec connectivity-association]
```

Release Information

Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

Description

Specifies the size of the replay protection window.

This statement has to be configured to enable replay protection.

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.

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.

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.

Default

Replay protection is disabled.

Options

`number-of-packets`—Specifies the size of the replay protection window, in packets.

When this variable is set to 0, all packets that arrive out-of-order are dropped.

Required Privilege

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>admin</td>
<td>To view this statement in the configuration.</td>
</tr>
<tr>
<td>admin-control</td>
<td>To add this statement to the configuration.</td>
</tr>
</tbody>
</table>

Related Documentation

- Configuring Media Access Control Security (MACsec) on MX Series Routers
replay-protect (MX Series)

**Syntax**

```
replay-protect {
  replay-window-size number-of-packets;
}
```

**Hierarchy Level**

```
[edit security macsec connectivity-association
  connectivity-association-name]
```

**Release Information**

Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

**Description**

Enable replay protection for MACsec.

A replay window size specified using the `replay-window-size number-of-packets` statement must be specified to enable replay protection.

**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
**restore-interval**

**Syntax**  
restore-interval number;

**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.  

**Description**  
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.

**Options**  
*number*—Specify the restore interval.  
**Range:** 1 through 12 minutes

**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 237  
- 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 on Switches (CLI Procedure)
retries

Syntax  retries integer;

Hierarchy Level  [edit protocols dot1x authenticator interface interface-id]

Release Information  Statement introduced in Junos OS Release 9.3.

Description  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 quiet-period statement configured at the same hierarchy level.

Options  integer—Specify the number of retries.

  Range: 1 through 10

  Default: 3 retries

Required Privilege  interface—To view this statement in the configuration.

  interface-control—To add this statement to the configuration.

Related Documentation  • IEEE 802.1x Port-Based Network Access Control Overview on page 35

  • dot1x on page 1270

  • interface (IEEE 802.1x) on page 1356

  • quiet-period on page 1492
retries (MX Series in Enhanced LAN Mode)

Syntax

retries number;

Hierarchy Level

[edit protocols authentication-access-control interface (all | [interface-names])]

Release Information

Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.

Description

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.

Options

number—Number of retries.

Default: 3 retries

Range: 1 through 10

Required Privilege Level

routing—to view this statement in the configuration.

routing-control—to add this statement to the configuration.
## revertive

<table>
<thead>
<tr>
<th>Syntax</th>
<th>revertive;</th>
</tr>
</thead>
</table>

| Hierarchy Level | [edit interfaces aeX aggregated-ether-options lACP link-protection] |

### Release Information
- Statement introduced in Junos OS Release 9.3.
- Statement introduced in Junos OS Release 12.3 for EX Series switches.
- Statement introduced in Junos OS Release 15.1F4 for PTX Series routers.

### Description
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.

### Required Privilege
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

### Related Documentation
- non-revertive (Chassis)
- Configuring LACP Link Protection of Aggregated Ethernet Interfaces for Switches
## ring-id

### Syntax

```
ring-id number;
```

### Hierarchy Level

```
[edit protocols protection-group ethernet-ring ring-name]
```

### Release Information

Statement introduced in Junos OS Release 14.2.

### Description

Specify the ring ID.

### Options

- **number**—Ring ID number.
  - **Range:** 1 through 239
  - **Default:** 1

### 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 237
- Configuring Ethernet Ring Protection Switching on Switches (CLI Procedure)
**ring-protection-link-end**

**Syntax**

```
ring-protection-link-end;
```

**Hierarchy Level**

```
[edit protocols protection-group ethernet-ring ring-name (east-interface | west-interface)]
```

**Release Information**

Statement introduced in Junos OS Release 9.4.
Statement introduced in Junos OS Release 12.1 for EX Series switches.

**Description**

Specify that the port is one side of a ring protection link (RPL) by setting the RPL end flag.

**Required Privilege Level**

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**

- Ethernet Ring ProtectionSwitching Overview on page 237
- 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 on Switches (CLI Procedure)
**ring-protection-link-owner**

<table>
<thead>
<tr>
<th>Syntax</th>
<th><code>ring-protection-link-owner;</code></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchy Level</td>
<td><code>[edit protocols protection-group ethernet-ring ring-name]</code></td>
</tr>
</tbody>
</table>
Statement introduced in Junos OS Release 12.1 for EX Series switches.  
| Description         | 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). |
| 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 237  
- 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 |
**routing-instance**

**Syntax**
```
routing-instance {
    destination routing-instance-name;
}
```

**Hierarchy Level**
```
[edit interfaces interface-name unit logical-unit-number tunnel],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number tunnel]
```

**Release Information**
Statement introduced before Junos OS Release 7.4.

**Description**
To configure interfaces and logical-systems, specify the destination routing instance that points to the routing table containing the tunnel destination address.

**Default**
The default Internet routing table is inet.0.

**Required Privilege Level**
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**
- Junos OS Services Interfaces Library for Routing Devices
**routing-instance (PPPoE Service Name Tables)**

**Syntax**
```
routing-instance routing-instance-name;
```

**Hierarchy Level**
```
[edit protocols pppoe service-name-tables table-name service service-name],
[edit protocols pppoe service-name-tables table-name service service-name agent-specifier
   aci circuit-id-string ari remote-id-string ]
```

**Release Information**
Statement introduced in Junos OS Release 10.2.

**Description**
Use in conjunction with the `dynamic-profile` 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, `empty` service entry, or any 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.

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.

If you include the `routing-instance` statement at the `[edit protocols pppoe service-name-tables table-name service service-name agent-specifier aci circuit-id-string ari remote-id-string ]` hierarchy level, you cannot also include the `static-interface` statement at this level. The `routing-instance` and `static-interface` statements are mutually exclusive for ACI/ARI pair configurations.

**Options**
`routing-instance-name`—Name of the routing instance in which the router instantiates the dynamic PPPoE interface.

**Required Privilege Level**
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

**Related Documentation**
- Configuring PPPoE Service Name Tables
- Assigning a Dynamic Profile and Routing Instance to a Service Name or ACI/ARI Pair for Dynamic PPPoE Interface Creation
rx-enable

Syntax

```plaintext
expected-defect [ rx-enable ; ]
```

Hierarchy Level

```plaintext
[edit protocols oam ethernet connectivity-fault-management expected-defect]
```

Release Information

Statement introduced in Junos OS Release 19.1.

Description

Enable the ethernet expected defect (ETH-ED) function to process the received EDM PDUs.

The remaining statements are explained separately. See CLI Explorer.

Default

The MEP does not process EDM PDUs.

Required Privilege Level

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

Related Documentation

- connectivity-fault-management on page 1258
- show oam ethernet connectivity-fault-management mep-database on page 2262
**rx-max-duration**

**Syntax**

```
expected-defect {
  rx-max-duration ;
}
```

**Hierarchy Level**

```
[edit protocols oam ethernet connectivity-fault-management expected-defect]
```

**Release Information**

Statement introduced in Junos OS Release 19.1.

**Description**

Duration to indicate the maximum acceptable value at which the loss of continuity alarms are suppressed. If the duration in the received EDM PDU exceeds this configured value then the duration value will be truncated to this configured value and loss of continuity (LoC) alarms shall be suppressed for this duration.

**Options**

**Minimum value**—The minimum value at which the loss of continuity alarms will be suppressed is 120 seconds.

**Minimum value**—The maximum acceptable value at which the loss of continuity alarms will be suppressed is 3600 seconds.

**Default**—900 seconds.

**Required Privilege Level**

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

**Related Documentation**

- connectivity-fault-management on page 1258
- show oam ethernet connectivity-fault-management mep-database on page 2262
sa-multicast (100-Gigabit Ethernet)

Syntax

```
sa-multicast;
```

Hierarchy Level

```
[edit chassis fpc slot pic slot forwarding-mode]
```

Release Information

Statement introduced in Junos OS Release 10.4.

Description

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-1CE-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).

Required Privilege Level

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

Related Documentation

- Interoperability Between the 100-Gigabit Ethernet PICs PD-ICE-CFP-FPC4 and PF-1CGE-CFP on page 473
- Configuring the Interoperability Between the 100-Gigabit Ethernet PICs PF-1CGE-CFP and PD-ICE-CFP-FPC4 on page 475
- Configuring 100-Gigabit Ethernet MICs to Interoperate with Type 4 100-Gigabit Ethernet PICs (PD-ICE-CFP-FPC4) Using SA Multicast Mode
- Interoperability Between MPC4E (MPC4E-3D-2CGE-8XGE) and 100-Gigabit Ethernet PICs on Type 4 FPC
- Configuring MPC4E (MPC4E-3D-2CGE-8XGE) to Interoperate with 100-Gigabit Ethernet PICs on Type 4 FPC Using SA Multicast Mode
- Interoperability Between the 100-Gigabit Ethernet PICs PD-ICE-CFP-FPC4 and P1-PTX-2-100GE-CFP on page 474
- Configuring the Interoperability Between the 100-Gigabit Ethernet PICs P1-PTX-2-100GE-CFP and PD-ICE-CFP-FPC4 on page 478
sa-multicast (PTX Series Packet Transport Routers)

Syntax

\[ \text{sa-multicast;} \]

Hierarchy Level

\[ \text{[edit chassis fpc slot pic slot port port-number forwarding-mode]} \]

Release Information

Statement introduced in Junos OS Release 12.1X48R4.

Description

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-ICE-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.

Required Privilege Level

interface—to view this statement in the configuration.

interface-control—to add this statement to the configuration.

Related Documentation

- Interoperability Between the 100-Gigabit Ethernet PICs PD-ICE-CFP-FPC4 and P1-PTX-2-100GE-CFP on page 474
- Configuring the Interoperability Between the 100-Gigabit Ethernet PICs P1-PTX-2-100GE-CFP and PD-ICE-CFP-FPC4 on page 478
**secure-authentication (MX Series in Enhanced LAN Mode)**

| **Syntax** | secure-authentication (http | https); |
|------------|----------------------------------|
| **Hierarchy Level** | [edit protocols captive-portal-custom-options] |
| **Release Information** | Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode. |
| **Description** | Enable HTTP or HTTPS access on the captive portal interface. |
| **Default** | http |
| **Options** | http—Enables HTTP access on the captive portal interface. |
| | https—Enables HTTPS access on the captive portal interface. HTTPS is recommended. |
| **Required Privilege Level** | routing—To view this statement in the configuration. | routing–control—To add this statement to the configuration. |
secure-channel

Syntax

secure-channel secure-channel-name {
  direction (inbound | outbound);
  encryption (MACsec);
  id {
    mac-address mac-address;
    port-id port-id-number;
  }
  offset (0|30|50);
  security-association security-association-number {
    key key-string;
  }
}

Hierarchy Level
[edit security macsec connectivity-association connectivity-association-name]

Release Information
Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

Description
Create and configure a secure channel to enable and configure MACsec when MACsec
is enabled using static secure association key (SAK) security mode.

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.

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
**security-association**

**Syntax**

```plaintext
security-association security-association-number {
    key key-string;
}
```

**Hierarchy Level**

```
[edit security macsec connectivity-association
connectivity-association-name secure-channel
secure-channel-name]
```

**Release Information**

Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

**Description**

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 `security-association` statement is not used when enabling MACsec using static CAK security mode.

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.

**Default**

No security keys are configured, by default.

**Options**

`security-association-number`—Specifies the security association number and creates the SAK.

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.

**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
### send-critical-event

**Syntax**

```
send-critical-event;
```

**Hierarchy Level**

```
[edit protocols oam ethernet link-fault-management action-profile action]
```

**Release Information**

Statement introduced in Junos OS Release 8.5.

**Description**

Send OAM PDUs with the critical event bit set.

**Required Privilege Level**

- interface—to view this statement in the configuration.
- interface-control—to add this statement to the configuration.

**Related Documentation**

- Specifying the Actions to Be Taken for Link-Fault Management Events on page 832

### server

**Syntax**

```
server;
```

**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 in Junos OS Release 8.5.

**Description**

Configure the router to operate in the PPPoE server mode. Supported on M120 and M320 Multiservice Edge Routers and MX Series 5G Universal Routing Platforms operating as access concentrators.

**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 Server Mode on page 375
server-fail

**Syntax**

```
server-fail (deny | permit | use-cache | vlan-id | vlan-name);
```

**Hierarchy Level**

```
[edit protocols authentication-access-control interface (all | [interface-names]) dot1x]
```

**Release Information**

Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.

**Description**

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.

When you specify the action `vlan-name` or `vlan-id`, the VLAN must already be configured on the switch.

**Default**

Authentication is denied.

**Options**

- **deny**—Force fail the supplicant authentication. No traffic will flow through the interface.
- **permit**—Force succeed the supplicant authentication. Traffic will flow through the interface as if it were successfully authenticated by the RADIUS server.
- **use-cache**—Force succeed the supplicant authentication only if it was previously authenticated successfully. This action ensures that already authenticated supplicants are not affected.
- **vlan-id**—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.
- **vlan-name**—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.

**Required Privilege**

- **Level**
  - routing—to view this statement in the configuration.
  - routing-control—to add this statement to the configuration.
**server-reject-vlan (MX Series in Enhanced LAN Mode)**

**Syntax**

```
server-reject-vlan (vlan-id | vlan-name) {
    eapol-block;
    block-interval block-interval;
}
```

**Hierarchy Level**

```
[edit protocols authentication-access-control interface (all | [interface-names]) dot1x]
```

**Release Information**

Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.

**Description**

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.

When you specify the VLAN ID or VLAN name, the VLAN must already be configured on the switch.

The remaining statements are explained separately. See [CLI Explorer](https://www.juniper.net/documentation/).  

**Default**

None

**Options**

- **vlan-id**—Numeric identifier of the VLAN to which the supplicant is moved.
- **vlan-name**—Name of the VLAN to which the supplicant is moved.

**Required Privilege Level**

- routing—to view this statement in the configuration.
- routing-control—to add this statement to the configuration.
server-timeout

Syntax

server-timeout seconds;

Hierarchy Level

[edit protocols dot1x authenticator interface interface-id]

Release Information

Statement introduced in Junos OS Release 9.3.

Description

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.

Options

seconds—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.

Range: 1 through 60 seconds

Default: 30 seconds

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Related Documentation

• IEEE 802.1x Port-Based Network Access Control Overview on page 35
  • authenticator on page 1232
  • dot1x on page 1270
  • interface (IEEE 802.1x) on page 1356
server-timeout (MX Series in Enhanced LAN Mode)

Syntax
server-timeout seconds;

Hierarchy Level
[edit protocols authentication-access-control interface (all | [interface-names])]

Release Information
Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.

Description
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.

Default
30 seconds

Options
seconds — Number of seconds.
Range: 1 through 60 seconds
Default: 30 seconds

Required Privilege
Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.
service (PPPoE)

Syntax

```
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;
    }
  }
}
```

Hierarchy Level

```
[edit protocols pppoe service-name-tables table-name]
```

Release Information

Statement introduced in Junos OS Release 10.0.

any, dynamic-profile, routing-instance, max-sessions, and static-interface options introduced in Junos OS Release 10.2.

Description

Specify the action taken by the interface on receipt of a PPPoE Active Discovery Initiation (PADI) control packet for the specified named service, empty service, or any 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.

Default

The default action is terminate.

Options

- **service-name**—Service entry in the PPPoE service name table:
  - **service-name**—Named service entry of up to 32 characters; for example, premiumService. You can configure a maximum of 512 named service entries across all PPPoE service name tables on the router.
  - **empty**—Service entry of zero length that represents an unspecified service. Each PPPoE service name table includes one empty service entry by default.
  - **any**—Default service for non-empty service entries that do not match the named or empty service entries configured in the PPPoE service name table. Each PPPoE service name table includes one any service entry by default.
The remaining statements are explained separately. Search for a statement in CLI Explorer or click a linked statement in the Syntax section for details.

### Required Privilege Level
- **interface**—To view this statement in the configuration.
- **interface-control**—To add this statement to the configuration.

### 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

```plaintext
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 375
- Junos OS Interfaces and Routing Configuration Guide
service-name-table

Syntax

service-name-table table-name;

Hierarchy Level

[edit dynamic-profiles profile-name interfaces demux0 unit logical-unit-number family pppoe],
[edit dynamic-profiles profile-name interfaces interface-name unit logical-unit-number family pppoe],
[edit interfaces interface-name unit logical-unit-number family pppoe],
[edit interfaces interface-name unit logical-unit-number family pppoe-underlying-options],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number family pppoe],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number pppoe-underlying-options]

Release Information

Statement introduced in Junos OS Release 10.0.
Support at the [edit... family pppoe] hierarchies introduced in Junos OS Release 11.2.

Description

Specify the PPPoE service name table assigned to a PPPoE underlying interface. This underlying interface is configured with either the encapsulation ppp-over-ether statement or the family pppoe statement; the two statements are mutually exclusive.

NOTE: The [edit... family pppoe] hierarchies are supported only on MX Series routers with MPCs.

Options

table-name—Name of the PPPoE service name table, a string of up to 32 alphanumeric characters.

Required Privilege

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring PPPoE Service Name Tables
- Assigning a Service Name Table to a PPPoE Underlying Interface
- Configuring the PPPoE Family for an Underlying Interface
service-name-tables

Syntax

```plaintext
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 {
      acl circuit-id-string ari remote-id-string {
        drop;
        delay seconds;
        terminate;
        dynamic-profile profile-name;
        routing-instance routing-instance-name;
        static-interface interface-name;
      }
    }
  }
}
```

Hierarchy Level

[edit protocols pppoe]

Release Information

Statement introduced in Junos OS Release 10.0. dynamic-profile, routing-instance, max-sessions, and static-interface options introduced in Junos OS Release 10.2.

Description

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.

Options

`table-name`—Name of the PPPoE service name table, a string of up to 32 alphanumeric characters.

The remaining statements are explained separately. Search for a statement in CLI Explorer or click a linked statement in the Syntax section for details.

Required Privilege

`interface`—To view this statement in the configuration.
`interface-control`—To add this statement to the configuration.

Related Documentation

- Configuring PPPoE Service Name Tables
- Creating a Service Name Table
# session-expiry (MX Series in Enhanced LAN Mode)

<table>
<thead>
<tr>
<th>Syntax</th>
<th><code>session-expiry seconds;</code></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchy Level</td>
<td>`[edit protocols authentication-access-control interface (all</td>
</tr>
<tr>
<td>Release Information</td>
<td>Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.</td>
</tr>
<tr>
<td>Description</td>
<td>Configure the maximum duration in seconds of a session.</td>
</tr>
<tr>
<td>Options</td>
<td><code>seconds</code>—Duration of session.</td>
</tr>
<tr>
<td></td>
<td><strong>Range:</strong> 1 through 65535</td>
</tr>
<tr>
<td></td>
<td><strong>Default:</strong> 3600</td>
</tr>
<tr>
<td>Required Privilege Level</td>
<td>routing—To view this statement in the configuration.</td>
</tr>
<tr>
<td></td>
<td>routing–control—To add this statement to the configuration.</td>
</tr>
</tbody>
</table>
source-address-filter

Syntax  
source-address-filter {
  mac-address;
}

Hierarchy Level  
[edit interfaces interface-name aggregated-ether-options],
[edit interfaces interface-name fastether-options],
[edit interfaces interface-name gigether-options]

Release Information  
Statement introduced before Junos OS Release 7.4.
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 source-filtering statement in the configuration to enable source address filtering.

Options  
mac-address—MAC address filter. You can specify the MAC address as nnn:nnn:nnn:nnn:nnn
or nnn.nnn.nnn.nnn, where n is a decimal digit. To specify more than one address,
include multiple mac-address options in the source-address-filter statement.

If you enable the VRRP on a Fast Ethernet or Gigabit Ethernet interface, as described in
“VRRP and VRRP for IPv6 Overview” on page 363, 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 source-address-filter statement.
MAC addresses ranging from 00:00:5e:00:01:00 through 00:00:5e:00:01:ff are
reserved for VRRP, as defined in RFC 3768, Virtual Router Redundancy Protocol. When
you configure the VRRP group, the group number must be the decimal equivalent
of the last hexadecimal byte of the virtual MAC address.

On untagged Gigabit Ethernet interfaces, you should not configure the source-address-filter
statement and the accept-source-mac statement simultaneously. On tagged Gigabit
Ethernet interfaces, you should not configure the source-address-filter statement
and the accept-source-mac statement with an identical MAC address specified in
both filters.

Required Privilege

Level  
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation  
• Configuring MAC Address Filtering for Ethernet Interfaces on page 14
• Configuring MAC Address Filtering on PTX Series Packet Transport Routers on page 16
• source-filtering on page 1529
source-filtering

Syntax  (source-filtering | no-source-filtering);

Hierarchy Level  [edit interfaces interface-name aggregated-ether-options],
[edit interfaces interface-name fastether-options],
[edit interfaces interface-name gigether-options]

Release Information  Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1X48 for PTX Packet Transport Routers.

Description  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 source-address-filter statement.

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.

Default  Source address filtering is disabled.

Required Privilege Level  interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation  • Configuring MAC Address Filtering for Ethernet Interfaces on page 14
• Configuring MAC Address Filtering on PTX Series Packet Transport Routers on page 16
• accept-source-mac on page 1206
• source-address-filter on page 1528
**speed (Ethernet)**

### List of Syntax
- Syntax (EX Series) on page 1530
- Syntax (EX2300 and EX4300) on page 1530
- Syntax (EX Series, ACX Series, MX Series) on page 1530
- Syntax (QFX Series, OCX1100, EX4600) on page 1530

### Syntax (EX Series)
```
speed (auto-negotiation | speed) ;
```

### Syntax (EX2300 and EX4300)
```
speed speed;
```

### Syntax (EX Series, ACX Series, MX Series)
```
speed (10m | 10g | 100m | 1g | 2.5g | 5g | auto | auto-10m-100m);
```

### Syntax (QFX Series, OCX1100, EX4600)
```
speed (10g | 1g | 100m)
```

### Hierarchy Level (EX Series)
```
[edit interfaces interface-name ether-options]
```

### Hierarchy Level (EX2300 and EX4300)
```
[edit interfaces interface-name]
```

### Hierarchy Level (ACX Series, EX Series, MX Series)
```
[edit interfaces interface-name],
[edit interfaces ge-pim/0/0 switch-options switch-port port-number]
```

### Hierarchy Level (QFX Series, EX4600, OCX Series)
```
[edit interfaces interface-name]
```

### Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced in Junos OS Release 12.2 for ACX Series Universal Metro Routers.
Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
Speed option 2.5Gbps introduced in Junos OS Release 18.1R2 for EX2300 switch.
Speed option 10Gbps and 5Gbps introduced in Junos OS Release 18.2R1 for EX4300 switch.
Speed option 1-Gbps is introduced in Junos OS Release 19.1R1 on the 4-port 1-Gigabit Ethernet/10-Gigabit Ethernet uplink module on EX4300-48MP switches.

### Description
Configure the interface speed. This statement applies to the management Ethernet interface (fxp0 or em0), Fast Ethernet 12-port and 48-port PICs, the built-in Fast Ethernet interfaces.
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.

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.

NOTE: On MX Series routers with Tri-rate Enhanced DPC (DPCE-R-40GE-TX), when you configure the interface speed using the auto-10m-100m option, the speed is negotiated to the highest value possible (100 Mbps), if the same value is configured on both sides of the link. However, when you view the interface speed of the DPC, using the show interfaces command, the value of the speed is not accurately displayed. For instance, if you configure the speed of the Tri-rate enhanced DPC, as 100Mbps on both sides of the link, the interface speed of the DPC is negotiated to 100 Mbps. However, the interface speed of the DPC displays 1 bps. This is an issue with the show interfaces command only. The actual interface speed is 100 Mbps.

On 10-Gigabit Ethernet SFP interfaces, autonegotiation is enabled by default and auto-detects the speed to be either 1 Gbps or 10 Gbps. On QFX5100-48S, QFX5100-96S, and QFX5100-24Q devices using 10-Gigabit Ethernet SFP interfaces, the speed is set to 10 Gbps by default and cannot be configured to operate in a different speed. On QFX5100-48S and QFX5100-96S devices using 1-Gigabit Ethernet SFP interfaces, the speed is set to 1 Gbps by default and cannot be configured to operate in a different speed.

NOTE: In Junos OS Release 14.1X53-D35 on QFX5100-48T-6Q devices using 10-Gigabit Ethernet Copper interfaces, autonegotiation is disabled by default on the copper ports, and the interfaces operate at a speed of 100M. You can, however, enable auto-negotiation by issuing the set interface name ether-options auto-negotiation command on the interface for which you want to change the interface speed. With autonegotiation enabled, the interface auto-detects the speed in which to operate.

NOTE: Only 10 Gbps and 40 Gbps interfaces are supported on OCX Series switches.

NOTE: When displaying interface information with show interfaces commands, you might see speed values for 1 Gbps interfaces displayed as 1000mbps.
(For EX2300 only) Starting in Junos OS Release 18.1R2, the multi-rate speed is supported on EX2300-48MP and EX2300-24MP switches. The speed configuration statement is supported on both multi-rate gigabit ethernet interface (mge) and gigabit ethernet (ge) interface. The mge interface is a rate-selectable (multirate) Gigabit Ethernet interface that can support speeds of 10-Gbps, 5-Gbps, and 2.5-Gbps over CAT5e/CAT6/CAT6a cables. In the EX2300, the mge interface supports 100-Mbps, 1-Gbps, and 2.5-Gbps speeds, which can be configured by using the speed configuration statement. Note that 10Mbpss speed is supported only on ge interfaces of EX2300 switch.

On EX2300-24MP and EX2300-48MP switches, if both Energy Efficient Ethernet (EEE) and 100-Mbps speed are configured on a rate-selectable (or multirate) Gigabit Ethernet (mge) port, the port operates only at 100-Mbps speed but EEE is not enabled on that port. EEE is supported only on mge interfaces that operate at 1-Gbps and 2.5-Gbps speeds.

(For EX4300-48MP only) Starting with Junos OS Release 19.1R1, the 4-port 1-Gigabit Ethernet/10-Gigabit Ethernet uplink module (EX-UM-4SFPP-MR) on EX4300-48MP switches supports 1-Gbps speed. You do not need to explicitly configure 1-Gbps speed on the uplink module as it automatically identifies the installed 1-gigabit SFP transceivers and creates the interface accordingly.

NOTE: On EX4300-48MP, the status LED of 1-Gigabit Ethernet uplink module port is solid green (instead of blinking green) because of a device limitation. However, there is no impact on device functionality.

Default (EX Series) If the auto-negotiation statement at the [edit interfaces interface-name ether-options] hierarchy level is enabled, the auto-negotiation option is enabled by default.
Options  You can specify the speed as either 10m (10 Mbps), 100m (100 Mbps), and on MX Series routers, 1g (1 Gbps). You can also specify the auto option on MX Series routers.

For Gigabit Ethernet interfaces on EX Series switches, you can specify one of the following options:
### Table 137: Options for speed

<table>
<thead>
<tr>
<th>Platforms</th>
<th>Speed Supported</th>
<th>Auto-negotiation</th>
</tr>
</thead>
<tbody>
<tr>
<td>EX Series Switches</td>
<td>100m—100 Mbps</td>
<td>auto-negotiation—Automatically negotiate the speed based on the speed of the other end of the link. This option is available only when the <code>auto-negotiation</code> statement at the <code>[edit interfaces interface-name ether-options]</code> hierarchy level is enabled.</td>
</tr>
<tr>
<td></td>
<td>10m—10 Mbps</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1g—1 Gbps</td>
<td></td>
</tr>
<tr>
<td>ACX, MX Series</td>
<td>100m—100 Mbps</td>
<td>auto—Automatically negotiate the speed (10 Mbps, 100 Mbps, or 1 Gbps) based on the speed of the other end of the link.</td>
</tr>
<tr>
<td></td>
<td>10m—10 Mbps</td>
<td>auto—10m—100m—Automatically negotiate the speed (10 Mbps or 100 Mbps) based on the speed of the other end of the link.</td>
</tr>
<tr>
<td></td>
<td>1g—1 Gbps</td>
<td></td>
</tr>
<tr>
<td>EX4600, QFX Series, QFabric, OCX100, QFX Series</td>
<td>10g—10 Gbps</td>
<td>auto-negotiation—Automatically negotiate the speed based on the speed of the other end of the link. This option is available only when the <code>auto-negotiation</code> statement at the <code>[edit interfaces interface-name ether-options]</code> hierarchy level is enabled.</td>
</tr>
<tr>
<td></td>
<td>1g—1 Gbps</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100m—100 Mbps</td>
<td></td>
</tr>
<tr>
<td>EX2300</td>
<td>10m—10 Mbps (supported on EX series switches and only on <code>ge</code> interfaces of EX2300 switch)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100m—100 Mbps</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1g—1 Gbps</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.5g—2.5 Gbps (supported only on <code>mge</code> interfaces of E2300 switch)</td>
<td></td>
</tr>
<tr>
<td>EX4300-48MP (EX-UM-4SFPP-MR)</td>
<td>10m—10 Mbps (supported only on <code>ge</code> interfaces)</td>
<td>speed—Specify the interface speed. If the <code>auto-negotiation</code> statement at the <code>[edit interfaces interface-name ether-options]</code> hierarchy level is disabled, you must specify a specific value. This value sets the speed that is used on the link. If the <code>auto-negotiation</code> statement is enabled, you might want to configure a specific speed value to advertise the desired speed to the remote end.</td>
</tr>
<tr>
<td></td>
<td>100m—100 Mbps (supported on <code>ge</code> and <code>mge</code> interfaces)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1g—1 Gbps (supported on <code>ge</code>, <code>mge</code> interfaces, and 4-port 1-Gigabit Ethernet/10-Gigabit Ethernet uplink module on EX4300–48MP switches). The 1-Gbps speed is supported on the 4-port 1-Gigabit Ethernet/10-Gigabit Ethernet uplink module of EX4300–48MP switches from Junos OS Release 19.1R1 onwards.</td>
<td>The Multi-rate gigabit ethernet interface (MGE) on EX2300-24MP and EX2300-48MP switches flaps (becomes unavailable, and then available again) while performing timeout detection and recovery (TDR) test.</td>
</tr>
<tr>
<td></td>
<td>2.5g—2.5 Gbps (supported only on <code>mge</code> interfaces)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5g—5 Gbps (supported only on <code>mge</code> interfaces)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10g—10 Gbps (supported on <code>mge</code> interfaces)</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** On 4-port 1-Gigabit Ethernet/10-Gigabit Ethernet uplink module, no explicit configuration is required as it automatically identifies the transceivers and creates the interface accordingly.
Table 137: Options for speed (continued)

<table>
<thead>
<tr>
<th>Required Privilege</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>interface</td>
<td>To view this statement in the configuration.</td>
</tr>
<tr>
<td>interface-control</td>
<td>To add this statement to the configuration.</td>
</tr>
</tbody>
</table>

### Release History Table

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
<th>18.2R1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Starting in Junos OS Release 18.1R2, the multi-rate speed is supported on EX2300-48MP and EX2300-24MP switches.</td>
<td></td>
</tr>
</tbody>
</table>

### Related Documentation

- Configuring the Interface Speed
- Configuring the Interface Speed on Ethernet Interfaces on page 8
- Configuring Gigabit Ethernet Autonegotiation on page 683
- Configuring Gigabit Ethernet Interfaces for EX Series Switches with ELS support
- auto-negotiation
- Configuring Gigabit and 10-Gigabit Ethernet Interfaces for EX4600 and QFX Series Switches
- Junos OS Network Interfaces Library for Routing Devices
- Configuring Gigabit Ethernet Interfaces (CLI Procedure)
- Configuring Gigabit Ethernet Interfaces (J-Web Procedure)
- Junos OS Ethernet Interfaces Configuration Guide
# speed (MX Series DPC)

**Syntax**

speed (auto | 1Gbps | 100Mbps | 10Mbps);

**Hierarchy Level**

[edit interfaces ge-fpc/pic/port]

**Release Information**

Statement introduced in Junos OS Release 9.5.

**Description**

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 `speed (auto | 1Gbps | 100Mbps | 10Mbps)` statement under the [edit interface ge-/fpc/pic/port] hierarchy level. The `auto` 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 1Gbps, 100Mbps, or 10Gbps.

---

**NOTE:** If the negotiated speed and the interface speed do not match, the link will not be brought up. Half duplex mode is not supported.

---

**Options**

You can specify the speed as either `auto` (autonegotiate), `10Mbps` (10 Mbps), `100Mbps` (100 Mbps), or `1Gbps` (1 Gbps).

**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 Autonegotiation on page 683
- `no-auto-mdix` on page 1428
### stacked-vlan-tagging

<table>
<thead>
<tr>
<th>Syntax</th>
<th>stacked-vlan-tagging:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchy Level</td>
<td>[edit interfaces interface-name]</td>
</tr>
</tbody>
</table>

**Release Information**
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.2 for ACX Series Universal Metro Routers.

**Description**
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.

For pseudowire subscriber interfaces, enable stacked VLAN tagging for logical interfaces on the pseudowire service.

**Required Privilege Level**
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**
- Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview on page 691
**static (Protocols 802.1X)**

**Syntax**

```plaintext
static mac-address {
  interface interface-names;
  vlan-assignment (vlan-id |vlan-name );
}
```

**Hierarchy Level**

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

**Release Information**

Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.

**Description**

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.

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.

You can optionally configure the VLAN that the supplicant is moved to or the interfaces on which the MAC address can gain access from.

**Options**

- `mac-address` — The MAC address of the device for which 802.1X authentication should be bypassed and the device permitted access to the port.

  The remaining statements are explained separately. See CLI Explorer.

**Required Privilege Level**

- routing—To view this statement in the configuration.
- routing-control—To add this statement to the configuration.
static-interface

Syntax
static-interface interface-name;

Hierarchy Level
[edit protocols pppoe service-name-tables table-name service service-name agent-specifier aci circuit-id-string ari remote-id-string]

Release Information
Statement introduced in Junos OS Release 10.2.

Description
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, empty service entry, or any service entry in the PPPoE service name table.

The static interface associated with an ACI/ARI pair takes precedence over the general pool of static interfaces associated with the PPPoE underlying interface.

If you include the static-interface statement in the configuration, you cannot also include either the dynamic-profile statement or the routing-instance statement. The dynamic-profile, routing-instance, and static-interface statements are mutually exclusive for ACI/ARI pair configurations.

Options
interface-name—Name of the static PPPoE interface reserved for use by the PPPoE client with matching ACI/ARI information. Specify the interface in the format pp0.logical, where logical is a logical unit number from 0 through 16385 for static interfaces.

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
• Configuring PPPoE Service Name Tables
• Reserving a Static PPPoE Interface for Exclusive Use by a PPPoE Client
**supplicant**

<table>
<thead>
<tr>
<th>Syntax</th>
<th>supplicant single;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchy Level</td>
<td>[edit protocols dot1x authenticator interface interface-id]</td>
</tr>
<tr>
<td>Release Information</td>
<td>Statement introduced in Junos OS Release 9.3.</td>
</tr>
</tbody>
</table>
| Description | Specify the supplicant mode. Only single mode is supported.  
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. |
| Options    | single—Sets single mode. |
| Required Privilege Level | interface—To view this statement in the configuration.  
interface-control—To add this statement to the configuration. |
| Related Documentation |  
- IEEE 802.1x Port-Based Network Access Control Overview on page 35  
- authenticator on page 1232  
- dot1x on page 1270  
- interface (IEEE 802.1x) on page 1356 |
supplicant (MX Series in Enhanced LAN Mode)

**Syntax**
supplicant (multiple | single | single-secure);

**Hierarchy Level**
[edit protocols authentication-access-control interface (all | [interface-names])]

**Release Information**
Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.

**Description**
Configure the MAC-based method used to authenticate clients for 802.1X or captive portal authentication.

**Default**
single

**Options**
single—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.

single-secure—Authenticates only one client to connect to an authenticator port. The host must be directly connected to the switch.

multiple—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.

**Required Privilege**
routing—To view this statement in the configuration.

Level routing-control—To add this statement to the configuration.
### supplicant-timeout

<table>
<thead>
<tr>
<th>Syntax</th>
<th>supplicant-timeout seconds;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchy Level</td>
<td>[edit protocols dot1x authenticator interface interface-id]</td>
</tr>
<tr>
<td>Release Information</td>
<td>Statement introduced in Junos OS Release 9.3.</td>
</tr>
<tr>
<td>Description</td>
<td>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.</td>
</tr>
</tbody>
</table>
| Options       | seconds—Specify the number of seconds the port waits for the supplicant timeout.  
Range: 1 through 60 seconds  
Default: 30 seconds |
| Required Privilege Level | interface—To view this statement in the configuration.  
interface-control—To add this statement to the configuration. |
| Related Documentation | • IEEE 802.1x Port-Based Network Access Control Overview on page 35  
• authenticator on page 1232  
• dot1x on page 1270  
• interface (IEEE 802.1x) on page 1356 |
**supplicant-timeout (MX Series in Enhanced LAN Mode)**

<table>
<thead>
<tr>
<th>Syntax</th>
<th>supplicant-timeout seconds;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchy Level</td>
<td>[edit protocols authentication-access-control interface (all</td>
</tr>
<tr>
<td>Release Information</td>
<td>Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.</td>
</tr>
<tr>
<td>Description</td>
<td>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.</td>
</tr>
<tr>
<td>Default</td>
<td>30 seconds</td>
</tr>
<tr>
<td>Options</td>
<td>seconds — Number of seconds. Range: 1 through 60 seconds Default: 30 seconds</td>
</tr>
<tr>
<td>Required Privilege Level</td>
<td>routing—To view this statement in the configuration. routing-control—To add this statement to the configuration.</td>
</tr>
</tbody>
</table>
**swap**

**Syntax**

```
swap;
```

**Hierarchy Level**

- `[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]`

**Release Information**

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.
Statement introduced in Junos OS Release 13.2X51-D20 for the QFX Series.

**Description**

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.

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.

**Required Privilege Level**

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**

- *Rewriting the VLAN Tag on Tagged Frames*
- *Configuring Q-in-Q Tunneling on EX Series Switches with ELS Support*
swap-by-poppush

Syntax
swap-by-poppush;

Hierarchy Level
[edit interfaces interface-name unit logical-unit-number]

Release Information
Statement introduced in Junos OS Release 11.2

Description
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.

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

swap-push

Syntax
swap-push;

Hierarchy Level
[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]

Release Information
Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

Description
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.

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.

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
• Rewriting a VLAN Tag and Adding a New Tag
**swap-swap**

**Syntax**

```
swap-swap;
```

**Hierarchy Level**

```
[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]
```

**Release Information**

Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

**Description**

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.

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.

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- *Rewriting the Inner and Outer VLAN Tags*
# switch-options

**Syntax**

```c
switch-options {
    switch-port *port-number* {
        (auto-negotiation | no-auto-negotiation);
        speed (10m | 100m | 1g);
        link-mode (full-duplex | half-duplex);
    }
}
```

**Hierarchy Level**  
[edit interfaces ge-pim/0/0]

**Release Information**  
Statement introduced in Junos OS Release 8.4.

**Description**  
Configuration of the physical port characteristics is done under the single physical interface.

**Required Privilege Level**  
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.
### switch-port

**Syntax**

```
switch-port port-number {
(auto-negotiation | no-auto-negotiation);
speed (10m | 100m | 1g);
link-mode (full-duplex | half-duplex);
}
```

**Hierarchy Level**

```
[edit interfaces ge-pim/0/0 switch-options]
```

**Release Information**

Statement introduced in Junos OS Release 8.4.

**Description**

Configuration of the physical port characteristics, done under the single physical interface.

**Default**

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.

**Options**

- **port-number**—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.

  The remaining statements are explained separately. See CLI Explorer.

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.
## symbol-period

<table>
<thead>
<tr>
<th>Syntax</th>
<th>symbol-period count;</th>
</tr>
</thead>
</table>

### Hierarchy Level

- [edit protocols oam ethernet link-fault-management action-profile event, link-event-rate],
- [edit protocols oam link-fault-management interface interface-name event-thresholds]

### Release Information

Statement introduced in Junos OS Release 8.4.

### Description

Configure the threshold for sending symbol period events or taking the action specified in the action profile.

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.

### Options

- **count**—Threshold count for symbol period events.
  - **Range:** 0 through 100

### Required Privilege Level

- **interface**—To view this statement in the configuration.
- **interface-control**—To add this statement to the configuration.

### Related Documentation

- Configuring Threshold Values for Local Fault Events on an Interface on page 827
- Configuring Threshold Values for Fault Events in an Action Profile on page 835
## syslog (OAM Action)

<table>
<thead>
<tr>
<th><strong>Syntax</strong></th>
<th>syslog;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hierarchy Level</strong></td>
<td>[edit protocols oam ethernet link-fault-management action-profile action]</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Generate a syslog message for the Ethernet Operation, Administration, and Management (OAM) event. Generate a system log message for the Ethernet Operation, Administration, and Maintenance (OAM) link fault management (LFM) event.</td>
</tr>
<tr>
<td><strong>Required Privilege Level</strong></td>
<td>interface—To view this statement in the configuration. interface-control—To add this statement to the configuration. routing—To view this statement in the configuration. routing-control—To add this statement to the configuration.</td>
</tr>
<tr>
<td><strong>Related Documentation</strong></td>
<td>• Specifying the Actions to Be Taken for Link-Fault Management Events on page 832 • Configuring Ethernet OAM Link Fault Management</td>
</tr>
</tbody>
</table>
## system-id

**Syntax**

```
system-id system-id;
```

**Hierarchy Level**

```
[edit interfaces aeX aggregated-ether-options lacp]
```

**Release Information**

Statement introduced in Junos OS Release 12.2R1
Statement introduced in Junos OS Release 15.1F4 for PTX Series routers.

**Description**

Define the LACP system identifier at the aggregated Ethernet interface level.

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.

**Required Privilege Level**

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**

- Configuring LACP for Aggregated Ethernet Interfaces on page 143
**system-priority**

**Syntax**

```
system-priority priority;
```

**Hierarchy Level**

```
[edit interfaces aeX aggregated-ether-options lacp]
```

**Release Information**

Statement introduced in Junos OS Release 9.3.
Statement introduced in Junos OS Release 11.4 for EX Series switches.
Statement introduced in Junos OS Release 15.1F4 for PTX Series routers.

**Description**

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.

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.

**Options**

- **priority**—Priority for the aggregated Ethernet system. A smaller value indicates a higher priority.
  - **Range:** 0 through 65535
  - **Default:** 127

**Required Privilege Level**

- interface—to view this statement in the configuration.
- interface-control—to add this statement to the configuration.
tag-protocol-id (TPIDs Expected to Be Sent or Received)

Syntax

```
tag-protocol-id [tpids];
```

Hierarchy Level

```
[edit interfaces interface-name gigether-options ethernet-switch-profile],
[edit interfaces interface-name aggregated-ether-options ethernet-switch-profile],
[edit interfaces interface-name aggregated-ether-options ethernet-switch-profile],
[edit interfaces interface-name ether-options ethernet-switch-profile]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.2 for ACX Series Universal Metro Routers.
Statement introduced in Junos OS Release 13.2X50-D15 for EX Series switches.
Statement introduced in Junos OS Release 14.1X53-D15 for the QFX Series.

Description

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 `tag-protocol-id` statement; but only the first four TPIDs are supported on IQ2 and IQ2-E interfaces.

For 10-Gigabit Ethernet LAN/WAN PIC interfaces on T Series routers only the default TPID value (`0x8100`) is supported.

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 `0x8100`. Other supported values are `0x88a8`, `0x9100`, and `0x9200`.

Options

`tpids`—TPIDs to be accepted on the VLAN. Specify TPIDs in hexadecimal.

Required Privilege Level

`interface`—To view this statement in the configuration.
`interface-control`—To add this statement to the configuration.

Related Documentation

- Configuring Frames with Particular TPIDs to Be Processed as Tagged Frames on page 695
- Configuring Q-in-Q Tunneling on EX Series Switches with ELS Support
tag-protocol-id (TPID to Rewrite)

**Syntax**
tag-protocol-id tpid;

**Hierarchy Level**
[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]

**Release Information**
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

**Description**
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 [edit interfaces interface-name gigether-options ethernet-switch-profile tag-protocol-id [tpids]] hierarchy level.

For 10-Gigabit Ethernet LAN/WAN PIC interfaces on T Series routers the default TPID value (0x8100) is supported.

**Default**
If the `tag-protocol-id` statement is not configured, the TPID value is 0x8100.

**Required Privilege Level**
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**
- Configuring Inner and Outer TPIDs and VLAN IDs on page 698
targeted-options (Grouping Subscribers by Bandwidth Usage)

**Syntax**

```
targeted-options {
  backup backup;
  group group;
  primary primary;
  weight ($junos-interface-target-weight | weight-value);
}
```

**Hierarchy Level**

- `edit dynamic-profiles name interfaces name unit logical-unit-number`,
- `edit dynamic-profiles name logical-systems name interfaces name unit logical-unit-number`,
- `edit interfaces name unit logical-unit-number`

**Release Information**


- `weight` option added in Junos OS Release 17.3 for MX Series and MX Virtual Chassis.
- `$junos-interface-target-weight` option added in Junos OS Release 18.4R1.

**Description**

Configure primary and backup links, group similar subscribers, and specify a subscriber weight for manual targeting to distribute subscribers across aggregated Ethernet member links.

**Options**

- **backup**—(Optional) Specify a backup member link per subscriber when you configure manual targeting.

  **group**—(Optional) Assign a group name for subscribers with similar bandwidth usage. Subscribers that are configured for targeted distribution without a group name are added to the `default` group and distributed evenly across member links. Grouping of subscribers is supported only for static subscribers.

  **Default**: default

- **primary**—Specify a primary member link per subscriber when you configure manual targeting. You must always configure a primary link when you configure manual targeting.

- **weight ($junos-interface-target-weight | weight-value)**—Specify the weight for targeted subscribers like PPPoe, demux, and conventional VLANs based on factors such as customer preferences, class of service (CoS), or bandwidth requirement. Member links for logical interfaces of aggregated Ethernet logical interfaces are assigned based on the value of the weight. When a new VLAN is added to the same aggregated Ethernet bundle, then the primary member link selected for targeting is the one with the minimum primary load and the backup link selected for targeting is the one with the minimum overall load.

  The `$junos-interface-target-weight` predefined variable is supported for dynamic configuration only. When you configure this predefined variable, the weight value is sourced from VSA 26–213 in the RADIUS Access-Accept message when a dynamic subscriber is authenticated.
Range: 1 through 1000

**Required Privilege Level**
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**
- Understanding Support for Targeted Distribution of Logical Interface Sets of Static VLANs over Aggregated Ethernet Logical Interfaces
- Using RADIUS-Sourced Weights for Interface and Interface Set Targeted Distribution
- RADIUS-Sourced Weights for Interface and Interface Set Targeted Distribution
targeted-options (Manual Targeting)

Syntax

```plaintext
targeted-options {
  (logical-interface-chassis-redundancy | logical-interface-fpc-redundancy);
  rebalance-periodic {
    interval interval;
    start-time start-time;
  }
  type (auto | manual);
}
```

Hierarchy Level

- [edit dynamic-profiles name interfaces name aggregated-ether-options],
- [edit dynamic-profiles name logical-systems name interfaces name aggregated-ether-options],
- [edit interfaces name aggregated-ether-options]
- [edit interfaces name unit ]

Release Information


Description

Configure manual targeting or auto-targeting.

Options

- **type**—Configure manual targeting type as manual or auto.
  - **Values:**
    - **auto**—Configure targeted-distribution without specific primary and backup links.
    - **manual**—Configure targeted distribution with specific member links as primary and backup for a subscriber. When you configure manual targeting, you must always configure a primary link. Configuring a backup link is optional. You specify the primary and backup links for a subscriber in the individual interface configuration. You configure primary and backup links by using the `targeted-options` statement at the [edit interfaces name unit] hierarchy level.

  Manual targeting enhances the distribution of targeted VLANs or subscribers across member links of an aggregated Ethernet bundle by making it bandwidth-aware.

  Default: **auto**

  The remaining statements are described 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
- targeted-options (Grouping Subscribers by Bandwidth Usage) on page 1555
- Targeted Traffic Distribution on Aggregated Ethernet Interfaces in a Virtual Chassis
**targeted-distribution**

**Syntax**  
```targeted-distribution primary-list primary-list [backup-list backup-list];```

**Hierarchy Level**  
```[edit logical-systems name interfaces name unit ]```

**Release Information**  
Statement introduced in Junos OS Release 16.1R1.

**Description**  
Configure egress data for a member link in an aggregated Ethernet bundle. Specify a distribution list as primary list and a different distribution list as backup list. A backup list is provisioned in the event the primary list goes down.

**Options**
- `primary-list`—(Optional) Specify the role of the distribution list as primary. Member links of the aggregated Ethernet are assigned membership to the distribution list.
- `backup-list`—(Optional) Specify the role of the distribution list as backup. Member links of the aggregated Ethernet are assigned membership to the distribution list.

**Required Privilege Level**
- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**
- Targeted Distribution of Static Logical interfaces Across Aggregated Ethernet Member Links on page 217
- `distribution-list` on page 1268
- `targeted-options` on page 1559
targeted-options

**Syntax**

```plaintext
targeted-options {
    type (auto | manual);
}
```

**Hierarchy Level**

- `[edit dynamic-profiles name interfaces name aggregated-ether-options]`
- `[edit dynamic-profiles name logical-systems name interfaces name aggregated-ether-options]`
- `[edit interfaces name aggregated-ether-options]`

**Release Information**


**Description**

Specify the type of targeting to be used for targeted distribution. Specify the targeting option as `manual` for conventional VLAN targeting. By default, the targeting option is `auto`.

**Options**

- `type`—Specify the type of targeting to be used for targeted distribution.
  - **Default**: `auto`—By default, targeted option is set to `auto`.
  - **Values**:
    - `manual`—Use `manual` keyword to enforce manual targeting on conventional VLANs.

**Required Privilege**

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**

- Targeted Distribution of Static Logical interfaces Across Aggregated Ethernet Member Links on page 217
- `distribution-list` on page 1268
- `targeted-distribution` on page 1558
**terminate (PPPoE Service Name Tables)**

**Syntax**

```
terminate;
```

**Hierarchy Level**

```
[edit protocols pppoe service-name-tables table-name service service-name],
[edit protocols pppoe service-name-tables table-name service service-name agent-specifier
  aci circuit-id-string ari remote-id-string]
```

**Release Information**

Statement introduced in Junos OS Release 10.0.
Support at [edit protocols pppoe service-name-tables table-name service service-name
  agent-specifier aci circuit-id-string ari remote-id-string] hierarchy level introduced in Junos
OS Release 10.2.

**Description**

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 **terminate** action is the
default action for a named service entry, **empty** service entry, **any** service entry, or **agent
circuit identifier/agent remote identifier (ACI/ARI) pair** in a PPPoE service name table.

**Required Privilege**

- **Level**
  - interface—To view this statement in the configuration.
  - interface-control—To add this statement to the configuration.

**Related Documentation**

- Configuring PPPoE Service Name Tables
thresholds

Syntax

```plaintext
thresholds {
  clear clear-value;
  interval interval-value;
  set set-value;
  warning-clear warning-clear-value;
  warning-set warning-set-value;
}
```

Hierarchy Level

```
[edit interfaces interfaces-name link-degrade-monitor]
```

Release Information

Statement introduced in Junos OS Release 15.1.

Description

Configure the BER threshold values (such as set and clear thresholds) at which different corrective actions must be triggered on a degraded interface.

Options

**clear clear-value**—The BER threshold value at which the degraded link is considered recovered and the corrective action applied to the interface is reverted. You can configure this value in the $1E^{-n}$ format, where $1$ is the mantissa (remains constant) and $n$ is the exponent. For example, a threshold value of $1E^{-3}$ refers to the BER threshold value of $1x10^{-3}$. The supported exponent range is 1 through 16, and the default value is 12.

**interval interval-value**—The number of consecutive link degrade events that are considered before any corrective action is taken. The supported value range for the interval is 1 through 256, and the default interval is 10.

**set set-value**—The BER threshold value at which the link is considered degraded and a corrective action, specified by the user, is triggered. You can configure this value in the $1E^{-n}$ format, where $1$ is the mantissa (remains constant) and $n$ is the exponent. For example, a threshold value of $1E^{-3}$ refers to the BER threshold value of $1x10^{-3}$. The supported exponent range is 1 through 16, and the default value is 7.

**warning clear warning-clear-value**—The link clear warning threshold. Every time this threshold value is reached, a system message is logged to indicate that the link degrade condition has been cleared on the interface. You can configure this value in the $1E^{-n}$ format, where $1$ is the mantissa (remains constant) and $n$ is the exponent. For example, a threshold value of $1E^{-3}$ refers to the BER threshold value of $1x10^{-3}$. The supported exponent range is 1 through 16, and the default value is 11.

**warning set warning-set-value**—The link degrade warning threshold. Every time this threshold value is reached, a system message is logged to indicate that a link degrade has occurred on the interface. You can configure this value in the $1E^{-n}$ format, where $1$ is the mantissa (remains constant) and $n$ is the exponent. For example, a threshold value of $1E^{-3}$ refers to the BER threshold value of $1x10^{-3}$. The supported exponent range is 1 through 16, and the default value is 9.
NOTE: The lower the BER with high confidence level, the longer it takes to estimate it. In such cases, a few packet drops might be noticed (based on the bit error distribution) before a link degrade event is detected.

**Required Privilege**
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**
- Link Degrade Monitoring Overview on page 399
- link-degrade-monitor on page 1371
- recovery on page 1497
- request interface link-degrade-recover on page 1671
traceoptions

Syntax

```
traceoptions {
  file filename <files number> <size maximum-file-size> <world-readable | no-world-readable>;
  flag flag <disable>;
}
```

Hierarchy Level

- [edit protocols lldp]
- [edit routing-instances routing-instance-name protocols lldp]

Release Information


Description

Set LLDP protocol-level tracing options.

Default

The default LLDP protocol-level trace options are inherited from the global traceoptions statement.

Options

- **disable**—(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 all.

- **file filename**—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 `/var/log/stp-log`.

- **files number**—(Optional) Maximum number of trace files. 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, you must also specify a maximum file size with the `size` option.

  **Range:** 2 through 1000 files

  **Default:** 1 trace file only

- **flag**—Tracing operation to perform. To specify more than one tracing operation, include multiple `flag` statements. The following are the LLDP-specific tracing options:

  - **all**—Trace all operations.
  - **config**—Log configuration events.
  - **interface**—Trace interface update events.
  - **protocol**—Trace protocol information.
• **rtsock**—Trace socket events.

• **vlan**—Trace vlan update events.

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:** `x k` to specify KB, `x m` to specify MB, or `x g` 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.

**Required Privilege**

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>routing</td>
<td>To view this statement in the configuration.</td>
</tr>
<tr>
<td>routing-control</td>
<td>To add this statement to the configuration.</td>
</tr>
</tbody>
</table>
Related Documentation

• Tracing LLDP Operations on page 362
traceoptions (Individual Interfaces)

List of Syntax

Syntax (Individual interfaces with PTX Series, EX Series, ACX Series)

```
traceoptions {
  file <files name> <size size> <world-readable | no-world-readable>;
  flag flag;
  match;
}
```

Syntax (Individual interfaces with QFX Series, OCX1100, EX4600, NFX Series)

```
traceoptions {
  flag flag;
}
```

Syntax (OAMLFM with EX Series, QFX Series, NFX Series)

```
traceoptions {
  file <files number> <match regex> <size size> <world-readable | no-world-readable>;
  flag flag ;
  no-remote-trace;
}
```

Syntax (Interface process with ACX Series, SRX Series, MX Series, M Series, T Series)

```
traceoptions {
  file <files number> <match regular-expression> <size size> <world-readable | no-world-readable>;
  flag flag <disable>;
  no-remote-trace;
}
```

Hierarchy Level

(Individual interfaces with PTX Series, EX Series, ACX Series, QFX Series, OCX1100, EX4600, NFX Series)

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

Hierarchy Level

(Interface process with ACX Series, SRX Series, MX Series, M Series, T Series)

```
[edit interfaces]
```

Copyright © 2019, Juniper Networks, Inc.
| Release Information | Statement introduced before Junos OS Release 7.4.  
Statement introduced in Junos OS Release 9.0 for EX Series switches.  
Statement introduced in Junos OS Release 12.2 for ACX Series Universal Metro Routers.  
Statement introduced in Junos OS Release 9.0 for EX Series switches.  
Statement introduced in JUNOS Release 10.2 for EX Series switches.  
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 | Define tracing operations for individual interfaces.  
To specify more than one tracing operation, include multiple `flag` statements.  
The interfaces `traceoptions` statement does not support a trace file. The logging is done by the kernel, so the tracing information is placed in the system `syslog` file in the directory `/var/log/dcd`.  
On EX Series, QFX Series, and NFX Series platforms, configure tracing options the link fault management.  
On ACX Series, SRX Series, MX Series, M Series, and T Series platforms define tracing operations for the interface process (dcd). |
| Default | If you do not include this statement, no interface-specific tracing operations are performed. |
Options  Table 138 on page 1569 lists options for traceoption command for the following platforms:
### Table 138: Options for traceoptions

<table>
<thead>
<tr>
<th>Option</th>
<th>Individual interfaces with PTX Series, ACX Series, EX Series</th>
<th>Individual interfaces with QFX Series, QFabric System, OCX1100, EX4600, NFX Series</th>
<th>Interface Process with QAMLFM with EX Series, QFX Series, NFX Series</th>
<th>Interface process with ACX Series, SRX Series, MX Series, M Series, T Series</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>file filename</strong></td>
<td>—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/dcd</code>. By default, interface process tracing output is placed in the file.</td>
<td>—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/dcd</code>.</td>
<td>—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/dcd</code>.</td>
<td>—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/dcd</code>. By default, interface process tracing output is placed in the file <code>dcd</code>.</td>
</tr>
<tr>
<td><strong>files number</strong></td>
<td>—(Optional) Maximum number of trace files. When a trace file named <code>trace-file</code> reaches its maximum size, it is renamed <code>trace-file.0</code>, then <code>trace-file.1</code>, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten.</td>
<td>—(Optional) Maximum number of trace files. When a trace file named <code>trace-file</code> reaches its maximum size, it is renamed <code>trace-file.0</code>, then <code>trace-file.1</code>, 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 with the <code>size</code> option.</td>
<td>—(Optional) Maximum number of trace files. When a trace file named <code>trace-file</code> reaches its maximum size, it is renamed <code>trace-file.0</code>, then <code>trace-file.1</code>, 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 with the <code>size</code> option.</td>
<td>—(Optional) Maximum number of trace files. When a trace file named <code>trace-file</code> reaches its maximum size, it is renamed <code>trace-file.0</code>, then <code>trace-file.1</code>, 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 with the <code>size</code> option.</td>
</tr>
<tr>
<td><strong>flag</strong></td>
<td>—Tracing operation to perform. To specify more than one tracing operation, include multiple <code>flag</code> statements. The following are the interface-specific tracing options.</td>
<td>—Tracing operation to perform. To specify more than one tracing operation, include multiple <code>flag</code> statements. The following are the interface-specific tracing options.</td>
<td>—Tracing operation to perform. To specify more than one tracing operation, include multiple <code>flag</code> statements. You can include the following flags:</td>
<td>—Tracing operation to perform. To specify more than one tracing operation, include multiple <code>flag</code> statements. You can include the following flags:</td>
</tr>
<tr>
<td>• all</td>
<td>—All interface tracing operations</td>
<td>• all</td>
<td>—All interface tracing operations</td>
<td>• all</td>
</tr>
<tr>
<td>• event</td>
<td>—Interface events</td>
<td>• event</td>
<td>—Interface events</td>
<td>• change-events — Log changes that produce configuration events</td>
</tr>
<tr>
<td>• ipc</td>
<td>—Interface interprocess</td>
<td>• ipc</td>
<td>—Interface interprocess</td>
<td>• config-states — Log the configuration</td>
</tr>
</tbody>
</table>
### Table 138: Options for traceoptions (continued)

<table>
<thead>
<tr>
<th>Option</th>
<th>Individual interfaces with PTX Series, ACX Series, EX Series</th>
<th>Individual interfaces with QFX Series, QFabric System, OCX1100, EX4600, NFX Series</th>
<th>Interface Process with OAMLFM with EX Series, QFX Series, NFX Series</th>
<th>Interface process with ACX Series, SRX Series, MX Series, M Series, T Series</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>communication (IPC) messages</td>
<td>protocol processing events.</td>
<td>state machine changes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>media</strong>—Interface media changes</td>
<td>• <strong>routing socket</strong>—Trace routing socket events.</td>
<td>• <strong>kernel</strong>—Log configuration IPC messages to kernel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>q921</strong>—Trace ISDN Q.921 frames</td>
<td></td>
<td>• <strong>kernel-detail</strong>—Log details of configuration messages to kernel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>q931</strong>—Trace ISDN Q.931 frames</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>match</strong></td>
<td>—(Optional) Regular expression for lines to be traced.</td>
<td>—(Optional) Refine the output to log only those lines that match the given regular expression.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>size size</strong></td>
<td>—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named <code>trace-file</code> reaches this size, it is renamed <code>trace-file.0</code>. When the <code>trace-file</code> again reaches its maximum size, <code>trace-file.0</code> is renamed <code>trace-file.1</code> and <code>trace-file</code> is renamed <code>trace-file.0</code>. This renaming scheme continues until the maximum number of trace files is reached. Then, the oldest trace file is overwritten.</td>
<td>—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named <code>trace-file</code> reaches its maximum size, it is renamed <code>trace-file.0</code>, then <code>trace-file.1</code>, 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 with the file option.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 138: Options for traceoptions (continued)

<table>
<thead>
<tr>
<th>Option</th>
<th>Interface process with ACX Series, SRX Series, MX Series, M Series, TSeries</th>
<th>Individual Interfaces with QFX Series, QFabric System, OCX1100, EX4600, NFX Series</th>
<th>Individual Interfaces with OAM, LFM with EXSeries, QFX Series, NFX Series</th>
<th>Interface process with ACX Series, SRX Series, MX Series, M Series, TSeries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>— (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. <strong>Default:</strong> 1 MB</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| no-world-readable     | — (Optional) Prevent any user from reading the log file.                     | — (Optional) Restrict file access to the user who created the file.            | — (Optional) Disallow any user to read the log file.                     |
| world-readable        | — (Optional) Allow any user to read the log file.                           | — (Optional) Enable unrestricted file access.                                 | — (Optional) Allow any user to read the log file.                        |
| disable               |                                                                              |                                                                                 |                                                                          |</p>
<table>
<thead>
<tr>
<th>Option</th>
<th>Individual interfaces with PTX Series, ACX Series, EX Series</th>
<th>Individual interfaces with QFX Series, QFabric System, OCX1100, EX4600, NFX Series</th>
<th>Interface Process with OAMLFM with EX Series, QFX Series, NFX Series</th>
<th>Interface process with ACX Series, SRX Series, MX Series, M Series, T Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>no-remote-trace</td>
<td>—(Optional) Disable the remote trace.</td>
<td>-</td>
<td>—(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 all.</td>
<td></td>
</tr>
<tr>
<td>match regex</td>
<td>—(Optional) Refine the output to include only those lines that match the given regular expression.</td>
<td>-</td>
<td>—(Optional) Refine the output to include only those lines that match the given regular expression.</td>
<td></td>
</tr>
</tbody>
</table>

**Required Privilege Level**
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.
- routing—To view this statement in the configuration.
- routing-control—To add this statement to the configuration.

**Related Documentation**
- Tracing Operations of an Individual Router Interface
- Tracing Operations of an Individual Router or Switch Interface
- Example: Configuring Ethernet OAM Link Fault Management
- Configuring Ethernet OAM Link Fault Management
- Tracing Operations of the Interface Process
**traceoptions (LACP)**

**Syntax**
```
traceoptions {
    file <filename> <files number> <size size> <world-readable | no-world-readable>;
    flag flag;
    no-remote-trace;
}
```

**Hierarchy Level**
```
[edit protocols lacp]
```

**Release Information**
Statement introduced in Junos OS Release 7.6.
Statement introduced in Junos OS Release 15.1F4 for PTX Series routers.

**Description**
Define tracing operations for the LACP protocol.

**Default**
If you do not include this statement, no LACP protocol tracing operations are performed.

**Options**
- **filename**—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 `/var/log`. By default, interface process tracing output is placed in the file `lacpd`.

- **files number**—(Optional) Maximum number of trace files. 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, you also must specify a maximum file size with the `size` option.

**Range:** 2 through 1000

**Default:** 3 files

- **flag**—Tracing operation to perform. To specify more than one tracing operation, include multiple `flag` statements. You can include the following flags:
  - `all`—All LACP tracing operations
  - `configuration`—Configuration code
  - `packet`—Packets sent and received
  - `process`—LACP process events
  - `protocol`—LACP protocol state machine
  - `routing-socket`—Routing socket events
  - `startup`—Process startup events

- **no-world-readable**—(Optional) Prevent any user from reading the log 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 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.

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
• Tracing LACP Operations on page 150
traceoptions (MACsec)

**Syntax**
```plaintext
traceoptions {
  file filename <files number> <size size> <world-readable | no-world-readable>
  flag flag;
}
```

**Hierarchy Level**
[edit security macsec]

**Release Information**
Statement introduced in Junos OS Release 15.1 for MIC-3D-20GE-SFP-E on MX Series routers.
Statement introduced in Junos OS Release 16.1 for MPC7E-10G on MX Series routers.
Statement introduced in Junos OS Release 17.3R2 for JNP-MIC1-MACSEC MIC on MX10003 routers.

**Description**
Define tracing operations at the MACsec level. Tracing operations provide support for debugging protocol-level issues. MACsec is an industry-standard security technology that provides secure communication for almost all types of traffic on Ethernet links. To specify more than one tracing operation, include multiple flag statements.

The interfaces traceoptions statement does not support a separate trace file. The logging is done by the kernel, so the tracing information is placed in the syslog file in the directory /var/log/dcd.

**Default**
If you do not include this statement, no tracing operations are performed.

**Options**
- **file filename**—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. By default, interface process tracing output is placed in the directory. If you do not specify the name of the trace file, all files are placed in the directory /var/log/dcd.

- **files number**—(Optional) Maximum number of trace files. When a trace file named trace-file reaches the maximum value, 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. Values range from 2 through 1000.

- **flag flag**—Tracing operation to perform. To specify more than one tracing operation, include multiple flag statements. The following are the tracing operation options:
  - **all**—Trace all operations.
  - **config**—Trace configuration messages.
  - **debug**—Trace debug messages.
  - **normal**—Trace normal messages.
no-world-readable—(Optional) Prevent any user from reading the log 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 this size, it is renamed trace-file.0. When 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.

world-readable—(Optional) Allow any user to read the log file.

---

**Required Privilege**

- admin—To view this statement in the configuration.
- admin-control—To add this statement to the configuration.

**Related Documentation**

- [Understanding Media Access Control Security (MACsec)]
- [Configuring Media Access Control Security (MACsec) on MX Series Routers]
traceoptions (MACsec interfaces)

Syntax

```
traceoptions {
  file filename <files number> <size size> <world-readable | no-world-readable>;
  flag flag;
}
```

Hierarchy Level

[edit security macsec interfaces interface-name]

Release Information

Statement introduced in Junos OS Release 16.1 for MPC7E-10G on MX Series routers.
Statement introduced in Junos OS Release 17.3R2 for JNP-MIC1-MACSEC MIC on MX10003 routers.

Description

Define tracing operations for individual MACsec interfaces. Tracing operations provide support for debugging protocol-level issues. MACsec is an industry-standard security technology that provides secure communication for almost all types of traffic on Ethernet links. To specify more than one tracing operation, include multiple flag statements.

The interfaces traceoptions statement does not support a separate trace file. The logging is done by the kernel, so the tracing information is placed in the system syslog file in the directory /var/log/dcd.

Default

If you do not include this statement, no tracing operations are performed.

Options

file filename—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. By default, interface process tracing output is placed in the directory. If you do not specify the name of the tracefile, all files are placed in the directory /var/log/dcd.

files number—(Optional) Maximum number of trace files. When a trace file named trace-file reaches the maximum value, 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. Values range from 2 through 1000.

flag flag—Tracing operation to perform. To specify more than one tracing operation, include multiple flag statements. The following are the tracing operation options:

  all—Trace all operations.
  keys—Trace key creation or generation information.
  mka-packets—Trace MACsec Key Agreement (MKA) protocol input and output packet information.
  normal—Trace all normal events and messages.
  state—Trace MKA protocol state information.
to-secy—Trace MKA to security entity state change information.

no-world-readable—(Optional) Prevent any user from reading the log 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 this size, it is renamed `trace-file.0`. When `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.

world-readable—(Optional) Allow any user to read the log file.

**Required Privilege Level**
- admin—To view this statement in the configuration.
- admin-control—To add this statement to the configuration.

**Related Documentation**
- Understanding Media Access Control Security (MACsec)
- Configuring Media Access Control Security (MACsec) on MX Series Routers
traceoptions (PPPoE)

Syntax

```
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;
}
```

Hierarchy Level

[edit protocols pppoe]

Release Information

Option filter introduced in Junos OS Release 12.3

Description

Define tracing operations for PPPoE processes.

Options

- **file filename**—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 `/var/log`.

- **files number**—(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 `size` option.

  Range: 2 through 1000

  Default: 3 files

- **disable**—Disable this trace flag.

- **filter**—Additional filter to refine the output to display particular subscribers. Filtering based on the following subscriber identifiers simplifies troubleshooting in a scaled environment.

  - **aci regular-expression**—Regular expression to match the agent circuit identifier provided by PPPoE client.

  - **ari regular-expression**—Regular expression to match the agent remote identifier provided by PPPoE client.

BEST PRACTICE: 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.
• **ari regular-expression**—Regular expression to match the agent remote identifier provided by PPPoE client.

• **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: 
- size k to specify KB,
- size m to specify MB, or
- size g to specify GB

Range: 10240 through 1073741824

Default: 128 KB

world-readable—(Optional) Enable unrestricted file access.

Required Privilege

Level
trace—To view this statement in the configuration.
trace-control—To add this statement to the configuration.

Related Documentation

- Configuring PPPoE Service Name Tables
- Tracing PPPoE Operations on page 379
## traceoptions (802.1X and Captive Portal for MX Series in Enhanced LAN Mode)

**Syntax**

```plaintext
traceoptions {
  file filename <files number> <size size> <world-readable | no-world-readable> <match regex>;
  flag flag;
}
```

**Hierarchy Level**

[edit protocols authentication-access-control]

**Release Information**

Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.

**Description**

Define tracing operations for the 802.1X protocol, LLDP, and captive portal authentication.

**Default**

Tracing operations are disabled.

**Options**

- **file filename**—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 `/var/log`.

- **files number**—(Optional) Maximum number of trace files. 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, you also must specify a maximum file size by using the `size` option.

  - **Range:** 2 through 1000
  - **Default:** 3 files

- **flag flag**—Tracing operation to perform. To specify more than one tracing operation, include multiple flag statements. You can include the following flags:

  - **all**—All tracing operations.
  - **config-internal**—Trace internal configuration operations.
  - **dot1x-event**—Trace 802.1x events.
  - **dot1x-debug**—Trace 802.1x events.
  - **dot1x-ipc**—Trace IPC interactions.
  - **eapol**—Trace EAPOL packets transmitted and received.
  - **general**—Trace general operations.
  - **normal**—Trace normal operations.
  - **parse**—Trace reading of the configuration.
  - **regex-parse**—Trace regular-expression parsing operations.
• **state**—Trace protocol state changes.
• **task**—Trace protocol task operations.
• **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.

**Required Privilege**

**Level** routing—To view this statement in the configuration.

**Level** routing-control—To add this statement to the configuration.
transmit-delay

Syntax
transmit-delay seconds;

Hierarchy Level
[edit protocols lldp],
[edit routing-instances routing-instance-name protocols lldp]

Release Information

Description
(MX Series and T Series routers only) Configure a delay between two successive LLDP advertisements.

Options
seconds—Delay between two successive LLDP advertisements.
Default: 2
Range: 1 through 8192

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
• Configuring LLDP on page 356
transmit-interval (MACsec for MX Series)

Syntax  
transmit-interval interval;

Hierarchy Level  
[edit security macsec connectivity-association]
connectivity-association-name mka

Release Information  
Statement introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

Description  
Specifies the transmit interval for MACsec Key Agreement (MKA) protocol data units (PDUs).

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 interval increases bandwidth overhead on the link; a higher interval optimizes the MKA protocol data unit exchange process.

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.

We recommend increasing the interval to 6000 milliseconds in high-traffic and large scale configuration load environments.

Default  
The default transmit interval is 2000 milliseconds.

Options  
interval—Specifies the transmit interval, in milliseconds.

Required Privilege  
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
transmit-period

Syntax

```plaintext
transmit-period seconds;
```

Hierarchy Level

```plaintext
[edit protocols dot1x authenticator interface interface-id]
```

Release Information

Statement introduced in Junos OS Release 9.3.

Description

Set the number of seconds the port waits before retransmitting the initial EAPOL PDUs to the client.

Options

- `seconds`—The number of seconds the port waits before retransmitting the initial EAPOL PDUs to the client.
  - Range: 1 through 65,535 seconds
  - Default: 30 seconds

Required Privilege Level

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

Related Documentation

- IEEE 802.1x Port-Based Network Access Control Overview on page 35
- authenticator on page 1232
- dot1x on page 1270
- interface (IEEE 802.1x) on page 1356
### transmit-period (MX Series in Enhanced LAN Mode)

- **Syntax**: `transmit-period seconds;`
- **Hierarchy Level**: `[edit protocols authentication-access-control interface (all | [interface-names]) dot1x]`
- **Description**: For 802.1X authentication, how long the port waits before retransmitting the initial EAPOL PDUs to the supplicant.
- **Default**: 30 seconds
- **Options**: `seconds`—Number of seconds the port waits before retransmitting the initial EAPOL PDUs to the supplicant.  
  **Range**: 1 through 65,535 seconds  
  **Default**: 30 seconds
- **Required Privilege Level**:  
  - `routing`—To view this statement in the configuration.  
  - `routing-control`—To add this statement to the configuration.
### tx-duration

<table>
<thead>
<tr>
<th>Syntax</th>
</tr>
</thead>
<tbody>
<tr>
<td>expected-defect [</td>
</tr>
<tr>
<td>tx-duration;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hierarchy Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>[edit protocols oam ethernet connectivity-fault-management expected-defect]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Release Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statement introduced in Junos OS Release 19.1.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>The expected duration for which the peer MEP should suppress the LoC alarms.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minimum value</strong>—The minimum value at which the peer MEP should suppress the LoC alarms is 120 seconds.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minimum value</strong>—The maximum acceptable value at which the peer MEP should suppress the LoC alarms is 3600 seconds.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Default</strong>—900 seconds.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Required Privilege Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>interface—To view this statement in the configuration.</td>
</tr>
<tr>
<td>interface-control—To add this statement to the configuration.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Related Documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>connectivity-fault-management on page 1258</td>
</tr>
<tr>
<td>show oam ethernet connectivity-fault-management mep-database on page 2262</td>
</tr>
</tbody>
</table>
tx-enable

Syntax

expected-defect
  tx-enable;

Hierarchy Level

[edit protocols oam ethernet connectivity-fault-management expected-defect]

Release Information

Statement introduced in Junos OS Release 19.1.

Description

Enable the ethernet expected defect (ETH-ED) function to control if EDM transmission need to be triggered on ISSU.

The remaining statements are explained separately. See CLI Explorer.

Default

The MEP does not generate EDM PDUs by default.

Required Privilege Level

interface—To view this statement in the configuration.
  interface-control—To add this statement to the configuration.

Related Documentation

• connectivity-fault-management on page 1258
• show oam ethernet connectivity-fault-management mep-database on page 2262
### uac-policy (MX Series in Enhanced LAN Mode)

<table>
<thead>
<tr>
<th>Syntax</th>
<th><code>uac-policy;</code></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchy Level</td>
<td><code>[edit protocols authentication-access-control]</code></td>
</tr>
<tr>
<td>Release Information</td>
<td>Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.</td>
</tr>
<tr>
<td>Description</td>
<td>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.</td>
</tr>
<tr>
<td>Default</td>
<td>The Access Control Service access policy is disabled.</td>
</tr>
<tr>
<td>Required Privilege Level</td>
<td>routing—To view this statement in the configuration. routing-control—To add this statement to the configuration.</td>
</tr>
<tr>
<td>Related Documentation</td>
<td></td>
</tr>
</tbody>
</table>
# underlying-interface

## Syntax

```
underlying-interface interface-name;
```

## Hierarchy Level

```
[edit interfaces pp0 unit logical-unit-number pppoe-options],
[edit interfaces demux0 unit logical-unit-number demux-options],
[edit logical-systems logical-system-name interfaces demux0 unit logical-unit-number demux-options],
[edit logical-systems logical-system-name interfaces pp0 unit logical-unit-number pppoe-options],
[edit logical-systems logical-system-name routing-instances routing-instance-name interfaces demux0 unit logical-unit-number demux-options],
[edit logical-systems logical-system-name routing-instances routing-instance-name interfaces pp0 unit logical-unit-number pppoe-options]
```

## Release Information


## Description

Configure the interface on which PPP over Ethernet is running.

For demux interfaces, configure the underlying interface on which the demultiplexing (demux) interface is running.

## Options

- **interface-name**—Name of the interface on which PPP over Ethernet or demux is running.

  For example, `at-0/0/1.0` (ATM VC), `fe-1/0/1.0` (Fast Ethernet interface), `ge-2/0/0.0` (Gigabit Ethernet interface), `ae1.0` (for IP demux on an aggregated Ethernet interface), or `ae1` (for VLAN demux on an aggregated Ethernet interface).

---

**NOTE:** Demux interfaces are currently supported on Gigabit Ethernet, Fast Ethernet, 10-Gigabit Ethernet interfaces, or aggregated Ethernet devices.

## Required Privilege Level

- **interface**—To view this statement in the configuration.
- **interface-control**—To add this statement to the configuration.

## Related Documentation

- [Configuring an IP Demultiplexing Interface](#)
- [Configuring a VLAN Demultiplexing Interface](#)
- [Configuring the PPPoE Underlying Interface on page 374](#)
- [Junos OS Interfaces and Routing Configuration Guide](#)
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);
  auto-configure {
    agent-circuit-identifier {
      dynamic-profile profile-name;
    }
    line-identity {
      include {
        accept-no-ids;
        circuit-id;
        remote-id;
      }
      dynamic-profile profile-name;
    }
    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;
etree-ac-role (leaf | root);
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;
dic dpci-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;
host-prefix-only;
intranet-id-range start start-id end end-id;
intranet-vlan-map {
  (pop | pop-pop | pop-swap | push | push-push | swap |
   swap-push | swap-swap);
intranet-tag-protocol-id tpid;
intranet-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;
}
passive-monitor-mode;
peer-unit unit-number;
pip-to-clp;
point-to-point;
ppp-options {
  mru size;
  mtu (size | use-lower-layer);
  chap {
    access-profile name;
    default-chap-secret name;
    local-name name;
    passive;
  }
  compression {
    acfc;
    pfc;
  }
dynamic-profile profile-name;
ipcp-suggest-dns-option;
lcp-restart-timer milliseconds;
loopback-clear-timer seconds;
cncp-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 vpl-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
-targeted-options {
    backup backup;
group group;
   primary primary;
   weight ($junos-interface-target-weight | weight-value);
}
(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;
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 vpl-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;
vrp-inherit-from {
    active-interface interface-name;
    active-group group-number;
    }

Hierarchy Level
[edit interfaces interface-name],
[edit logical-systems logical-system-name interfaces interface-name],
[edit interfaces interface-set interface-set-name interface interface-name]

Release Information
Statement introduced before Junos OS Release 7.4.
Range increased for static pseudowire interfaces to 1,073,741,823 in Junos OS Release 18.3R1.

Description
Configure a logical interface on the physical device. You must configure a logical interface to be able to use the physical device.

Options
logical-unit-number—Number of the logical unit.
Range: 0 through 1,073,741,823 for demux, PPPoE, and pseudowire static interfaces. 0 through 16,385 for all other static interface types.

etree-ac-role (leaf | root)—To configure an interface as either leaf or root.

The remaining statements are explained separately. Search for a statement in CLI Explorer or click a linked statement in the Syntax section for details.

Required Privilege
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
- Configuring Logical Interface Properties
- Junos OS Services Interfaces Library for Routing Devices
unnumbered-address (Dynamic Profiles)

Syntax
unnumbered-address interface-name <preferred-source-address address>;

Hierarchy Level
[edit dynamic-profiles profile-name interfaces interface-name unit logical-unit-number family family],
[edit dynamic-profiles profile-name interfaces demux0 unit logical-unit-number family family]

Release Information
Statement introduced in Junos OS Release 9.2.
Support for the $junos-preferred-source-address and $junos-preferred-source-ipv6-address predefined variables introduced in Junos OS Release 9.6.

Description
For Ethernet interfaces, enable the local address to be derived from the specified interface. Configuring unnumbered Ethernet interfaces enables IP processing on the interface without assigning an explicit IP address to the interface. To configure unnumbered address dynamically, include the $junos-loopback-interface-address predefined variable.

You can configure unnumbered address support on Ethernet interfaces for IPv4 and IPv6 address families.

Options

interface-name—Name of the interface from which the local address is derived. The specified interface must have a logical unit number, a configured IP address, and must not be an unnumbered interface. This value can be a specific interface name or the $junos-loopback-interface predefined variable.

When defining the unnumbered-address statement using a static interface, keep the following in mind:

- If you choose to include the routing-instance statement at the [edit dynamic-profiles] hierarchy level, that statement must be configured with a dynamic value by using the $junos-routing-instance predefined variable. In addition, whatever static unnumbered interface you specify must belong to that routing instance; otherwise, the profile instantiation fails.

- If you choose to not include the routing-instance statement at the [edit dynamic-profiles] hierarchy level, the unnumbered-address statement uses the default routing instance. The use of the default routing instance requires that the unnumbered interface be configured statically and that it reside in the default routing instance.

NOTE: When you specify a static logical interface for the unnumbered interface in a dynamic profile that includes the $junos-routing-instance predefined variable, you must not configure a preferred source address, whether with the $junos-preferred-source-address predefined variable, the $junos-preferred-source-ipv6-address predefined variable, or the
preferred-source-address statement. Configuring the preferred source address in this circumstance causes a commit failure.

When defining the unnumbered-address statement using the $junos-loopback-interface predefined variable, keep the following in mind:

- To use the $junos-loopback-interface predefined variable, the dynamic profile must also contain the routing-instance statement configured with the $junos-routing-instance predefined variable at the [edit dynamic-profiles] hierarchy level.
- The applied loopback interface is based on the dynamically obtained routing instance of the subscriber.

address—(Optional) Secondary IP address of the donor interface. Configuring the preferred source address enables you to use an IP address other than the primary IP address on some of the unnumbered Ethernet interfaces in your network. This value can be a static IP address, the $junos-preferred-source-address predefined variable for the inet family, or the $junos-preferred-source-ipv6-address predefined variable for the inet6 family.

When defining the preferred-source-address value using a static IP address, keep the following in mind:

- The unnumbered interface must be statically configured.
- The IP address specified as the preferred-source-address must be configured in the specified unnumbered interface.

When defining the preferred-source-address value using the $junos-preferred-source-address or the $junos-preferred-source-ipv6-address predefined variables, keep the following in mind:

- You must configure the unnumbered-address statement using the $junos-loopback-interface predefined variable.
- You must configure the routing-instance statement using the $junos-routing-instance predefined variable at the [edit dynamic-profiles] hierarchy level.
- The preferred source address chosen is based on the dynamically applied loopback address which is in turn derived from the dynamically obtained routing instance of the subscriber. The configured loopback address with the closest network match to the user IP address is selected as the preferred source address.

Required Privilege

- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

Related Documentation

- Dynamic Profiles Overview
unnumbered-address (PPP)

Syntax

```
unnumbered-address interface-name destination address destination-profile profile-name;
```

Hierarchy Level

```
[edit interfaces interface-name unit logical-unit-number family inet],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number family inet]
```

Release Information

Statement introduced before Junos OS Release 7.4.

Description

For interfaces with PPP encapsulation, enable the local address to be derived from the specified interface.

Options

```
interface-name—Interface from which the local address is derived. The interface name must include a logical unit number and must have a configured address.
```

The remaining statements are explained separately. Search for a statement in CLI Explorer or click a linked statement in the Syntax section for details.

Required Privilege Level

```
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.
```

Related Documentation

- Configuring IPCP Options for Interfaces with PPP Encapsulation
**version-3**

**Syntax**
```
version-3;
```

**Hierarchy Level**
```
[edit protocols vrrp]
```

**Release Information**
Statement introduced in Junos OS Release 12.2.

**Description**
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.

**Required Privilege**
- **Level**
  - routing—To view this statement in the configuration.
  - routing-control—To add this statement to the configuration.

**Related Documentation**
- Junos OS Support for VRRPv3
virtual-control-channel

**Syntax**

virtual-control-channel channel-name {
  west-interface name;
  east-interface name;
}

**Hierarchy Level**

[edit protocols protection-group ethernet-ring name (east-interface | west-interface)]

**Release Information**

Statement introduced in Junos OS Release 14.2.

**Description**

Specify virtual control channels which are logical interfaces on the east and west interfaces of the major ring.

**Options**

- **west-interface name**—Logical interface on the major ring’s west port.
- **east-interface name**—Logical interface on the major ring’s east port.

**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 237
- Configuring Ethernet Ring Protection Switching on Switches (CLI Procedure)

virtual-switch

**Syntax**

virtual-switch name bridge-domain name vlan-id [vlan-ids];

**Hierarchy Level**

[edit protocols oam ethernet connectivity-fault-management maintenance-domain domain-name default-x]

**Release Information**


**Description**

Specify the routing-instance type as a virtual switch, under which bridge-domain MIPs must be enabled.

**Required Privilege Level**

- interface—to view this statement in the configuration.
- interface-control—to add this statement to the configuration.

**Related Documentation**

- Configuring MIP for Bridge Domains of a Virtual Switch
## vlan-assignment

**Syntax**

```
vlan-assignment (vlan-id | vlan-name);
```

**Hierarchy Level**

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

**Release Information**

Statement introduced in Junos OS Release 14.2 for MX240, MX480, and MX960 routers in enhanced LAN mode.

**Description**

Configure the VLAN that is associated with the list of MAC addresses that are excluded from RADIUS authentication.

**Options**

`vlan-id | vlan-name`—The name of the VLAN or the VLAN tag identifier to associate with the device. The VLAN already exists on the switch.

**Required Privilege Level**

- **routing**—To view this statement in the configuration.
- **routing-control**—To add this statement to the configuration.
### vlan-id (VLAN ID to Be Bound to a Logical Interface)

<table>
<thead>
<tr>
<th><strong>Syntax</strong></th>
<th><code>vlan-id number;</code></th>
</tr>
</thead>
</table>
| **Hierarchy Level** | [edit interfaces interface-name unit logical-unit-number],  
                   | [edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number] |
| **Release Information** | Statement introduced before Junos OS Release 7.4. |
| **Description**  | For Fast Ethernet, Gigabit Ethernet, and Aggregated Ethernet interfaces only, bind a 802.1Q VLAN tag ID to a logical interface. |
| **Options**      | `number`—A valid VLAN identifier.  
                   | **Range:** For aggregated Ethernet, 4-port, 8-port, and 12-port Fast Ethernet PICs, and for management and internal Ethernet interfaces, 1 through 1023. In Junos OS Evolved `vlan-id 0` is not supported.  
                   | For 48-port Fast Ethernet and Gigabit Ethernet PICs, 1 through 4094.  
                   | VLAN ID 0 is reserved for tagging the priority of frames used in Junos OS. In Junos OS Evolved `vlan-id 0` is not supported. |
| **Required Privilege Level** | interface—To view this statement in the configuration.  
                   | interface-control—To add this statement to the configuration. |
| **Related Documentation** | *Enabling VLAN Tagging* |
**vlan-id**

**Syntax**

```
vlan-id (all | none | number);
```

**VLANs and Bridge Domain VLANs**

For platforms without ELS:

```
[edit vlans vlan-name vlan-range]
```

For platforms without ELS and with ELS:

```
[edit vlans vlan-name]
```

For ELS platforms only:

```
[edit interfaces interface-name unit number]
[edit vlans vlan-name vlan-id-list]
```

```
[edit vlans vlan-name],
[edit logical-systems logical-system-name vlans vlan-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name vlans vlan-name],
[edit routing-instances routing-instance-name vlans vlan-name]
```

**802.1Q Tagging**

```
[edit vlans vlan-name]
```

**VLAN ID to Rewrite**

```
[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]
```

**VLAN Tagging and Layer 3 Subinterfaces**

```
[edit interfaces interface-name unit logical-unit-number]
```

**Release Information**

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 8.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 9.2 for EX Series switches VLAN tagging and Layer 3 subinterfaces.
Support for logical systems added in Junos OS Release 9.6.
Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.
For VLANs, specify a VLAN identifier (VID) to include in the packets sent to and from the VLAN, or a VPLS routing instance.

**NOTE:** When configuring a VLAN identifier for provider backbone bridge (PBB) routing instances, dual-tagged VIDs and the none option are not permitted.

For 802.1Q tagging, configure an 802.1Q tag to apply to all traffic that originates on the VLAN.

The number zero is reserved for priority tagging and the number 4095 is also reserved.

For VLAN ID to Rewrite 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.

You cannot include the `vlan-id` statement with the `swap` statement, `swap-push` statement, `push-push` statement, or `push-swap` statement at the `[edit interfaces interface-name unit logical-unit-number output-vlan-map]` 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 `vlan-id` statement that you include at the `[edit interfaces interface-name unit logical-unit-number]` hierarchy level.
**Default**  For 802.1Q Tagging on EX Series and SRX Series, if you use the default factory configuration, all traffic originating on the VLAN is untagged and has a VLAN identifier of 1.

On a EX2300 switch, the maximum number of vlans supported is 2024. The vlans can be in the range of 1-4093.

On a EX3400 switch, the maximum number of vlans that can be created is 4093 including the default vlan with id 1. In a single **vlan-id-list** **default** **vlan1** is always inherited, so the valid configurable vlan range is 2-4093. You can use **vlan-id** up to and including 4094, but 4093 is the maximum number of vlans that can be configured.

For VLANs on a QFX3500 and QFX3500 switch, if you use the default factory configuration, all traffic originating on the VLAN is untagged and has a VLAN identifier of 1. The number zero is reserved for priority tagging and the number 4093 is also reserved.

On a QFX5100 switch, if you use the default factory configuration, all traffic originating on the VLAN is untagged and has a VLAN identifier of 1. The number zero is reserved for priority tagging and the number 4093 is also reserved.

---

**NOTE:** You can only create up 4090 VLANs on a QFX5100 switch. If you create more than 4090 VLANs, the interfaces associated with the extra VLANs are not displayed in the show vlans command output. For example, if you create 4094 VLANs, the extra VLANs will not have interfaces associated with the VLANs. The order in which you configure the extra VLANs determines which interfaces are missing from the show vlans command output.

---

For VLAN tagging and Layer 3 subinterfaces, bind an 802.1Q VLAN tag ID to a logical interface.

---

**NOTE:** The VLAN tag ID cannot be configured on logical interface unit 0. The logical unit number must be 1 or higher.
Options

For VLANs:

- **number**—A valid VLAN identifier. If you configure multiple VLANs with a valid VLAN identifier, you must specify a unique VLAN identifier for each. However, you can use the same VLAN identifier for VLANs that belong to different virtual switches. Use this option to send single tagged frames with the specified VLAN identifier over VPLS VT interfaces.

  **NOTE:** If you specify a VLAN identifier, you cannot also use the all option. They are mutually exclusive.

- **all**—Specify that the VLAN spans all the VLAN identifiers configured on the member logical interfaces.

  **NOTE:** You cannot specify the all option if you include a routing interface in the VLAN.

- **none**—Specify to enable shared VLAN learning or to send untagged frames over VPLS VT interfaces.

  **NOTE:** Multichassis link aggregation (MC-LAG) does not support the none option with the vlan-id statement with VLANs.

For 802.1Q Tagging:

- **number**—VLAN tag identifier
  
  **Range:**
  
  - 1 through 4094 (all switches except EX8200 Virtual Chassis)
  - 1 through 4092 (EX8200 Virtual Chassis only)
  
  **Default:** 1

**Required Privilege Level**

- routing—To view this statement in the configuration.
- routing-control—To add this statement to the configuration.
- system—To view this statement in the configuration.
- system-control—To add this statement to the configuration.
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.
**Related Documentation**

- Example: Connecting Access Switches with ELS Support to a Distribution Switch with ELS Support
- Example: Configuring a Private VLAN on a Single Switch with ELS Support
- Creating a Private VLAN on a Single Switch with ELS Support (CLI Procedure)
- Creating a Private VLAN Spanning Multiple EX Series Switches (CLI Procedure)
- Example: Configuring VLANs on Security Devices
- Example: Configuring Interfaces and Routing Instances for a User Logical Systems
- Rewriting the VLAN Tag on Tagged Frames
- Binding VLAN IDs to Logical Interfaces on page 270
- vlan-tagging on page 1618
- Example: Configuring Layer 3 Subinterfaces for a Distribution Switch and an Access Switch
- Configuring Gigabit Ethernet Interfaces (CLI Procedure)
- Configuring Gigabit Ethernet Interfaces for EX Series Switches with ELS support
- Configuring Gigabit Ethernet Interfaces (J-Web Procedure)
- Configuring a Layer 3 Subinterface (CLI Procedure)
- Configuring Q-in-Q Tunneling on EX Series Switches with ELS Support
- Junos OS Ethernet Interfaces Configuration Guide
**vlan-id-list (Ethernet VLAN Circuit)**

**Syntax**

```
vlan-id-list [vlan-id vlan-id–vlan-id];
```

**Hierarchy Level**

- [edit interfaces interface-name unit logical-unit-number]
- [edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number]

**Release Information**
Statement introduced in Junos OS Release 9.5.

**Description**
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 routinginstances 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.

**Options**

```
[vlan-id vlan-id–vlan-id]—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.
```

**Range:** 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 270
- encapsulation (Logical Interface) on page 1277
- encapsulation on page 1281
- encapsulation-type (Layer 2 VPN routing instance), see the *Junos OS VPNs Library for Routing Devices*
- flexible-vlan-tagging on page 1317
- vlan-tagging on page 1618
- vlan-tags (Dual-Tagged Logical Interface) on page 1621
vlan-id-list (Interface in Bridge Domain)

Syntax

```
vlan-id-list [ number number-number ];
```

Hierarchy Level

[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]

Release Information

Statement introduced in Junos OS Release 9.2.
Statement introduced in Junos OS Release 15.1.

Description

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.

Options

- `number number`—Individual VLAN IDs separated by a space.
- `number-number`—Starting VLAN ID and ending VLAN ID in an inclusive range.

Range: 1 through 4095

Required Privilege Level

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

Related Documentation

- Configuring a Logical Interface for Trunk Mode on page 281
- Configuring the VLAN ID List for a Trunk Interface on page 281
- Tunnel Services Overview
- Tunnel Interface Configuration on MX Series Routers Overview
### vlan-id-range

<table>
<thead>
<tr>
<th>Syntax</th>
<th><code>vlan-id-range vlan-id–vlan-id</code></th>
</tr>
</thead>
</table>

**Hierarchy Level**

[edit interfaces `interface-name` unit `logical-unit-number`],
[edit logical-systems `logical-system-name` interfaces `interface-name` unit `logical-unit-number`]

**Release Information**

Statement introduced in Junos OS Release 8.4.
Statement introduced in Junos OS Release 12.3R2 for EX Series switches.

**Description**

Bind a range of VLAN IDs to a logical interface.

**Options**

`number`—The first number is the lowest VLAN ID in the range the second number is the highest VLAN ID in the range.

**Range:** 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:

```plaintext
[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.

**Required Privilege Level**

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**

- Binding a Range of VLAN IDs to a Logical Interface
## vlan-rewrite

| Syntax          | `vlan-rewrite translate (200 500 | 201 501)` |
|-----------------|--------------------------------------------------|
| Hierarchy Level | [edit interfaces `interface-name` unit `number` family bridge interface-mode trunk]  
[edit interfaces `interface-name` unit `number` family ethernet-switching interface-mode trunk] |
Statement introduced in Junos OS Release 12.3R2 for EX Series switches. |
| Description     | 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. |
| Options         | translate `200 500`—Translates incoming packets with VLAN 200 to 500.  
translate `201 501`—Translates incoming packets with VLAN 201 to 501.  
translate `202 502`—Translates incoming packets with VLAN 202 to 502. |
| Required Privilege Level | interface—To view this statement in the configuration.  
interface-control—To add this statement to the configuration. |
| Related Documentation | *Rewriting a VLAN Tag and Adding a New Tag* |
### vlan-rule (100-Gigabit Ethernet Type 4 PIC with CFP)

| Syntax       | `vlan-rule (high-low | odd-even);` |
|--------------|-------------------|
| Hierarchy Level | `[edit chassis fpc slot pic slot forwarding-mode vlan-steering]` |
| Release Information | Statement introduced in Junos OS Release 10.4. |
| Description | 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. If no VLAN rule is configured, all tagged packets are distributed to PFE0. |
| Options      | **high-low**—VLAN IDs 1 through 2047 are distributed to PFE0 and VLAN IDs 2048 through 4096 are distributed to PFE1. **odd-even**—Odd number VLAN IDs are distributed to PFE1 and even number VLAN IDs are distributed to PFE0. |
| Required Privilege Level | interface—To view this statement in the configuration. interface-control—To add this statement to the configuration. |
| Related Documentation | • Configuring VLAN Steering Mode for 100-Gigabit Ethernet Type 4 PIC with CFP on page 466  
• forwarding-mode (100-Gigabit Ethernet) on page 1322  
• vlan-steering (100-Gigabit Ethernet Type 4 PIC with CFP) on page 1617 |
### vlan-steering (100-Gigabit Ethernet Type 4 PIC with CFP)

**Syntax**

```
 vlan-steering {
   vlan-rule (high-low | odd-even);
 }
```

**Hierarchy Level**

```
[edit chassis fpc slot pic slot forwarding-mode]
```

**Release Information**

Statement introduced in Junos OS Release 9.4.

**Description**

Configure the 100-Gigabit Ethernet Type 4 PIC with CFP (PD-ICE-CFP-FPC4) to interoperate with 100 gigabit Ethernet interfaces from other vendors.

The other statement is 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 VLAN Steering Mode for 100-Gigabit Ethernet Type 4 PIC with CFP on page 466
- forwarding-mode (100-Gigabit Ethernet) on page 1322
- sa-multicast (100-Gigabit Ethernet) on page 1513
- vlan-rule (100-Gigabit Ethernet Type 4 PIC with CFP) on page 1616
**vlan-tagging**

**Syntax**

```shell
clan-tagging;
```

**Syntax (QFX Series, NFX Series, and EX4600)**

```shell
clan-tagging;
```

**Syntax (SRX Series Interfaces)**

```shell
clan-tagging native-vlan-id vlan-id;
```

**Hierarchy Level**

- [edit interfaces interface-name],
- [edit logical-systems logical-system-name interfaces interface-name]

**QFX Series, NFX Series, and EX4600 Interfaces**

- [edit interfaces (QFX Series) interface-name ]
- [edit interfaces (QFX Series) interface-range interface-range-name ]

**SRX Series Interfaces**

- [edit interfaces interface ]

**Release Information**

- Statement introduced before Junos OS Release 7.4.
- Statement introduced in Junos OS Release 9.0 for EX Series switches.
- Statement introduced in Junos OS Release 9.5.
- Statement introduced in Junos OS Release 11.3 for the QFX Series.
- Statement introduced in Junos OS Release 12.2 for ACX Series Universal Metro Routers.
- Statement introduced in Junos OS Release 13.2 for PTX Series Routers.
- Statement introduced in Junos OS Release 14.1X53-D10 for the QFX Series.

**Description**

For Fast Ethernet and Gigabit Ethernet interfaces, aggregated Ethernet interfaces configured for VPLS, and pseudowire subscriber interfaces, enable the reception and transmission of 802.1Q VLAN-tagged frames on the interface.

**NOTE:** For QFX Series configure VLAN identifier for untagged packets received on the physical interface of a trunk mode interface. Enable VLAN tagging. The platform receives and forwards single-tag frames with 802.1Q VLAN tags.

On EX Series switches except for EX4300 and EX9200 switches, the `clan-tagging` and `family ethernet-switching` statements cannot be configured on the same interface. Interfaces on EX2200, EX3200, EX3300, EX4200, and EX4500 switches are set to `family ethernet-switching` by the default factory configuration. EX6200 and EX8200 switch interfaces do not have a default family setting.
VLAN tagging is disabled by default.

**Options**

- `native-vlan-id`— (SRX Series) Configures a VLAN identifier for untagged packets. Enter a number from 0 through 4094.

  **NOTE:** The `native-vlan-id` can be configured only when either flexible-vlan-tagging mode or interface-mode trunk is configured.

**Required Privilege Level**

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**

- [802.1Q VLANs Overview on page 260](#)
- [Configuring a Layer 3 Subinterface (CLI Procedure)](#)
- [Configuring Tagged Aggregated Ethernet Interfaces on page 142](#)
- [Example: Configuring Layer 3 Subinterfaces for a Distribution Switch and an Access Switch](#)
- `vlan-id`
- [Configuring a Layer 3 Logical Interface](#)
- [Configuring VLAN Tagging](#)
**vlan-tags**

**Syntax**

```plaintext
types outer [tpid].vlan-id [inner [tpid].vlan-id];
```

**Hierarchy Level**

```plaintext
[edit dynamic-profiles profile-name interfaces interface-name unit logical-unit-number]
```

**Release Information**

Statement introduced in Junos OS Release 9.5. VLAN demux interface support introduced in Junos OS Release 10.2.

**Description**

For Gigabit Ethernet IQ and IQE interfaces only, binds TPIDs and 802.1Q VLAN tag IDs to a logical interface. You must include the `stacked-vlan-tagging` statement at the `[edit interfaces interface-name]` hierarchy level.

**NOTE:** The inner-range `vid1–vid2` option is supported on IQE PICs only.

**Options**

- `inner [tpid].vlan-id`—A TPID (optional) and a valid VLAN identifier in the format `tpid`.vlan-id. When used in the `dynamic-profiles` hierarchy, specify the `junos-vlan-id` predefined variable to dynamically obtain the VLAN ID.

**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.

- `outer [tpid].vlan-id`—A TPID (optional) and a valid VLAN identifier in the format `tpid`.vlan-id. When used in the `dynamic-profiles` hierarchy, specify the `junos-stacked-vlan-id` predefined variable.

**Range:** For VLAN ID, 1 through 4094. VLAN ID 0 is reserved for tagging the priority of frames.

- `outer [tpid].vlan-id`—A TPID (optional) and a valid VLAN identifier in the format `tpid`.vlan-id. When used in the `dynamic-profiles` hierarchy, specify the `junos-stacked-vlan-id` predefined variable.

**Range:** 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.

**Required Privilege Level**

- `interface`—To view this statement in the configuration.
- `interface-control`—To add this statement to the configuration.

**Related Documentation**

- Configuring Dual VLAN Tags on page 697
**vlan-tags (Dual-Tagged Logical Interface)**

**Syntax**

```
vlan-tags inner-list [vlan-id vlan-id–vlan-id ] outer <tpid.>vlan-id;
```

**Hierarchy Level**

[edit interfaces interface-name unit logical-unit-number],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number]

**Release Information**

Statement introduced in Junos OS Release 9.5.

**Description**

(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.

---

**Options**

**inner-list [vlan-id vlan-id vlan-id–vlan-id]**—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.

**Range:** 1 through 4094. VLAN ID 0 is reserved for tagging the priority of frames.

**outer <tpid.>vlan-id**—An optional Tag Protocol ID (TPID) and a valid VLAN ID.

**Range:** For TPID, specify a hexadecimal value in the format 0xnnnn.

**Range:** For VLAN ID, 1 through 4094. VLAN ID 0 is reserved for tagging the priority of frames.

---

**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;
  }
```

---

**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 270
- encapsulation (Logical Interface) on page 1277
- encapsulation on page 1281
- encapsulation-type (Layer 2 VPN routing instance), see the Junos OS VPNs Library for Routing Devices.
- flexible-vlan-tagging on page 1317
- vlan-id-list (Ethernet VLAN Circuit) on page 1611
- vlan-tagging on page 1618
**vlan-tags (Stacked VLAN Tags)**

**Syntax**

```text
vlan-tags inner tpid.vlan-id inner-list value inner-range vid1—vid2 outer tpid.vlan-id;
```

**Hierarchy Level**

```text
[edit interfaces interface-name unit logical-unit-number],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number]
```

**Release Information**

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers.

**Description**

Bind TPIDs and 802.1Q VLAN tag IDs to a logical interface. TPID fields are used to identify the frame as an IEEE 802.1Q-tagged frame.

**Options**

- **inner tpid.vlan-id**—A TPID and a valid VLAN identifier. TPID is a 16-bit field set to a value of 0x8100 in order to identify the frame as an IEEE 802.1Q-tagged frame.

  **Range:** (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.

- **inner-list value**—List or a set of VLAN identifiers.

  **NOTE:** This is supported on MX Series routers with Trio-based FPCs.

- **inner-range tpid. vid1—vid2**—Specify a TPID and a range of VLAN IDs where vid1 is the start of the range and vid2 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.

- **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. The inner-range must 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 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;
}
```

---

**Required Privilege Level**
- interface—To view this statement in the configuration.
- interface-control—To add this statement to the configuration.

**Related Documentation**
- Configuring Dual VLAN Tags on page 697
- Configuring Flexible VLAN Tagging on PTX Series Packet Transport Routers on page 267
- stacked-vlan-tagging on page 1537
### wait-to-block-interval

**Syntax**

```
wait-to-block-interval number;
```

**Hierarchy Level**

```
[edit protocols protection-group ethernet-ring ring-name]
```

**Release Information**

Statement introduced in Junos OS Release 14.2.

**Description**

Enable the Wait to Block (WTB) timer interval when clearing force switch and manual switch commands.

**Options**

- **number**—Wait-to-block interval, in seconds.
- **Range:** 5 through 10 s
- **Default:** 5 s

**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 237
- Configuring Ethernet Ring Protection Switching on Switches (CLI Procedure)
west-interface

Syntax

```countries
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.

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 remaining statements are explained separately. See CLI Explorer.

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 237
- Ethernet Ring Protection Using Ring Instances for Load Balancing on page 991
- east-interface on page 1275
- ethernet-ring on page 1301
- 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 on Switches (CLI Procedure)
CHAPTER 41

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
- monitor ethernet synthetic-loss-measurement
- request interface link-degrade-recover
- 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 ethernet-switching redundancy-groups
• 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
• 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

**Syntax**

`clear interfaces interface-set statistics interface-set-name`

**Release Information**

Command introduced in Junos OS Release 8.5.

**Description**

Set interface set statistics to zero.

**Options**

`interface-set-name`—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.

**Required Privilege**

`clear`

**List of Sample Output**

`clear interfaces interface-set statistics on page 1632`

**Output Fields**

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

Syntax

clear interfaces interval interface-name

Release Information

Command introduced before Junos OS Release 7.4.

Description

Clear the channel service unit (CSU) alarm and defect counters so that only the current time interval is displayed. This operation affects the show interface interval command, but not an SNMP query.

Options

interface-name—Name of a particular interface.

Required Privilege

Level

clear

Related Documentation

• show interfaces interval on page 2180

List of Sample Output

clear interfaces interval on page 1633

Output Fields

See show interfaces interval 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, SEFS: 195, UAS: 206
14:58-15:13:
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 logical-unit-number aggregate forwarding-options load-balance state
```

Release Information

Command introduced in Junos OS Release 13.2R1.

Description

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.

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.

Options

- **aeX**—Name of a particular aggregated Ethernet interface.
- **logical-unit-number**—Number of the logical unit of the interface.
- **forwarding-options load-balance state**—Cause the load-balancing state to be cleared for the specific interface.

Required Privilege Level

```
clear
```

Related Documentation

- show interfaces interval on page 2180

List of Sample Output

```
clear interfaces aeX aggregate forwarding-options on page 1636
```

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

<table>
<thead>
<tr>
<th>Syntax</th>
<th>clear interfaces aggregate forwarding-options load-balance state</th>
</tr>
</thead>
</table>

**Release Information**  
Command introduced in Junos OS Release 13.2R1.

**Description**  
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.

**Options**  
`interface-name`—Name of a particular interface.

**Required Privilege**  
`clear` Level

**Related Documentation**  
- show interfaces interval on page 2180

**List of Sample Output**  
clear interfaces aggregate forwarding-options on page 1637

**Sample Output**

clear interfaces aggregate forwarding-options

```
user@host> clear interfaces aggregate forwarding-options load-balance state
```
**clear interfaces transport pm**

**Syntax**

```
clear interfaces transport pm (all | optics | otn) (all | current | current-day) (all | interface-name)
```

**Release Information**

Command introduced in Junos OS Release 14.2 on the PTX Series.

**Description**

Clear optics and OTN information from the transport performance monitoring data.

**Options**

- (all | optics | otn)—Clear both optics and OTN information or either only optics or only OTN information.
- (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.
- (all | interface-name)—Clear information for all interfaces or only for the specified interface (for example, et-fpc/pic/port).

**Required Privilege**

`clear`

**Related Documentation**

- show interfaces transport pm on page 2201
- 100-Gigabit Ethernet OTN Options Configuration Overview on page 574
- tca on page 1114

**List of Sample Output**

clear interfaces transport pm on page 1638

**Output Fields**

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

**Syntax**

```plaintext
clear lldp neighbor
<interface interface-name>
```

**Release Information**

**Description**
Clear information regarding all Link Layer Discovery Protocol (LLDP) neighbors or LLDP neighbors of the specified interface.

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 interface names in the Junos Fusion technology, see [Understanding Junos Fusion Ports](#).

**Options**

- `interface interface-name`—(Optional) Clear the LLDP neighbors on the specified interface.

**Required Privilege Level**
clear

**Related Documentation**
- [clear lldp statistics on page 1640](#)

**List of Sample Output**
- clear lldp neighbors on page 1639
- clear lldp neighbors interface ge-0/1/1.0 on page 1639

**Output Fields**
When you enter this command, you are provided no feedback on the status of your request. You can enter the `show lldp neighbors` 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

**Syntax**
clear lldp neighbor
<interface interface-name>

**Release Information**

**Description**
Clear all Link Layer Discovery Protocols (LLDP) statistics or LLDP statistics associated with the specified interface.

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 interface names in the Junos Fusion technology, see *Understanding Junos Fusion Ports*.

**Options**
- **interface interface-name**—(Optional) Clear LLDP statistics on the specified interface.

**Required Privilege Level**
clear

**Related Documentation**
- clear lldp neighbors on page 1639

**List of Sample Output**
clear lldp statistics on page 1640
clear lldp statistics interface ge-0/1/1.0 on page 1640

**Output Fields**
When you enter this command, you are provided no feedback on the status of your request. You can enter the `show lldp statistics` 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

Syntax

```
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>
```

Release Information

Command introduced in Junos OS Release 11.1.

Description

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).

Options

- **maintenance-domain md-name**—Name of an existing CFM maintenance domain.
- **maintenance-association ma-name**—Name of an existing CFM maintenance association.
- **local-mep local-mep-id**—(Optional) Display connectivity fault management information for the specified local MEP only.
- **remote-mep remote-mep-id**—(Optional) Display connectivity fault management information for the specified remote MEP only.

Required Privilege Level

view

Related Documentation

- Managing Continuity Measurement Statistics on page 936
- Ethernet Interfaces Feature Guide for Routing Devices

List of Sample Output

```
clear oam ethernet connectivity-fault-management continuity-measurement
```

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

```
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

Syntax

```
clear oam ethernet connectivity-fault-management linktrace path-database mac-address maintenance-association ma-name maintenance-domain md-name
```

Release Information

Command introduced in Junos OS Release 9.0.

Description

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.

Options

- **mac-address**—Clear connectivity fault management path database information for the specified MAC address of the remote host.

- **maintenance-association ma-name**—Clear connectivity fault management path database information for the specified maintenance association.

- **maintenance-domain md-name**—Clear connectivity fault management path database information for the specified maintenance domain.

Required Privilege

view

Level

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

**Syntax**

```plaintext
clear oam ethernet connectivity-fault-management loss-statistics
  <interface ethernet-interface-name>
  <level md-level>
```

**Release Information**

Command introduced in Junos OS Release 11.1.

**Description**

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.

In addition, for Ethernet interfaces on MX Series routers, clear any ITU-T Y.1731 Ethernet frame loss measurement (ETH-LM) statistics.

By default, the command clears ETH-LM statistics for CFM maintenance association end points (MEPs) attached to any interface on the router.

**Options**

- `interface ethernet-interface-name`—(Optional) Clear ETH-LM statistics and ETH-LM frame counts only for MEPs attached to the specified Ethernet physical interface.

- `level md-level`—(Optional) Clear ETH-LM statistics and ETH-LM frame counts only for MEPs within CFM maintenance domains (MDs) of the specified level.

**Required Privilege**

- `view` Level

**Related Documentation**

- Clearing ETH-LM Statistics on page 935
- Displaying ETH-LM Statistics on page 934
- Managing ETH-LM Statistics on page 934

**List of Sample Output**

clear oam ethernet connectivity-fault-management loss-statistics on page 1643

**Output Fields**

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

Syntax

```plaintext
clear oam ethernet connectivity-fault-management policer maintenance-domain md-name
maintenance-association ma-name
```

Release Information

- Command introduced in Junos OS Release 10.0.

Description

On M7i and M10i with the Enhanced CFEB (CFEB-E), M320, M120, MX Series, T320, and T640 routers, clear connectivity-fault-management policer statistics.

Options

The following options are supported:

- **maintenance-domain md-name** — 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.

- **maintenance-association ma-name** — Name of an existing CFM maintenance association. If this option is not specified, policer statistics are cleared for all maintenance associations for a given maintenance domain. This option cannot be specified without specifying maintenance-domain name.

Required Privilege Level

- **view**

Related Documentation

- show oam ethernet connectivity-fault-management policer on page 2288

Output Fields

When you enter this command, you are provided feedback on the status of your request.

```plaintext
user@host> clear oam ethernet connectivity-fault-management policer
Policer statistics cleared
```

```plaintext
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

Syntax

```
clear oam ethernet connectivity-fault-management statistics
   <interface ethernet-interface-name>
   <level md-level>
```

Release Information


Description

For all routers that support IEEE 802.1ag OAM connectivity-fault management (CFM), clear all statistics maintained by CFM.

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.

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.

Options

- `ethernet-interface-name`—(Optional) Clear CFM statistics, ETH-DM statistics, and ETH-DM frame counts only for MEPS attached to the specified Ethernet physical interface.

- `level`—(Optional) Clear CFM statistics, ETH-DM statistics, and ETH-DM frame counts only for MEPS within CFM maintenance domains (MDs) of the specified level.

Required Privilege

view

Related Documentation

- show oam ethernet connectivity-fault-management delay-statistics on page 2236
- show oam ethernet connectivity-fault-management interfaces on page 2244
- show oam ethernet connectivity-fault-management mep-database on page 2262
- show oam ethernet connectivity-fault-management mep-statistics on page 2274

List of Sample Output

- clear oam ethernet connectivity-fault-management statistics on page 1645

Output Fields

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

Syntax

```
clear oam ethernet connectivity-fault-management synthetic-loss-measurement
maintenance-domain md-name
maintenance-association ma-name
<local-mep local-mep-id>
<remote-mep remote-mep-id>
```

Release Information

Command introduced in Junos OS Release 13.2 for MX Series routers.

Description

(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.

Options

- `maintenance-domain md-name`—Name of an existing CFM maintenance domain.
- `maintenance-association ma-name`—Name of an existing CFM maintenance association.
- `local-mep local-mep-id`—(Optional) Clear connectivity fault management information for the specified local MEP only.
- `remote-mep remote-mep-id`—(Optional) Clear connectivity fault management information for the specified remote MEP only.

Required Privilege Level

- `view`

Related Documentation

- `monitor ethernet synthetic-loss-measurement` on page 1663
- `show oam ethernet connectivity-fault-management synthetic-loss-statistics` on page 2301

List of Sample Output

- clear oam ethernet connectivity-fault-management synthetic-loss-measurement on page 1647

Output Fields

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

Syntax

```
clear oam ethernet link-fault-management state <interface-name>
```

Release Information

Command introduced in Junos OS Release 8.4.

Description

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.

Options

- **none**—Clear OAM link fault management state information, restart the link discovery process, and reset OAM loopback state (if set previously) on all Ethernet interfaces.
- **interface-name**—(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.

Required Privilege

- **Level**
  - **view**

List of Sample Output

- clear oam ethernet link-fault-management state on page 1648

Output Fields

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

Syntax

```
clear oam ethernet link-fault-management <interface-name>
```

Release Information

Command introduced in Junos OS Release 8.2.

Description

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.

Options

- **none**—Clear OAM link fault management statistics from all Ethernet interfaces.
- **interface-name**—(Optional) Clear OAM link fault management statistics from the specified Ethernet interface only.

Required Privilege

*View* Level

List of Sample Output

clear oam ethernet link-fault-management statistics on page 1649

Output Fields

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**

**Syntax**
```plaintext
clear protection-group ethernet-ring statistics
<group-name group-name>
```

**Release Information**
Command introduced in Junos OS Release 9.4.

**Description**
On MX Series routers, clear the statistics for all Ethernet ring protection groups or a specific Ethernet ring protection group.

**Options**
```
group-name group-name—(Optional) Clear the Ethernet ring protection statistics for the specified group.
```

**Required Privilege Level**
view

**List of Sample Output**
clear protection-group ethernet-ring statistics on page 1650
clear protection-group ethernet-ring statistics on page 1650

**Output Fields**
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
```

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)

**Syntax**

<table>
<thead>
<tr>
<th>Syntax</th>
<th>clear security mka statistics &lt;interface interface-name&gt;</th>
</tr>
</thead>
</table>

**Release Information**

Command introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

**Description**

Clear—reset to zero (0)—all MACsec Key Agreement (MKA) protocol statistics.

You are clearing the statistics that are viewed using the `show security mka statistics` when you enter this command.

**Options**

- **none**—Clear all MKA counters for all interfaces on the switch.
- **interface interface-name**—(Optional) Clear MKA traffic counters for the specified interface only.

**Required Privilege Level**

- clear

**Sample Output**

`clear security mka statistics`

```
user@switch> clear security mka statistics
```
clear security mka statistics (MX Series)

Syntax

```
clear security mka statistics
<interface interface-name>
```

Release Information
Command introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers.

Description
Clear—reset to zero (0)—all MACsec Key Agreement (MKA) protocol statistics.
You are clearing the statistics that are viewed using the `show security mka statistics` when you enter this command.

Options
- `none`—Clear all MKA counters for all interfaces on the switch.
- `interface interface-name`—(Optional) Clear MKA traffic counters for the specified interface only.

Required Privilege
Clear

Sample Output
```
clear security mka statistics
user@switch> clear security mka statistics
```
**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 endpoint (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.
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 1656
- `monitor ethernet delay-measurement two-way` on page 1657
- `monitor ethernet delay-measurement two-way (Invalid DMR Frames Received)` on page 1657

### 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 139 on page 1655 lists the run-time output fields for the `monitor ethernet delay-measurement one-way` command.
- Table 140 on page 1656 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 139: `monitor ethernet delay-measurement one-way` Output Fields

<table>
<thead>
<tr>
<th>Output Field Name</th>
<th>Output Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>One-way ETH-DM request to</strong></td>
<td>Unicast MAC address of the remote peer MEP.</td>
</tr>
<tr>
<td>Interface</td>
<td>Name of the Ethernet physical, logical, or trunk interface to which the local MEP is attached.</td>
</tr>
<tr>
<td>1DM Frames sent</td>
<td>PDU frames sent to the remote MEP in this ETH-DM session.</td>
</tr>
<tr>
<td>Packets transmitted</td>
<td>Total number of 1DM PDU frames sent to the remote MEP during this measurement session.</td>
</tr>
</tbody>
</table>
Table 139: monitor ethernet delay-measurement one-way Output Fields (continued)

<table>
<thead>
<tr>
<th>Output Field Name</th>
<th>Output Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average delay</td>
<td>Average two-way frame delay measured in this session.</td>
</tr>
<tr>
<td>Average delay variation</td>
<td>Average frame jitter measured in this session.</td>
</tr>
<tr>
<td>Best case delay</td>
<td>Lowest two-way frame delay measured in this session.</td>
</tr>
<tr>
<td>Worst case delay</td>
<td>Highest two-way frame delay measured in this session.</td>
</tr>
</tbody>
</table>

**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 140: monitor ethernet delay-measurement two-way Output Fields

<table>
<thead>
<tr>
<th>Output Field Name</th>
<th>Output Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two-way Ethernet frame delay measurement request to</td>
<td>Unicast MAC address of the remote peer MEP.</td>
</tr>
<tr>
<td>Interface</td>
<td>Name of the Ethernet physical, logical, or trunk interface to which the local MEP is attached.</td>
</tr>
<tr>
<td>DMR received from</td>
<td>Unicast MAC address of the remote MEP that transmitted this DMR frame in response to a DMM frame.</td>
</tr>
<tr>
<td>Delay</td>
<td>Two-way delay, in microseconds, for the initiator-transmitted DMM frame.</td>
</tr>
<tr>
<td>Delay variation</td>
<td>Difference, in microseconds, between the current and previous delay values. This is also known as frame jitter.</td>
</tr>
<tr>
<td>Packets transmitted</td>
<td>Total number of DMM PDU frames sent to the remote MEP in this measurement session.</td>
</tr>
<tr>
<td>Valid packets received</td>
<td>Total number of DMR PDU frames received from the remote MEP in this measurement session.</td>
</tr>
<tr>
<td>Average delay</td>
<td>Average two-way frame delay measured in this session.</td>
</tr>
<tr>
<td>Average delay variation</td>
<td>Average frame jitter measured in this session.</td>
</tr>
<tr>
<td>Best case delay</td>
<td>Lowest two-way frame delay measured in this session.</td>
</tr>
<tr>
<td>Worst case delay</td>
<td>Highest two-way frame delay measured in this session.</td>
</tr>
</tbody>
</table>

Sample Output

```plaintext
monitor ethernet delay-measurement one-way
```

```plaintext
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 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
**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: \texttt{nnnn.nnnn.nnnn} or \texttt{nnnn:nnnn:nnnn} (for example, \texttt{0011.2233.4455} or \texttt{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:

- \texttt{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:

- \texttt{show oam ethernet connectivity-fault-management loss-statistics}
- \texttt{show oam ethernet connectivity-fault-management interfaces detail}
- \texttt{show oam ethernet connectivity-fault-management mep-database}
- \texttt{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:

- \texttt{show oam ethernet connectivity-fault-management delay-statistics}
- \texttt{show oam ethernet connectivity-fault-management mep-statistics}

To clear both the frame counts and the statistics collected for MEPs, use the \texttt{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.
## List of Sample Output

**Related Documentation**

- Ethernet Frame Loss Measurement Overview on page 860
- Junos OS Network Interfaces Library for Routing Devices
- CLI Explorer

**Output Fields**

Table 141 on page 1660 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 141: `monitor ethernet loss-measurement` output fields

<table>
<thead>
<tr>
<th>Output Field Name</th>
<th>Output Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethernet loss delay measurement request to</td>
<td>Unicast MAC address of the remote peer MEP.</td>
</tr>
<tr>
<td>Interface</td>
<td>Name of the Ethernet physical, logical, or trunk interface to which the local MEP is attached.</td>
</tr>
<tr>
<td>LMR received from</td>
<td>Unicast MAC address of the remote MEP that transmitted this LMR frame in response to a loss measurement message (LMM) frame.</td>
</tr>
<tr>
<td>Near-end frame loss</td>
<td>Count of frame loss associated with ingress data frames.</td>
</tr>
<tr>
<td>Far-end frame loss</td>
<td>Count of frame loss associated with egress data frames.</td>
</tr>
<tr>
<td>Near-end loss ratio</td>
<td>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.</td>
</tr>
<tr>
<td>Far-end loss ratio</td>
<td>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.</td>
</tr>
<tr>
<td>LMM packets transmitted</td>
<td>Total number of LMM PDU frames sent to the remote MEP in this measurement session.</td>
</tr>
<tr>
<td>LMR packets received</td>
<td>Total number of LMR PDU frames received from the remote MEP in this measurement session.</td>
</tr>
<tr>
<td>Average near-end frame loss</td>
<td>Average frame loss measured in this session associated with ingress data frames.</td>
</tr>
<tr>
<td>Average near-end loss ratio</td>
<td>Average frame loss ratio measured in this session associated with ingress data frames.</td>
</tr>
<tr>
<td>Average far-end frame loss</td>
<td>Average frame loss measured in this session associated with egress data frames.</td>
</tr>
<tr>
<td>Average far-end loss ratio</td>
<td>Average frame loss ratio measured in this session associated with egress data frames.</td>
</tr>
<tr>
<td>Near-end best case frame loss</td>
<td>Lowest frame loss measured in this session associated with ingress data frames.</td>
</tr>
</tbody>
</table>
### Table 141: monitor ethernet loss-measurement output fields (continued)

<table>
<thead>
<tr>
<th>Output Field Name</th>
<th>Output Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near-end best case loss ratio</td>
<td>Lowest frame loss ratio measured in this session associated with ingress data frames.</td>
</tr>
<tr>
<td>Near-end worst case frame loss</td>
<td>Highest frame loss measured in this session associated with ingress data frames.</td>
</tr>
<tr>
<td>Near-end worst case loss ratio</td>
<td>Highest frame loss ratio measured in this session associated with ingress data frames.</td>
</tr>
<tr>
<td>Far-end best case frame loss</td>
<td>Lowest frame loss measured in this session associated with egress data frames.</td>
</tr>
<tr>
<td>Far-end best case loss ratio</td>
<td>Lowest frame loss ratio measured in this session associated with egress data frames.</td>
</tr>
<tr>
<td>Far-end worst case frame loss</td>
<td>Highest frame loss measured in this session associated with egress data frames.</td>
</tr>
<tr>
<td>Far-end worst case loss ratio</td>
<td>Highest frame loss ratio measured in this session associated with egress data frames.</td>
</tr>
</tbody>
</table>

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

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
```

Copyright © 2019, Juniper Networks, Inc.
<table>
<thead>
<tr>
<th>LMR received from 64:87:88:6a:da:94</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near-end frame loss (CIR)</td>
</tr>
<tr>
<td>Far-end frame loss (CIR)</td>
</tr>
<tr>
<td>Near-end frame loss ratio (CIR)</td>
</tr>
<tr>
<td>Far-end frame loss ratio (CIR)</td>
</tr>
<tr>
<td>Near-end frame loss (EIR)</td>
</tr>
<tr>
<td>Far-end frame loss (EIR)</td>
</tr>
<tr>
<td>Near-end frame loss ratio (EIR)</td>
</tr>
<tr>
<td>Far-end frame loss ratio (EIR)</td>
</tr>
</tbody>
</table>

--- Loss measurement statistics ---

<table>
<thead>
<tr>
<th>LMM packets transmitted: 10, Valid LMR packets received: 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average near-end loss (CIR) : 0.00000</td>
</tr>
<tr>
<td>Average near-end loss ratio (CIR) : 0.00000%</td>
</tr>
<tr>
<td>Average far-end loss (CIR) : 0.42857</td>
</tr>
<tr>
<td>Average far-end loss ratio (CIR) : 0.21941%</td>
</tr>
<tr>
<td>Near-end best case loss (CIR) : 0</td>
</tr>
<tr>
<td>Near-end best case loss ratio (CIR) : 0.00000%</td>
</tr>
<tr>
<td>Near-end worst case loss (CIR) : 0</td>
</tr>
<tr>
<td>Near-end worst case loss ratio (CIR) : 0.00000%</td>
</tr>
<tr>
<td>Far-end best case loss (CIR) : 0</td>
</tr>
<tr>
<td>Far-end best case loss ratio (CIR) : 0.00000%</td>
</tr>
<tr>
<td>Far-end worst case loss (CIR) : 1</td>
</tr>
<tr>
<td>Far-end worst case loss ratio (CIR) : 0.51546%</td>
</tr>
<tr>
<td>Average near-end loss (EIR) : 296.42857</td>
</tr>
<tr>
<td>Average near-end loss ratio (EIR) : 0.00000%</td>
</tr>
<tr>
<td>Average far-end loss (EIR) : 88.41011%</td>
</tr>
<tr>
<td>Average far-end loss ratio (EIR) : 88.77551%</td>
</tr>
</tbody>
</table>
monitor ethernet synthetic-loss-measurement

Syntax

```plaintext
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 nnnn:nnnn:nnnn:nnnn. 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 50,000 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 1647
• monitor ethernet synthetic-loss-measurement on page 1663
• show oam ethernet connectivity-fault-management loss-statistics on page 2258

List of Sample Output
monitor ethernet synthetic-loss-measurement on page 1666

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 142 on page 1665 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 142: monitor ethernet synthetic-loss-measurement Output Fields

<table>
<thead>
<tr>
<th>Output Field Name</th>
<th>Output Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETH-SLM request to</td>
<td>Unicast MAC address of the remote peer MEP.</td>
</tr>
<tr>
<td>Interface</td>
<td>Name of the Ethernet physical, logical, or trunk interface to which the local MEP is attached.</td>
</tr>
<tr>
<td>SLM packets sent</td>
<td>Total number of synthetic loss message (SLM) PDU frames sent from the source MEP to the remote MEP during this ETH-SLM session.</td>
</tr>
<tr>
<td>SLR packets received</td>
<td>Total number of synthetic loss reply (SLR) PDU frames received by the source MEP from the remote MEP during this measurement session.</td>
</tr>
<tr>
<td>Local TXFC1 value</td>
<td>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.</td>
</tr>
<tr>
<td>Local RXFC1 value</td>
<td>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.</td>
</tr>
<tr>
<td>Last Received SLR frame</td>
<td>Value of the local counter TxFC1 at the time of SLM frame transmission.</td>
</tr>
<tr>
<td>TXFC1(t)</td>
<td></td>
</tr>
<tr>
<td>Last Received SLR frame</td>
<td>Value of the local counter RxFC1 at the time of SLR frame transmission.</td>
</tr>
<tr>
<td>TXFCb(t)</td>
<td></td>
</tr>
<tr>
<td>Frame loss (near-end)</td>
<td>Count of frame loss associated with ingress data frames.</td>
</tr>
<tr>
<td>Frame loss (far-end)</td>
<td>Count of frame loss associated with egress data frames.</td>
</tr>
</tbody>
</table>
Sample Output

```bash
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

<table>
<thead>
<tr>
<th>Synthetic Loss measurement statistics:</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLM packets sent</td>
</tr>
<tr>
<td>SLR packets received</td>
</tr>
</tbody>
</table>

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 %) |
```
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: nnnnnnnn.nn or nnnnnnnnnnnnnnnnnnnnnnn.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 50,000 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.
List of Sample Output

The `monitor ethernet synthetic-loss-measurement` command displays different output at the CLI, depending on when you start a synthetic frame loss measurement:

- Table 142 on page 1665 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>
<thead>
<tr>
<th>Output Field Name</th>
<th>Output Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETH-SLM request to</td>
<td>Unicast MAC address of the remote peer MEP.</td>
</tr>
<tr>
<td>Interface</td>
<td>Name of the Ethernet physical, logical, or trunk interface to which the local MEP is attached.</td>
</tr>
<tr>
<td>SLM packets sent</td>
<td>Total number of synthetic loss message (SLM) PDU frames sent from the source MEP to the remote MEP during this ETH-SLM session.</td>
</tr>
<tr>
<td>SLR packets received</td>
<td>Total number of synthetic loss reply (SLR) PDU frames received by the source MEP from the remote MEP during this measurement session.</td>
</tr>
<tr>
<td>Local TXFC1 value</td>
<td>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.</td>
</tr>
<tr>
<td>Local RXFC1 value</td>
<td>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.</td>
</tr>
<tr>
<td>Last Received SLR frame TXFC1(t_c)</td>
<td>Value of the local counter TxFC1 at the time of SLM frame transmission.</td>
</tr>
<tr>
<td>Last Received SLR frame TXFC1(t)</td>
<td>Value of the local counter RxFC1 at the time of SLR frame transmission.</td>
</tr>
<tr>
<td>Frame loss (near-end)</td>
<td>Count of frame loss associated with ingress data frames.</td>
</tr>
<tr>
<td>Frame loss (far-end)</td>
<td>Count of frame loss associated with egress data frames.</td>
</tr>
</tbody>
</table>
Sample Output

```
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 link-degrade-recover

Syntax

request interface link-degrade-recover interfaces-name

Release Information

Command introduced in Junos OS Release 15.1.

Description

Manually recover a degraded physical link. Manual recovery is used when the interface has any Layer 2 and Layer 3 protocols that prevents autorecovery. This command is applicable only if you have configured the manual link recovery option on the interface.

NOTE: Manual recovery option is recommended for user deployments that have static route configurations causing the remote end of the link to start forwarding packets (as soon as the physical link is up) while auto-recovery is in progress.

Options

interfaces-name—Name of the interface.

Required Privilege

Level View

Related Documentation

• Link Degrade Monitoring Overview on page 399
• link-degrade-monitor on page 1371
• thresholds on page 1561
• recovery on page 1497

List of Sample Output

Manual recovery on page 1671
Interface status when link degrade is enabled on page 1671
Interface status when the defect is active on page 1672

Output Fields

When you enter this command, Junos OS displays the status of your request.

Sample Output

Manual recovery

user@host>run request interface link-degrade-recover xe-9/1/11
FPC 9 PIC 1 PORT 11 Link Degrade Recovery Started

Interface status when link degrade is enabled

user@host>run show interfaces xe-9/1/11
Physical interface: xe-9/1/11, Enabled, Physical link is Up
Interface index: 181, SNMP ifIndex: 664
Link-level type: Ethernet, MTU: 1514, MRU: 1522, LAN-PHY mode, Speed: 10Gbps,
BPDU Error: None, Loop Detect PDU Error: None, MAC-REWRITE Error: None, Loopback:
None, Source filtering: Disabled,
Flow control: Enabled, Speed Configuration: Auto
Pad to minimum frame size: Disabled
Device flags : Present Running
Interface flags: SNMP-Traps Internal: 0x4000
Link flags : None
CoS queues : 8 supported, 8 maximum usable queues
Schedulers : 0
Current address: 28:8a:1c:c9:0e:32, Hardware address: 28:8a:1c:c9:0e:32
Last flapped : 2017-10-25 01:53:17 PDT (00:00:10 ago)
Input rate : 0 bps (0 pps)
Output rate : 0 bps (0 pps)
Active alarms : None
Active defects : None
PCS statistics Seconds
Bit errors : 0
Errored blocks : 0
Link Degraded:
Link Monitoring : Enable
Link Degradation Set Threshold : 1E-8
Link Degradation Clear Threshold : 1E-11
Link Degradation War Set Threshold : 1E-9
Link Degradation War Clear Threshold : 1E-10
Estimated BER : <= 1E-16
Link-degrade event : Seconds Count
State
0 0
OK
Interface transmit statistics: Disabled
Logical interface xe-9/1/11.0 (Index 32368) (SNMP ifIndex 33153)
Flags: Up SNMP-Traps 0x4004000 Encapsulation: ENET2
Input packets : 0
Output packets: 0
Protocol inet, MTU: 1500
Max nh cache: 75000, New hold nh limit: 75000, Curr nh cnt: 0, Curr new hold
cnt: 0, NH drop cnt: 0
Flags: Sendcast-pkt-to-re
Addresses, Flags: Is-Preferred Is-Primary
Destination: 1.1.1/24, Local: 1.1.1.1, Broadcast: 1.1.1.255
Protocol multiservice, MTU: Unlimited
Flags: Is-Primary

Interface status when the defect is active

user@host>run show interfaces xe-9/1/11

Physical interface: xe-9/1/11, Enabled, Physical link is Down
Interface index: 181, SNMP ifIndex: 664
Link-level type: Ethernet, MTU: 1514, MRU: 1522, LAN-PHY mode, Speed: 10Gbps,
BPDU Error: None, Loop Detect PDU Error: None, MAC-REWRITE Error: None, Loopback:
None, Source filtering: Disabled,
Flow control: Enabled, Speed Configuration: Auto
Pad to minimum frame size: Disabled
Device flags : Present Running Down
Interface flags: Hardware-Down SNMP-Traps Internal: 0x4000
### Link flags
- None

### CoS queues
- 8 supported, 8 maximum usable queues

### Schedulers
- 0

### Current address
- 28:8a:1c:c9:0e:32, Hardware address: 28:8a:1c:c9:0e:32

### Last flapped
- 2017-10-25 01:54:09 PDT (00:00:03 ago)

### Input rate
- 0 bps (0 pps)

### Output rate
- 0 bps (0 pps)

### Active alarms
- LINK

### Active defects
- LINK, LOCAL-FAULT

### PCS statistics

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit errors</td>
<td>0</td>
</tr>
<tr>
<td>Errored blocks</td>
<td>0</td>
</tr>
</tbody>
</table>

### Link Degradate

<table>
<thead>
<tr>
<th>Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link Monitoring</td>
<td>Enable</td>
</tr>
<tr>
<td>Link Degradate Set Threshold</td>
<td>1E-8</td>
</tr>
<tr>
<td>Link Degradate Clear Threshold</td>
<td>1E-11</td>
</tr>
<tr>
<td>Link Degradate War Set Threshold</td>
<td>1E-9</td>
</tr>
<tr>
<td>Link Degradate War Clear Threshold</td>
<td>1E-10</td>
</tr>
<tr>
<td>Estimated BER</td>
<td>1E-4</td>
</tr>
</tbody>
</table>

### Link-degrade event

<table>
<thead>
<tr>
<th>State</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

### Defect Active Interface transmit statistics
- Disabled

### Logical interface xe-9/1/11.0 (Index 32368) (SNMP ifIndex 33153)

<table>
<thead>
<tr>
<th>Flags</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device-Down SNMP-Traps</td>
<td>0x4004000 Encapsulation: ENET2</td>
</tr>
<tr>
<td>Input packets</td>
<td>0</td>
</tr>
<tr>
<td>Output packets</td>
<td>0</td>
</tr>
<tr>
<td>Protocol inet, MTU: 1500</td>
<td></td>
</tr>
<tr>
<td>Max nh cache: 75000</td>
<td>New hold nh limit: 75000, Curr nh cnt: 0, Curr new hold cnt: 0, NH drop cnt: 0</td>
</tr>
<tr>
<td>Flags</td>
<td>Sendbcast-pkt-to-re</td>
</tr>
<tr>
<td>Addresses</td>
<td>Dest-route-down Is-Preferred Is-Primary</td>
</tr>
<tr>
<td>Destination</td>
<td>1.1.1.24, Local: 1.1.1.1, Broadcast: 1.1.1.255</td>
</tr>
<tr>
<td>Protocol multiservice, MTU:</td>
<td>Unlimited</td>
</tr>
<tr>
<td>Flags</td>
<td>Is-Primary</td>
</tr>
</tbody>
</table>
**request interface mc-ae switchover (Multichassis Link Aggregation)**

**Syntax**
```
request interface mc-ae switchover
<immediate> mcae-id mcae-id;
```

**Release Information**
Command introduced in Junos OS Release 13.3.

**Description**
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 `switchover-mode` statement for the multichassis aggregated Ethernet interface is configured as `non-revertive` at the `[edit interfaces aeX mc-ae]` hierarchy level.

**NOTE:** To run this command successfully, the `status-control` statement should be configured as `active` at the `[edit interfaces aeX mc-ae]` hierarchy level.

**Options**
- **immediate**—(Optional) Trigger immediate switchover to the preferred node. If this option is not configured, Junos OS waits for the timer configured using the `revert-time` statement at the `[edit interfaces aeX mc-ae]` hierarchy level to expire before it triggers the switchover.

- **mcae-id mcae-id**—Triggers switchover for the specified mc-ae interface.

**Required Privilege Level**
view

**Related Documentation**
- Configuring Multichassis Link Aggregation on MX Series Routers
- Configuring Manual and Automatic Link Switchover for MC-LAG Interfaces on MX Series Routers

**List of Sample Output**
request interface mc-ae switchover immediate mcae-id on page 1674
request interface mc-ae switchover mcae-id on page 1675

**Output Fields**
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) ae

**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.
- **ae**—Aggregated Ethernet logical interface number: 0 through 15.

**Required Privilege Level**

- **view**

**List of Sample Output**  
request interface revert on page 1676

**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 ae1
```
request lacp link-switchover

Syntax
request lacp link-switchover ae

Release Information
Command introduced in Junos OS Release 9.3.

Description
Manually switch aggregated Ethernet active or standby LACP links.

NOTE: 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.

Options
ae—Aggregated Ethernet logical interface number: 0 through 15.

Required Privilege Level
view

List of Sample Output
request lacp link-switchover aeX on page 1677

Output Fields
When you enter this command, you are provided feedback on the status of your request. To view the switchover, use the show lacp interfaces command.

Sample Output
request lacp link-switchover aeX

user@host >request lacp link-switchover aeOaeO: Request succeeded
### show chassis hardware

<table>
<thead>
<tr>
<th>List of Syntax</th>
<th>Syntax on page 1678</th>
<th>Syntax (EX Series, MX104, MX204, MX2010, MX2020, MX10003, MX10008, and MX2008 Universal Routing Platforms) on page 1678</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax (TX Matrix Router)</td>
<td>Syntax on page 1678</td>
<td>Syntax on page 1678</td>
</tr>
<tr>
<td>Syntax (TX Matrix Plus Router)</td>
<td>Syntax on page 1678</td>
<td>Syntax on page 1678</td>
</tr>
<tr>
<td>Syntax (MX Series Routers)</td>
<td>Syntax on page 1678</td>
<td>Syntax on page 1678</td>
</tr>
<tr>
<td>Syntax (QFX Series)</td>
<td>Syntax on page 1678</td>
<td>Syntax on page 1678</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Syntax</th>
<th>show chassis hardware</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;detail</td>
</tr>
<tr>
<td></td>
<td>&lt;clei-models&gt;</td>
</tr>
<tr>
<td></td>
<td>&lt;models&gt;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Syntax (EX Series, MX104, MX204, MX2010, MX2020, MX10003, MX10008, and MX2008 Universal Routing Platforms)</th>
<th>show chassis hardware</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;clei-models&gt;</td>
</tr>
<tr>
<td></td>
<td>&lt;detail</td>
</tr>
<tr>
<td></td>
<td>&lt;models&gt;</td>
</tr>
<tr>
<td></td>
<td>&lt;satellite [slot-id slot-id [device-alias alias-name ]]&gt;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Syntax (TX Matrix Router)</th>
<th>show chassis hardware</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;clei-models&gt;</td>
</tr>
<tr>
<td></td>
<td>&lt;detail</td>
</tr>
<tr>
<td></td>
<td>&lt;models&gt;</td>
</tr>
<tr>
<td></td>
<td>&lt;lcc number</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Syntax (TX Matrix Plus Router)</th>
<th>show chassis hardware</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;clei-models&gt;</td>
</tr>
<tr>
<td></td>
<td>&lt;detail</td>
</tr>
<tr>
<td></td>
<td>&lt;models&gt;</td>
</tr>
<tr>
<td></td>
<td>&lt;lcc number</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Syntax (MX Series Routers)</th>
<th>show chassis hardware</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;detail</td>
</tr>
<tr>
<td></td>
<td>&lt;clei-models&gt;</td>
</tr>
<tr>
<td></td>
<td>&lt;models&gt;</td>
</tr>
<tr>
<td></td>
<td>&lt;all-members&gt;</td>
</tr>
<tr>
<td></td>
<td>&lt;local&gt;</td>
</tr>
<tr>
<td></td>
<td>&lt;member member-id&gt;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Syntax (QFX Series)</th>
<th>show chassis hardware</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;detail</td>
</tr>
<tr>
<td></td>
<td>&lt;clei-models&gt;</td>
</tr>
</tbody>
</table>
### Release Information

- **interconnect-device name**: Command introduced before Junos OS Release 7.4.
- **node-device name**: Command introduced in Junos OS Release 9.0 for EX Series switches.
- **models**: Command introduced in Junos OS Release 8.2.
- **sfc** option introduced in Junos OS Release 9.6 for the TX Matrix Plus router.
- **Command introduced in Junos OS Release 11.1 for QFX Series.**
- **Command introduced in Junos OS Release 12.1X48 for PTX Series Packet Transport Routers.**
- **Command introduced in Junos OS Release 12.2 for ACX Series Universal Metro Routers.**
- **Command introduced in Junos OS Release 12.3 for MX2010 and MX2020 Universal Routing Platforms.**
- **Information for disk and usb** introduced in Junos OS Release 15.1X53-D60 for QFX10002, QFX10008, and QFX10016 switches.
- **Command introduced in Junos OS Release 15.1X54-D20 for ACX5048 and ACX5096 Routers.**
- **Command introduced in Junos OS Release 17.2 for MX2008 Universal Routing Platforms.**
- **Command introduced in Junos OS Release 17.2 for PTX10008 Routers.**
- **Command introduced in Junos OS Release 17.3 for MX10003 Universal Routing Platforms.**
- **Command introduced in Junos OS Release 17.3 for MX150 Router Appliance.**
- **Command introduced in Junos OS Release 17.4 for MX204 Routers.**
- **Command introduced in Junos OS Release 18.1R1 for EX9251 Switches.**
- **Command introduced in Junos OS Release 18.2 for EX9253 Switches.**
- **Command introduced in Junos OS Release 18.2R1 for MX10008 Routers**

---

### Description

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.

In the EX Series switch command output, FPC refers to the following:

- On EX2200 switches, EX3200 switches, EX4200 standalone switches, and EX4500 switches—Refers to the switch; FPC **number** is always 0.
- On EX4200 switches in a Virtual Chassis configuration—Refers to the member of a Virtual Chassis; FPC **number** equals the member ID, from 0 through 9.
- On EX8208 and EX8216 switches—Refers to a line card; FPC **number** equals the slot number for the line card.

On QFX3500, QFX5100, and 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, as shown in Table 144 on page 1681.

**Table 144: Routing Engines Displaying DiMM Information**

<table>
<thead>
<tr>
<th>Routing Engines</th>
<th>Routers</th>
</tr>
</thead>
<tbody>
<tr>
<td>RE-S-1800x2 and RE-S-1800x4</td>
<td>MX240, MX480, and MX960 routers</td>
</tr>
<tr>
<td>RE-A-1800x2</td>
<td>M120 and M320 routers</td>
</tr>
</tbody>
</table>

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.

Starting with Junos OS Release 17.3R1, the output of the `show chassis hardware` command displays the mode in which vMX is running (performance mode or lite mode) in the part
number field for the FPC. RIOT-PERF indicates performance mode and RIOT-LITE indicates lite mode.

**Required Privilege**

view

**Related Documentation**

- `show chassis power`

**List of Sample Output**

- `show chassis hardware (EX8216 Switch)` on page 1689
- `show chassis hardware clei-models (EX8216 Switch)` on page 1691
- `show chassis hardware clei-models (TT600 Router)` on page 1691
- `show chassis hardware clei-models (PTX10008 Routers)` on page 1692
- `show chassis hardware clei-models (PTX10016 Routers)` on page 1692
- `show chassis hardware (EX2300-C Switch)` on page 1693
- `show chassis hardware (EX2300 Switch)` on page 1694
- `show chassis hardware detail (EX4200 Switch)` on page 1694
- `show chassis hardware (EX4300 Switch)` on page 1694
- `show chassis hardware models (EX4500 Switch)` on page 1695
- `show chassis hardware detail (EX9200 Switch)` on page 1695
- `show chassis hardware detail (EX9251 Switch)` on page 1696
- `show chassis hardware detail (EX9253 Switch)` on page 1696
- `show chassis hardware detail (PTX10008 Routers)` on page 1697
- `show chassis hardware detail (PTX10016 Routers)` on page 1699
- `show chassis hardware (M7i Router)` on page 1700
- `show chassis hardware (M10 Router)` on page 1701
- `show chassis hardware models (M10 Router)` on page 1701
- `show chassis hardware (M20 Router)` on page 1702
- `show chassis hardware models (M20 Router)` on page 1702
- `show chassis hardware (M40 Router)` on page 1703
- `show chassis hardware (M40e Router)` on page 1703
- `show chassis hardware (M120 Router)` on page 1704
- `show chassis hardware detail (M120 Router)` on page 1705
- `show chassis hardware models (M120 Router)` on page 1705
- `show chassis hardware (M160 Router)` on page 1706
- `show chassis hardware models (M160 Router)` on page 1706
- `show chassis hardware detail (M160 Router)` on page 1707
- `show chassis hardware models (M160 Router)` on page 1707
- `show chassis hardware (M320 Router)` on page 1709
- `show chassis hardware models (M320 Router)` on page 1710
- `show chassis hardware (MX5 Router)` on page 1711
- `show chassis hardware (MX10 Router)` on page 1711
- `show chassis hardware (MX40 Router)` on page 1712
- `show chassis hardware (Fixed MX80 Router)` on page 1712
- `show chassis hardware (Modular MX80 Router)` on page 1713
- `show chassis hardware (MX150)` on page 1713
- `show chassis hardware (MX150)` on page 1714
- `show chassis hardware (MX104 Router)` on page 1714
- `show chassis hardware detail (MX104 Router)` on page 1715
show chassis hardware detail (MX480 Packet Transport Router with details of virtual disk size) on page 1715
show chassis hardware extensive (MX104 Router) on page 1716
show chassis hardware extensive (PTX10008 Router) on page 1719
show chassis hardware extensive (PTX10016 Router) on page 1732
show chassis hardware models (MX104 Router) on page 1744
show chassis hardware models (PTX10008 Router) on page 1744
show chassis hardware models (PTX10016 Router) on page 1745
show chassis hardware celi-models (MX104 Router) on page 1746
show chassis hardware (MX240 Router) on page 1746
show chassis hardware detail (MX 240 Router with Routing Engine Displaying DIMM Information) on page 1747
show chassis hardware (MX240 Router with Enhanced MX SCB) on page 1747
show chassis hardware (MX480 Router) on page 1748
show chassis hardware (MX480 Router with Enhanced MX SCB) on page 1749
show chassis hardware (MX480 Routers with MPC5E and Built-In OTNPIC) on page 1749
show chassis hardware detail (MX480 Routers with MPC5E and Built-In OTNPIC) on page 1751
show chassis hardware extensive (MX480 Routers with MPC5E and Built-In OTNPIC) on page 1752
show chassis hardware (MX960 Router) on page 1755
show chassis hardware (MX960 Router with Bidirectional Optics) on page 1756
show chassis hardware (MX960 Router with Enhanced MX SCB) on page 1756
show chassis hardware models (MX960 Router with Enhanced MX SCB) on page 1758
show chassis hardware (MX960 Router with MPC5EQ) on page 1759
show chassis hardware detail (MX960 Router) on page 1762
show chassis hardware extensive (MX960 Router with MPC5EQ) on page 1762
show chassis hardware models (MX960 Router with MPC5EQ) on page 1774
show chassis hardware celi-models (MX960 Router with MPC5EQ) on page 1775
show chassis hardware (MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC) on page 1775
show chassis hardware celi-models (MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC) on page 1776
show chassis hardware (MX10008 Router) on page 1777
show chassis hardware celi-models (MX10008 Router) on page 1778
show chassis hardware detail (MX10008 Router) on page 1778
show chassis hardware extensive (MX10008 Router) on page 1780
show chassis hardware models (MX10008 Router) on page 1794
show chassis hardware (PTX3000 Router with 5-port 100-Gigabit DWDM OTNPIC) on page 1794
show chassis hardware celi-models (PTX3000 Router with 5-port 100-Gigabit DWDM OTNPIC) on page 1795
show chassis hardware (MX2010 Router) on page 1796
show chassis hardware detail (MX2010 Router) on page 1798
show chassis hardware extensive (MX2010 Router) on page 1803
show chassis hardware models (MX2010 Router) on page 1808
show chassis hardware celi-models (MX2010 Routers) on page 1809
show chassis hardware (MX2010 Routers with MPC6E and OTN MIC) on page 1810
show chassis hardware detail (MX2010 Routers with MPC6E and OTN MIC) on page 1812
show chassis hardware extensive (MX2010 Routers with MPC6E and OTN MIC) on page 1814
show chassis hardware (MX2020 Router) on page 1819
show chassis hardware detail (MX2020 Router) on page 1827
show chassis hardware (MX2020 Router with 240-V high-voltage DC PSMs and PDMs) on page 1836
show chassis hardware models (MX2020 Router) on page 1838
show chassis hardware clei-models (MX2020 Router) on page 1839
show chassis hardware (MX2020 Router with MPC5EQ and MPC6E) on page 1840
show chassis hardware detail (MX2020 Router with MPC5EQ and MPC6E) on page 1845
show chassis hardware extensive (MX2020 Router with MPC5EQ and MPC6E) on page 1847
show chassis hardware models (MX2020 Routers with MPC5EQ and MPC6E) on page 1853
show chassis hardware clei-models (MX2020 Router with MPC5EQ and MPC6E) on page 1854
show chassis hardware (MX Series routers with ATM MIC) on page 1855
show chassis hardware (MX240, MX480, MX960 routers with Application Services Modular Line Card) on page 1855
show chassis hardware extensive (MX240, MX480, MX960 Routers with Application Services Modular Line Card) on page 1856
show chassis hardware (MX480 Router with MPC4E) on page 1857
show chassis hardware (MX2020 Router with MPC4E) on page 1858
show chassis hardware (MX5, MX10, MX40, MX80, MX240, MX480, and MX960 Routers with Enhanced 20-Port Gigabit Ethernet MIC) on page 1860
show chassis hardware models (MX5, MX10, MX40, MX80, MX240, MX480, and MX960 Routers with Enhanced 20-Port Gigabit Ethernet MIC) on page 1860
show chassis hardware (MX2008 Router) on page 1861
show chassis hardware detail (MX2008 Router) on page 1862
show chassis hardware extensive (MX2008 Router) on page 1863
show chassis hardware models (MX2008 Router) on page 1875
show chassis hardware clei-models (MX2008 Router) on page 1876
show chassis hardware (MX10003 Router) on page 1877
show chassis hardware (MX204 Router) on page 1877
show chassis hardware (vMX running in lite mode) on page 1878
show chassis hardware (vMX running in performance mode) on page 1878
show chassis hardware (T320 Router) on page 1878
show chassis hardware (T640 Router) on page 1879
show chassis hardware models (T640 Router) on page 1880
show chassis hardware extensive (T640 Router) on page 1880
show chassis hardware (T4000 Router) on page 1881
show chassis hardware (T4000 Router with 16-GB Line Card Chassis (LCC) Routing Engine) on page 1883
show chassis hardware (T4000 Router with LSR FPC) on page 1884
show chassis hardware clei-models (T4000 Router) on page 1884
show chassis hardware detail (T4000 Router) on page 1885
show chassis hardware models (T4000 Router) on page 1887
show chassis hardware lcc (TX Matrix Router) on page 1887
show chassis hardware scc (TX Matrix Router) on page 1888
show chassis hardware (T1600 Router) on page 1888
show chassis hardware (TX Matrix Plus Router) on page 1891
show chassis hardware sfc (TX Matrix Plus Router) on page 1896
show chassis hardware extensive (TX Matrix Plus Router) on page 1897
show chassis hardware clei-models (TX Matrix Plus Router) on page 1898
show chassis hardware detail (TX Matrix Plus Router) on page 1901
show chassis hardware models (TX Matrix Plus Router) on page 1902
show chassis hardware (TX Matrix Plus Router with 3D SIBs) on page 1905
show chassis hardware clei-models (TX Matrix Plus Router with 3D SIBs) on page 1909
show chassis hardware detail (TX Matrix Plus Router with 3D SIBs) on page 1913
show chassis hardware lcc (TX Matrix Plus Router with 3D SIBs) on page 1916
show chassis hardware sfc (TX Matrix Plus Router with 3D SIBs) on page 1917
show chassis hardware (16-Port 10-Gigabit Ethernet MPC with SFP+ Optics [MX Series Routers]) on page 1919
show chassis hardware (MPC3E [MX Series Routers]) on page 1919
show chassis hardware (QFX3500 Switches) on page 1920
show chassis hardware detail (QFX3500 Switches) on page 1921
show chassis hardware models (QFX3500 Switches) on page 1922
show chassis hardware clei-models (QFX3500 Switches) on page 1922
show chassis hardware (QFX5100 Switches) on page 1922
show chassis hardware (QFX10002 Switches) on page 1923
show chassis hardware (QFX10002 and QFX10016 Switches) on page 1924
show chassis hardware detail (QFX10002 and QFX10016 Switches) on page 1925
show chassis hardware interconnect-device (QFabric Systems) on page 1925
show chassis hardware node-device (QFabric Systems) on page 1925
show chassis hardware (PTX5000 Packet Transport Router) on page 1926
show chassis hardware (PTX5000 Packet Transport Router with AC PSM and PDU) on page 1927
show chassis hardware (PTX5000 Packet Transport Router with FPC2-PTX-PIA) on page 1928
show chassis hardware clei-models (PTX5000 Packet Transport Router) on page 1928
show chassis hardware clei-models (PTX5000 Packet Transport Router with AC PSM and PDU) on page 1929
show chassis hardware clei-models (PTX5000 Packet Transport Router with FPC2-PTX-PIA) on page 1929
show chassis hardware detail (PTX5000 Packet Transport Router) on page 1929
show chassis hardware detail (PTX5000 Packet Transport Router with AC PSM and PDU) on page 1931
show chassis hardware detail (PTX5000 Packet Transport Router with FPC2-PTX-PIA) on page 1931
show chassis hardware models (PTX5000 Packet Transport Router) on page 1932
show chassis hardware models (PTX5000 Packet Transport Router with AC PSM and PDU) on page 1932
show chassis hardware models (PTX5000 Packet Transport Router with FPC2-PTX-PIA) on page 1933
show chassis hardware extensive (PTX5000 Packet Transport Router) on page 1933
show chassis hardware extensive (PTX1000 Packet Transport Router) on page 1934
show chassis hardware extensive (PTX5000 with Control Board 2) on page 1935
show chassis hardware (MX Routers with Media Services Blade [MSB]) on page 1935
show chassis hardware extensive (MX Routers with Media Services Blade [MSB]) on page 1935
show chassis hardware (ACX5048 Router) on page 1936
show chassis hardware detail (ACX5048 Router) on page 1937
show chassis hardware clei-models (ACX5048 Router) on page 1938
show chassis hardware models (ACX5048 Router) on page 1938
show chassis hardware (ACX5096 Router) on page 1938
show chassis hardware detail (ACX5096 Router) on page 1939
show chassis hardware clei-models (ACX5096 Router) on page 1939
show chassis hardware models (ACX5096 Router) on page 1940
show chassis hardware (ACX500 Router) on page 1940
show chassis hardware detail (ACX500 Router) on page 1940
show chassis hardware extensive (ACX500 Router) on page 1941
show chassis hardware clei-models (ACX500 Router) on page 1942
show chassis hardware models (ACX500 Router) on page 1943
show chassis hardware (MX960 Router with MPC10E-15C-MRATE Line Card) on page 1943

**Output Fields**

Table 145 on page 1687 lists the output fields for the `show chassis hardware` command. Output fields are listed in the approximate order in which they appear.
Table 145: show chassis hardware Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>Chassis component:</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>• (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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• (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).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• (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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• (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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• (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).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• (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).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• (MX2010, MX2020, and MX2008 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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• (vMX routers)—Information about the chassis, midplane, Routing Engines, and Control Boards (CBs). Also displays information about Flexible PIC Concentrators (FPCs) and associated Modular Interface Cards (MICs) and Physical Interface Cards (PICs).</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Version</th>
<th>Revision level of the chassis component.</th>
<th>All levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part number</td>
<td>Part number of the chassis component.</td>
<td>All levels</td>
</tr>
</tbody>
</table>
### Table 145: show chassis hardware Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial number</td>
<td>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.</td>
<td>All levels</td>
</tr>
<tr>
<td>Assb ID or Assembly ID</td>
<td>(extensive keyword only) Identification number that describes the FRU hardware.</td>
<td>extensive</td>
</tr>
<tr>
<td>Assembly Version</td>
<td>(extensive keyword only) Version number of the FRU hardware.</td>
<td>extensive</td>
</tr>
<tr>
<td>Assembly Flags</td>
<td>(extensive keyword only) Flags.</td>
<td>extensive</td>
</tr>
<tr>
<td>FRU model number</td>
<td>(clei-models, extensive, and models keyword only) Model number of the FRU hardware component.</td>
<td>none specified</td>
</tr>
<tr>
<td>CLEI code</td>
<td>(clei-models and extensive 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.</td>
<td>none specified</td>
</tr>
<tr>
<td>EEPROM Version</td>
<td>ID EEPROM version used by the hardware component: 0x00 (version 0), 0x01 (version 1), or 0x02 (version 2).</td>
<td>extensive</td>
</tr>
</tbody>
</table>

**Description**
- Type of power supply.
- Type of PIC. If the PIC type is not supported on the current software release, the output states **Hardware Not Supported**.
- Type of FPC: FPC Type 1, FPC Type 2, FPC Type 3, FPC Type 4, or FPC Type OC192.

On EX Series switches, a brief description of the FPC.

The following list shows the PIM abbreviation in the output and the corresponding PIM name.
- **2x FE**—Either two built-in Fast Ethernet interfaces (fixed PIM) or dual-port Fast Ethernet PIM
- **4x FE**—4-port Fast Ethernet ePIM
- **1x GE Copper**—Copper Gigabit Ethernet ePIM (one 10-Mbps, 100-Mbps, or 1000-Mbps port)
- **1x GE SFP**—SFP Gigabit Ethernet ePIM (one fiber port)
- **2x Serial**—Dual-port serial PIM
- **2x T1**—Dual-port T1 PIM
- **2x E1**—Dual-port E1 PIM
- **2x CT1E1**—Dual-port channelized T1/E1 PIM
- **1x T3**—T3 PIM (one port)
- **1x E3**—E3 PIM (one port)
- **4x BRI S/T**—4-port ISDN BRI S/T PIM
- **4x BRI U**—4-port ISDN BRI U PIM
- **1x ADSL Annex A**—ADSL 2/2+ Annex A PIM (one port, for POTS)
Table 145: show chassis hardware Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 1x ADSL Annex B</td>
<td>ADSL 2/2+ Annex B PIM (one port, for ISDN)</td>
</tr>
<tr>
<td>• 2x SHDSL (ATM)</td>
<td>G SHDSL PIM (2-port two-wire module or 1-port four-wire module)</td>
</tr>
<tr>
<td>• 1x TGM550</td>
<td>TGM550 Telephony Gateway Module (Avaya VoIP gateway module with one console port, two analog LINE ports, and two analog TRUNK ports)</td>
</tr>
<tr>
<td>• 1x DS1 TIM510</td>
<td>TIM510 E1/T1 Telephony Interface Module (Avaya VoIP media module with one E1 or T1 trunk termination port and ISDN PRI backup)</td>
</tr>
<tr>
<td>• 4x FXS, 4xFX0, TIM514</td>
<td>TIM514 Analog Telephony Interface Module (Avaya VoIP media module with four analog LINE ports and four analog TRUNK ports)</td>
</tr>
<tr>
<td>• 4x BRI TIM521</td>
<td>TIM521 BRI Telephony Interface Module (Avaya VoIP media module with four ISDN BRI ports)</td>
</tr>
<tr>
<td>• Crypto Accelerator Module</td>
<td>For enhanced performance of cryptographic algorithms used in IP Security (IPsec) services</td>
</tr>
<tr>
<td>• MPC M 16x10GE</td>
<td>16-port 10-Gigabit Module Port Concentrator that supports SFP+ optical transceivers. (Not on EX Series switches.)</td>
</tr>
<tr>
<td>• For hosts, the Routing Engine type.</td>
<td></td>
</tr>
<tr>
<td>• For small form-factor pluggable transceiver (SFP) modules, the type of fiber: LX, SX, LH, or T.</td>
<td></td>
</tr>
<tr>
<td>• LCD description for EX Series switches (except EX2200 switches).</td>
<td></td>
</tr>
<tr>
<td>• MPC2—1-port MPC2 that supports two separate slots for MICs.</td>
<td></td>
</tr>
<tr>
<td>• MPC3E—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.</td>
<td></td>
</tr>
<tr>
<td>• 100GBASE-LR4, pluggable CFP optics</td>
<td></td>
</tr>
<tr>
<td>• Supports the Enhanced MX Switch Control Board with fabric redundancy and existing SCBs without fabric redundancy.</td>
<td></td>
</tr>
<tr>
<td>• Interoperates with existing MX Series line cards, including Flexible Port Concentrators (FPC), Dense Port Concentrators (DPCs), and Modular Port Concentrators (MPCs).</td>
<td></td>
</tr>
<tr>
<td>• MPC4E—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.</td>
<td></td>
</tr>
<tr>
<td>• LCD description for MX Series routers</td>
<td></td>
</tr>
</tbody>
</table>

Sample Output

show chassis hardware (EX8216 Switch)

```
user@host> show chassis hardware
Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis          REV 06                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
```
<table>
<thead>
<tr>
<th>Component</th>
<th>Revision</th>
<th>Model Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routing Engine 1</td>
<td>BUILTIN</td>
<td>BUILTIN</td>
<td>RE-EX8216</td>
</tr>
<tr>
<td>FPC 3</td>
<td>REV 19</td>
<td>710-020683</td>
<td>BCO109083125 EX8200-48F</td>
</tr>
<tr>
<td>CPU</td>
<td>REV 13</td>
<td>710-020598</td>
<td>BF0109144549 EX8200-CPU</td>
</tr>
<tr>
<td>FPC 4</td>
<td>REV 17</td>
<td>710-020683</td>
<td>BCO108500127 EX8200-48F</td>
</tr>
<tr>
<td>CPU</td>
<td>REV 10</td>
<td>710-020598</td>
<td>BF0108460510 EX8200-CPU</td>
</tr>
<tr>
<td>PIC 0</td>
<td></td>
<td>BUILTIN</td>
<td>48x 100 Base-QFX/1000</td>
</tr>
<tr>
<td>Base-X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xcvr 1</td>
<td>REV 01</td>
<td>740-011613</td>
<td>PE70V89 SFP-SX</td>
</tr>
<tr>
<td>Xcvr 11</td>
<td>REV 01</td>
<td>740-011613</td>
<td>PE70YCE SFP-SX</td>
</tr>
<tr>
<td>Xcvr 12</td>
<td>REV 01</td>
<td>740-011613</td>
<td>PE70VSH SFP-SX</td>
</tr>
<tr>
<td>Xcvr 13</td>
<td>REV 01</td>
<td>740-011613</td>
<td>E08C02063 SFP-SX</td>
</tr>
<tr>
<td>Xcvr 14</td>
<td>REV 01</td>
<td>740-011613</td>
<td>PE70VKU SFP-SX</td>
</tr>
<tr>
<td>Xcvr 21</td>
<td>REV 01</td>
<td>740-011613</td>
<td>PE70VAD SFP-SX</td>
</tr>
<tr>
<td>Xcvr 22</td>
<td>REV 01</td>
<td>740-011613</td>
<td>E08E03372 SFP-SX</td>
</tr>
<tr>
<td>Xcvr 23</td>
<td>REV 01</td>
<td>740-011613</td>
<td>PE70VSL SFP-SX</td>
</tr>
<tr>
<td>Xcvr 24</td>
<td>REV 01</td>
<td>740-011613</td>
<td>E08E03409 SFP-SX</td>
</tr>
<tr>
<td>Xcvr 25</td>
<td>REV 01</td>
<td>740-011613</td>
<td>PE70VL4 SFP-SX</td>
</tr>
<tr>
<td>Xcvr 26</td>
<td>REV 01</td>
<td>740-011613</td>
<td>PE70VLS SFP-SX</td>
</tr>
<tr>
<td>Xcvr 27</td>
<td>REV 01</td>
<td>740-011613</td>
<td>PE70VFK SFP-SX</td>
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<tr>
<td>Xcvr 28</td>
<td>REV 01</td>
<td>740-011782</td>
<td>PD228SU SFP-SX</td>
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<tr>
<td>Xcvr 29</td>
<td>REV 01</td>
<td>740-011613</td>
<td>PE70OQX SFP-SX</td>
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<tr>
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<td>REV 01</td>
<td>740-011613</td>
<td>PE70VLS SFP-SX</td>
</tr>
<tr>
<td>Xcvr 31</td>
<td>REV 01</td>
<td>740-011613</td>
<td>PE70VOF SFP-SX</td>
</tr>
<tr>
<td>Xcvr 32</td>
<td>REV 01</td>
<td>740-011613</td>
<td>E08C02052 SFP-SX</td>
</tr>
<tr>
<td>Xcvr 33</td>
<td>REV 01</td>
<td>740-011613</td>
<td>E08C02197 SFP-SX</td>
</tr>
<tr>
<td>Xcvr 34</td>
<td>REV 01</td>
<td>740-011613</td>
<td>E08C02050 SFP-SX</td>
</tr>
<tr>
<td>Xcvr 35</td>
<td>REV 01</td>
<td>740-011613</td>
<td>E08C02197 SFP-SX</td>
</tr>
<tr>
<td>Xcvr 36</td>
<td>REV 01</td>
<td>740-011613</td>
<td>PE70VOL SFP-SX</td>
</tr>
<tr>
<td>Xcvr 37</td>
<td>REV 01</td>
<td>740-011613</td>
<td>E08C03390 SFP-SX</td>
</tr>
<tr>
<td>Xcvr 38</td>
<td>REV 01</td>
<td>740-011613</td>
<td>E08C03362 SFP-SX</td>
</tr>
<tr>
<td>Xcvr 39</td>
<td>REV 01</td>
<td>740-011613</td>
<td>E08C02065 SFP-SX</td>
</tr>
<tr>
<td>Xcvr 40</td>
<td>REV 01</td>
<td>740-011613</td>
<td>E08C03405 SFP-SX</td>
</tr>
<tr>
<td>Xcvr 41</td>
<td>REV 01</td>
<td>740-011613</td>
<td>E08C03411 SFP-SX</td>
</tr>
<tr>
<td>Xcvr 43</td>
<td>REV 01</td>
<td>740-011613</td>
<td>E08C02171 SFP-SX</td>
</tr>
<tr>
<td>Xcvr 45</td>
<td>REV 01</td>
<td>740-011613</td>
<td>E08E03410 SFP-SX</td>
</tr>
<tr>
<td>FPC 1</td>
<td>REV 16</td>
<td>710-016837</td>
<td>BB0109051344 EX8200-8XS</td>
</tr>
<tr>
<td>CPU</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SIB 0</td>
<td>REV 10</td>
<td>710-021613</td>
<td>AYO109166244 EX8216-SF320</td>
</tr>
<tr>
<td>SIB 1</td>
<td>REV 10</td>
<td>710-021613</td>
<td>AYO109166357 EX8216-SF320</td>
</tr>
<tr>
<td>SIB 2</td>
<td>REV 10</td>
<td>710-021613</td>
<td>AYO109166362 EX8216-SF320</td>
</tr>
<tr>
<td>SIB 3</td>
<td>REV 10</td>
<td>710-021613</td>
<td>AYO109166338 EX8216-SF320</td>
</tr>
<tr>
<td>SIB 4</td>
<td>REV 10</td>
<td>710-021613</td>
<td>AYO109166350 EX8216-SF320</td>
</tr>
<tr>
<td>SIB 5</td>
<td>REV 10</td>
<td>710-021613</td>
<td>AYO109166365 EX8216-SF320</td>
</tr>
<tr>
<td>SIB 6</td>
<td>REV 10</td>
<td>710-021613</td>
<td>AYO109166361 EX8216-SF320</td>
</tr>
<tr>
<td>SIB 7</td>
<td>REV 10</td>
<td>710-021613</td>
<td>AYO109166399 EX8216-SF320</td>
</tr>
<tr>
<td>PSU 0</td>
<td>REV 17</td>
<td>740-021466</td>
<td>BG0709170003 EX8200-AC2K</td>
</tr>
<tr>
<td>PSU 1</td>
<td>REV 17</td>
<td>740-021466</td>
<td>BG0709170004 EX8200-AC2K</td>
</tr>
<tr>
<td>PSU 2</td>
<td>REV 17</td>
<td>740-021466</td>
<td>BG0709170020 EX8200-AC2K</td>
</tr>
<tr>
<td>PSU 3</td>
<td>REV 17</td>
<td>740-021466</td>
<td>BG0709170017 EX8200-AC2K</td>
</tr>
<tr>
<td>PSU 4</td>
<td>REV 17</td>
<td>740-021466</td>
<td>BG0709170008 EX8200-AC2K</td>
</tr>
<tr>
<td>PSU 5</td>
<td>REV 17</td>
<td>740-021466</td>
<td>BG0709170018 EX8200-AC2K</td>
</tr>
<tr>
<td>Top Fan Tray</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FTC 0</td>
<td>REV 4</td>
<td>760-022620</td>
<td>CX1209140212 EX8216-FT</td>
</tr>
<tr>
<td>FTC 1</td>
<td>REV 4</td>
<td>760-022620</td>
<td>CX1209140212 EX8216-FT</td>
</tr>
<tr>
<td>Bottom Fan Tray</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FTC 2</td>
<td>REV 4</td>
<td>760-022620</td>
<td>CX1209140211 EX8216-FT</td>
</tr>
<tr>
<td>FTC 1</td>
<td>REV 4</td>
<td>760-022620</td>
<td>CX1209140211 EX8216-FT</td>
</tr>
<tr>
<td>LCD 0</td>
<td>REV 04</td>
<td>710-025742</td>
<td>CE0109186919 EX8200 LCD</td>
</tr>
</tbody>
</table>
show chassis hardware clei-models (EX8216 Switch)

    user@host> show chassis hardware clei-models

Hardware inventory:

<table>
<thead>
<tr>
<th>Item</th>
<th>Version</th>
<th>Part number</th>
<th>CLEI code</th>
<th>FRU model number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midplane</td>
<td>REV 08</td>
<td>710-016845</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSU 0</td>
<td>REV 05</td>
<td>740-023002</td>
<td>COUPAEAEA</td>
<td>EX8200-PWR-AC3KR</td>
</tr>
<tr>
<td>PSU 1</td>
<td>REV 05</td>
<td>740-023002</td>
<td>COUPAEAEA</td>
<td>EX8200-PWR-AC3KR</td>
</tr>
<tr>
<td>PSU 2</td>
<td>REV 05</td>
<td>740-023002</td>
<td>COUPAEAEA</td>
<td>EX8200-PWR-AC3KR</td>
</tr>
<tr>
<td>PSU 3</td>
<td>REV 05</td>
<td>740-023002</td>
<td>COUPAEAEA</td>
<td>EX8200-PWR-AC3KR</td>
</tr>
<tr>
<td>PSU 4</td>
<td>REV 05</td>
<td>740-023002</td>
<td>COUPAEAEA</td>
<td>EX8200-PWR-AC3KR</td>
</tr>
<tr>
<td>PSU 5</td>
<td>REV 05</td>
<td>740-023002</td>
<td>COUPAEAEA</td>
<td>EX8200-PWR-AC3KR</td>
</tr>
<tr>
<td>Top Fan Tray</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottom Fan Tray</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

show chassis hardware clei-models (TI600 Router)

    user@host> show chassis hardware clei-models

Hardware inventory:

<table>
<thead>
<tr>
<th>Item</th>
<th>Version</th>
<th>Part number</th>
<th>CLEI code</th>
<th>FRU model number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midplane</td>
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show chassis hardware clei-models (PTX10008 Routers)

user@host> show chassis hardware clei-models

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show chassis hardware clei-models (PTX10016 Routers)

user@host> show chassis hardware clei-models

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**show chassis hardware (EX2300-C Switch)**

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user@switch> show chassis hardware

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### show chassis hardware (EX2300 Switch)

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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan Tray 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

### show chassis hardware detail (EX4200 Switch)

```
user@host> show chassis hardware detail
Hardware inventory:
<table>
<thead>
<tr>
<th>Item</th>
<th>Version</th>
<th>Part number</th>
<th>Serial number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chassis</td>
<td>REV 11</td>
<td>650-044930</td>
<td>PD3713160055</td>
<td>EX4300-48P</td>
</tr>
<tr>
<td>Routing Engine 0</td>
<td>REV 04</td>
<td>650-044930</td>
<td>PD3713160055</td>
<td>EX4300-48P</td>
</tr>
<tr>
<td>CPU</td>
<td></td>
<td></td>
<td></td>
<td>FPC CPU</td>
</tr>
<tr>
<td>PIC 0</td>
<td>REV 04</td>
<td>650-044930</td>
<td>PD3713160055</td>
<td>48x10/100/1000 Base-T 4x 40GE</td>
</tr>
<tr>
<td>Xcvr 0</td>
<td>REV 01</td>
<td>740-046871</td>
<td>IEDA3090026</td>
<td>PS 11000 AC</td>
</tr>
<tr>
<td>Fan Tray 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan Tray 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

### show chassis hardware (EX4300 Switch)

```
user@host> show chassis hardware
Hardware inventory:
<table>
<thead>
<tr>
<th>Item</th>
<th>Version</th>
<th>Part number</th>
<th>Serial number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chassis</td>
<td>REV 04</td>
<td>PD3713160055</td>
<td>PD3713160055</td>
<td>EX4300-48P</td>
</tr>
<tr>
<td>Routing Engine 0</td>
<td>REV 04</td>
<td>PD3713160055</td>
<td>PD3713160055</td>
<td>EX4300-48P</td>
</tr>
<tr>
<td>CPU</td>
<td></td>
<td></td>
<td></td>
<td>FPC CPU</td>
</tr>
<tr>
<td>PIC 0</td>
<td>REV 04</td>
<td>PD3713160055</td>
<td>PD3713160055</td>
<td>48x10/100/1000 Base-T 4x 40GE</td>
</tr>
<tr>
<td>Xcvr 0</td>
<td>REV 01</td>
<td>740-046871</td>
<td>IEDA3090026</td>
<td>PS 11000 AC</td>
</tr>
<tr>
<td>Fan Tray 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan Tray 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

---

Ethernet Interfaces Feature Guide for Routing Devices

1694  Copyright © 2019, Juniper Networks, Inc.
### show chassis hardware models (EX4500 Switch)

```
user@host> show chassis hardware models

Hardware inventory:
<table>
<thead>
<tr>
<th>Item</th>
<th>Version</th>
<th>Part number</th>
<th>Serial number</th>
<th>FRU model number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routing Engine 0</td>
<td>REV 01</td>
<td>750-035700</td>
<td>GG0210271867</td>
<td>EX4500-40F-FB-C</td>
</tr>
<tr>
<td>FPC 0</td>
<td>REV 01</td>
<td>750-035700</td>
<td>GG0210271867</td>
<td>EX4500-40F-FB-C</td>
</tr>
<tr>
<td>PIC 0</td>
<td></td>
<td>BUILTIN</td>
<td>BUILTIN</td>
<td>EX4500-40F-FB-C</td>
</tr>
<tr>
<td>Power Supply 1</td>
<td>REV 01</td>
<td>740-029654</td>
<td>H884FS00JC09</td>
<td>EX4500-PWR1-AC-FB</td>
</tr>
</tbody>
</table>
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### show chassis hardware detail (EX9200 Switch)

```
user@switch> show chassis hardware

Hardware inventory:
<table>
<thead>
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<th>Item</th>
<th>Version</th>
<th>Part number</th>
<th>Serial number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chassis</td>
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<td>JN111DA44RFB</td>
<td>9009122883</td>
<td>RE-S-EX9200-1800X4</td>
</tr>
<tr>
<td>Midplane</td>
<td>REV 05</td>
<td>710-017414</td>
<td>TS2912</td>
<td>EX9208-BP</td>
</tr>
<tr>
<td>FPM Board</td>
<td>REV 02</td>
<td>710-017254</td>
<td>XN1804</td>
<td>Front Panel Display</td>
</tr>
<tr>
<td>PEM 0</td>
<td>Rev 01</td>
<td>740-022697</td>
<td>QCS0906C033</td>
<td>PS 1.2-1.7kW; 100-240V</td>
</tr>
<tr>
<td>AC in</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEM 1</td>
<td>Rev 01</td>
<td>740-022697</td>
<td>QCS0906C095</td>
<td>PS 1.2-1.7kW; 100-240V</td>
</tr>
<tr>
<td>AC in</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Routing Engine 0</td>
<td>REV 08</td>
<td>740-031116</td>
<td>9009122883</td>
<td>RE-S-EX9200-1800X4</td>
</tr>
<tr>
<td>CB 0</td>
<td>REV 16</td>
<td>750-031391</td>
<td>CAAW4391</td>
<td>EX9200-SCBEF</td>
</tr>
<tr>
<td>PC 0</td>
<td>REV 07</td>
<td>750-049612</td>
<td>CABJ9312</td>
<td>EX9200 40x1G Copper</td>
</tr>
<tr>
<td>CPU</td>
<td>REV 04</td>
<td>711-038484</td>
<td>CABH8268</td>
<td>MPCE PMB 2G</td>
</tr>
<tr>
<td>MIC 0</td>
<td>REV 02</td>
<td>750-049607</td>
<td>CBT9623</td>
<td>40x 1GE RJ45</td>
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<tr>
<td>PIC 0</td>
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<td>BUILTIN</td>
<td>BUILTIN</td>
<td>10x 1GE RJ45</td>
</tr>
<tr>
<td>PIC 1</td>
<td></td>
<td>BUILTIN</td>
<td>BUILTIN</td>
<td>10x 1GE RJ45</td>
</tr>
<tr>
<td>PIC 2</td>
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<td>BUILTIN</td>
<td>BUILTIN</td>
<td>10x 1GE RJ45</td>
</tr>
<tr>
<td>PIC 3</td>
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<td>BUILTIN</td>
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<tr>
<td>FPC 1</td>
<td>REV 10</td>
<td>710-013699</td>
<td>CAAN3529</td>
<td>EX9200-40x1G-SFP</td>
</tr>
<tr>
<td>Xcvr 8</td>
<td>REV 01</td>
<td>740-011613</td>
<td>E08L03674</td>
<td>SFP-SX</td>
</tr>
<tr>
<td>Xcvr 9</td>
<td>REV 01</td>
<td>740-011613</td>
<td>E08M00243</td>
<td>SFP-SX</td>
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<tr>
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<td>BUILTIN</td>
<td>BUILTIN</td>
<td>10x 1GE RJ45</td>
</tr>
<tr>
<td>PIC 1</td>
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<td>BUILTIN</td>
<td>BUILTIN</td>
<td>10x 1GE RJ45</td>
</tr>
<tr>
<td>MIC 1</td>
<td>REV 26</td>
<td>750-028392</td>
<td>CAAC8006</td>
<td>20x 1GE SFP</td>
</tr>
<tr>
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<td>BUILTIN</td>
<td>BUILTIN</td>
<td>10x 1GE SFP</td>
</tr>
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<td>Xcvr 8</td>
<td>REV 01</td>
<td>740-011613</td>
<td>E08L03674</td>
<td>SFP-SX</td>
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<tr>
<td>Xcvr 9</td>
<td>REV 01</td>
<td>740-011613</td>
<td>E08M00243</td>
<td>SFP-SX</td>
</tr>
<tr>
<td>PIC 3</td>
<td></td>
<td>BUILTIN</td>
<td>BUILTIN</td>
<td>10x 1GE SFP</td>
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<tr>
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<td>740-011613</td>
<td>AM0943SKGZ</td>
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<td>Xcvr 4</td>
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<tr>
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<td>BUILTIN</td>
<td>10x 1GE SFP</td>
</tr>
<tr>
<td>PIC 1</td>
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<td>BUILTIN</td>
<td>BUILTIN</td>
<td>10x 1GE SFP</td>
</tr>
<tr>
<td>MIC 1</td>
<td>REV 26</td>
<td>750-028392</td>
<td>CAAS5132</td>
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</tr>
<tr>
<td>PIC 2</td>
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<td>BUILTIN</td>
<td>10x 1GE SFP</td>
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<tr>
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<td>E08D02625</td>
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<tr>
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<tr>
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<td>BUILTIN</td>
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<tr>
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<td>740-011613</td>
<td>AM0813S8YME</td>
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</tr>
<tr>
<td>Fan Tray</td>
<td></td>
<td></td>
<td></td>
<td>Left Fan Tray</td>
</tr>
</tbody>
</table>
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### show chassis hardware detail (EX9251 Switch)

```plaintext
user@switch> show chassis hardware

Hardware inventory:

<table>
<thead>
<tr>
<th>Item</th>
<th>Version</th>
<th>Part number</th>
<th>Serial number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chassis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Routing Engine 0</td>
<td>BUILTIN</td>
<td>BUILTIN</td>
<td>RE-S-2X00x6</td>
<td></td>
</tr>
<tr>
<td>CB 0</td>
<td>REV 05</td>
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<td>CAGT1382</td>
<td>EX9251</td>
</tr>
<tr>
<td>FPC 0</td>
<td>BUILTIN</td>
<td>BUILTIN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIC 0</td>
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<td>BUILTIN</td>
<td>4XQFP28 PIC</td>
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</tr>
<tr>
<td>Xcvr 0</td>
<td>REV 01</td>
<td>740-044512</td>
<td>APF14500007NHC</td>
<td>QSFP++-40G-CU50CM</td>
</tr>
<tr>
<td>Xcvr 2</td>
<td>REV 01</td>
<td>740-046565</td>
<td>QH21035H</td>
<td>QSFP++-40G-SR4</td>
</tr>
<tr>
<td>PIC 1</td>
<td>BUILTIN</td>
<td>BUILTIN</td>
<td>BXSFPP PIC</td>
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</tr>
<tr>
<td>Xcvr 0</td>
<td>REV 01</td>
<td>740-031980</td>
<td>AA1539URH7</td>
<td>SFP+-10G-SR</td>
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<td>AA162832LVG</td>
<td>SFP+-10G-SR</td>
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<td>Xcvr 2</td>
<td>REV 01</td>
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<td>MXA0NKJ</td>
<td>SFP+-10G-SR</td>
</tr>
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<td>740-031980</td>
<td>MXA0K75</td>
<td>SFP+-10G-SR</td>
</tr>
<tr>
<td>Xcvr 4</td>
<td>REV 01</td>
<td>740-021308</td>
<td>MXA138L</td>
<td>SFP+-10G-SR</td>
</tr>
<tr>
<td>Xcvr 5</td>
<td>REV 01</td>
<td>740-021308</td>
<td>13T511102684</td>
<td>SFP+-10G-SR</td>
</tr>
<tr>
<td>Xcvr 6</td>
<td>REV 01</td>
<td>740-021308</td>
<td>MXA138E</td>
<td>SFP+-10G-SR</td>
</tr>
<tr>
<td>Xcvr 7</td>
<td>REV 01</td>
<td>740-021308</td>
<td>MXA152N</td>
<td>SFP+-10G-SR</td>
</tr>
<tr>
<td>PEM 0</td>
<td>REV 02</td>
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<td>1F186390060</td>
<td>AC AFO 650W PSU</td>
</tr>
<tr>
<td>PEM 1</td>
<td>REV 02</td>
<td>740-070749</td>
<td>1F186390045</td>
<td>AC AFO 650W PSU</td>
</tr>
</tbody>
</table>

Fan Tray 0
Airflow - AFO
Fan Tray 1
Airflow - AFO
```

### show chassis hardware detail (EX9253 Switch)

```plaintext
user@switch> show chassis hardware

Hardware inventory:

<table>
<thead>
<tr>
<th>Item</th>
<th>Version</th>
<th>Part number</th>
<th>Serial number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chassis</td>
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<td></td>
</tr>
<tr>
<td>Midplane</td>
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<td>750-074276</td>
<td>CAJE4108</td>
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</tr>
<tr>
<td>Routing Engine 0</td>
<td>BUILTIN</td>
<td>BUILTIN</td>
<td>RE-S-2X00x6</td>
<td></td>
</tr>
<tr>
<td>Routing Engine 1</td>
<td>BUILTIN</td>
<td>BUILTIN</td>
<td>RE-S-2X00x6</td>
<td></td>
</tr>
<tr>
<td>CB 0</td>
<td>REV 24</td>
<td>750-067071</td>
<td>CAJF6414</td>
<td>Control Board</td>
</tr>
<tr>
<td>Mezz</td>
<td>REV 14</td>
<td>711-066896</td>
<td>CAJF6327</td>
<td>Control Mezz Board</td>
</tr>
<tr>
<td>CB 1</td>
<td>REV 24</td>
<td>750-067071</td>
<td>CAJF6398</td>
<td>Control Board</td>
</tr>
<tr>
<td>Mezz</td>
<td>REV 14</td>
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<td>750-066879</td>
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</tr>
<tr>
<td>CPU</td>
<td>BUILTIN</td>
<td>BUILTIN</td>
<td>SMPC PMB</td>
<td></td>
</tr>
<tr>
<td>PIC 0</td>
<td>BUILTIN</td>
<td>BUILTIN</td>
<td>6xQSFPP</td>
<td></td>
</tr>
<tr>
<td>Xcvr 0</td>
<td>REV 01</td>
<td>740-054053</td>
<td>QH20019A</td>
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</tr>
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<td>750-068806</td>
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<tr>
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<tr>
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<td>1ECQ11511AK</td>
<td>QSFP+-100GBASE-SR4</td>
</tr>
<tr>
<td>Xcvr 2</td>
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<td>740-032986</td>
<td>QB160112</td>
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<td>FPC 1</td>
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<td>BUILTIN</td>
<td>SMPC PMB</td>
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</tr>
<tr>
<td>PIC 0</td>
<td>BUILTIN</td>
<td>BUILTIN</td>
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<td></td>
</tr>
<tr>
<td>PIC 1</td>
<td>REV 15</td>
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<td>UWE2CBQ</td>
<td>QSFP+-40G-LR4</td>
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<td>QB120701</td>
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<td>REV 01</td>
<td>740-066937</td>
<td>1HS17070027</td>
<td>JNP-PWR1600-AC</td>
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</tbody>
</table>
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show chassis hardware detail (PTX10008 Routers)

user@switch> show chassis hardware detail

<table>
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<th>Version</th>
<th>Part number</th>
<th>Serial number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
<td>DE487</td>
<td>JNP10008 [PTX10008 - PILOT BUILD V1.1]</td>
</tr>
<tr>
<td>Midplane</td>
<td>REV 27</td>
<td>750-054097</td>
<td>ACPD4307</td>
<td>Midplane 8</td>
</tr>
<tr>
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<td>BUILTIN</td>
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<td>Virtio Block Disk</td>
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<tr>
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<tr>
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**show chassis hardware detail** *(PTX10016 Routers)*

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user@switch> show chassis hardware detail

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show chassis hardware (M10 Router)

user@host> show chassis hardware

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show chassis hardware models (M10 Router)

user@host> show chassis hardware models

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show chassis hardware (M20 Router)

user@host> show chassis hardware

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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
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SSRAM bank 2   REV 01   710-001385   S001:1            2 MB
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PIC 1          REV 11   750-002992   PE-4FE-TX
PIC 2          REV 03   750-002977   PE-2OC3-ATM-MM
PIC 3          REV 08   750-005724   PE-2OC3-ATM2-MM
FPC 1
PIC 2          REV 12   750-008425   PE-AS
PIC 3          REV 13   750-005636   PE-4CHDS3-QPP
Fan Tray 0                                               Front Upper Fan Tray
Fan Tray 1                                               Front Middle Fan Tray
Fan Tray 2                                               Front Bottom Fan Tray
Fan Tray 3                                               Rear Fan Tray

show chassis hardware models (M20 Router)

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Hardware inventory:
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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
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SSB 1            N/A      N/A                        SSB-E-M20
FPC 0            REV 03   710-003308                     FPC-E
FPC 2            REV 01   710-001292                     FPC-E
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show chassis hardware (M40 Router)

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show chassis hardware (M120 Router)

user@host> show chassis hardware

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Xcvr 6       REV 01   740-011163   P9F16NN           SFP-SX
Xcvr 7       REV 01   740-011172   PBG2X9Y           SFP-SX
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FPC 4            REV 02   710-011398   CP6741            M120 FPC Type 3
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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:
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Midplane         REV 01   710-013667   RB4170            M120 Midplane
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PEM 1            Rev 05   740-011936   RM28321           AC Power Entry Module
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ad2     38154 MB HITEC1040CG54A00  MPB887X2HS2E3M Hard Disk
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CB 1             REV 06   710-011403   CB6728            1x G/E SFP, 1000 BASE
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FPC 2             REV 03   710-011800   JW1284            8x 1GE(LAN), IQ2
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show chassis hardware models (M120 Router)

user@host> show chassis hardware models

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### show chassis hardware (M160 Router)

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user@host> show chassis hardware
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### show chassis hardware models (M160 Router)

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user@host> show chassis hardware detail

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### show chassis hardware (M320 Router)

**user@host> show chassis hardware**

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show chassis hardware models (M320 Router)

user@host> show chassis hardware models

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user@host> show chassis hardware

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### show chassis hardware (MX10 Router)

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user@host> show chassis hardware

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show chassis hardware (Fixed MX80 Router)

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user@host> show chassis hardware

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### show chassis hardware (Modular MX80 Router)

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### show chassis hardware (MX150)

```
user@host> show chassis hardware
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### show chassis hardware
show chassis hardware models (MX150)

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show chassis hardware (MX104 Router)

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show chassis hardware detail (MX104 Router)

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show chassis hardware detail (MX480 Packet Transport Router with details of virtual disk size)

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show chassis hardware extensive (MX104 Router)

```
user@host> show chassis hardware extensive

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  S/N:               G3503
  Assembly ID:  0x0560            Assembly Version:  00.00
  Date:         00-00-0000        Assembly Flags:    0x00
  ID: MX104
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    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
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  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
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  ID: MX104
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    Address 0x60: 00 00 00 00 00 00 41 30 30 30 ff ff ff ff ff ff
    Address 0x70: ff ff ff c2 47 33 35 30 33 00 00 00 00 00 00 00 00
PEM 0            REV 03   740-045933   1H072500016       AC Power Entry Module
  Jedec Code:   0x7fb0            EEPROM Version:    0x02
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<td>IP9IAM2DAA</td>
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<td>Address 0x10:</td>
<td>53 2f 4e 20 43 41 41 4d 36 33 38 30 00 11 09 07</td>
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<td>Address 0x20:</td>
<td>42 55 49 4c 54 49 4e 00 0d 58 43 00 00 00 00 00</td>
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</tbody>
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Ethernet Interfaces Feature Guide for Routing Devices
show chassis hardware extensive (PTX10008 Router)

Hardware inventory:

<table>
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<tr>
<th>Item</th>
<th>Version</th>
<th>Part number</th>
<th>Serial number</th>
<th>Description</th>
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<td>JNP10008 [PTX10008 - PILOT BUILD V1.1]</td>
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<td>QFX10008-CHAS</td>
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Board Information Record:

Address 0x00: ad 01 08 00 30 b6 4f e9 74 c4 ff ff ff ff ff ff ff
I2C Hex Data:

Address 0x00: 7f b0 02 ff 05 66 01 0b 00 45 56 20 32 37 00 00
Address 0x10: 00 00 00 00 00 35 30 2d 30 35 34 30 39 37 00 00
Address 0x20: 44 45 34 38 07 00 00 00 00 00 00 00 00 00 08 07
Address 0x30: e0 ff ff ff ad 01 08 00 30 b6 4f e9 74 c4 ff ff
Address 0x40: ff ff ff ff 01 43 4d 4d 55 4d 30 30 41 52 41 51
Address 0x50: 46 58 31 30 30 38 2d 43 48 41 33 00 00 00 00
Address 0x60: 00 00 00 00 00 00 41 44 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff ff ff ff 63 44 45 34 38 37 00 00 00 00 00 00

Midplane        | REV 27 750-054097 | ACDP4307 | Midplane 8
| Jedec Code:    | 0x7fb0    | EEPROM Version: 0x02 |
| P/N:           | 750-054097 | ACDP4307 |
| Assembly ID:   | 0x0b3     | Assembly Version: 01.27 |
| Date:          | 08-08-2016 | Assembly Flags: 0x00 |
| Version:       | REV 27    | CLEI Code: CM0M000ARA |
ID: QFX10008 Midplane  FRU Model Number: QFX10008-CHAS

Board Information Record:
Address 0x00: ad 01 08 00 30 b6 4f e9 74 c4 ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 0b e3 01 1b 52 45 56 20 32 37 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 35 34 30 39 37 00 00
Address 0x20: 53 2f 4e 20 41 43 5a 34 34 30 00 0d 06 07
Address 0x30: e0 ff ff ff ad 01 08 00 30 b6 4f e9 74 c4 ff ff
Address 0x40: ff ff ff ff 01 43 4d 4d 55 4d 30 30 41 44 51 51
Address 0x50: 46 58 31 30 30 30 2d 52 45 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 42 41 00 00 00 00 00 00 00 00
Address 0x70: ff ff ff ff 63 44 45 34 38 37 00 00 00 00 00 00 00
Routing Engine 0    BUILTIN BUILTIN RE-PTX-2X00x4
vtbd0 15360 MB   Virtio Block Disk
vtbd1 15360 MB   Virtio Block Disk
ada0 128 MB   QEMU QM00002 Virtio Block Disk
usb0 (addr 0.1) EHCI root HUB 0 Intel uhub0
usb1 (addr 0.2) product 0x0020 32 vendor 0x8087 uhub1
Routing Engine 1    BUILTIN BUILTIN RE-PTX-2X00x4
vtbd0 15360 MB   Virtio Block Disk
vtbd1 15360 MB   Virtio Block Disk
ada0 128 MB   QEMU QM00002 Virtio Block Disk
usb0 (addr 0.1) EHCI root HUB 0 Intel uhub0
usb1 (addr 0.2) product 0x0020 32 vendor 0x8087 uhub1

CB 0   REV 02 750-068820 ACNZ4440 Control Board
Jedec Code: 0x7fb0 EEPROM Version: 0x02
P/N: 750-068820 S/N: ACNZ4440
Assembly ID: 0xb9d Assembly Version: 0.02
Date: 06-13-2016 Assembly Flags: 0x00
Version: REV 02 CLEI Code: CMUCAH3CTB
ID: Control Board FRU Model Number: QFX10000-RE

Board Information Record:
Address 0x00: ad 01 00 10 84 c1 c1 54 10 be ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 0b 9d 01 02 52 45 56 20 30 32 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 36 38 38 32 30 00 00
Address 0x20: 53 2f 4e 20 41 43 5a 34 34 34 30 00 0d 06 07
Address 0x30: e0 ff ff ff ad 01 00 10 84 c1 c1 54 10 be ff ff
Address 0x40: ff ff ff ff 01 43 4d 4d 55 4d 30 30 41 44 51 51
Address 0x50: 46 58 31 30 30 30 2d 52 45 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 42 41 00 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff db ff ff ff ff ff ff ff ff ff ff ff ff ff

CB 1   REV 02 750-068820 ACNZ82984 Control Board
Jedec Code: 0x7fb0 EEPROM Version: 0x02
P/N: 750-068820 S/N: ACNZ82984
Assembly ID: 0xb9d Assembly Version: 0.02
Date: 06-27-2016 Assembly Flags: 0x00
Version: REV 02 CLEI Code: CMUCAH3CTB
ID: Control Board FRU Model Number: QFX10000-RE

Board Information Record:
Address 0x00: ad 01 00 10 84 c1 c1 54 10 be ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff 0b 9d 01 02 52 45 56 20 30 32 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 36 38 38 32 30 00 00
Address 0x20: 53 2f 4e 20 41 43 43 5a 34 34 34 30 00 0d 06 07
Address 0x30: e0 ff ff ff ad 01 00 10 84 c1 c1 54 10 be ff ff
Address 0x40: ff ff ff ff 01 43 4d 4d 55 43 41 48 33 43 54 42 51
Address 0x50: 46 58 31 30 30 30 2d 52 45 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 42 41 00 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff db ff ff ff ff ff ff ff ff ff ff ff ff ff

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Chapter 41: Operational Commands

FPC 0  
REV 36  750-051354  ACNP4679  LC1102 - 12C / 36Q / 144X

Jedec Code:  0x7fb0  EEPROM Version:  0x02
P/N:  750-051354  S/N:  ACNP4679
Assembly ID:  0x0be7  Assembly Version:  01.36
Date:  11-11-2016  Assembly Flags:  0x00
Version:  REV 36  CLEI Code:  CMUIAM98BA
ID:  ULC-36Q-12Q28  FRU Model Number:  QFX10000-36Q
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 e7 01 24 52 45 56 20 33 36 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 35 31 33 33 35 34 00
Address 0x20: 53 2f 4e 20 41 43 4e 50 34 36 37 39 00 0b 0b 07
Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4d 55 49 41 4d 39 42 41 41 51
Address 0x50: 46 58 31 30 30 30 30 2d 33 36 51 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: ff ff ff fe ff ff ff ff ff ff ff ff ff ff ff ff
CPU  BUILTIN  BUILTIN  FPC CPU

Jedec Code:  0x7fb0  EEPROM Version:  0x02
P/N:  BUILTIN  S/N:  BUILTIN
Assembly ID:  0xf020  Assembly Version:  02.17
Date:  04-19-2012  Assembly Flags:  0x00
Board Information Record:
Address 0x00: ad 01 01 04 ac b8 c8 1d f7 b6 ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff f0 20 02 11 00 e0 3c fa 09 00 70 87
Address 0x10: 09 38 bb ff 42 55 49 4c 54 49 4e 00 25 73 3a 20
Address 0x20: 42 55 49 4c 54 49 4e 00 42 55 49 4c 00 13 04 07
Address 0x30: dc ff ff ff ad 01 01 04 ac 4b c8 1d f7 b6 ff ff
Address 0x40: ff ff ff ff 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: ff ff ff ff 00 00 00 00 00 00 00 00 00 00 00 00 00
PIC 0  BUILTIN  BUILTIN  12x100GE/36x40GE/144x10GE

Jedec Code:  0x7fb0  EEPROM Version:  0x02
P/N:  BUILTIN  S/N:  BUILTIN
Assembly ID:  0xf050  Assembly Version:  02.17
Date:  04-19-2012  Assembly Flags:  0x00
Board Information Record:
Address 0x00: ad 01 01 04 ac b8 c8 1d f7 b6 ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff f0 50 02 11 00 e0 3c fa 09 00 70 87
Address 0x10: 09 38 bb ff 6c 61 70 73 42 55 49 4c 54 49 4e 00 25 73 3a 20
Address 0x20: 42 55 49 4c 54 49 4e 00 42 55 49 4c 00 13 04 07
Address 0x30: dc ff ff ff ad 01 01 04 ac 4b c8 1d f7 b6 ff ff
Address 0x40: ff ff ff ff 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: ff ff ff ff f3 50 36 36 36 36 00 00 00 00 00 00 00
Xcvr 1  REV 01  740-058734  1ECQ113834D  QSFP-100GBASE-SR4
Xcvr 5  REV 01  740-058734  1ECQ1137067  QSFP-100GBASE-SR4
Xcvr 6  REV 01  740-054053  QF3205SD  QSFP+-4X10G-SR
Xcvr 7  REV 01  740-058734  1ECQ11381MP  QSFP-100GBASE-SR4
Xcvr 11  REV 01  740-061405  1ACQ110507K  QSFP-100GBASE-SR4
Xcvr 13  REV 01  740-058734  1ECQ11390ZB  QSFP-100GBASE-SR4
Xcvr 17  REV 01  740-058734  1ECQ11381JS  QSFP-100GBASE-SR4
Xcvr 19  REV 01  740-058734  1ECQ11381JS  QSFP-100GBASE-SR4

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## Ethernet Interfaces Feature Guide for Routing Devices

| Xcvr 23 | REV 01 | 740–058734 1ACQ112000E | QSFP-100GBASE-SR4 |
| Xcvr 25 | REV 01 | 740–058734 1ECQ113831NT | QSFP-100GBASE-SR4 |
| Xcvr 28 | REV 01 | 740–054053 QG1502W | QSFP+-4X10G-SR |
| Xcvr 29 | REV 01 | 740–058734 1ACQ112000D | QSFP-100GBASE-SR4 |
| Xcvr 33 | REV 01 | 740–058734 1ACQ1134065 | QSFP-100GBASE-SR4 |
| Xcvr 34 | REV 01 | 740–067442 XV20L4L | QSFP+-40G-SR4 |

| FPC 1 | REV 33 | 750–051354 ACNX8831 | LC1102 – 12C / 36Q / 144X |

- **Jedec Code:** 0x7fb0
- **EEPROM Version:** 0x02
- **P/N:** 750-051354
- **S/N:** ACNX8831
- **Assembly ID:** 0x0be7
- **Assembly Version:** 01.33
- **Date:** 06-03-2016
- **Assembly Flags:** 0x00
- **Version:** REV 33
- **CLEI Code:** CMUIAM9BAA
- **ID:** ULC-36Q-12Q28
- **FRU Model Number:** QFX10000-36Q

### 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 e7 01 21 52 45 56 20 33 33 00 00
- **Address 0x10:** 00 00 00 00 37 35 30 2d 30 35 31 33 35 34 00 00
- **Address 0x20:** 53 2f 4e 20 41 43 4e 58 38 38 33 31 00 03 06 07
- **Address 0x30:** e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
- **Address 0x40:** ff ff ff ff 01 43 4d 55 49 41 4d 39 42 41 51
- **Address 0x50:** 46 58 31 30 30 30 30 2d 33 36 51 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:** ff ff ff fb ff ff ff ff ff ff ff ff ff ff ff ff

**CPU**

- **BUILTIN**
- **BUILTIN**
- **FPC CPU**

- **Jedec Code:** 0x7fb0
- **EEPROM Version:** 0x02
- **P/N:** BUILTIN
- **S/N:** BUILTIN
- **Assembly ID:** 0xf020
- **Assembly Version:** 02.17
- **Date:** 04-19-2012
- **Assembly Flags:** 0x00

### Board Information Record:

**Address 0x00:** ad 01 01 04 ac 4b c8 1d f7 b6 ff ff ff ff ff

**I2C Hex Data:**

- **Address 0x00:** 7f b0 02 ff f0 20 02 11 00 20 3e fa 09 00 10 8a
- **Address 0x10:** 09 38 bb ff 42 55 49 4c 54 49 4e 00 20 3e fa
- **Address 0x20:** 42 55 49 4c 54 49 4e 00 42 55 49 4c 00 13 04 07
- **Address 0x30:** dc ff ff ff ad 01 01 04 ac 4b c8 1d f7 b6 ff ff
- **Address 0x40:** ff ff ff ff 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:** ff ff ff f3 50 36 36 36 36 00 00 00 00 00 00 00 00

**PIC 0**

- **BUILTIN**
- **BUILTIN**
- **12x100GE/36x40GE/144x10GE**

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Xcvr 29 NON-JNPR GDF2008750 QSFP-100GBASE-LR4
FPC 2 REV 32 750-051357 ACPB0341 LC1101 - 3C / 3Q / 96X

Jedec Code: 0x7fb0 EEPROM Version: 0x02
P/N: 750-051357 S/N: ACPB0341
Assembly ID: 0x00e8 Assembly Version: 01.32
Date: 06-04-2016 Assembly Flags: 0x00
Version: REV 32 CLEI Code: CMUIANABAA
ID: ULC-30Q28 FRU Model Number: QFX10000-30C
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 e8 01 20 52 45 56 20 33 32 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 35 31 33 35 37 00 00
Address 0x20: 53 2f 4e 20 41 43 50 42 30 33 34 31 00 04 06 07
Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4d 55 49 41 42 41 41 51
Address 0x50: 46 58 31 30 3d 30 33 30 2d 33 30 43 00 00 00 00
Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x70: ff ff ff ef ff ff ff ff ff ff ff ff ff ff ff ff
CPU BUILTIN BUILTIN FPC CPU
Jedec Code: 0x7fb0 EEPROM Version: 0x02
P/N: BUILTIN S/N: BUILTIN
Assembly ID: 0xf020 Assembly Version: 02.17
Date: 04-19-2012 Assembly Flags: 0x00
Board Information Record:
Address 0x00: ad 01 01 04 ac 4b c8 1d f7 b6 ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff f0 20 02 11 00 00 67 00 0a 00 b0 8c
Address 0x10: 03 38 bb ff 42 55 49 4c 54 49 4e 00 00 00 67 00
Address 0x20: 42 55 49 4c 54 49 4e 00 42 55 49 4c 00 13 04 07
Address 0x30: dc ff ff ff ad 01 01 04 ac 4b c8 1d f7 b6 ff ff
Address 0x40: ff ff ff ff 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: ff ff ff f3 50 36 36 36 36 00 00 00 00 00 00 00
PIC 0 BUILTIN BUILTIN 30x100GE/30x40GE/96x10GE

Jedec Code: 0x7fb0 EEPROM Version: 0x02
P/N: BUILTIN S/N: BUILTIN
Assembly ID: 0xf050 Assembly Version: 02.17
Date: 04-19-2012 Assembly Flags: 0x00
Board Information Record:
Address 0x00: ad 01 01 04 ac 4b c8 1d f7 b6 ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff f0 20 02 11 00 00 67 00 0a 00 b0 8c
Address 0x10: 03 38 bb ff 42 55 49 4c 54 49 4e 00 00 00 67 00
Address 0x20: 42 55 49 4c 54 49 4e 00 42 55 49 4c 00 13 04 07
Address 0x30: dc ff ff ff ad 01 01 04 ac 4b c8 1d f7 b6 ff ff
Address 0x40: ff ff ff ff 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: ff ff ff f3 50 36 36 36 36 00 00 00 00 00 00 00

Xcvr 0 NON-JNPR 37700170YQC305 QSFP-100GBASE-LR4
Xcvr 4 NON-JNPR 37700170YQC306 QSFP-100GBASE-LR4
Xcvr 9 REV 01 740-054053 QF36013S QSFP+4X10G-5R
Xcvr 12 REV 01 740-067442 XV301AU QSFP+-40G-5R4
Xcvr 14 REV 01 740-043308 UWE2CG9 QSFP+-40G-LR4
Xcvr 16 REV 01 740-043308 UWH141S QSFP+40G-LR4
Xcvr 17 REV 01 740-058734 1ECQ11180VH QSFP-100GBASE-SR4
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| P/N: | 750-051357 | S/N: | ACPD2186 |
| Assembly ID: | 0x0be8 | Assembly Version: | 01.35 |
| Date: | 09-21-2016 | Assembly Flags: | 0x00 |
| Version: | REV 35 | CLEI Code: | CMUIANABAA |
| ID: | ULC-30Q28 | FRU Model Number: | QFX10000-30C |

| 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 e8 01 23 52 45 56 20 33 35 00 00 |
| Address 0x10: | 00 00 00 00 37 35 30 2d 30 35 31 33 35 37 00 00 |
| Address 0x20: | 53 2f 4e 20 41 43 50 44 32 31 38 36 00 15 09 07 |
| Address 0x30: | e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff |
| Address 0x40: | ff ff ff ff 01 43 4d 55 49 41 4e 41 42 41 43 51 |
| Address 0x50: | 46 58 31 30 30 30 30 30 30 30 30 30 30 30 30 30 |
| Address 0x60: | 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |
| Address 0x70: | ff ff ff f1 ff ff ff ff ff ff ff ff ff ff ff |

| CPU | BUILTIN |
| P/N: | BUILTIN |
| Assembly ID: | 0xf020 |
| Date: | 04-19-2012 |
| Assembly Flags: | 0x00 |

| Board Information Record: |
| Address 0x00: | ad 01 01 04 ac 4b c8 1d f7 b6 ff ff ff ff ff ff |
| I2C Hex Data: |
| Address 0x00: | 7f b0 02 ff f0 20 02 11 00 80 70 fa 09 00 50 8f |
| Address 0x10: | 09 38 bb ff 42 55 49 4c 54 49 4e 00 00 00 80 70 fa |
| Address 0x20: | 42 55 49 4c 54 49 4e 00 42 55 49 4c 00 13 04 07 |
| Address 0x30: | dc ff ff ff ad 01 01 04 ac 4b c8 1d f7 b6 ff ff |
| Address 0x40: | ff ff ff ff 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: | ff ff ff f3 50 36 36 36 36 00 00 00 00 00 00 00 00 |

| PIC 0 | BUILTIN |
| P/N: | BUILTIN |
| Assembly ID: | 0xf050 |
| Date: | 04-19-2012 |
| Assembly Flags: | 0x00 |

| Board Information Record: |
| Address 0x00: | ad 01 01 04 ac 4b c8 1d f7 b6 ff ff ff ff ff ff |
| I2C Hex Data: |
| Address 0x00: | 7f b0 02 ff f0 20 02 11 00 80 70 fa 09 00 50 8f |
| Address 0x10: | 09 38 bb ff 42 55 49 4c 54 49 4e 00 00 00 80 70 fa |
| Address 0x20: | 42 55 49 4c 54 49 4e 00 42 55 49 4c 00 13 04 07 |
| Address 0x30: | dc ff ff ff ad 01 01 04 ac 4b c8 1d f7 b6 ff ff |
| Address 0x40: | ff ff ff ff 01 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: | ff ff ff f3 50 36 36 36 36 00 00 00 00 00 00 00 00 |

| Xcvr 0 | REV 01 | 740-061409 | 1GCQA1470A3 | QSFP-100GBASE-LR4-T2 |
| Xcvr 1 | REV 01 | 740-061409 | 1GCQA1470XC | QSFP-100GBASE-LR4-T2 |
| Xcvr 7 | NON-JNPR | FG4550500008 | QSFP-100G-CWDM4 |
| Xcvr 24 | REV 01 | 740-058734 | 1ECQ11381LX | QSFP-100GBASE-SR4 |
| Xcvr 29 | REV 01 | 740-043308 | UWE0UY5 | QSFP+-40G-LR4 |
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 e7 01 08 52 45 56 20 30 38 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 36 38 32 32 00 00
Address 0x20: 53 2f 4e 20 41 43 50 45 39 39 35 31 00 01 09 07
Address 0x30: 00 00 00 00 37 35 30 2d 30 36 38 32 32 00 00
Address 0x40: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x50: 00 00 00 00 37 35 30 2d 30 36 38 32 32 00 00
Address 0x60: 00 00 00 00 00 00 42 45 00 00 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         BUILTIN    BUILTIN          FPC CPU
Jedec Code:  0x7fb0      EEPROM Version:  0x02
P/N:         BUILTIN      S/N:             BUILTIN
Assembly ID: 0xf020       Assembly Version: 02.17
Date:        04-19-2012   Assembly Flags:  0x00

Board Information Record:
Address 0x00: ad 01 01 04 ac 4b c8 1d f7 b6 ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff f0 20 02 11 00 c0 3e fa 09 00 30 97
Address 0x10: 09 38 bb ff 42 55 49 4c 54 49 4e 00 00 00 00 00
Address 0x20: 42 55 49 4c 54 49 4e 00 00 00 00 00 00 00 00 00
Address 0x30: dc ff ff ff ad 01 01 04 ac 4b c8 1d f7 b6 ff ff
Address 0x40: ff ff ff ff ff 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: ff ff ff ff f3 50 36 36 36 36 00 00 00 00 00 00 00 00 00 00
PIC 0        BUILTIN    BUILTIN          12x100GE/36x40GE/144x10GE
Jedec Code:  0x7fb0      EEPROM Version:  0x02
P/N:         BUILTIN      S/N:             BUILTIN
Assembly ID: 0xf050       Assembly Version: 02.17
Date:        04-19-2012   Assembly Flags:  0x00

Board Information Record:
Address 0x00: ad 01 01 04 ac 4b c8 1d f7 b6 ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff f0 20 02 11 00 c0 3e fa 09 00 30 97
Address 0x10: 09 38 bb ff 42 55 49 4c 54 49 4e 00 00 00 00 00
Address 0x20: 42 55 49 4c 54 49 4e 00 00 00 00 00 00 00 00 00
Address 0x30: dc ff ff ff ad 01 01 04 ac 4b c8 1d f7 b6 ff ff
Address 0x40: ff ff ff ff ff 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
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Address 0x70: ff ff ff ff f3 50 36 36 36 36 00 00 00 00 00 00 00 00 00 00
Xcvr 1 REV 01 740-054053 QF3208LG QSFP+-4X10G-SR
Xcvr 7 REV 01 740-067442 XV20LGN QSFP+-40G-SR4
Xcvr 8 REV 01 740-067442 XV20VMV QSFP+-40G-SR4
Xcvr 9 REV 01 740-067442 XV20KCN QSFP+-40G-SR4
Xcvr 10 REV 01 740-067442 XVU504QD QSFP+-40G-SR4
Xcvr 11 REV 01 740-067442 XVU504KX QSFP+-40G-SR4
Xcvr 12 REV 01 740-067442 XVU504W8 QSFP+-40G-SR4
Xcvr 16 REV 01 740-032986 QF43013P QSFP+-40G-SR4
Xcvr 17 REV 01 740-032986 QF4303AE QSFP+-40G-SR4
Xcvr 18 REV 01 740-054050 INFA10492400 QSFP+-4X10G-LR
Xcvr 19 REV 01 740-054050 INFA10492142 QSFP+-4X10G-LR
Xcvr 24 REV 01 740-032986 QF4301KB QSFP+-40G-SR4
Xcvr 25 REV 01 740-032986 QF4303YP QSFP+-40G-SR4
Xcvr 30 REV 01 740-067442 XV300ZX QSFP+-40G-SR4
Xcvr 31 REV 01 740-043308 UWH2KBW QSFP+-40G-LR4
Xcvr 34 REV 01 740-054053 QG1501YU QSFP+-4X10G-SR
Chapter 41: Operational Commands

FPD Board  
**REV 07**  711-054687  ACPC7142  Front Panel Display

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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 f2 01 07 52 45 56 20 30 37 00 00
  - **Address 0x10:** 53 2f 4e 20 41 43 50 43 37 31 34 32 00 16 07 07
  - **Address 0x30:** e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  - **Address 0x40:** 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

Power Supply 0  
**REV 02**  740-049388  1EDL62102N9  Power Supply AC

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FRU Model Number: QFX10000-PWR-AC

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 83 01 02 52 45 56 20 30 32 00 00
  - **Address 0x10:** 31 45 44 4c 36 32 31 30 32 4e 39 00 00 19 05 07
  - **Address 0x30:** e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  - **Address 0x40:** 46 58 31 30 30 30 30 4b 58 00 00 14 01 07
  - **Address 0x60:** 00 00 00 00 00 00 01 30 31 ff ff ff ff ff ff

Power Supply 3  
**REV 02**  740-049388  1EDL60300KK  Power Supply AC

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FRU Model Number: QFX10000-PWR-AC

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:** 77 b0 02 ff 04 83 01 02 52 45 56 20 30 32 00 00
  - **Address 0x10:** 31 45 44 4c 36 32 31 30 32 4e 39 00 00 14 01 07
  - **Address 0x30:** e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  - **Address 0x40:** 46 58 31 30 30 30 30 4b 58 00 00 14 01 07

Power Supply 4  
**REV 02**  740-049388  1EDL60300DL  Power Supply AC

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FRU Model Number: QFX10000-PWR-AC

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:** 77 b0 02 ff 04 83 01 02 52 45 56 20 30 32 00 00
  - **Address 0x10:** 31 45 44 4c 36 32 31 30 32 4e 39 00 00 14 01 07
  - **Address 0x30:** e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  - **Address 0x40:** 46 58 31 30 30 30 30 4b 58 00 00 14 01 07

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ID: QFX10000 AC  FRU Model Number:  QFX10000-Pwr-AC
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 83 01 02 52 45 56 20 30 32 00 00
  Address 0x10: 00 00 00 00 37 34 30 30 34 39 33 38 38 00 00
  Address 0x20: 31 45 44 4c 36 30 33 30 34 39 33 38 38 00 00
  Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 43 4d 55 50 41 44 44 4e 42 41 41 51
  Address 0x50: 46 58 31 30 30 30 30 30 50 57 52 2d 41 43 00 00
  Address 0x60: 00 00 00 00 00 00 01 30 30 30 30 30 30 50 57 52 2d 41 43 00 00
  Address 0x70: ff ff ff dc ff ff ff ff ff ff ff ff ff ff ff ff

Power Supply 3  REV 02  740-049388  1EDL61701BT  Power Supply AC
Jedec Code:  0x7fb0  EEPROM Version:  0x02
P/N:          740-049388  S/N:  1EDL61701BT
Assembly ID:  0x0483  Assembly Version:  01.02
Date:         05-01-2016  Assembly Flags:  0x00
Version:      REV 02  CLEI Code:  CMUPADNBAA
ID: QFX10000 AC  FRU Model Number:  QFX10000-Pwr-AC
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 83 01 02 52 45 56 20 30 32 00 00
  Address 0x10: 00 00 00 00 37 34 30 2d 30 34 39 33 38 38 00 00
  Address 0x20: 31 45 44 4c 36 30 33 30 34 39 33 38 38 00 00
  Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 43 4d 55 50 41 44 44 4e 42 41 41 51
  Address 0x50: 46 58 31 30 30 30 30 30 50 57 52 2d 41 43 00 00
  Address 0x60: 00 00 00 00 00 00 01 30 30 30 30 30 30 50 57 52 2d 41 43 00 00
  Address 0x70: ff ff ff dc ff ff ff ff ff ff ff ff ff ff ff ff

Power Supply 4  REV 02  740-049388  1EDL62102P7  Power Supply AC
Jedec Code:  0x7fb0  EEPROM Version:  0x02
P/N:          740-049388  S/N:  1EDL62102P7
Assembly ID:  0x0483  Assembly Version:  01.02
Date:         05-25-2016  Assembly Flags:  0x00
Version:      REV 02  CLEI Code:  CMUPADNBAA
ID: QFX10000 AC  FRU Model Number:  QFX10000-Pwr-AC
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 83 01 02 52 45 56 20 30 32 00 00
  Address 0x10: 00 00 00 00 37 34 30 2d 30 34 39 33 38 38 00 00
  Address 0x20: 31 45 44 4c 36 30 33 30 34 39 33 38 38 00 00
  Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 43 4d 55 50 41 44 44 4e 42 41 41 51
  Address 0x50: 46 58 31 30 30 30 30 30 50 57 52 2d 41 43 00 00
  Address 0x60: 00 00 00 00 00 00 01 30 30 30 30 30 30 50 57 52 2d 41 43 00 00
  Address 0x70: ff ff ff dc ff ff ff ff ff ff ff ff ff ff ff ff

Power Supply 5  REV 02  740-049388  1EDL62102PP  Power Supply AC
Jedec Code:  0x7fb0  EEPROM Version:  0x02
P/N:          740-049388  S/N:  1EDL62102PP
Assembly ID:  0x0483  Assembly Version:  01.02
Date:         05-25-2016  Assembly Flags:  0x00
Version:      REV 02  CLEI Code:  CMUPADNBAA
ID: QFX10000 AC  FRU Model Number:  QFX10000-Pwr-AC
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 83 01 02 52 45 56 20 30 32 00 00
  Address 0x10: 00 00 00 00 37 34 30 30 34 39 33 38 38 00 00
  Address 0x20: 31 45 44 4c 36 30 33 30 34 39 33 38 38 00 00
  Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 43 4d 55 50 41 44 44 4e 42 41 41 51
  Address 0x50: 46 58 31 30 30 30 30 30 50 57 52 2d 41 43 00 00
  Address 0x60: 00 00 00 00 00 00 01 30 30 30 30 30 30 50 57 52 2d 41 43 00 00
  Address 0x70: ff ff ff dc ff ff ff ff ff ff ff ff ff ff ff ff

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Chapter 41: Operational Commands

FTC 0      REV 14      750-050108     ACPE4038 Fan Controller 8
Jedec Code: 0x7fb0     EEPROM Version: 0x02
P/N: 750-050108     S/N: ACPE4038
Assembly ID: 0xObbe     Assembly Version: 01.14
Date: 09-27-2016     Assembly Flags: 0x00
Version: REV 14     CLEI Code: CMUCAHZCAA
ID: QFX10000 FTC     FRU Model Number: QFX10008-FAN-CTRL
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 ee 01 0e 52 45 56 20 31 34 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 35 30 31 30 38 00 00
Address 0x20: 53 2f 4e 20 41 43 50 44 36 37 39 39 00 1c 09 07
Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4d 55 43 41 48 5a 43 41 41 51
Address 0x50: 46 58 31 30 30 30 38 2d 46 41 4e 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: ff ff ff 98 ff ff ff ff ff ff ff ff ff ff ff ff

FTC 1      REV 14      750-050108     ACPE4032 Fan Controller 8
Jedec Code: 0x7fb0     EEPROM Version: 0x02
P/N: 750-050108     S/N: ACPE4032
Assembly ID: 0xObbe     Assembly Version: 01.14
Date: 09-27-2016     Assembly Flags: 0x00
Version: REV 14     CLEI Code: CMUCAHZCAA
ID: QFX10000 FTC     FRU Model Number: QFX10008-FAN-CTRL
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 ee 01 0e 52 45 56 20 31 34 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 35 30 31 30 38 00 00
Address 0x20: 53 2f 4e 20 41 43 50 44 36 37 39 39 00 1c 09 07
Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4d 55 43 41 48 5a 43 41 41 51
Address 0x50: 46 58 31 30 30 30 38 2d 46 41 4e 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: ff ff ff 98 ff ff ff ff ff ff ff ff ff ff ff ff

Fan Tray 0      REV 09      760-054372     ACPD6799 Fan Tray 8
Jedec Code: 0x7fb0     EEPROM Version: 0x02
P/N: 760-054372     S/N: ACPD6799
Assembly ID: 0xObf0     Assembly Version: 01.09
Date: 09-28-2016     Assembly Flags: 0x00
Version: REV 09     CLEI Code: CMUCAHYCAA
ID: QFX10008 FHB     FRU Model Number: QFX10008-FAN
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 f0 01 09 52 45 56 20 30 39 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 35 30 31 30 38 00 00
Address 0x20: 53 2f 4e 20 41 43 50 44 36 37 39 39 00 1c 09 07
Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4d 55 43 41 48 59 43 41 41 51
Address 0x50: 46 58 31 30 30 30 38 2d 46 41 4e 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: ff ff ff f1 ff ff ff ff ff ff ff ff ff ff ff ff

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</table>
| Fan Tray 1 | REV 09 | 760-054372 | ACNZ3584 | 0x0bf0 | 06-30-2016 | REV 09 | CMUCAHYCAA | QFX10008 FHB | QFX10008-FAN | Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff Address 0x00: 7f b0 02 ff 0b 00 00 00 00 37 36 30 32 30 35 34 33 37 32 00 00 Address 0x20: 53 2f 4e 20 41 43 4e 5a 33 35 38 34 00 01 08 07 Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff Address 0x40: ff ff ff ff 01 43 4d 55 43 41 48 59 43 41 41 51 Address 0x50: 46 58 31 30 30 30 38 2d 46 41 4e 00 00 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 ff ff ff ff ff ff ff ff ff ff ff ff ff | I2C Hex Data: 
| Fan Tray 8 | REV 09 | 760-054372 | ACNZ3584 | 0x0bf0 | 06-30-2016 | REV 09 | CMUCAHYCAA | QFX10008 FHB | QFX10008-FAN | Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff Address 0x00: 7f b0 02 ff 0b 00 00 00 00 37 36 30 32 30 35 34 33 37 32 00 00 Address 0x20: 53 2f 4e 20 41 43 4e 5a 33 35 38 34 00 01 08 07 Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff Address 0x40: ff ff ff ff 01 43 4d 55 43 41 48 59 43 41 41 51 Address 0x50: 46 58 31 30 30 30 38 2d 46 41 4e 00 00 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 ff ff ff ff ff ff ff ff ff ff ff ff ff | I2C Hex Data: 
| SIB 0 | REV 24 | 750-050058 | ACPD4587 | 0x0bec | 06-19-2016 | REV 24 | CMUCAH0CAA | QFX10008 SIB | QFX10008-SF | Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff Address 0x00: 7f b0 02 ff 0b ec 01 18 52 45 56 20 32 34 00 00 Address 0x10: 00 00 00 00 37 35 30 2d 30 35 30 35 38 30 00 00 Address 0x20: 53 2f 4e 20 41 43 50 44 34 35 38 37 00 13 06 07 Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff Address 0x40: ff ff ff ff 01 43 4d 55 43 41 48 59 43 41 41 51 Address 0x50: 46 58 31 30 30 30 38 2d 53 46 00 00 00 00 00 00 Address 0x60: 00 00 00 00 00 00 41 45 00 ff ff ff ff ff ff ff Address 0x70: ff ff ff ff 01 00 00 00 00 00 00 00 00 00 00 00 00 | I2C Hex Data: 
| SIB 1 | REV 24 | 750-050058 | ACNZ0635 | 0x0bec | 06-06-2016 | REV 24 | CMUCAH0CAA | QFX10008 SIB | QFX10008-SF | Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff Address 0x00: 7f b0 02 ff 0b ec 01 18 52 45 56 20 32 34 00 00 Address 0x10: 00 00 00 00 37 35 30 2d 30 35 30 35 38 30 00 00 Address 0x20: 53 2f 4e 20 41 43 50 44 34 35 38 37 00 13 06 07 Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff Address 0x40: ff ff ff ff 01 43 4d 55 43 41 48 59 43 41 41 51 Address 0x50: 46 58 31 30 30 30 38 2d 53 46 00 00 00 00 00 00 Address 0x60: 00 00 00 00 00 00 41 45 00 ff ff ff ff ff ff ff Address 0x70: ff ff ff ff 01 00 00 00 00 00 00 00 00 00 00 00 00 | I2C Hex Data: 
| SIB 2 | REV 24 | 750-050058 | ACPD4908 | 0x0bec | 07-12-2016 | REV 24 | CMUCAH0CAA | QFX10008 SIB | QFX10008-SF | Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff Address 0x00: 7f b0 02 ff 0b ec 01 18 52 45 56 20 32 34 00 00 Address 0x10: 00 00 00 00 37 35 30 2d 30 35 30 35 38 30 00 00 Address 0x20: 53 2f 4e 20 41 43 50 44 34 35 38 37 00 13 06 07 Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff Address 0x40: ff ff ff ff 01 43 4d 55 43 41 48 59 43 41 41 51 Address 0x50: 46 58 31 30 30 30 38 2d 53 46 00 00 00 00 00 00 Address 0x60: 00 00 00 00 00 00 41 45 00 ff ff ff ff ff ff ff Address 0x70: ff ff ff ff 01 00 00 00 00 00 00 00 00 00 00 00 00 | I2C Hex Data: 

Copyright ©2019, Juniper Networks, Inc.
ID: QFX10008 SIB                FRU Model Number: QFX10008-SF
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 0f 0b ec 01 18 52 45 56 20 32 34 00 00
  Address 0x10: 00 00 00 00 37 35 30 2d 30 35 30 35 38 00 00
  Address 0x20: 53 2f 4e 20 41 43 4e 5a 30 36 31 37 00 06 06 07
  Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 43 4d 55 43 41 48 30 43 41 41 51
  Address 0x50: 46 58 31 30 30 30 38 2d 53 46 00 00 00 00 00 00
  Address 0x60: 00 00 00 00 00 00 41 45 00 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff df 00 00 00 00 00 00 00 00 00 00 00 00
SIB 4            REV 24   750-050058   ACNZ0527          Switch Fabric 8
Jedec Code:   0x7fb0            EEPROM Version:    0x02
P/N:          750-050058        S/N:               ACNZ0527
Assembly ID:  0x0bec            Assembly Version:  01.24
Date:         06-06-2016        Assembly Flags:    0x00
Version:      REV 24            CLEI Code:         CMUCAH0C0A
ID: QFX10008 SIB                FRU Model Number: QFX10008-SF
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 0f 0b ec 01 17 52 45 56 20 32 33 00 00
  Address 0x10: 00 00 00 00 37 35 30 2d 30 35 30 35 38 00 00
  Address 0x20: 53 2f 4e 20 41 43 4e 5a 30 35 32 37 00 06 06 07
  Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 43 4d 55 43 41 48 30 43 41 41 51
  Address 0x50: 46 58 31 30 30 30 38 2d 53 46 00 00 00 00 00 00
  Address 0x60: 00 00 00 00 00 00 41 45 00 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff d1 00 00 00 00 00 00 00 00 00 00 00 00
SIB 5            REV 23   750-050058   ACNX6980          Switch Fabric 8
Jedec Code:   0x7fb0            EEPROM Version:    0x02
P/N:          750-050058        S/N:               ACNX6980
Assembly ID:  0x0bec            Assembly Version:  01.23
Date:         05-16-2016        Assembly Flags:    0x00
Version:      REV 23            CLEI Code:         CMUCAH0C0A
ID: QFX10008 SIB                FRU Model Number: QFX10008-SF
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 ec 01 17 52 45 56 20 32 33 00 00
  Address 0x10: 00 00 00 00 37 35 30 2d 30 35 30 35 38 00 00
  Address 0x20: 53 2f 4e 20 41 43 50 44 34 39 30 38 00 00 00 00
  Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 43 4d 55 43 41 48 30 43 41 41 51
  Address 0x50: 46 58 31 30 30 30 38 2d 53 46 00 00 00 00 00 00
  Address 0x60: 00 00 00 00 00 00 41 45 00 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff df 00 00 00 00 00 00 00 00 00 00 00 00
SIB 6            REV 23   750-050058   ACNZ6980          Switch Fabric 8
Jedec Code:   0x7fb0            EEPROM Version:    0x02
P/N:          750-050058        S/N:               ACNZ6980
Assembly ID:  0x0bec            Assembly Version:  01.23
Date:         05-16-2016        Assembly Flags:    0x00
Version:      REV 23            CLEI Code:         CMUCAH0C0A
ID: QFX10008 SIB                FRU Model Number: QFX10008-SF
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 ec 01 17 52 45 56 20 32 33 00 00
  Address 0x10: 00 00 00 00 37 35 30 2d 30 35 30 35 38 00 00
  Address 0x20: 53 2f 4e 20 41 43 50 44 34 39 30 38 00 00 00 00
  Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff 01 43 4d 55 43 41 48 30 43 41 41 51
  Address 0x50: 46 58 31 30 30 30 38 2d 53 46 00 00 00 00 00 00
  Address 0x60: 00 00 00 00 00 00 41 45 00 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff df 00 00 00 00 00 00 00 00 00 00 00 00

---

Chapter 41: Operational Commands
show chassis hardware extensive (PTX10016 Router)

user@host> show chassis hardware extensive

Hardware inventory:

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<th>Item</th>
<th>Version</th>
<th>Part number</th>
<th>Serial number</th>
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Board Information Record:

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<td>Address 0x30:</td>
<td>e1 ff ff ff ad 01 10 00 44 aa 50 ab 1b b6 ff</td>
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<td>Address 0x40:</td>
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<td>Address 0x50:</td>
<td>46 48 39 39 35 00 00 00 00 00 00 00 00 00 00</td>
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<td>Address 0x60:</td>
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<td>Address 0x70:</td>
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Routing Engine 0

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<th>Description</th>
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<td>Virtio Block Disk</td>
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<td>ada0 128 MB QEMU</td>
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<td>QEMU</td>
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<td>usb0 (addr 0.1)</td>
<td>Intel</td>
<td>uhub0</td>
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<td>usb1 (addr 0.2)</td>
<td>vendor 0x8087</td>
<td>uhub1</td>
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Routing Engine 1

<table>
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<tr>
<th>Device</th>
<th>Type</th>
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<td>vtbd0 15360 MB</td>
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<td>ada0 128 MB QEMU</td>
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**Board Information Record:**
- Address 0x00: ad 01 00 10 e8 b6 c2 46 aa 29 ff ff ff ff ff ff
- I2C Hex Data:
  - Address 0x00: 7f b0 02 ff 0b 9d 01 03 52 45 56 20 30 33 30 00 00
  - Address 0x10: 00 00 00 00 37 35 30 2d 30 36 38 38 32 30 00 00
  - Address 0x20: 53 2f 4e 20 41 43 50 4c 37 32 33 30 00 0f 03 07
  - Address 0x30: e1 ff ff ff 0a 00 10 e8 b6 c2 46 aa 29 ff ff
  - Address 0x40: ff ff ff ff 01 41 43 50 4d 43 45 43 45 34 34 34 34
  - Address 0x50: 46 58 31 30 30 30 30 2d 52 45 00 00 00 00 00 00
  - Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

**FPC 1**
- P/N: 750-077140
- Date: 10-17-2016
- Version: REV 36
- ID: ULC-36Q-12Q28
- FRU Model Number: QFX10000-36Q

**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 9d 01 03 52 45 56 20 30 33 30 00 00
  - Address 0x10: 00 00 00 00 37 35 30 2d 30 36 38 38 32 30 00 00
  - Address 0x20: 53 2f 4e 20 41 43 50 4c 37 32 33 30 00 0f 03 07
  - Address 0x30: e1 ff ff ff ad 01 00 10 e8 b6 c2 46 99 b9 ff ff
  - Address 0x40: ff ff ff ff 01 41 43 50 55 43 45 48 33 43 54 42 51
  - Address 0x50: 46 58 31 30 30 30 30 2d 52 45 00 00 00 00 00 00
  - Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

**CPU**
- P/N: BUILTIN
- FRU Model Number: QFX10000-36Q

**FPC CPU**
- P/N: BUILTIN
- FRU Model Number: BUILTIN
Ethernet Interfaces Feature Guide for Routing Devices

Assembly ID: 0xf020      Assembly Version: 02.17
Date: 04-19-2012        Assembly Flags: 0x00

Board Information Record:
Address 0x00: ad 01 01 04 ac 4b c8 1d f7 b6 ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff f0 20 02 11 00 40 36 bd 09 40 25 32
Address 0x10: 09 e8 ba ff 4f 54 49 44 4e 00 25 73 3a 20
Address 0x20: 42 55 49 4c 54 49 4e 00 01 07 52 45 56 00 25 73 3a 20
Address 0x30: dc ff ff ff ff ad 01 01 04 ac 4b c8 1d f7 b6 ff ff
Address 0x40: ff ff ff ff 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: ff ff ff f3 50 36 36 36 36 00 00 00 00 00 00 00 00 00

Jedec Code: 0x7fb0      EEPROM Version: 0x02
P/N: BUILTIN           S/N: BUILTIN
Assembly ID: 0xf050      Assembly Version: 02.17
Date: 04-19-2012        Assembly Flags: 0x00

Board Information Record:
Address 0x00: ad 01 01 04 ac 4b c8 1d f7 b6 ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff f0 20 02 11 00 40 36 bd 09 40 25 32
Address 0x10: 09 e8 ba ff 4f 54 49 44 4e 00 25 73 3a 20
Address 0x20: 42 55 49 4c 54 49 4e 00 01 07 52 45 56 00 25 73 3a 20
Address 0x30: dc ff ff ff ff ad 01 01 04 ac 4b c8 1d f7 b6 ff ff
Address 0x40: ff ff ff ff 01 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: ff ff ff ff f3 50 36 36 36 36 00 00 00 00 00 00 00 00 00

CPU                     BUILTIN      BUILTIN           FPC CPU
Jedec Code: 0x7fb0      EEPROM Version: 0x02
P/N: BUILTIN           S/N: BUILTIN
Assembly ID: 0xf020      Assembly Version: 02.17
Date: 04-19-2012        Assembly Flags: 0x00

Board Information Record:
Address 0x00: ad 01 01 04 ac 4b c8 1d f7 b6 ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff f0 20 02 11 00 60 b6 be 09 c0 cf 38
Table of Contents
Chapter 41: Operational Commands

Jedec Code: 0x7fb0
EEPROM Version: 0x02
P/N: 750-068822
S/N: ACPD6501
Assembly ID: 0x0be7
Assembly Version: 01.13
Date: 06-29-2017
Assembly Flags: 0x00
Version: REV 13
CLEI Code: CMUIAM9BAC
ID: ULC-36Q-12Q28
FRU Model Number: QFX10000-36Q
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 f0 50 02 11 00 00 00 00 07 0a 20 45
Address 0x10: 00 00 00 00 37 35 30 2d 30 36 38 32 32 00 00
Address 0x20: 53 2f 4e 20 41 4c 46 45 30 31 00 1d 06 07
Address 0x30: f6 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: 46 58 31 30 30 30 30 2d 36 51 00 00 00 00 00
Address 0x50: 00 00 00 00 00 00 43 41 00 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x70: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
CPU: BUILTIN

Jedec Code: 0x7fb0
EEPROM Version: 0x02
P/N: BUILTIN
S/N: BUILTIN
Assembly ID: 0xf020
Assembly Version: 02.17
Date: 04-19-2012
Assembly Flags: 0x00
Board Information Record:
Address 0x00: ad 01 01 04 ac 4b c8 1d f7 b6 ff ff ff ff ff ff
I2C Hex Data:
Address 0x00: 7f b0 02 ff f0 20 02 11 00 c0 06 0c 09 c0 ca 40
Address 0x10: 09 e8 ba ff 42 55 49 4c 54 49 4e 00 42 55 49 4c 00 13 04 07
Address 0x20: 42 55 49 4c 54 49 4e 00 42 55 49 4c 00 13 04 07
Address 0x30: dc ff ff ff ad 01 01 04 ac 4b c8 1d f7 b6 ff ff
Address 0x40: ff ff ff ff 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 00 00 00 00
Address 0x60: 00 00 00 00 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 00 00 00 00

CPU: BUILTIN

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Address 0x060: 00 00 00 00 00 00 45 00 00 ff ff ff ff ff ff
Address 0x070: ff ff ff f3 50 36 36 36 00 00 00 00 00 00 00
PIC 0 BUILTIN BUILTIN 12x100GE/36x40GE/144x10GE

Jedec Code: 0x7fb0 EEPROM Version: 0x02
P/N: BUILTIN S/N: BUILTIN
Assembly ID: 0xf050 Assembly Version: 02.17
Date: 04-19-2012 Assembly Flags: 0x00

Board Information Record:
Address 0x000: ad 01 01 04 ac 4b c8 1d f7 b6 ff ff ff ff ff
I2C Hex Data:
Address 0x000: 7f b0 02 ff f0 50 02 11 00 00 00 07 0a 20 45
Address 0x010: 6c 61 70 73 42 55 49 4c 54 49 4e 00 25 73 3a 20
Address 0x020: 42 55 49 4c 54 49 4e 00 25 73 3a 20 00 13 04 07
Address 0x030: dc ff ff ff ad 01 01 04 ac 4b c8 1d f7 b6 ff ff
Address 0x040: ff ff ff ff 01 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x050: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x060: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x070: ff ff ff ff f3 55 55 55 55 55 55 55 55 55 55 55 55 55 55
Xcvr 1 REV 01 740-058734 1ECQ11381LA QSFP-100GBASE-SR4
Xcvr 2 REV 01 740-043308 UWH141S QSFP+-40G-LR4
Xcvr 3 REV 01 740-043308 UWE2CG9 QSFP+-40G-LR4
FPC 6 REV 37 750-077140 ACNS2793 LC1102 - 12C / 36Q / 144X

Jedec Code: 0x7fb0 EEPROM Version: 0x02
P/N: 750-077140 S/N: ACNS2793
Assembly ID: 0x0be7 Assembly Version: 01.37
Date: 03-25-2017 Assembly Flags: 0x00
Version: REV 37 CLEI Code: CMUIAM9BAA
ID: ULC-36Q-12Q28 FRU Model Number: QFX10000-36Q
Board Information Record:
Address 0x000: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
I2C Hex Data:
Address 0x000: 7f b0 02 ff 0b e7 01 25 52 45 56 20 33 37 00 00
Address 0x010: 00 00 00 00 37 35 30 2d 30 37 37 31 34 30 00 00
Address 0x020: 53 2f 4e 20 41 43 4e 53 32 37 39 33 00 19 03 07
Address 0x030: e1 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x040: ff ff ff ff 01 43 4d 55 49 41 4d 39 42 41 51 51
Address 0x050: 46 58 31 30 30 30 2d 33 36 51 00 00 00 00 00
Address 0x060: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x070: ff ff ff fe ff ff ff ff ff ff ff ff ff ff ff ff
CPU BUILTIN BUILTIN FPC CPU
Jedec Code: 0x7fb0 EEPROM Version: 0x02
P/N: BUILTIN S/N: BUILTIN
Assembly ID: 0xf020 Assembly Version: 02.17
Date: 04-19-2012 Assembly Flags: 0x00
Board Information Record:
Address 0x000: ad 01 01 04 ac 4b c8 1d f7 b6 ff ff ff ff ff
I2C Hex Data:
Address 0x000: 7f b0 02 ff f0 20 02 11 00 a0 e6 d4 09 00 bd 43
Address 0x010: 09 e8 ba ff 42 55 49 4c 54 49 4e 00 00 a0 e6 d4
Address 0x020: 42 55 49 4c 54 49 4e 00 42 55 49 4c 00 13 04 07
Address 0x030: dc ff ff ff ad 01 01 04 ac 4b c8 1d f7 b6 ff ff
Address 0x040: ff ff ff ff 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x050: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x060: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x070: ff ff ff ff f3 50 36 36 36 00 00 00 00 00 00 00 00
PIC 0 BUILTIN BUILTIN 12x100GE/36x40GE/144x10GE

Jedec Code: 0x7fb0 EEPROM Version: 0x02
### I2C Hex Data:

| Address 0x00: | 7f b0 02 ff f0 50 02 11 00 00 00 07 0a 20 45 |
| Address 0x10: | 6c 61 70 73 42 55 49 4c 54 49 4e 00 25 73 3a 20 |
| Address 0x20: | 6c 61 70 73 42 55 49 4c 54 49 4e 00 25 73 3a 20 |
| Address 0x30: | dc ff ff ff ff ad 01 01 04 ac 4b c8 1d f7 b6 ff ff |
| Address 0x40: | ff ff ff ff ff 00 00 00 00 00 00 00 00 00 00 00 00 00 |
| Address 0x50: | ff ff ff ff 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |
| Address 0x60: | ff ff ff ff 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |
| Address 0x70: | ff ff ff ff f3 ff ff ff ff ff ff ff ff ff ff ff ff ff |

### Xcvr 1
- REV 01
- 740-058732
- 1AMQA14206D
- QSFP-100GBASE-LR4

### Xcvr 10
- REV 01
- 740-032986
- QF4301KB
- QSFP+-40G-SR4

### Xcvr 24
- REV 01
- 740-054050
- INFAJ0492244
- QSFP+-4X10G-LR

### FPC 9
- REV 35
- 750-071976
- ACPD3055
- LC1101 - 30C / 30Q / 96X

### CPU
- BUILTIN

### PIC 0
- BUILTIN

### Xcvr 1       REV 01   740-058732   1AMQA14206D       QSFP-100GBASE-LR4

### Xcvr 10      REV 01   740-032986   QF4301KB          QSFP+-40G-SR4

### Xcvr 24      REV 01   740-054050   INFAJ0492244      QSFP+-4X10G-LR

### FPC 9            REV 35   750-071976   ACPD3055          LC1101 - 30C / 30Q / 96X

### Jede Code:   0x7fb0            EEPROM Version:    0x02
### P/N:          750-071976        S/N:               ACPD3055
### Assembly ID:  0x0be8            Assembly Version:  01.35
### Date:         05-26-2016        Assembly Flags:    0x00
### Version:      REV 35            CLEI Code:         CMUIANABAA
### ID: ULC-30Q28                   FRU Model Number:  JNP10K-LC1101

### Board Information Record:

| Address 0x00: | ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff |

### CPU                     BUILTIN      BUILTIN           FPC CPU

### Jede Code:   0x7fb0            EEPROM Version:    0x02
### P/N:          BUILTIN           S/N:               BUILTIN
### Assembly ID:  0xf020            Assembly Version:  02.17
### Date:         04-19-2012        Assembly Flags:    0x00
### Board Information Record:

| Address 0x00: | ad 01 01 04 ac 4b c8 1d f7 b6 ff ff ff ff ff ff ff |

### PIC 0
- BUILTIN

### Jede Code:   0x7fb0            EEPROM Version:    0x02
### P/N:          BUILTIN           S/N:               BUILTIN
### Assembly ID:  0xf050            Assembly Version:  02.17
### Date:         04-19-2012        Assembly Flags:    0x00
### Board Information Record:

| Address 0x00: | ad 01 01 04 ac 4b c8 1d f7 b6 ff ff ff ff ff ff ff |

### PIC 0
- BUILTIN

### Jede Code:   0x7fb0            EEPROM Version:    0x02
### P/N:          BUILTIN           S/N:               BUILTIN
### Assembly ID:  0xf050            Assembly Version:  02.17
### Date:         04-19-2012        Assembly Flags:    0x00
### Board Information Record:

| Address 0x00: | ad 01 01 04 ac 4b c8 1d f7 b6 ff ff ff ff ff ff ff |

### PIC 0
- BUILTIN

### Jede Code:   0x7fb0            EEPROM Version:    0x02
### P/N:          BUILTIN           S/N:               BUILTIN
### Assembly ID:  0xf050            Assembly Version:  02.17
### Date:         04-19-2012        Assembly Flags:    0x00
### Board Information Record:

| Address 0x00: | ad 01 01 04 ac 4b c8 1d f7 b6 ff ff ff ff ff ff ff |

### PIC 0
- BUILTIN

### Jede Code:   0x7fb0            EEPROM Version:    0x02
### P/N:          BUILTIN           S/N:               BUILTIN
### Assembly ID:  0xf050            Assembly Version:  02.17
### Date:         04-19-2012        Assembly Flags:    0x00
### Board Information Record:

| Address 0x00: | ad 01 01 04 ac 4b c8 1d f7 b6 ff ff ff ff ff ff ff |

### PIC 0
- BUILTIN

### Jede Code:   0x7fb0            EEPROM Version:    0x02
### P/N:          BUILTIN           S/N:               BUILTIN
### Assembly ID:  0xf050            Assembly Version:  02.17
### Date:         04-19-2012        Assembly Flags:    0x00
### Board Information Record:

| Address 0x00: | ad 01 01 04 ac 4b c8 1d f7 b6 ff ff ff ff ff ff ff |
Ethernet Interfaces Feature Guide for Routing Devices

Power Supply 3  REV 02  740-049388  1EDL702004E  Power Supply AC
Jedec Code:  0x7fb0  EEPROM Version:  0x02
P/N:  740-049388  S/N:  1EDL702004E
Assembly ID:  0x0483  Assembly Version:  01.02
Date:  01-18-2017  Assembly Flags:  0x00
Version:  REV 02  CLEI Code:  CMUPADNBAA
ID:  QFX10000 AC  FRU Model Number:  QFX10000-Pwr-AC
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 83 01 02 52 45 56 20 30 32 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 34 39 33 38 00 00
Address 0x20: 31 45 44 4c 37 30 32 30 34 45 00 00 13 06 07
Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4d 55 50 41 44 4e 42 41 41 51
Address 0x50: 46 58 31 30 30 30 30 2d 50 57 52 2d 41 43 00 00
Address 0x60: 00 00 00 00 00 00 01 30 31 3f ff ff ff ff ff ff ff
Address 0x70: ff ff ff dc ff ff ff ff ff ff ff ff ff ff ff ff

Power Supply 4  REV 02  740-049388  1EDL625039D  Power Supply AC
Jedec Code:  0x7fb0  EEPROM Version:  0x02
P/N:  740-049388  S/N:  1EDL625039D
Assembly ID:  0x0483  Assembly Version:  01.02
Date:  06-19-2016  Assembly Flags:  0x00
Version:  REV 02  CLEI Code:  CMUPADNBAA
ID:  QFX10000 AC  FRU Model Number:  QFX10000-Pwr-AC
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 83 01 02 52 45 56 20 30 32 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 34 39 33 38 00 00
Address 0x20: 31 45 44 4c 36 33 37 30 36 4a 44 00 00 09 07
Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4d 55 50 41 44 4e 42 41 41 51
Address 0x50: 46 58 31 30 30 30 30 2d 50 57 52 2d 41 43 00 00
Address 0x60: 00 00 00 00 00 00 01 30 31 3f ff ff ff ff ff ff
Address 0x70: ff ff ff dc ff ff ff ff ff ff ff ff ff ff ff ff

Power Supply 5  REV 02  740-049388  1EDL63706JD  Power Supply AC
Jedec Code:  0x7fb0  EEPROM Version:  0x02
P/N:  740-049388  S/N:  1EDL63706JD
Assembly ID:  0x0483  Assembly Version:  01.02
Date:  09-13-2016  Assembly Flags:  0x00
Version:  REV 02  CLEI Code:  CMUPADNBAA
ID:  QFX10000 AC  FRU Model Number:  QFX10000-Pwr-AC
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 83 01 02 52 45 56 20 30 32 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 34 39 33 38 00 00
Address 0x20: 31 45 44 4c 36 33 37 30 36 4a 44 00 00 09 07
Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4d 55 50 41 44 4e 42 41 41 51
Address 0x50: 46 58 31 30 30 30 30 2d 50 57 52 2d 41 43 00 00
Address 0x60: 00 00 00 00 00 00 01 30 31 3f ff ff ff ff ff ff
Address 0x70: ff ff ff dc ff ff ff ff ff ff ff ff ff ff ff ff
### Power Supply 6   REV 02   740-049388   1EDL63706JH   Power Supply AC

- **Jedec Code:** 0x7fb0
- **EEPROM Version:** 0x02
- **P/N:** 740-049388
- **S/N:** 1EDL63706JH
- **Assembly ID:** 0x0483
- **Assembly Version:** 01.02
- **Date:** 09-13-2016
- **Assembly Flags:** 0x00
- **Version:** REV 02
- **CLEI Code:** CMUPADNBA
- **ID:** QFX10000 AC
- **FRU Model Number:** QFX10000-Pwr-AC

**Board Information Record:**

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**I2C Hex Data:**

- **Address 0x00:** 7f b0 02 ff 04 83 01 02 52 45 56 20 30 32 00 00
- **Address 0x10:** 31 45 44 4c 36 33 37 30 36 4a 48 00 00 0d 09 07
- **Address 0x20:** 0x00 00 00 00 37 34 30 2d 30 34 39 33 38 38 00 00
- **Address 0x30:** 01 43 44 4e 45 56 20 30 32 0d 50 57 32 2d 41 43 00 00
- **Address 0x40:** 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
- **Address 0x50:** 46 58 31 30 30 30 30 2d 50 57 32 2d 41 43 00 00
- **Address 0x60:** 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

### FTC 0   REV 10   750-050309   ACPM2918   Fan Controller 16

- **Jedec Code:** 0x7fb0
- **EEPROM Version:** 0x02
- **P/N:** 750-050309
- **S/N:** ACPM2918
- **Assembly ID:** 0x0b9c
- **Assembly Version:** 01.10
- **Date:** 01-13-2017
- **Assembly Flags:** 0x00
- **Version:** REV 10
- **CLEI Code:** CMUCAH5CA
- **ID:** QFX10016 FTC
- **FRU Model Number:** QFX10016-FAN-CTRL

**Board Information Record:**

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**I2C Hex Data:**

- **Address 0x00:** 7f b0 02 ff 0b 9c 01 0a 52 45 56 20 31 30 00 00
- **Address 0x10:** 37 35 30 2d 30 35 30 33 30 39 30 00 00
- **Address 0x20:** 53 2f 4e 20 41 43 50 32 39 31 38 00 0d 01 07
- **Address 0x30:** 01 43 44 4e 45 56 35 43 41 48 35 43 41 51
- **Address 0x40:** 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
- **Address 0x50:** 46 58 31 30 30 30 30 2d 46 41 4e 2d 43 54 52 4c
- **Address 0x60:** 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

### FTC 1   REV 10   750-050309   ACPE8185   Fan Controller 16

- **Jedec Code:** 0x7fb0
- **EEPROM Version:** 0x02
- **P/N:** 750-050309
- **S/N:** ACPE8185
- **Assembly ID:** 0x0b9c
- **Assembly Version:** 01.10
- **Date:** 12-22-2016
- **Assembly Flags:** 0x00
- **Version:** REV 10
- **CLEI Code:** CMUCAH5CA
- **ID:** QFX10016 FTC
- **FRU Model Number:** QFX10016-FAN-CTRL

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**I2C Hex Data:**

- **Address 0x00:** 7f b0 02 ff 0b 9c 01 0a 52 45 56 20 31 30 00 00
- **Address 0x10:** 00 00 00 00 37 35 30 2d 30 35 30 33 30 39 30 00
- **Address 0x20:** 53 2f 4e 20 41 43 50 32 39 31 38 00 0d 01 07
- **Address 0x30:** 01 43 44 4e 45 56 35 43 41 48 35 43 41 51
- **Address 0x40:** 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
- **Address 0x50:** 46 58 31 30 30 30 30 2d 46 41 4e 2d 43 54 52 4c
- **Address 0x60:** 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

### Fan Tray 0   REV 10   760-077141   ACPV7288   Fan Tray 16

- **Jedec Code:** 0x7fb0
- **EEPROM Version:** 0x02
- **P/N:** 760-077141
- **S/N:** ACPV7288
- **Assembly ID:** 0x0bf1
- **Assembly Version:** 01.10
- **Date:** 06-07-2017
- **Assembly Flags:** 0x00
- **Version:** REV 10
- **CLEI Code:** CMUCAH4CA
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Address 0x20: 53 2f 4e 20 41 43 50 4d 32 38 30 00 15 0c 07
Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4d 32 38 30 00 15 0c 07
Address 0x50: 46 58 31 30 30 31 36 2d 53 46 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 41 42 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff d3 00 00 00 00 00 00 00 00 00 00 00 00
SIB 2            REV 15   750-058270   ACPL4450          Switch Fabric 16
Jedec Code:   0x7fb0            EEPROM Version:    0x02
P/N:          750-058270        S/N:               ACPL4450
Assembly ID:  0x0bed            Assembly Version:  01.15
Date:         02-17-2017        Assembly Flags:    0x00
Version:      REV 15            CLEI Code:         CMUCAH6CAA
ID: QFX10016 SIB                FRU Model Number:  QFX10016-SF
Board Information Record:
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I2C Hex Data:
Address 0x00: 7f b0 02 ff 0b ed 01 0f 52 45 35 30 20 31 35 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 35 38 32 37 00 00
Address 0x20: 53 2f 4e 20 41 43 40 3a 98 34 00 11 0c 07
Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4d 55 43 41 48 36 43 41 41 51
Address 0x50: 46 58 31 30 30 31 36 2d 53 46 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 41 42 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff d3 00 00 00 00 00 00 00 00 00 00 00 00
SIB 3            REV 15   750-058270   ACPJ9834          Switch Fabric 16
Jedec Code:   0x7fb0            EEPROM Version:    0x02
P/N:          750-058270        S/N:               ACPJ9834
Assembly ID:  0x0bed            Assembly Version:  01.15
Date:         12-17-2016        Assembly Flags:    0x00
Version:      REV 15            CLEI Code:         CMUCAH6CAA
ID: QFX10016 SIB                FRU Model Number:  QFX10016-SF
Board Information Record:
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I2C Hex Data:
Address 0x00: 7f b0 02 ff 0b ed 01 0f 52 45 35 30 20 31 35 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 35 38 32 37 30 00
Address 0x20: 53 2f 4e 20 41 43 50 4a 39 38 33 34 00 11 0c 07
Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4d 55 43 41 48 36 43 41 41 51
Address 0x50: 46 58 31 30 30 31 36 2d 53 46 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 41 42 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff d3 00 00 00 00 00 00 00 00 00 00 00 00
SIB 4            REV 15   750-058270   ACPM2814          Switch Fabric 16
Jedec Code:   0x7fb0            EEPROM Version:    0x02
P/N:          750-058270        S/N:               ACPM2814
Assembly ID:  0x0bed            Assembly Version:  01.15
Date:         12-21-2016        Assembly Flags:    0x00
Version:      REV 15            CLEI Code:         CMUCAH6CAA
ID: QFX10016 SIB                FRU Model Number:  QFX10016-SF
Board Information Record:
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I2C Hex Data:
Address 0x00: 7f b0 02 ff 0b ed 01 0f 52 45 35 30 20 31 35 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 35 38 32 37 30 00
Address 0x20: 53 2f 4e 20 41 43 50 32 81 34 00 15 0c 07
Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4d 55 43 41 48 36 43 41 41 51
Address 0x50: 46 58 31 30 30 31 36 2d 53 46 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 41 42 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff d3 00 00 00 00 00 00 00 00 00 00 00 00
show chassis hardware models (MX104 Router)

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user@host> show chassis hardware models
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<td>711-049570</td>
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show chassis hardware models (PTX10008 Router)

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user@host> show chassis hardware models
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**show chassis hardware models (PTX10016 Router)**

```plaintext
user@host> show chassis hardware models

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Copyright © 2019, Juniper Networks, Inc.
### show chassis hardware clei-models (MX104 Router)

```
user@host> show chassis hardware clei-models

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### show chassis hardware (MX240 Router)

```
user@host> show chassis hardware

Hardware inventory:

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**show chassis hardware detail (MX 240 Router with Routing Engine Displaying DIMM Information)**

```
user@host> show chassis hardware detail

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**show chassis hardware (MX240 Router with Enhanced MX SCB)**

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user@host> show chassis hardware

Hardware inventory:

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<th>Description</th>
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<td>JS4642</td>
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Chapter 41: Operational Commands

---

**Copyright © 2019, Juniper Networks, Inc.**
show chassis hardware (MX480 Router)

```
user@host> show chassis hardware

Hardware inventory:

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<tr>
<th>Item</th>
<th>Version</th>
<th>Part number</th>
<th>Serial number</th>
<th>Description</th>
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user@host> show chassis hardware

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### show chassis hardware (MX480 Routers with MPC5E and Built-In OTN PIC)

```txt
user@host> show chassis hardware

Hardware inventory:

<table>
<thead>
<tr>
<th>Item</th>
<th>Version</th>
<th>Part number</th>
<th>Serial number</th>
<th>Description</th>
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<tr>
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<tr>
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<td>QCS1314U0FJ</td>
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</tr>
<tr>
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</tr>
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</tr>
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| 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 | AHNOW85 | SFP+-10G-SR |
| PIC 1  | REV 01 | 740-031980 | B11J03627 | SFP+-10G-SR |
| Xcvr 0 | REV 01 | 740-031980 | AQ42WSS | SFP+-10G-SR |
| Xcvr 3 | REV 01 | 740-031980 | AHN0WR5 | SFP+-10G-SR |
| PIC 3  | REV 01 | 740-031980 | AQ43HGC | SFP+-10G-SR |
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| Xcvr 2 | REV 01 | 740-031980 | AHN0WR5 | SFP+-10G-SR |
| PIC 2  | REV 01 | 740-031980 | AHN0WR5 | SFP+-10G-SR |
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| Xcvr 1 | REV 01 | 740-031980 | B11J03627 | SFP+-10G-SR |
| Xcvr 2 | REV 01 | 740-031980 | B11J03627 | SFP+-10G-SR |
| Xcvr 3 | REV 01 | 740-031980 | B11J03627 | SFP+-10G-SR |
show chassis hardware detail (MX480 Routers with MPC5E and Built-In OTN PIC)

user@host> show chassis hardware detail

Hardware inventory:

<table>
<thead>
<tr>
<th>Item</th>
<th>Version</th>
<th>Part number</th>
<th>Serial number</th>
<th>Description</th>
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</thead>
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show chassis hardware extensive (MX480 Routers with MPC5E and Built-In OTN PIC)

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Ethernet Interfaces Feature Guide for Routing Devices

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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
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AC in
Jedec Code: 0x7fb0  EEPROM Version: 0x01
P/N: 740-029970  S/N: QCS1114U0FJ
Assembly ID: 0x0432  Assembly Version: 01.10
Date: 04-04-2013  Assembly Flags: 0x00
Version: Rev 10
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Date: 11-01-2011  Assembly Flags: 0x00
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show chassis hardware (MX960 Router)

user@host> show chassis hardware

Hardware inventory:

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### show chassis hardware (MX960 Router with Bidirectional Optics)

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### show chassis hardware (MX960 Router with Enhanced MX SCB)

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show chassis hardware models (MX960 Router with Enhanced MX SCB)

```
user@host> show chassis hardware models

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## Chapter 41: Operational Commands
**show chassis hardware detail (MX960 Router)**

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user@host> show chassis hardware detail

Hardware inventory:

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show chassis hardware extensive (MX960 Router with MPC5EQ)

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user@host>  show chassis hardware extensive

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Midplane         REV 01   710-030012   ACAX3674          MX960 Backplane

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| 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  |             |               |                              |
| ID:                | MX960 Backplane |       |               |                              |

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  - Address 0x10: 00 00 00 00 37 31 30 2d 30 33 30 31 31 32 00 00
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  - Address 0x40: ff ff ff ff ff 01 43 4f 4d 38 34 35 30 30 30 30 43 52 42 43
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FPM Board        REV 03   710-014974   CAAZ9326          Front Panel Display

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| S/N:               | CAAZ9326 |           |               |                              |
| Assembly ID:       | 0x01a6  |             |               |                              |
| Assembly Version:  | 01.03   |             |               |                              |
| Date:              | 12-31-2012 |           |               |                              |
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| Version:           | REV 03  |             |               |                              |
| ID:                | Front Panel Display | |               |                              |

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  - 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 00 00 00
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  - Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
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PDM              Rev 03   740-013110   QCS17025017       Power Distribution Module

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#### I2C Hex Data:

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<tr>
<th>Address 0x00</th>
<th>7f b0 01 ff 04 16 01 03 52 65 76 20 30 33 00 00</th>
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<tr>
<td>Address 0x10</td>
<td>00 00 00 00 37 34 30 2d 30 31 33 31 31 30 00 00</td>
</tr>
<tr>
<td>Address 0x20</td>
<td>51 43 53 31 37 30 32 35 30 31 37 00 00 0a 01 07</td>
</tr>
<tr>
<td>Address 0x30</td>
<td>dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff f</td>
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<tr>
<td>Address 0x40</td>
<td>ff 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00</td>
</tr>
<tr>
<td>Address 0x50</td>
<td>00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00</td>
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<td>Address 0x60</td>
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### PEM 0

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<th>740-027760</th>
<th>QCS1702N062</th>
<th>PS 4.1kW; 200-240V AC</th>
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#### Jecde 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

#### FRU Model Number: PWR-MX960-4100-AC-S

#### Board Information Record:

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#### I2C Hex Data:

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<th>Address 0x00</th>
<th>7f b0 01 ff 04 30 01 0a 52 65 76 20 31 30 30 00</th>
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<tbody>
<tr>
<td>Address 0x10</td>
<td>00 00 00 00 37 34 30 2d 30 32 37 37 36 30 00 00</td>
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<td>Address 0x20</td>
<td>51 43 53 31 37 30 32 34 36 32 00 00 00 0f 01 07</td>
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<td>Address 0x30</td>
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<td>Address 0x40</td>
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<td>Address 0x50</td>
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<td>Address 0x60</td>
<td>00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00</td>
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#### Jecde 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

#### FRU Model Number: PWR-MX960-4100-AC-S

#### Board Information Record:

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#### I2C Hex Data:

<table>
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<tr>
<th>Address 0x00</th>
<th>7f b0 01 ff 04 30 01 0a 52 65 76 20 31 30 30 00</th>
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<tbody>
<tr>
<td>Address 0x10</td>
<td>00 00 00 00 37 34 30 2d 30 32 37 37 36 30 00 00</td>
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<td>51 43 53 31 37 30 32 34 36 32 00 00 00 0f 01 07</td>
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<td>Address 0x50</td>
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<td>Address 0x60</td>
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<th>QCS1614N01X</th>
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#### Jecde 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
| Address 0x00: | ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff |
| Address 0x10: | 00 00 00 00 37 35 30 2d 30 34 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 c2 ff ff ff ff ff ff ff ff ff ff ff |
| CPU          | REV 09 711-045719 CACG8908 RMPC PMB |
| Jede Code:   | 0x7fb0 |
| P/N:         | 711-045719 |
| S/N:         | CACG8908 |
| Assembly ID: | 0x0b85 |
| Assembly Version: | 01.09 |
| Date:        | 11-13-2013 |
| Version:     | REV 09 |
| ID:          | RMPC PMB |

| Address 0x00: | ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff |
| 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 ff ff ff ff ff ff ff ff ff ff ff |
| PIC 0        | BUILTIN BUILTIN 2X100GE SFPP OTN |
| Jede Code:   | 0x0000 |
| P/N:         | BUILTIN |
| S/N:         | BUILTIN |
| Assembly ID: | 0x0a90 |
| Assembly Version: | 00.00 |
| Date:        | 00-00-0000 |
| Assembly Flags: | 0x00 |
| ID:          | 2X100GE SFPP OTN |

| Address 0x00: | ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff |
| Address 0x10: | 00 00 00 00 42 55 49 4c 54 45 54 4f 58 43 4c 45 49 50 |
| CPU          | REV 01 740-021308 AQAODYT SFP+-10G-SR |
| Jede Code:   | 0x0000 |
| P/N:         | BUILTIN |
| S/N:         | BUILTIN |
| Assembly ID: | 0x0a6e |
| Assembly Version: | 00.00 |
| Date:        | 00-00-0000 |
| Assembly Flags: | 0x00 |
| ID:          | 1X100GE CFP2 OTN |

| Address 0x00: | ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff |
| Address 0x10: | 00 00 00 00 0a 90 00 00 00 00 00 00 00 00 00 00 00 00 |
| Address 0x20: | 42 55 49 4c 54 45 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 00 00 |
| Address 0x40: | 00 00 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 00 00 |
| Address 0x60: | 00 00 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 00 00 |

| Xcrr 0       | REV 01 740-021308 AQAODYT SFP+-10G-SR |
| Xcrr 1       | REV 01 740-021308 AQCOM57 SFP+-10G-SR |
| PIC 1        | BUILTIN BUILTIN 1X100GE CFP2 OTN |

| Address 0x00: | ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff |
| Address 0x10: | 00 00 00 00 0a 6e 00 00 00 00 00 00 00 00 00 00 00 00 |
| Address 0x20: | 42 55 49 4c 54 45 49 4e 00 25 73 3a 20 00 00 00 00 |

Copyright © 2019, Juniper Networks, Inc.
| 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 CF2P-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: 0.00  
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 ANA0NAJ SFP+-10G-SR  

**Xcvr 1**  
REV 01 740-021308 AQG0MRQ 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: 0.00  
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 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 44 00 12 05 07  
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff  
Address 0x40: ff ff ff ff f1 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 ff  

**FPC 1**  
REV 11 740-049775 J13K72993 CF2P-100G-LR4  

Jedec Code: 0x7fb0  
EEPROM Version: 0x02  
P/N: 750-045372 CABK8154  
S/N: CABK8154  
Assembly ID: 0x09db  
Assembly Version: 04.11  
Date: 05-18-2013  
Assembly Flags: 0x00  
Version: REV 11  
CLEI Code: COUIBNNBAA  
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 ff ff ff  
I2C Hex Data:  
Address 0x00: 7f b0 02 ff 0f 0b 09 db 04 0b 52 45 56 20 31 31 00 00  
Address 0x10: 00 00 00 00 00 37 35 30 3d 30 3d 30 3d 30 3d 30 3d  
Address 0x20: 3f 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 ff ff ff  
Address 0x40: ff ff ff ff f1 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 ff  

1771

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Address 0x00: ff ff ff ff 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 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 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

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 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 2f 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 00 ff ff ff ff ff ff
Address 0x70: ff ff ff ff ff ff ff ff ff 82 c0 03 00 00 ff ff ff

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 ff
I2C Hex Data:
Address 0x00: 7f b0 02 02 fe 0a 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 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 4a 2f 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 00 ff ff ff ff ff ff
Address 0x70: ff ff ff ff ff 82 c0 03 00 00 bc 57 79 83 80 00 00 02
Chapter 41: Operational Commands

Address 0x30: dc ff ff ff 34 01 07 07 08 ff 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 00 00 00 00 00 00 00 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 56 34 36 34 36 34 35 00 01
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 00 00
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:
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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 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x20: 53 2f 4e 20 43 41 41 52 45 56 00 25 73 3a 20
Address 0x30: 42 55 49 4c 54 49 4e 00 25 73 3a 20 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 c0 02 6b 94 00 00 00 00 02 fe 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 00 25 73 3a 20
Address 0x20: 53 2f 4e 20 43 41 41 56 34 36 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 ff
Address 0x40: ff ff ff ff ff 00 00 00 00 00 00 00 00 00 00 00 00 00
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
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 00 25 73 3a 20
Address 0x20: 53 2f 4e 20 43 41 41 56 34 36 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 ff
Address 0x40: ff ff ff ff ff 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
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show chassis hardware models (MX960 Router with MPC5EQ)

user@host> show chassis hardware models

Hardware inventory:

<table>
<thead>
<tr>
<th>Item</th>
<th>Version</th>
<th>Part number</th>
<th>Serial number</th>
<th>FRU model number</th>
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<td>Midplane</td>
<td>REV 01</td>
<td>710-030012</td>
<td>ACAX3674</td>
<td>CHAS-BP-MX960-S</td>
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<td>FPM Board</td>
<td>REV 03</td>
<td>710-014974</td>
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<td>CRAFT-MX960-S</td>
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<td>740-027760</td>
<td>QCS1702N062</td>
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show chassis hardware clei-models (MX960 Router with MPC5EQ)

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user@host> show chassis hardware clei-models

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show chassis hardware (MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC)

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user@host> show chassis hardware

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show chassis hardware clei-models

user@host> show chassis hardware clei-models

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show chassis hardware (MX10008 Router)

user@host> show chassis hardware

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### Show Chassis Hardware Clei-Models (MX10008 Router)

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## show chassis hardware extensive(MX10008 Router)

user@host> **show chassis hardware extensive**

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<td>Virtio Block Disk</td>
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<td>XHCI root HUB 0</td>
<td>0x8086</td>
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Routing Engine 1          BUILTIN      BUILTIN           RE X10
vtbd0 17408 MB                                         Virtio Block Disk
vtbd1 57344 MB                                         Virtio Block Disk
vtbd2 12288 MB                                         Virtio Block Disk
ada0    128 MB  QEMU                 QM0002           Virtio Block Disk
usb0 (addr 0.1) XHCI root HUB 0      0x8086       hub0

CB 0          REV 02  750-079563     CAF4580          Control Board
Jedec Code:  0x7fb0  EEPROM Version:  0x01
P/N:  750-079563      S/N:            CAFF4580
Assembly ID:  0x0ca3  Assembly Version:  01.02
Date:  06-06-2016  Assembly Flags:  0x00
Version:  REV 02
ID:  Control Board

Board Information Record:
Address 0x00:  ad 01 00 40 4c 16 fc 91 7c 85 ff ff ff ff ff ff
I2C Hex Data:
Address 0x00:  7f b0 01 fe 0c a3 01 02 52 45 56 20 30 32 00 00
Address 0x10:  00 00 00 00 37 35 30 2d 30 37 39 35 36 33 00 00
Address 0x20:  53 2f 4e 20 43 41 46 46 34 35 38 30 00 06 06 07
Address 0x30:  e0 fe ff ff ff ad 01 00 40 4c 16 fc 91 7c 85 ff ff
Address 0x40:  ff ff ff ff ff ff ff ff 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 ff ff ff
Address 0x60:  ff ff ff 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 ff ff ff

CB 1          REV 04  750-079563     CAGL8034          Control Board
Jedec Code:  0x7fb0  EEPROM Version:  0x01
P/N:  750-079563      S/N:            CAGL8034
Assembly ID:  0x0ca3  Assembly Version:  01.04
Date:  06-28-2018  Assembly Flags:  0x00
Version:  REV 04
ID:  Control Board

Board Information Record:
Address 0x00:  ad 01 00 40 4c 16 fc 91 7c c5 ff ff ff ff ff ff
I2C Hex Data:
Address 0x00:  7f b0 01 fe 0c a3 01 02 52 45 56 20 30 32 00 00
Address 0x10:  00 00 00 00 37 35 30 2d 30 37 39 35 36 33 00 00
Address 0x20:  53 2f 4e 20 43 41 47 47 4c 38 30 33 34 00 0c 06 07
Address 0x30:  e2 fc ff ff ff ad 01 00 40 4c 16 fc 91 7c c5 ff ff
Address 0x40:  ff ff ff ff ff ff ff ff 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 ff ff ff
Address 0x60:  ff ff ff 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 ff ff ff

FPC 0          REV 12  750-073174     CAJK0253          JNP10K-LC2102
Jedec Code:  0x7fb0  EEPROM Version:  0x02
P/N:  750-073174      S/N:            CAJK0253
Assembly ID:  0x0ca5  Assembly Version:  01.12
Date:  09-28-2017  Assembly Flags:  0x00
Version:  REV 12
ID:  JNP10K-LC2102
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 ff ff ff
I2C Hex Data:
Address 0x00:  7f b0 02 02 ff 0c a5 01 0c 52 45 56 20 31 32 00 00
Address 0x10:  00 00 00 00 37 35 35 30 2d 30 37 33 31 37 34 00 00
Address 0x20:  53 2f 4e 20 43 41 4a 4b 30 32 35 33 00 0c 09 07
Address 0x30:  e1 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40:  ff 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 ff ff
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Chapter 41: Operational Commands

Assembly ID: 0x0af1  Assembly Version: 00.00
Date: 00-00-0000  Assembly Flags: 0x00
ID: 4x QSFP28 10/40/100GE MACSec PIC

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 00 f1 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 83 80 73 e8 00 00 00 00 00 00 00 00

Xcvr 0 REV 01 740-058734 1ACQ113404E QSFP-100GBASE-SR4
PIC 3 BUILTIN BUILTIN 4xQSFP28 MACSEC
Jedec Code: 0x0000  EEPROM Version: 0x00
P/N: BUILTIN  S/N: BUILTIN
Assembly ID: 0x0af1  Assembly Version: 00.00
Date: 00-00-0000  Assembly Flags: 0x00
ID: 4x QSFP28 10/40/100GE MACSec PIC

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 00 f1 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 83 80 51 ea 00 00 00 00 00 f1 00 00
Address 0x70: 00 00 00 00 83 80 51 ea 00 00 00 00 00 f1 00 00

Xcvr 0 REV 01 740-058734 1ACQ1041018 QSFP+-40G-SR4
Xcvr 1 REV 01 740-067443 XWS08JK QSFP+-40G-SR4
Xcvr 2 REV 01 740-032986 QF340C63 QSFP+-40G-SR4
Xcvr 3 REV 01 740-067443 XWS08JL QSFP+-40G-SR4
PIC 4 BUILTIN BUILTIN 4xQSFP28 MACSEC
Jedec Code: 0x0000  EEPROM Version: 0x00
P/N: BUILTIN  S/N: BUILTIN
Assembly ID: 0x0af1  Assembly Version: 00.00
Date: 00-00-0000  Assembly Flags: 0x00
ID: 4x QSFP28 10/40/100GE MACSec PIC

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 00 f1 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
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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
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Xcvr 0 REV 01 740-058734 1ACQ1041018 QSFP-100GBASE-LR4
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Jedec Code: 0x0000  EEPROM Version: 0x00
P/N: BUILTIN  S/N: BUILTIN
Assembly ID: 0x0af1  Assembly Version: 00.00
Date: 00-00-0000  Assembly Flags: 0x00
ID: 4x QSFP28 10/40/100GE MACSec PIC

Board Information Record:
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I2C Hex Data:
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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
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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
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Xcvr 0 NON-JNPR 37700171YY0083 QSFP-100GBASE-LR4
PIC 6 BUILTIN BUILTIN 4xQSFP28 MACSEC
Jedec Code: 0x0000  EEPROM Version: 0x00
P/N: BUILTIN  S/N: BUILTIN
Assembly ID: 0x0af1  Assembly Version: 00.00
Date: 00-00-0000  Assembly Flags: 0x00
ID: 4x QSFP28 10/40/100GE MACSec PIC

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<td>Address 0x40: 0f 50 52 4f 54 4f 58 43 4c 45 49 50</td>
<td></td>
</tr>
<tr>
<td>Address 0x50: 52 4f 54 4f 2d 41 53 53 45 4d 42 4c 59 00 00 00</td>
<td></td>
</tr>
<tr>
<td>Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff ff</td>
<td></td>
</tr>
<tr>
<td>Address 0x70: ff ff ff ff c2 ff ff ff ff ff ff ff ff ff ff ff ff ff</td>
<td></td>
</tr>
<tr>
<td>PIC 0                   BUILTIN      BUILTIN           4xQSFP28 MACSEC</td>
<td></td>
</tr>
<tr>
<td>Board Information Record:</td>
<td>Address 0x00: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff</td>
</tr>
<tr>
<td>I2C Hex Data:</td>
<td>Address 0x10: 00 00 00 00 00 37 35 30 2d 30 37 33 33 39 31 00 00</td>
</tr>
<tr>
<td>Address 0x20: 53 2f 4e 20 43 41 48 4d 37 39 35 36 00 08 05 07</td>
<td></td>
</tr>
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<td>Address 0x30: 0e ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff</td>
<td></td>
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<tr>
<td>Address 0x40: 0f 50 52 4f 54 4f 58 43 4c 45 49 50</td>
<td></td>
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<tr>
<td>Address 0x50: 52 4f 54 4f 2d 41 53 53 45 4d 42 4c 59 00 00 00</td>
<td></td>
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<tr>
<td>Address 0x60: 00 00 00 00 00 00 41 30 30 ff ff ff ff ff ff ff ff</td>
<td></td>
</tr>
<tr>
<td>Address 0x70: ff ff ff ff c2 ff ff ff ff ff ff ff ff ff ff ff ff ff</td>
<td></td>
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| 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 00 00 00 00 00 00 00 00 00 00 00 00 |
Chapter 41: Operational Commands

Xcvr 0  REV 01  740-061405  1ACQ1210JK  QSFP-100GBASE-SR4
PIC 1  BUILTIN  BUILTIN  4xQSFPP28 MACSEC
Jedec Code:  0x0000  EEPROM Version:  0x00
P/N:  BUILTIN  S/N:  BUILTIN
Assembly ID:  0x0af1  Assembly Version:  0.00
Date:  00-00-0000  Assembly Flags:  0x00
ID:  4x QSFP28 10/40/100GE MACSec PIC
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 f1 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 83 00 d1 f1 00 00 00 00 0a f1 00 00

Xcvr 0  REV 01  740-046565  XYH0P6F  QSFP+-40G-SR4
Xcvr 1  REV 01  740-067442  XX401TT  QSFP+-40G-SR4
Xcvr 2  REV 01  740-067442  XX401SL  QSFP+-40G-SR4
Xcvr 3  REV 01  740-067443  XV30A78  QSFP+-40G-SR4
PIC 2  BUILTIN  BUILTIN  4xQSFPP28 MACSEC
Jedec Code:  0x0000  EEPROM Version:  0x00
P/N:  BUILTIN  S/N:  BUILTIN
Assembly ID:  0x0af1  Assembly Version:  0.00
Date:  00-00-0000  Assembly Flags:  0x00
ID:  4x QSFP28 10/40/100GE MACSec PIC
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 f1 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 83 80 b1 f3 00 00 00 00 0a f1 00 00

Xcvr 0  REV 01  740-067443  XV3002D  QSFP+-40G-SR4
Xcvr 1  REV 01  740-067442  XX401TT  QSFP+-40G-SR4
Xcvr 2  REV 01  740-067443  XV30A78  QSFP+-40G-SR4
Xcvr 3  REV 01  740-067442  XX401SL  QSFP+-40G-SR4
PIC 3  BUILTIN  BUILTIN  4xQSFPP28 MACSEC
Jedec Code:  0x0000  EEPROM Version:  0x00
P/N:  BUILTIN  S/N:  BUILTIN
Assembly ID:  0x0af1  Assembly Version:  0.00
Date:  00-00-0000  Assembly Flags:  0x00
ID:  4x QSFP28 10/40/100GE MACSec PIC
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 f1 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 83 80 73 e8 00 00 00 00 00 00 00 00

Xcvr 0  REV 01  740-067442  XX401TT  QSFP+-40G-SR4
Xcvr 1  REV 01  740-067443  XV3002D  QSFP+-40G-SR4
Xcvr 2  REV 01  740-067442  XX401SL  QSFP+-40G-SR4
Xcvr 3  REV 01  740-067443  XV30A78  QSFP+-40G-SR4
Address 0x30: e2 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
CPU          REV 05   750-073391   CAKJ2854          LC 2101 PMB
Jedec Code:  0x7fb0            EEPROM Version:    0x01
P/N:          750-073391        S/N:               CAKJ2854
Assembly ID:  0x0ccda            Assembly Version:  01.05
Date:         03-12-2018        Assembly Flags:    0x00
Version:      REV 05
ID: LC 2101 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 0c da 01 05 52 45 56 20 30 35 30 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 37 33 33 39 31 00 00
Address 0x20: 53 2f 4e 20 43 41 4b 4a 32 38 35 00 0c 03 07
Address 0x30: e2 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 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 00
PIC 0       BUILTIN      BUILTIN           4xQSFP28 SYNCE
Jedec Code:  0x0000            EEPROM Version:    0x00
P/N:          BUILTIN           S/N:               BUILTIN
Assembly ID:  0x0af3            Assembly Version:  00.00
Date:         00-00-0000        Assembly Flags:    0x00
ID: 4x QSFP28 10/40/100GE SYNCE PIC
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 f3 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 83 00 b1 f3 00 00 00 00 0a f3 00 00
Xcvr 0       REV 01   740-058734   1ACQ104300K       QSFP-100GBASE-SR4
PIC 1        BUILTIN      BUILTIN           4xQSFP28 SYNCE
Jedec Code:  0x0000            EEPROM Version:    0x00
P/N:          BUILTIN           S/N:               BUILTIN
Assembly ID:  0x0af3            Assembly Version:  00.00
Date:         00-00-0000        Assembly Flags:    0x00
ID: 4x QSFP28 10/40/100GE SYNCE PIC
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 f3 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 00 00 00 00 00 00 00 00 00 00 00 00
Xcvr 0       REV 01   740-061405   1ACQ12110AN       QSFP-100GBASE-SR4
PIC 2        BUILTIN      BUILTIN           4xQSFP28 SYNCE
Jedec Code:  0x0000            EEPROM Version:    0x00
P/N:          BUILTIN           S/N:               BUILTIN
Assembly ID:  0x0af3            Assembly Version:  00.00
Date:         00-00-0000        Assembly Flags:    0x00
ID: 4x QSFP28 10/40/100GE SYNCE PIC
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<th>REV 01</th>
<th>740-067443</th>
<th>XWR0RY7</th>
<th>QSFP+-40G-SR4</th>
<th>PIC 4</th>
<th>BUILTIN</th>
<th>BUILTIN</th>
<th>4xQSFP28 SYME</th>
<th>40GBASE eSR4</th>
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<td></td>
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<td>QH08036X</td>
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<td>BUILTIN</td>
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<td>REV 01</td>
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<td>XWR0RY7</td>
<td>QSFP+-40G-SR4</td>
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<td>BUILTIN</td>
<td>4xQSFP28 SYME</td>
<td></td>
</tr>
</tbody>
</table>

The above table provides a summary of the Ethernet interface configurations and specifications for routing devices.
Address 0x60: 00 00 00 00 00 00 00 00 00 01 30 31 ff ff ff ff ff ff ff
Address 0x70: ff ff ff dc ff ff ff ff ff ff ff ff ff ff

PEM 5
REV 02 740-049388 1EDL62102PP Power Supply AC

Jedec Code: 0x7fb0 EEPROM Version: 0x02
P/N: 740-049388 S/N: 1EDL62102PP
Assembly ID: 0x0483 Assembly Version: 0.02
Date: 05-25-2016 Assembly Flags: 0x00
Version: REV 02 CLEI Code: CMUADNBAE
ID: Power Supply AC FRU Model Number: QFX10000-PWR-AC

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 83 01 02 52 45 56 20 30 32 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 34 39 33 38 38 00 00
Address 0x20: 31 45 44 4c 36 32 31 02 50 50 00 00 19 05 07
Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4d 55 43 41 48 5a 43 41 41 51
Address 0x50: 46 58 31 30 30 38 2d 46 41 4e 2d 43 54 52 4c
Address 0x60: 00 00 00 00 00 00 01 30 31 ff ff ff ff ff ff ff
Address 0x70: ff ff ff dc ff ff ff ff ff ff ff ff ff ff ff ff

FTC 0
REV 0 750-050108 ACPE4038 Fan Controller 8

Jedec Code: 0x7fb0 EEPROM Version: 0x02
P/N: 750-050108 S/N: ACPE4038
Assembly ID: 0x0bee Assembly Version: 0.14
Date: 09-27-2016 Assembly Flags: 0x00
Version: REV 14 CLEI Code: CMUCAHZCAA
ID: Fan Controller 8 FRU Model Number: QFX10008-FAN-CTRL

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 ee 01 0e 52 45 56 20 31 34 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 34 39 33 38 38 00 00
Address 0x20: 53 2f 4e 20 41 43 50 45 34 30 33 38 00 1b 09 07
Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4d 55 43 41 48 5a 43 41 41 51
Address 0x50: 46 58 31 30 30 38 2d 46 41 4e 2d 43 54 52 4c
Address 0x60: 00 00 00 00 00 00 01 30 31 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 98 ff ff ff ff ff ff ff ff ff ff

FTC 1
REV 14 750-050108 ACPE4032 Fan Controller 8

Jedec Code: 0x7fb0 EEPROM Version: 0x02
P/N: 750-050108 S/N: ACPE4032
Assembly ID: 0x0bee Assembly Version: 0.14
Date: 09-27-2016 Assembly Flags: 0x00
Version: REV 14 CLEI Code: CMUCAHZCAA
ID: Fan Controller 8 FRU Model Number: QFX10008-FAN-CTRL

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 ee 01 0e 52 45 56 20 31 34 00 00
Address 0x10: 00 00 00 00 37 34 30 2d 30 34 39 33 38 38 00 00
Address 0x20: 53 2f 4e 20 41 43 50 45 34 30 33 38 00 1b 09 07
Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4d 55 43 41 48 5a 43 41 41 51
Address 0x50: 46 58 31 30 30 38 2d 46 41 4e 2d 43 54 52 4c
Address 0x60: 00 00 00 00 00 00 01 30 31 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 98 ff ff ff ff ff ff ff ff ff ff

Fan Tray 0
REV 09 760-054372 ACPD6799 Fan Tray 8

Jedec Code: 0x7fb0 EEPROM Version: 0x02
P/N: 760-054372 S/N: ACPD6799
Assembly ID: 0x0bf0 Assembly Version: 0.09
Chapter 41: Operational Commands

Address 0x00: 7f b0 02 ff 0b ec 01 18 52 45 56 20 32 34 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 35 30 35 30 38 00 00
Address 0x20: 53 2f 4e 20 41 43 4e 5a 30 36 33 35 00 06 06 07
Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4d 55 43 41 48 30 43 41 45 51
Address 0x50: 46 58 31 30 30 30 38 2d 53 46 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 41 45 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff d1 00 00 00 00 00 00 00 00 00 00 00 00

SFB 2  
REV 24  
750-050058  
ACPD4908  
Switch Fabric (SIB) 8

Jedec Code: 0x7fb0  
EEPROM Version: 0x02
P/N: 750-050058  
S/N: ACPD4908
Assembly ID: 0x0bec  
Assembly Version: 01.24
Date: 07-12-2016  
Assembly Flags: 0x00
Version: REV 24  
CLEI Code: CMUCAH0CAA
ID: Switch Fabric (SIB) 8  
FRU Model Number: QFX10008-SF
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 ec 01 18 52 45 56 20 32 34 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 35 30 35 30 38 00 00
Address 0x20: 53 2f 4e 20 41 43 4e 5a 30 36 33 35 00 06 06 07
Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4d 55 43 41 48 30 43 41 45 51
Address 0x50: 46 58 31 30 30 30 38 2d 53 46 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 41 45 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff d1 00 00 00 00 00 00 00 00 00 00 00 00

SFB 3  
REV 24  
750-050058  
ACNZ0617  
Switch Fabric (SIB) 8

Jedec Code: 0x7fb0  
EEPROM Version: 0x02
P/N: 750-050058  
S/N: ACNZ0617
Assembly ID: 0x0bec  
Assembly Version: 01.24
Date: 06-07-2016  
Assembly Flags: 0x00
Version: REV 24  
CLEI Code: CMUCAH0CAA
ID: Switch Fabric (SIB) 8  
FRU Model Number: QFX10008-SF
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 ec 01 18 52 45 56 20 32 34 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 35 30 35 30 38 00 00
Address 0x20: 53 2f 4e 20 41 43 4e 5a 30 36 33 35 00 06 06 07
Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4d 55 43 41 48 30 43 41 45 51
Address 0x50: 46 58 31 30 30 30 38 2d 53 46 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 41 45 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff d1 00 00 00 00 00 00 00 00 00 00 00 00

SFB 4  
REV 24  
750-050058  
ACNZ0527  
Switch Fabric (SIB) 8

Jedec Code: 0x7fb0  
EEPROM Version: 0x02
P/N: 750-050058  
S/N: ACNZ0527
Assembly ID: 0x0bec  
Assembly Version: 01.24
Date: 06-06-2016  
Assembly Flags: 0x00
Version: REV 24  
CLEI Code: CMUCAH0CAA
ID: Switch Fabric (SIB) 8  
FRU Model Number: QFX10008-SF
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 ec 01 18 52 45 56 20 32 34 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 35 30 35 30 38 00 00
Address 0x20: 53 2f 4e 20 41 43 4e 5a 30 36 33 35 00 06 06 07
Address 0x30: e0 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
Address 0x40: ff ff ff ff 01 43 4d 55 43 41 48 30 43 41 45 51
Address 0x50: 46 58 31 30 30 30 38 2d 53 46 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 41 45 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff d1 00 00 00 00 00 00 00 00 00 00 00 00
show chassis hardware models (MX10008 Router)

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<th>Item</th>
<th>Version</th>
<th>Part number</th>
<th>Serial number</th>
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<td>CAFP4307</td>
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show chassis hardware (PTX3000 Router with 5-port 100-Gigabit DWDM OTN PIC)

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show chassis hardware clei-models (PTX3000 Router with 5-port 100-Gigabit DWDM OTN PIC)

user@host> show chassis hardware clei-models

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show chassis hardware (MX2010 Router)

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user@host > show chassis hardware

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| Xcvr 4 | REV 02 | 740-011613 | AM1001SM9D | SFP-SX |
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| Xcvr 1 | REV 01 | 740-031851 | AC1102S00NG | SFP-SX |
| Xcvr 2 | REV 01 | 740-031851 | AC1102S00K3 | SFP-SX |
| Xcvr 3 | REV 01 | 740-031851 | AC1102S00R | SFP-SX |
| Xcvr 4 | REV 01 | 740-031851 | AM1107SUFVJ | SFP-SX |
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PIC 3
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Chapter 41: Operational Commands
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| Xcvr 4  | REV 01 | 740-031980 | 19T511101712 | SFP+-10G-SR |
| Xcvr 5  | REV 01 | 740-031980 | 193363A00568 | SFP+-10G-SR |
| Xcvr 6  | REV 01 | 740-031980 | 03DZ06A01017 | SFP+-10G-SR |
| Xcvr 7  | REV 01 | 740-021308 | 03DZ06A01016 | SFP+-10G-SR |

| Xcvr 0  | REV 01 | 740-032986 | QB230273  | QSFP+-40G-QSFP |
| Xcvr 1  | REV 01 | 740-032986 | QB230254  | QSFP+-40G-QSFP |
| Xcvr 2  | REV 01 | 740-032986 | QB390960  | QSFP+-40G-QSFP |
| Xcvr 3  | REV 01 | 740-032986 | QAAF1531  | MPC Type 4-2 |
| CPU     | REV 08 | 711-035209 | CAAB9927  | HMPC PMB 2G |
| PIC 0   | BUILTIN| BUILTIN    | 4x10GE SFPP|
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| 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 | A340JSS   | SFP+-10G-SR |

| PIC 2   | BUILTIN| BUILTIN    | 1X100GE CFP |

Ethernet Interfaces Feature Guide for Routing Devices
show chassis hardware extensive (MX2010 Router)

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Hardware inventory:

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I2C Hex Data:

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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 34 35 36 37 00 1c 08 07
Address 0x30: dc ff ff ff ad 01 08 00 00 00 00 00 00 00 00 00
Address 0x40: ff ff ff ff 01 50 52 4f 54 48 49 45 44 49 50
Address 0x50: 52 4f 54 48 49 45 44 49 45 44 49 50 00 00 00
Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

Midplane         REV 26   750-044636   ABAB9357          Lower Backplane
| Jedec Code:      | 0x7fb0  | EEPROM Version: 0x02  |
| P/N:             | 750-044636  | S/N: ABAB9357  |
| Assembly ID:     | 0x0b66  | Assembly Version: 0x1.26  |
| Date:            | 08-28-2012  | Assembly Flags: 0x00  |
| Version:         | REV 26  | CLEI Code: PROTOXCLEI  |
| ID:              | Lower Backplane  | FRU Model Number: PROTO-ASSEMBLY  |

Board Information Record:

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I2C Hex Data:

Address 0x00: 7f b0 02 ff 0b 66 01 1a 52 45 36 20 32 36 00 00
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Address 0x20: 53 2f 4e 20 41 42 41 42 39 33 35 37 00 01 08 07
Address 0x30: dc ff ff ff ad 01 08 00 2c 21 72 70 0a 00 ff ff
Address 0x40: ff ff ff ff 01 50 52 4f 54 48 49 45 44 49 50
Address 0x50: 52 4f 54 48 49 45 44 49 45 44 49 50 00 00 00
Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Chapter 41: Operational Commands

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:
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PSM 1  REV 01  740-045050  1E02242000M  DC 52V Power Supply Module
  Jede Code: 0x7fb0  EEPROM Version: 0x02
  P/N: 740-045050  S/N: 1E02242000M
  Assembly ID: 0x0478  Assembly Version: 01.01

Date: 12-06-2012  Assembly Flags: 0x00
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  Address 0x50: 58 32 30 30 30 2d 50 34 2d 48 43 2d 44 43 2d
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  Address 0x70: ff ff ff 4a 00 00 00 00 00 00 00 00 00 00 00 00

Routing Engine 0  REV 02  740-041821  9009099704  RE-S-1800x4
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  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:
Chapter 41: Operational Commands

Assembly ID: 0x0b29  Assembly Version: 01.02
Date: 08-14-2012  Assembly Flags: 0x00
Version: REV 02
ID: PMB Board
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  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 ff ff
  Address 0x40: ff ff ff ff 00 ff ff ff ff ff ff ff ff ff ff ff
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  Address 0x70: ff ff ff ff 00 00 00 00 00 00 00 00 00 00 00 00 00
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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:
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  Address 0x20: 53 2f 4e 20 43 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 ff
  Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 50
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  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 01 00 00 00 00 00 00 00 00 00
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FPC 0  REV 09  750-037355  CAAF0924  MPC Type 4-2
Jedec Code: 0x7fb0  EEPROM Version: 0x09
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
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show chassis hardware models (MX2010 Router)

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user@host > show chassis hardware models
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show chassis hardware clei-models (MX2010 Routers)

user@host > show chassis hardware clei-models

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user@host> show chassis hardware detail
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**Chapter 41: Operational Commands**

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show chassis hardware extensive (MX2010 Routers with MPC6E and OTN MIC)

user@host> show chassis hardware extensive

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Address 0x30: 00 00 00 ff 00 00 00 00 00 00 00 00 00 00 00 00
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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 Lower Backplane

Jedec Code: 0x7fb0
P/N: 750-044636
Assembly ID: 0x00b6
Assembly Version: 01.35
Date: 06-21-2013
Version: REV 35
ID: CHAS-BP-MX2010-S

Board Information Record:

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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 0b 00 3c 8a b0 38 68 00 ff ff
Address 0x40: 0f 0f 0f 0f 0f 0f 0f 0f 0f 0f 0f 0f 0f 0f 0f 0f
Address 0x50: 48 41 53 2d 42 50 2d 4d 58 32 30 31 30 32 53 00
Address 0x60: 00 00 00 00 00 00 00 30 36 00 ff ff ff ff ff ff
Address 0x70: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff

Midplane 1 Upper Backplane

Jedec Code: 0x7fb0
P/N: 711-044557
Assembly ID: 0x00b6
Assembly Version: 01.02
Date: 03-21-2013
Version: REV 02
ID: CHAS-BP-MX2010-S

Board Information Record:

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Chapter 41: Operational Commands
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Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff ff ff
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  P/N:  740-050037  S/N:  1EDB32000K8
  Assembly ID: 0x0478  Assembly Version: 01.01
  Date: 05-23-2013  Assembly Flags: 0x00
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  Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
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  Address 0x60: 00 00 00 00 00 00 31 30 31 ff ff ff ff ff ff
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show chassishardware (MX2020 Router)
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user@host > show chassishardware

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Chapter 41: Operational Commands
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| PIC 3  | BUILTIN | REV 01 | 740-031980 | SFP+-10G-SR |
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| Xcvr 2 | REV 01 | 740-031980 | AK80N1F | SFP+-10G-SR |
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| FPC 7  | REV 32 | 750-028467 | ABBN6831 | MPC 3D 16x 10GE |
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Chapter 41: Operational Commands

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show chassis hardware (MX2020 Router with 240-V high-voltage DC PSMs and PDMs)

user@host > show chassis hardware

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Chapter 41: Operational Commands

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### show chassis hardware models (MX2020 Router)

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user@host > show chassis hardware models

Hardware inventory:

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show chassis hardware clei-models (MX2020 Router)

user@ host > show chassis hardware clei-models

Hardware inventory:

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show chassis hardware (MX2020 Router with MPC5EQ and MPC6E)

user@host> show chassis hardware

Hardware inventory:

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Xcvr 4       REV 01   740-021308   AQ41F04           SFP+-10G-SR
Xcvr 5       REV 01   740-031980   AM316N3           SFP+-10G-SR
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CPU            REV 04   711-035209   CAA3639           MPCE PMB 2G
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show chassis hardware detail (MX2020 Router with MPC5EQ and MPC6E)

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user@host>show chassis hardware detail

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show chassis hardware extensive (MX2020 Router with MPC5EQ and MPC6E)

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user@host> show chassis hardware extensive

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PMP 1  REV 05  711-032428  ACAJ2541
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
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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 0a 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 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 ff ff ff ff ff ff ff ff ff ff ff

PMP 0  REV 04  711-032426  ACAJ2194
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 01 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff
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FPM Board  REV 13  760-040242  ABCA8835
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 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 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
Address 0x50: 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
Address 0x70: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff

PSM 0  REV 01  740-050037  1EDB32403L5
ID: DC 52V Power Supply Module
Chapter 41: Operational Commands

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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 33 33 00 00
Address 0x20: 31 45 44 42 33 31 33 30 37 37 00 00 10 05 07
Address 0x30: dd ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
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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
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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:
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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 33 33 00 00
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Address 0x70: ff ff ff 2a 00 00 00 00 00 00 00 00 00 00 00 00
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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 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 33 33 00 00
Address 0x20: 31 45 44 42 33 31 33 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 ff
Address 0x40: ff ff ff ff 01 49 50 55 33 40 4d 2d 44 43 2d 53 00 00
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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  1EDB3130095  DC 52V Power Supply Module
Jedec Code: 0x7fb0  EEPROM Version: 0x02
P/N: 740-050037  S/N: 1EDB3130095
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 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 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 ff
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    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:         IPUPAKRKA
ID: DC 52V Power Supply Module FRU Model Number:  MX2000-PSM-DC-S
Board Information Record:
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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 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 ff
    Address 0x40: ff ff ff ff 01 49 4f 50 55 50 41 4b 52 01 01 01 01
    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:         IPUPAKRKA
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 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 ff
    Address 0x40: ff ff ff ff 01 49 4f 50 55 50 41 4b 52 01 01 01 01
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    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:         IPUPAKRKA
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:
PSM 13          REV 01   740-050037   1ED83130074   DC 52V Power Supply Module
Jedec Code:   0x7fb0            EEPROM Version:    0x02
P/N:          740-050037        S/N:               1ED83130074
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 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 33 37 00 00
Address 0x20: 31 45 44 42 33 31 32 32 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 14          REV 01   740-050037   1ED8313009D   DC 52V Power Supply Module
Jedec Code:   0x7fb0            EEPROM Version:    0x02
P/N:          740-050037        S/N:               1ED8313009D
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
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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 15          REV 01   740-050-0037   1ED83130024   DC 52V Power Supply Module
Jedec Code:   0x7fb0            EEPROM Version:    0x02
P/N:          740-050-0037       S/N:               1ED83130024
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:
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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)

```plaintext
user@host> show chassis hardware models

Hardware inventory:

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<th>Serial number</th>
<th>FRU model number</th>
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Chapter 41: Operational Commands
**show chassis hardware clei-models (MX2020 Router with MPC5EQ and MPC6E)**

```
user@host> show chassis hardware clei-models
```

| Hardware inventory: show chassis hardware clei-models |
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| 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   | IPMYAESJRA | MX2020-CRAFT-S   |
| PSM 0            | REV 01   | 740-050037   | IPUPAKKKA  | MX2000-PSM-DC-S |
| PSM 1            | REV 01   | 740-050037   | IPUPAKKKA  | MX2000-PSM-DC-S |
| PSM 2            | REV 01   | 740-050037   | IPUPAKKKA  | MX2000-PSM-DC-S |
| PSM 3            | REV 01   | 740-050037   | IPUPAKKKA  | MX2000-PSM-DC-S |
| PSM 4            | REV 01   | 740-050037   | IPUPAKKKA  | MX2000-PSM-DC-S |
| PSM 5            | REV 01   | 740-050037   | IPUPAKKKA  | MX2000-PSM-DC-S |
| PSM 6            | REV 01   | 740-050037   | IPUPAKKKA  | MX2000-PSM-DC-S |
| PSM 7            | REV 01   | 740-050037   | IPUPAKKKA  | MX2000-PSM-DC-S |
| PSM 8            | REV 01   | 740-050037   | IPUPAKKKA  | MX2000-PSM-DC-S |
| PSM 12           | REV 01   | 740-050037   | IPUPAKKKA  | MX2000-PSM-DC-S |
| PSM 13           | REV 01   | 740-050037   | IPUPAKKKA  | MX2000-PSM-DC-S |
| PSM 14           | REV 01   | 740-050037   | IPUPAKKKA  | MX2000-PSM-DC-S |
| PSM 15           | REV 01   | 740-050037   | IPUPAKKKA  | MX2000-PSM-DC-S |
| PSM 16           | REV 01   | 740-050037   | IPUPAKKKA  | MX2000-PSM-DC-S |
| PSM 17           | REV 01   | 740-050037   | IPUPAKKKA  | MX2000-PSM-DC-S |
| PDM 0            | REV 03   | 740-045234   | IPUPAJSKA  | MX2000-PDM-DC-S |
| PDM 1            | REV 03   | 740-045234   | IPUPAJSKA  | MX2000-PDM-DC-S |
| PDM 2            | REV 03   | 740-045234   | IPUPAJSKA  | MX2000-PDM-DC-S |
| PDM 3            | REV 03   | 740-045234   | IPUPAJSKA  | MX2000-PDM-DC-S |
| CB 0             | REV 23   | 750-040257   | IPUCBAC7CA | RE-MX2000-1800X4-S |
| CB 1             | REV 23   | 750-040257   | IPUCBAC7CA | RE-MX2000-1800X4-S |
| SFB 0            | REV 06   | 711-044466   | IPUCB6CA   | MX2000-SFB-S   |
| SFB 1            | REV 06   | 711-044466   | IPUCB6CA   | MX2000-SFB-S   |
| SFB 2            | REV 06   | 711-044466   | IPUCB6CA   | MX2000-SFB-S   |
| SFB 3            | REV 06   | 711-044466   | IPUCB6CA   | MX2000-SFB-S   |
| SFB 4            | REV 06   | 711-044466   | IPUCB6CA   | MX2000-SFB-S   |
| SFB 5            | REV 06   | 711-044466   | IPUCB6CA   | MX2000-SFB-S   |
| SFB 6            | REV 06   | 711-044466   | IPUCB6CA   | MX2000-SFB-S   |
| SFB 7            | REV 06   | 711-044466   | IPUCB6CA   | MX2000-SFB-S   |
| FPC 0            | REV 39   | 750-045715   | PROTOXCLEI | PROTO-ASSEMBLY |
| FPC 1            | REV 11   | 750-045372   | COUIBBBNBA | MX-MPC3E-3D    |
| FPC 2            | REV 17   | 750-037355   | IPUIJ4DHAA | MPCAE-3D-2CGE-8XGE |
| FPC 3            | REV 05   | 750-044444   | COUIBBGBA  | 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   | PROTO-3D-XGE-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 |
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| ADC 2            | REV 17   | 750-043596   | IPUCBAC8CA | MX2000-LC-ADAPTER |
| ADC 3            | REV 17   | 750-043596   | IPUCBAC8CA | MX2000-LC-ADAPTER |
```
show chassis hardware (MX Series routers with ATM MIC)

user@host> show chassis hardware

Hardware inventory:

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<th>Part number</th>
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show chassis hardware (MX240, MX480, MX960 routers with Application Services Modular Line Card)

user@host> show chassis hardware

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**show chassis hardware extensive (MX240, MX480, MX960 Routers with Application Services Modular Line Card)**

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user@host> show chassis hardware extensive

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Address 0x10: 37 35 30 2d 30 33 37 32 30 37 00 00 00 11 02 07  
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 ff   
Address 0x40: 00 50 52 4f 54 4f 58 43 4c 45 49 37 31 31 2d 30 33 38 31 37 33 33 33 00 00  
Address 0x50: 30 37 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: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff   
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P/N:         711-038173       S/N:         ZW4817  
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Date:         12-30-2011      Assembly Flags:  0x00
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show chassis hardware (MX480 Router with MPC4E)

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user@host> show chassis hardware

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show chassis hardware (MX5, MX10, MX40, MX80, MX240, MX480, and MX960 Routers with Enhanced 20-Port Gigabit Ethernet MIC)

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user@host> show chassis hardware
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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          REV 02   750-049846   CAAV2153          3D 20x 1GE(LAN) -E, SFP
PIC 0                 BUILTIN      BUILTIN           10x 1GE(LAN) -E  SFP
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   AM081659B81           SFP-SX
Xcvr 1     REV 02   740-011613   AM09255BLK7           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   740-031851   B101501           SFP-T
PIC 1                 BUILTIN      BUILTIN           10x 1GE(LAN) -E  SFP
Xcvr 0     REV 01   740-011613   PFM1ML7           SFP-SX
Xcvr 4     REV 02   740-011613   PE729P6           SFP-SX
Xcvr 6     REV 02   740-011613   AM1014SC84          SFP-SX
Xcvr 9     REV 01   740-011613   AM081258UK3          SFP-SX
MIC 1          REV 26   750-028392   ZY0187            3D 20x 1GE(LAN) -E, SFP
PIC 2                 BUILTIN      BUILTIN           10x 1GE(LAN) -E  SFP
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Xcvr 5     REV 02   740-011613   AM10035FU4          SFP-SX
Xcvr 9     REV 01   740-031851   AM1041SU1M          SFP-SX
PIC 3                 BUILTIN      BUILTIN           10x 1GE(LAN) -E  SFP
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Xcvr 7     +        NON-JNPR     XG32A024          SFP-SX
Xcvr 8     NON-JNPR     PFR0V63           SFP-SX
Xcvr 9     REV 01   740-031851   AM1041SU02U          SFP-SX
Fan Tray
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show chassis hardware models (MX5, MX10, MX40, MX80, MX240, MX480, and MX960 Routers with Enhanced 20-Port Gigabit Ethernet MIC)

```plaintext
user@host> show chassis hardware models
Hardware inventory:
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PEM 0            Rev 04   740-028288   VE05267           PWR-MX80-AC-S
PEM 1            Rev 04   740-028288   VE05270           PWR-MX80-AC-S
Routing Engine            BUILTIN      BUILTIN
TFEB 0                    BUILTIN      BUILTIN
FPC 0                     BUILTIN      BUILTIN
FPC 1                     BUILTIN      BUILTIN
MIC 0          REV 02   750-049846   CAAV2153          MIC-3D-20GE-SFP-E
show chassis hardware (MX2008 Router)

user@host> show chassis hardware

Hardware inventory:

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show chassis hardware detail (MX2008 Router)

user@host>show chassis hardware detail

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show chassis hardware extensive (MX2008 Router)

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user@host> show chassis hardware extensive

Hardware inventory:
Item             Version  Part number  Serial number     Description
Chassis                                JN1259E1CAFL      MX2008
  Jedec Code:   0x7fb0            EEPROM Version:    0x02
  S/N:               JN1259E1CAFL
  Assembly ID:  0x0557            Assembly Version: 00.00
  Date:         00-00-0000        Assembly Flags:    0x00
  ID: MX2008
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 35 39 45 31 43 41 46 4c 00 00 00 00
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    Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
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Midplane         REV 47   750-044636   ABAD1739          Lower Backplane
  Jedec Code:   0x7fb0            EEPROM Version:    0x02
  P/N:          750-044636        S/N:               ABAD1739
  Assembly ID:  0x0b66            Assembly Version: 01.47
  Date:         06-08-2016        Assembly Flags:    0x00
  Version:      REV 47            CLEI Code:         IPMU810ARB
  ID: Lower Backplane             FRU Model Number:  CHAS-BP-MX2010-S
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  Address 0x00: ad 01 08 00 f4 cc 55 3e 35 00 ff ff ff ff ff ff
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    Address 0x30: e0 ff ff ff ad 01 08 00 f4 cc 55 3e 35 00 ff ff
    Address 0x40: ff ff ff ff 01 49 50 4d 55 38 31 30 41 52 42 43
    Address 0x50: 48 41 53 2d 42 50 2d 4d 58 32 30 31 30 2d 53 00
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PMP              REV 01   711-051406   ACVD0738          Power Midplane
  Jedec Code:   0x7fb0            EEPROM Version:    0x01
  P/N:          711-051406        S/N:               ACVD0738
  Assembly ID:  0x045d            Assembly Version: 01.01
  Date:         06-06-2016        Assembly Flags:    0x00
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Chapter 41: Operational Commands

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  Address 0x10: 00 00 00 00 37 34 30 2d 30 36 30 31 38 39 00 00
  Address 0x20: 31 45 46 46 35 32 35 30 30 37 34 00 00 15 07 07
  Address 0x30: df 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 41 4d
Routing Engine 0          BUILTIN      BUILTIN           RE-S-2X00x8
  Jedec Code:   0x0000            EEPROM Version:    0x00
  P/N:          BUILTIN           S/N:               BUILTIN
  Assembly ID:  0x0c10            Assembly Version: 00.00
  Date:         00-00-0000        Assembly Flags:    0x00
  ID: RE-S-2X00x8
Board Information Record:
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I2C Hex Data:
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  Address 0x10: 00 00 00 00 42 55 49 4c 54 49 4e 00 00 00 00 00
  Address 0x20: 42 55 49 4c 54 49 4e 00 00 00 00 00 00 00 00 00
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  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
  vtbd0 15361 MB                                         Virtio Block Disk
  vtbd1 15360 MB                                         Virtio Block Disk
  ada0 511 MB  QEMU HARDDISK        QM00002           Emulated IDE Disk
  usbo (addr 1)  XHCI root HUB 0       0x8086            uhub0
Routing Engine 1          BUILTIN      BUILTIN           RE-S-2X00x8
  Jedec Code:   0x0000            EEPROM Version:    0x00
  P/N:          BUILTIN           S/N:               BUILTIN
  Assembly ID:  0x0c10            Assembly Version: 00.00
  Date:         00-00-0000        Assembly Flags:    0x00
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  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
  vtbd0 15361 MB                                         Virtio Block Disk
  vtbd1 15360 MB                                         Virtio Block Disk
  ada0 511 MB  QEMU HARDDISK        QM00002           Emulated IDE Disk
  usbo (addr 1)  XHCI root HUB 0       0x8086            uhub0
CB 0             REV 01   750-067373   ABDJ0047          Control Board
  Jedec Code:   0x7fb0            EEPROM Version:    0x02
  P/N:          750-067373        S/N:               ABDJ0047
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  Date:         06-21-2016        Assembly Flags:    0x00
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<td>Address 0x20: 53 2f 4e 20 41 42 44 4b 37 31 38 30 00 1b 09 07</td>
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<td><strong>SFB 1 REV 08 750-067371 ABDK7024 Switch Fabric Board</strong></td>
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<td>Address 0x00: 7f b0 02 fe 0c 97 01 08 52 45 56 20 30 38 00 00</td>
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<tr>
<td>Address 0x10: 00 00 00 00 37 35 30 2d 30 36 37 33 37 31 00 00</td>
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<td>SFB 7</td>
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Copyright © 2019, Juniper Networks, Inc.
ID: MPC6E 3D  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 fe 0b 86 01 24 52 45 56 20 33 36 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 34 34 31 33 30 00 00
Address 0x20: 53 2f 4e 20 41 42 43 53 38 36 30 37 00 1d 0a 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: 7f b0 02 fe 0b 86 01 24 52 45 56 20 33 36 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 ff ff ff ff ff ff ff ff ff ff ff ff ff

CPU    REV 09   711-045719   ABCS8776          RMPC PMB
Jedec Code:   0x7fb0            EEPROM Version:    0x02
P/N:          711-045719        S/N:               ABCS8776
Assembly ID:  0x0b85            Assembly Version:  01.09
Date:         10-24-2013        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 41 42 43 53 38 36 30 37 36 00 18 0a 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 ff ff ff ff ff ff ff ff ff ff ff ff

MIC 0          REV 21   750-050008   ABCT5920          4X100GE CXP
Jedec Code:   0x7fb0            EEPROM Version:    0x02
P/N:          750-050008        S/N:               ABCT5920
Assembly ID:  0x0a83            Assembly Version:  01.21
Date:         09-29-2014        Assembly Flags:    0x00
Version:      REV 21
CLEI Code:    IP9IATYDAA
ID: 4X100GE CXP
FRU Model Number: MIC6-100G-CXP
Board Information Record:
Address 0x00: 12 01 07 02 03 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 00 00 37 35 30 2d 30 34 34 31 33 30 00 00
Address 0x20: 53 2f 4e 20 41 42 43 53 38 36 30 37 36 00 18 0a 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 39 41 45 54 59 44 41 41 4d
Address 0x50: 49 43 36 2d 31 30 30 47 2d 43 43 58 50 00 00 00 00
Address 0x60: 00 00 00 00 00 00 41 41 00 ff ff ff ff ff ff ff
Address 0x70: ff ff ff 74 00 00 00 00 10 09 73 3c c0 02 70 3c

PIC 0                 BUILTIN      BUILTIN           4X100GE CXP
XLM 0          REV 07.2.00 711-046638 ABCK3488         MPC6E XL
Jedec Code:   0x7fb0            EEPROM Version:    0x02
P/N:          711-046638        S/N:               ABCK3488
Assembly ID:  0x0b88            Assembly Version:  01.07
Date:         11-11-2013        Assembly Flags:    0x00
Version:      REV 07.2.00
ID: MPC6E XL
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 88 01 07 52 45 56 20 30 37 2e 32
Address 0x10: 2e 30 30 00 37 31 31 2d 30 34 36 36 33 38 00 00
Address 0x20: 53 2f 4e 20 41 42 43 34 38 32 00 15 0a 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 43 42 4d 55 43 41 41 4d
Address 0x50: 58 32 4b 2d 4d 50 43 39 45 00 00 00 00 00 00
Address 0x60: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
Address 0x70: ff ff ff c2 00 00 00 00 00 00 00 00 00 00 00 00

XLM 1          REV 07.2.00 711-046638 ABCK5482         MPC6E XL
Jedec Code:   0x7fb0            EEPROM Version:    0x02
P/N:          711-046638        S/N:               ABCK5482
Assembly ID:  0x0b88            Assembly Version:  01.07
Date:         10-21-2013        Assembly Flags:    0x00
Version:      REV 07.2.00
ID: MPC6E XL

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 88 01 07 52 45 56 20 30 37 2e 32
Address 0x10: 2e 30 30 00 37 31 31 2d 30 34 36 36 33 38 00 00
Address 0x20: 53 2f 4e 20 41 42 43 35 34 38 32 00 15 0a 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 30 30 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: ff ff ff c2 00 00 00 00 00 00 00 00 00 00 00 00 00

CPU            REV 16   750-057177   CAFF9332          SMPC PMB
Jedec Code:   0x7fb0            EEPROM Version:    0x01
P/N:          750-057177        S/N:               CAFF9332
Assembly ID:  0x0c22            Assembly Version:  01.16
Date:         03-20-2016        Assembly Flags:    0x00
Version:      REV 16
ID: SMPC 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 0c 43 01 16 52 45 56 20 32 32 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 36 36 33 34 31 34 00
Address 0x20: 53 2f 4e 20 43 41 46 46 4a 33 30 32 36 00 1c 03 07
Address 0x30: e0 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 43 42 4d 55 43 41 41 4d
Address 0x50: 58 32 4b 2d 4d 50 43 39 45 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: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff

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Address 0x70: ff ff ff ff 00 00 00 00 38 f9 0d e0 4f d1 4b 08
FPC 7  REV 08  750-038492  ZX4080  MPCE Type 2 3D EQ
Jedec Code:  0x7fb0  EEPROM Version:  0x02
P/N:          750-038492  S/N:  ZX4080
Assembly ID:  0x0b35  Assembly Version:  01.08
Date:         02-03-2012  Assembly Flags:  0x00
Version:      REV 08  CLEI Code:  COUIB58AA
ID: MPCE Type 2 3D EQ  FRU Model Number:  MX-MPC2E-3D-EQ
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 35 01 08 52 45 56 20 30 38 00 00
  Address 0x10: 00 00 00 00 37 35 30 2d 30 33 34 39 32 00 00
  Address 0x20: 53 2f 4e 20 5a 58 34 30 38 30 00 00 03 02 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 43 4f 55 49 42 41 35 42 41 4d 41
  Address 0x50: 58 2d 4d 50 43 2e 33 44 2d 45 51 00 00 00
  Address 0x60: 00 00 00 00 00 00 00 00 ff ff ff ff ff ff ff
  Address 0x70: ff ff ff ff 74 ff ff ff ff ff ff ff ff ff
CPU
FPC 7  REV 03  711-038484  ZX3665  MPCE PMB 2G
Jedec Code:  0x7fb0  EEPROM Version:  0x01
P/N:          711-038484  S/N:  ZX3665
Assembly ID:  0x0b36  Assembly Version:  01.03
Date:         02-01-2012  Assembly Flags:  0x00
Version:      REV 03
ID: MPCE PMB 2G
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 36 01 03 52 45 56 20 30 33 00 00
  Address 0x10: 00 00 00 00 37 31 31 2d 30 33 38 34 38 34 00
  Address 0x20: 53 2f 4e 20 5a 58 33 36 36 35 00 00 00 01 02
  Address 0x30: 00 00 00 00 00 00 00 00 ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff ff 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 74 ff ff ff ff ff ff ff ff ff
MIC 0          REV 05   750-037128   ZR4031            1xCOC12/4xCOC3 CH-CE
Jedec Code:  0x7fb0  EEPROM Version:  0x02
P/N:          750-037128  S/N:  ZR4031
Assembly ID:  0x0a1b  Assembly Version:  01.05
Date:         12-04-2011  Assembly Flags:  0x00
Version:      REV 05
CLEI Code:    PROTOXCLEI
ID: 1xCOC12/4xCOC3 CH-CE  FRU Model Number:  MIC-3D-4CHOC3-1OC12-CE
Board Information Record:
  Address 0x00: 12 01 05 03 05 ff ff ff ff ff ff ff ff ff ff ff
  I2C Hex Data:
  Address 0x00: 7f b0 01 ff 0b 0a 35 01 03 52 45 56 20 30 33 00 00
  Address 0x10: 00 00 00 00 37 31 31 2d 30 33 38 34 38 34 00
  Address 0x20: 53 2f 4e 20 5a 52 34 30 33 33 31 00 00 00 01 02
  Address 0x30: 00 00 00 00 00 00 00 00 ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff ff 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: 12 01 05 03 05 ff ff ff ff ff ff ff ff ff ff ff
MIC 1          REV 23   750-032479   CADE8614            1xCOC12/4xCOC3 CH-CE
Jedec Code:  0x7fb0  EEPROM Version:  0x02
P/N:          750-032479  S/N:  CADE8614
Assembly ID:  0x0a1b  Assembly Version:  01.23
Board Information Record:
  Address 0x00: 12 01 05 03 05 ff ff ff ff ff ff ff ff ff ff ff
  I2C Hex Data:
  Address 0x00: 7f b0 02 ff 0a 1b 01 05 52 45 56 20 30 35 00 00
  Address 0x10: 00 00 00 00 37 35 30 2d 30 33 33 31 32 38 00 00
  Address 0x20: 53 2f 4e 20 5a 52 34 30 33 33 31 00 00 00 04 0c
  Address 0x30: 00 00 00 00 00 00 00 00 ff ff ff ff ff ff ff
  Address 0x40: ff ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49
  Address 0x50: 43 44 2d 34 43 48 4f 43 43 3d 2d 31 4c 49 0d
  Address 0x60: 31 32 2d 43 45 00 30 32 00 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
PIC 0          REV 03  750-032479  CADE8614  PIC-3D-6DS3-E3
Jedec Code:  0x7fb0  EEPROM Version:  0x02
P/N:          750-032479  S/N:  CADE8614
Assembly ID:  0x0a1b  Assembly Version:  01.23
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  - **Address 0x40:** ff ff ff ff 01 43 4f 55 49 41 38 44 42 41 41 4d
  - **Address 0x60:** 49 43 2d 33 44 2d 38 44 53 33 2d 45 33 00 00 00
  - **Address 0x80:** ff ff ff 7b c0 03 e5 7c 4f 8a 9e 10 00 00 00 02

**PIC 2**

- **QXM 0**
  - **Assembly ID:** 0x097a
  - **Assembly Version:** 02.06
  - **Date:** 01-19-2012
  - **Assembly Flags:** 0x00

**Board Information Record:**

- **Address 0x00:** ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
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  - **Address 0x00:** 7f b0 01 ff 09 7a 02 06 52 45 56 20 30 36 00 00
  - **Address 0x10:** 53 2f 4e 20 5a 57 38 32 39 39 00 00 13 01 07
  - **Address 0x20:** dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  - **Address 0x40:** 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
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**PIXM 1**

- **QXM 1**
  - **Assembly ID:** 0x097a
  - **Assembly Version:** 02.06
  - **Date:** 01-19-2012
  - **Assembly Flags:** 0x00

**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 7a 02 06 52 45 56 20 30 36 00 00
  - **Address 0x10:** 53 2f 4e 20 5a 57 38 32 39 39 00 00 13 01 07
  - **Address 0x20:** dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  - **Address 0x40:** 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 0x80:** ff ff ff ff 00 00 00 00 00 00 00 00 00 00 00 00

**ADC 7**

- **QXM 0**
  - **Assembly ID:** 0x0b3d
  - **Assembly Version:** 01.17
  - **Date:** 03-07-2013
  - **Assembly Flags:** 0x00

**Board Information Record:**

- **Address 0x00:** ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
- **I2C Hex Data:**
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  - **Address 0x10:** 53 2f 4e 20 5a 59 30 36 30 39 00 00 13 01 07
  - **Address 0x20:** dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
  - **Address 0x40:** 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 0x80:** ff ff ff ff 00 00 00 00 00 00 00 00 00 00 00 00

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I2C Hex Data:
Address 0x00: 7f b0 02 ff 0b 3d 01 11 52 45 56 20 31 37 00 00
Address 0x10: 00 00 00 00 37 35 30 2d 30 34 33 35 39 36 00 00
Address 0x20: 52 45 56 01 11 52 45 56 20 31 37 00 00
Address 0x30: 00 00 00 00 37 35 30 2d 30 34 33 35 39 36 00 00
Address 0x40: 00 00 00 00 37 35 30 2d 30 34 33 35 39 36 00 00
Address 0x50: 52 45 56 01 11 52 45 56 20 31 37 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

Fan Tray 0       REV 01   760-052467   ACAY6190          172mm FanTray - 6 Fans
Jedec Code:   0x7fb0            EEPROM Version:    0x02
P/N:          760-052467        S/N:               ACAY6190
Assembly ID:  0x0b96            Assembly Version:  02.10
Date:         09-18-2015        Assembly Flags:    0x00
Version:      REV 01            CLEI Code:         IPUCBENCAA
ID: 172mm FanTray - 6 Fans      FRU Model Number:  MX2000-FANTRAY-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 3d 01 11 52 45 56 20 31 37 00 00
Address 0x10: 00 00 00 00 37 36 30 2d 30 34 33 35 39 36 00 00
Address 0x20: 52 45 56 01 11 52 45 56 20 31 37 00 00
Address 0x30: 00 00 00 00 37 36 30 2d 30 34 33 35 39 36 00 00
Address 0x40: 00 00 00 00 37 36 30 2d 30 34 33 35 39 36 00 00
Address 0x50: 52 45 56 01 11 52 45 56 20 31 37 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

Fan Tray 1       REV 01   760-052467   ACAY6414          172mm FanTray - 6 Fans
Jedec Code:   0x7fb0            EEPROM Version:    0x02
P/N:          760-052467        S/N:               ACAY6414
Assembly ID:  0x0b96            Assembly Version:  02.10
Date:         10-28-2015        Assembly Flags:    0x00
Version:      REV 01            CLEI Code:         IPUCBENCAA
ID: 172mm FanTray - 6 Fans      FRU Model Number:  MX2000-FANTRAY-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 3d 01 11 52 45 56 20 31 37 00 00
Address 0x10: 00 00 00 00 37 36 30 2d 30 34 33 35 39 36 00 00
Address 0x20: 52 45 56 01 11 52 45 56 20 31 37 00 00
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Address 0x50: 52 45 56 01 11 52 45 56 20 31 37 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

Fan Tray 2       REV 01   760-052467   ACAY6414          172mm FanTray - 6 Fans
Jedec Code:   0x7fb0            EEPROM Version:    0x02
P/N:          760-052467        S/N:               ACAY6414
Assembly ID:  0x0b96            Assembly Version:  02.10
Date:         10-28-2015        Assembly Flags:    0x00
Version:      REV 01            CLEI Code:         IPUCBENCAA
ID: 172mm FanTray - 6 Fans      FRU Model Number:  MX2000-FANTRAY-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 models (MX2008 Router)

table

show chassis hardware models

Hardware inventory:

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<th>Version</th>
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<th>FRU model number</th>
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1875
show chassis hardware clei-models (MX2008 Router)

user@host> show chassis hardware clei-models

Hardware inventory:

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<th>Item</th>
<th>Version</th>
<th>Part number</th>
<th>CLEI code</th>
<th>FRU model number</th>
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user@host> show chassis hardware

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### show chassis hardware (MX204 Router)

```plaintext
user@host> show chassis hardware

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show chassis hardware (vMX running in lite mode)

```
user@host> show chassis hardware
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show chassis hardware (T640 Router)

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Chapter 41: Operational Commands
show chassis hardware models (T640 Router)

user@host> show chassis hardware models

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show chassis hardware extensive (T640 Router)

user@host> show chassis hardware extensive

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show chassis hardware (T4000 Router)

```bash
user@host> show chassis hardware

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show chassis hardware (T4000 Router with 16-GB Line Card Chassis (LCC) Routing Engine)

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user@host> show chassis hardware

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show chassis hardware (T4000 Router with LSR FPC)

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show chassis hardware
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show chassis hardware clei-models (T4000 Router)

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show chassis hardware clei-models
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show chassis hardware detail (T4000 Router)

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user@host> show chassis hardware detail

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user@host> show chassis hardware scc

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show chassis hardware (T1600 Router)

user@host> show chassis hardware

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Xcvr 2 REV 01 740–011782 PB94K0L SFP-SX
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PIC 2 REV 14 750–001901 AP1092 4x OC-12 SONET, SMIR
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Xcvr 7 REV 01 740–011613 AM0812S8UP7 SFP-SX
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**Notes:**
- Ethernet Interfaces Feature Guide for Routing Devices
show chassis hardware (TX Matrix Plus Router)

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show chassis hardware sfc (TX Matrix Plus Router)

user@host> show chassis hardware sfc 0

sfc0-re0:

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show chassis hardware extensive (TX Matrix Plus Router)
show chassis hardware clei-models (TX Matrix Plus Router)

user@host> show chassis hardware clei-models

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show chassis hardware detail (TX Matrix Plus Router)

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| 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 |          | 737A-1024    | SFC RE               |
| Routing Engine 1 |          | 740-026942    | SFC RE               |
| CB 0             REV 01 | 710-022603 | DT947     | F13 SIB               |
| CB 1             REV 01 | 710-022606 | DT947     | F13 SIB               |
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| B Board          REV 02 | 710-023787 | DT1725    | NEO PMB               |
| SIB F2S 0/2      REV 02 | 710-022603 | DT2824    | F25 SIB               |
| B Board          REV 02 | 710-023787 | DT1706    | NEO PMB               |
| SIB F2S 0/4      REV 02 | 710-022603 | DT2822    | F25 SIB               |
| B Board          REV 02 | 710-023787 | DT1696    | NEO PMB               |
| SIB F2S 0/6      REV 02 | 710-022603 | DT2823    | F25 SIB               |
| B Board          REV 02 | 710-023787 | DT1717    | NEO PMB               |
| SIB F2S 1/0      REV 03 | 710-022603 | DT2833    | F25 SIB               |
| B Board          REV 03 | 710-023787 | DT1725    | NEO PMB               |
| SIB F2S 1/2      REV 03 | 710-022603 | DT2820    | F25 SIB               |
| B Board          REV 03 | 710-023787 | DT1713    | NEO PMB               |
| SIB F2S 1/4      REV 03 | 710-022603 | DVO0092   | F25 SIB               |
| B Board          REV 03 | 710-023787 | DV0000    | NEO PMB               |
| SIB F2S 1/6      REV 03 | 710-022603 | DVO0097   | F25 SIB               |
| B Board          REV 03 | 710-023787 | DVO0000   | NEO PMB               |
| SIB F2S 2/0      REV 03 | 710-022603 | DVO1000   | F25 SIB               |
| B Board          REV 03 | 710-023787 | DVO0007   | F25 SIB               |
| SIB F2S 2/2      REV 03 | 710-022603 | DVO0005   | F25 SIB               |
| B Board          REV 03 | 710-023787 | DVO0000   | NEO PMB               |
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**show chassis hardware** (TX Matrix Plus Router with 3D SIBs)

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user@host> show chassis hardware detail

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**lcc2-re0:**

---

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1915
show chassis hardware lcc (TX Matrix Plus Router with 3D SIBs)

user@host> show chassis hardware lcc 0

lcc0-re0:

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user@host> show chassis hardware sfc 0
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Fan Tray 1: Front Bottom Fan Tray
Fan Tray 2: Rear Fan Tray -- Rev 4
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</table>

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### show chassis hardware (16-Port 10-Gigabit Ethernet MPC with SFP+ Optics [MX Series Routers])

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user@host> show chassis hardware
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<th>Part number</th>
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### show chassis hardware (MPC3E [MX Series Routers])

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user@host> show chassis hardware
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<th>Description</th>
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```
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)**

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user@switch> show chassis hardware
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show chassis hardware detail (QFX3500 Switches)

user@switch> show chassis hardware detail

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show chassis hardware models (QFX3500 Switches)

```
user@switch> show chassis hardware models
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show chassis hardware clei-models (QFX3500 Switches)

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user@switch> show chassis hardware clei-models
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show chassis hardware clei-models (QFX5100 Switches)

```
user@switch> show chassis hardware clei-models
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show chassis hardware (QFX10002 Switches)

```plaintext
user@switch> show chassis hardware

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show chassis hardware detail (QFX10002 Switches)

```plaintext
user@switch> show chassis hardware detail

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ada1   4096 MB  QEMU                 QM00002           Virtio Block Disk
ada2   512 MB   QEMU                 QM00003           Virtio Block Disk
ada3   1024 MB  QEMU                 QM00004           Virtio Block Disk
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usb0 (addr 1.1)  EHCI root HUB 0     Intel             uhub1
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usb0 (addr 1.3)  Ultra Fit  21891    SanDisk           umass0
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CPU                     BUILTIN      BUILTIN           FPC CPU

show chassis hardware (QFX10008 and QFX10016 Switches)
user@switch> show chassis hardware
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show chassis hardware (PTX5000 Packet Transport Router)

user@host> show chassis hardware

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show chassis hardware (PTX5000 Packet Transport Router with AC PSM and PDU)

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user@host> show chassis hardware

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show chassis hardware (PTX5000 Packet Transport Router with FPC2-PTX-P1A)

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show chassis hardware clei-models (PTX5000 Packet Transport Router with AC PSM and PDU)

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show chassis hardware detail (PTX5000 Packet Transport Router)

user@host> **show chassis hardware detail**

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show chassis hardware detail (PTX5000 Packet Transport Router with AC PSM and PDU)

user@host> show chassis hardware detail

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show chassis hardware detail (PTX5000 Packet Transport Router with FPC2-PTX-P1A)

user@host> show chassis hardware detail

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show chassis hardware models (PTX5000 Packet Transport Router)

user@host> show chassis hardware models

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show chassis hardware models (PTX5000 Packet Transport Router with AC PSM and PDU)

user@host> show chassis hardware models
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**show chassis hardware models (PTX5000 Packet Transport Router with FPC2-PTX-P1A)**

```
user@host> show chassis hardware models
```

**Hardware inventory:**

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<thead>
<tr>
<th>Item</th>
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<th>Part number</th>
<th>Serial number</th>
<th>Description</th>
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**show chassis hardware extensive (PTX5000 Packet Transport Router)**

```
user@host> show chassis hardware extensive
```

**Hardware inventory:**

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<tr>
<th>Item</th>
<th>Version</th>
<th>Part number</th>
<th>Serial number</th>
<th>Description</th>
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<td>DC Power Dist Unit</td>
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Copyright © 2019, Juniper Networks, Inc.
**show chassis hardware extensive (PTX1000 Packet Transport Router)**

```
user@host> show chassis hardware extensive

Hardware inventory:

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<tr>
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<th>Serial number</th>
<th>Description</th>
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<tr>
<td>Routing Engine 0</td>
<td>REV 06</td>
<td>750-053330</td>
<td>ACAM4850</td>
<td>PTX1000-FPC-P2-BUILTIN</td>
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<td>FPC 0</td>
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<td>PTX1000 Fan Tray 0, Front to Back Airflow - AFO</td>
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<tr>
<td>Fan Tray 1</td>
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<td>PTX1000 Fan Tray 1, Front</td>
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</table>
```
show chassis hardware extensive (PTX5000 with Control Board 2)

```bash
user@host> show chassis hardware grep CB
CB 0             REV 06   750-055537   ACLZ9541          Control Board 2
CB 1             REV 06   750-055537   ACLY5329          Control Board 2
```

show chassis hardware (MX Routers with Media Services Blade [MSB])

```bash
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   ZW5734            AS-MSM
  PIC 0                 BUILTIN      BUILTIN           AS-MSM
  MIC 1          REV 00   750-037211   BUILTIN            AS-MMC
  PIC 2                 BUILTIN      BUILTIN           AS-MMC
```

show chassis hardware extensive (MX Routers with Media Services Blade [MSB])

```bash
user@switch> show chassis hardware extensive
FPC 1            REV 11   750-037207   Zw9726            AS-MCC
  Jede 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 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 ff
    Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 4e 52 45
    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
    Address 0x70: ff ff ff 5e ff ff ff ff ff ff ff ff ff ff
    CPU            REV 04   711-038173   Zw4819            AS-MCC-PMB
  Jede 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
```
**show chassis hardware (ACX5048 Router)**

```bash
user@host> show chassis hardware

Hardware inventory:

<table>
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<th>Item</th>
<th>Version</th>
<th>Part number</th>
<th>Serial number</th>
<th>Description</th>
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</thead>
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<tr>
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<td></td>
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**Board Information Record:**

**Board Information Record:**

<table>
<thead>
<tr>
<th>Address 0x00:</th>
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<td>Address 0x10: 00 00 00 00 37 31 31 2d 30 33 38 31 37 33 00 00</td>
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<td>Address 0x20: 53 2f 4e 20 5a 57 34 38 31 39 00 00 00 1e 0c 07</td>
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<td>Address 0x30: db ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff</td>
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<td>Address 0x40: ff ff ff ff 00 50 52 4f 54 4f 58 43 4c 45 49 37</td>
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<td>Address 0x50: 31 31 2d 30 33 38 31 37 33 00 00 00 00 00 00 00</td>
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<tr>
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<td>Address 0x60: 00 00 00 00 00 00 00 34 00 ff ff ff ff ff ff ff</td>
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<td>Address 0x70: ff ff ff 60 00 00 00 00 00 00 00 00 00 00 00 00 00</td>
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**PIC 0**

**MIC 0**

**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

**FRU Model Number:** 750-037214

**Board Information Record:**

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<td>Address 0x20: 53 2f 4e 20 5a 57 33 35 37 34 00 00 00 13 02 07</td>
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<td></td>
<td>Address 0x30: dc ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff</td>
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<td>Address 0x40: ff ff ff ff 01 50 52 4f 54 4f 58 43 4c 45 49 37</td>
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<td>Address 0x50: 35 30 2d 30 33 37 32 31 34 00 00 00 00 00 00 00 00</td>
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<td>Address 0x70: ff ff ff 60 c0 03 e5 f4 00 00 00 00 00 00 00 00 00</td>
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</table>

**PIC 1**

**MIC 1**

**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:**

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<td>Address 0x10: 00 00 00 00 37 35 30 2d 30 33 37 32 31 31 00 00</td>
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<td>Address 0x20: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ff ff ff</td>
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<tr>
<td></td>
<td>Address 0x30: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff</td>
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<td></td>
<td>Address 0x40: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff</td>
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<tr>
<td></td>
<td>Address 0x50: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff</td>
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<tr>
<td></td>
<td>Address 0x60: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff</td>
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<td>Address 0x70: ff ff ff ff ff c0 02 e6 7f b0 02 ff 0a 44 01 06</td>
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**PIC 2**

**MIC 2**

**Jedec Code:** 0x7fb0

**EEPROM Version:** 0x00

**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:**

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<tr>
<td></td>
<td>Address 0x20: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff</td>
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<tr>
<td></td>
<td>Address 0x30: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff</td>
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<tr>
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<td>Address 0x40: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff</td>
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<td>Address 0x50: ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff</td>
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<td></td>
<td>Address 0x70: ff ff ff ff ff c0 02 e6 6c 7f b0 02 ff 0a 44 01 06</td>
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</table>
### show chassis hardware clei-models (ACX5048 Router)

```
user@host> show chassis hardware clei-models
```

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<th>Version</th>
<th>Part number</th>
<th>CLEI code</th>
<th>FRU model number</th>
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<td>FPC 0</td>
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<td>CMMRG00BRA</td>
<td>ACX5048</td>
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<td>PIC 0</td>
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<td>BUILTIN</td>
<td>CMMRG00BRA</td>
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<tr>
<td>Power Supply 1</td>
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### show chassis hardware models (ACX5048 Router)

```
user@host> show chassis hardware models
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### show chassis hardware (ACX5096 Router)

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## show chassis hardware detail (ACX5096 Router)

```
user@host> show chassis hardware detail
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## show chassis hardware clei-models (ACX5096 Router)

```
user@host> show chassis hardware clei-models
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Copyright © 2019, Juniper Networks, Inc.
### show chassis hardware models (ACX5096 Router)

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show chassis hardware models
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### show chassis hardware (ACX500 Router)

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### show chassis hardware detail (ACX500 Router)

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show chassis hardware detail
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show chassis hardware extensive (ACX500 Router)

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show chassis hardware clei-models (ACX500 Router)

user@host> show chassis hardware clei-models

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Copyright © 2019, Juniper Networks, Inc.
show chassis hardware models (ACX500 Router)

```
user@host> show chassis hardware models
Hardware inventory:
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show chassis hardware (MX960 Router with MPC10E-15C-MRATE Line Card)

```
user@router> show chassis hardware
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</table>
show chassis pic

**List of Syntax**
- Syntax on page 1945
- Syntax (TX Matrix and TX Matrix Plus Routers) on page 1945
- Syntax (MX Series Routers and EX Series Switches) on page 1945
- Syntax (MX104, MX204, MX2010, MX2020, MX10003, and MX2008 3D Universal Edge Routers) on page 1945
- Syntax (PTX Series Packet Transport Router and MX240, MX480, MX960, MX2010, and MX2020 Routers) on page 1945
- Syntax (QFX Series) on page 1945
- Syntax (OCX Series) on page 1946
- Syntax (ACX Series Universal Access Routers) on page 1946
- Syntax (ACX5048 and ACX5096 Routers) on page 1946
- Syntax (ACX500 Routers) on page 1946

**Syntax**
```
show chassis pic fpc-slot slot-number pic-slot slot-number
```

**Syntax (TX Matrix and TX Matrix Plus Routers)**
```
show chassis pic fpc-slot slot-number pic-slot slot-number
<locc number>
```

**Syntax (MX Series Routers and EX Series Switches)**
```
show chassis pic fpc-slot slot-number pic-slot slot-number
<all-members>
<local>
<member member-id>
```

**Syntax (MX104, MX204, MX2010, MX2020, MX10003, and MX2008 3D Universal Edge Routers)**
```
show chassis pic fpc-slot slot-number pic-slot slot-number
```

**Syntax (PTX Series Packet Transport Router and MX240, MX480, MX960, MX2010, and MX2020 Routers)**
```
show chassis pic transport fpc-slot slot-number pic-slot slot-number
```

**Syntax (QFX Series)**
```
show chassis pic fpc-slot slot-number pic-slot slot-number
<interconnect-device name (fpc-slot slot-number | pic-slot slot-number)>
<node-device name pic-slot slot-number>
```
### Syntax (OCX Series)

`show chassis pic fpc-slot slot-number pic-slot slot-number`

### Syntax (ACX Series Universal Access Routers)

`show chassis pic fpc-slot slot-number pic-slot slot-number`

### Syntax (ACX5048 and ACX5096 Routers)

`show chassis pic (fpc-slot slot-number | pic-slot slot-number)`

### Syntax (ACX500 Routers)

`show chassis pic (fpc-slot slot-number | pic-slot slot-number)`

### Release Information

- Command introduced before Junos OS Release 7.4.
- Command introduced in Junos OS Release 9.0 for EX Series switches.
- Command introduced in Junos OS Release 11.1 for QFX Series.
- Command introduced in Junos OS Release 12.2 for ACX Series Universal Access Routers.
- Command introduced in Junos OS Release 12.3 for MX2020 3D Universal Edge Routers.
- Command introduced in Junos OS Release 12.3 for MX2010 3D Universal Edge Routers.
- Command introduced in Junos OS Release 13.2 for PTX Series Packet Transport Routers.
- Command introduced in Junos OS Release 13.2 for MX104 3D Universal Edge Routers.
- Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
- `transport` option introduced in Junos OS Release 16.1R1 for MX Series Routers.
- Command introduced in Junos OS Release 17.2 for MX2008 3D Universal Edge Routers.
- Command introduced in Junos OS Release 17.2 for PTX10008 Routers.
- Command introduced in Junos OS Release 17.3 for MX10003 3D Universal Edge Routers.
- Command introduced in Junos OS Release 17.3 for MX150 Router Appliance.
- Command introduced in Junos OS Release 17.4 for MX204 3D Universal Edge Routers.

### Description

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.
MX2008 routers only—Replace `slot-number` with a value from 0 through 9.
MX10003 routers only—Replace `slot-number` with a value from 0 through 1.
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 1678
- 100-Gigabit Ethernet Type 4 PIC with CFP Overview on page 459

List of Sample Output
- show chassis pic fpc-slot pic-slot on page 1952
- show chassis pic fpc-slot pic-slot (PIC Offline) on page 1952
- show chassis pic fpc-slot pic-slot (FPC Offline) on page 1953
- show chassis pic fpc-slot pic-slot (FPC Not Present) on page 1953
- show chassis pic fpc-slot pic-slot (PIC Not Present) on page 1953
- show chassis pic fpc-slot 3 pic-slot 0 (MI20 Router) on page 1953
- show chassis pic fpc-slot pic-slot (MX150) on page 1953
- show chassis pic fpc-slot pic-slot (MX104 Router) on page 1953
show chassis pic fpc-slot pic-slot (MX960 Router with Bidirectional Optics) on page 1954
show chassis pic fpc-slot pic-slot (MX480 Router with 100-Gigabit Ethernet MIC) on page 1954
show chassis pic fpc-slot pic-slot (MX240, MX480, MX960 Routers with Application Services Modular Line Card) on page 1955
show chassis pic fpc-slot pic-slot (MX960 Router with MPC5EQ) on page 1955
show chassis pic fpc-slot pic-slot (MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC) on page 1955
show chassis pic fpc-slot pic-slot on page 1955
show chassis pic fpc-slot pic-slot (MX10003 Routers) on page 1956
show chassis pic fpc-slot pic-slot (MX204 Routers) on page 1957
show chassis pic fpc-slot pic-slot (PTX3000 Router with 5-port 100-Gigabit DWDM OTN PIC) on page 1957
show chassis pic fpc-slot pic-slot (MX480 Router with MPC4E) on page 1958
show chassis pic fpc-slot pic-slot (MX480 router with OTN interface) on page 1958
show chassis pic fpc-slot pic-slot (MX2010 Router with OTN Interfaces) on page 1958
show chassis pic fpc-slot pic-slot (MX2010 Router) on page 1959
show chassis pic fpc-slot pic-slot (MX2020 Router) on page 1959
show chassis pic fpc-slot pic-slot (MX2020 Router with MPC5EQ and MPC6E) on page 1959
show chassis pic fpc-slot pic-slot (MX2020 Router with MPC6E and OTN MIC) on page 1960
show chassis pic fpc-slot pic-slot (MX2020 Router with MPC4E) on page 1960
show chassis pic fpc-slot pic-slot (MX2010 Router) on page 1961
show chassis pic fpc-slot pic-slot (T1600 Router with 100-Gigabit Ethernet PIC) on page 1961
show chassis pic fpc-slot pic-slot lcc (TX Matrix Router) on page 1961
show chassis pic fpc-slot pic-slot lcc (TX Matrix Plus Router) on page 1961
show chassis pic fpc-slot pic-slot (Next-Generation SONET/SDH SFP) on page 1962
show chassis pic fpc-slot pic-slot (12-Port T1/E1) on page 1962
show chassis pic fpc-slot 0 pic-slot 1 (4x CHOC3 SONET CE SFP) on page 1962
show chassis pic fpc-slot 0 pic-slot 0 (SONET/SDH OC3/STM1 [Multi-Rate] MIC with SFP) on page 1963
show chassis pic fpc-slot 3 pic-slot 0 (8-port Channelized SONET/SDH OC3/STM1 [Multi-Rate] MIC with SFP) on page 1963
show chassis pic fpc-slot 5 pic-slot 0 (4-port Channelized SONET/SDH OC3/STM1 [Multi-Rate] MIC with SFP) on page 1963
show chassis pic fpc-slot 1 pic-slot 0 (1-port OC192/STM64 MIC with XFP) on page 1963
show chassis pic fpc-slot 1 pic-slot 2 (8-port DS3/E3 MIC) on page 1964
show chassis pic fpc-slot pic-slot (OTN) on page 1964
show chassis pic fpc-slot pic-slot (QFX3500 Switch) on page 1964
show chassis pic fpc-slot pic-slot (QFX5100 Switches and OCX Series) on page 1964
show chassis pic interconnect-device fpc-slot pic-slot (QFabric Systems) on page 1964
show chassis pic node-device fpc-slot pic-slot (QFabric System) on page 1965
show chassis pic fpc-slot 0 pic-slot 1 (ACX2000 Universal Access Router) on page 1966
show chassis pic FPC-slot 1 PIC-slot 0 (MX Routers with Media Services Blade [MSB]) on page 1966
show chassis pic FPC slot 1, PIC slot 2 (MX Routers with Media Services Blade [MSB]) on page 1966
show chassis pic transport fpc-slot pic-slot (PTX Series Packet Transport Routers) on page 1966
show chassis pic transport fpc-slot pic-slot (MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC) on page 1966
show chassis pic fpc-slot 0 pic-slot 0 (ACX5096 Router) on page 1966
show chassis pic fpc-slot 0 pic-slot 0 (ACX5048 Router) on page 1970
show chassis pic fpc-slot 0 pic-slot 0 (ACX500 Router) on page 1971
show chassis pic fpc-slot 0 pic-slot 1 (ACX500 Router) on page 1971
show chassis pic transport fpc-slot pic-slot (PTX Series Packet Transport Routers) on page 1971
show chassis pic transport fpc-slot pic-slot (MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC) on page 1971
show chassis pic fpc-slot 7 pic-slot 1 (MX960 Router MPC10E-15C-MRATE Line Card) on page 1971

Output Fields Table 146 on page 1950 lists the output fields for the show chassis pic command. Output fields are listed in the approximate order in which they appear.

Table 146: show chassis pic Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>PIC type.</td>
</tr>
<tr>
<td></td>
<td><strong>NOTE:</strong> On the 1-port OC192/STM64 MICs with the SDH framing mode, the type is displayed as MIC-3D-1STM64-XFP and with the SONET framing mode, the type is displayed as MIC-3D-1OC192-XFP. By default, the 1-port OC192/STM64 MICs displays the type as MIC-3D-1OC192-XFP.</td>
</tr>
<tr>
<td>Account Layer2 Overhead</td>
<td>(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.</td>
</tr>
<tr>
<td>ASIC type</td>
<td>Type of ASIC on the PIC.</td>
</tr>
<tr>
<td>State</td>
<td>Status of the PIC. State is displayed only when a PIC is in the slot.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Online</strong>—PIC is online and running.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Offline</strong>—PIC is powered down.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Empty</strong>—No PIC is present.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Present</strong>—PIC is plugged in. The PIC is not powered on or operational.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Onlining</strong>—PIC is in the process of going online. PICs and rest of the hardware is initializing.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Offlining</strong>—PIC is in the process of going offline. PIC and rest of the hardware is being shutdown down to take the offline gracefully.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Fault</strong>—PIC is in an alarmed state and the PIC is not operational.</td>
</tr>
<tr>
<td>PIC version</td>
<td>PIC hardware version.</td>
</tr>
<tr>
<td>Uptime</td>
<td>How long the PIC has been online.</td>
</tr>
</tbody>
</table>
Table 146: show chassis pic Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>(Multiservices PICs only) Services package supported: Layer-2 or Layer-3.</td>
</tr>
<tr>
<td>Port Number</td>
<td>Port number for the PIC.</td>
</tr>
<tr>
<td>Cable Type</td>
<td>Type of cable connected to the port: LH, LX, or SX.</td>
</tr>
<tr>
<td>PIC Port Information (MX480 Router 100-Gigabit Ethernet CFP)</td>
<td>Port-level information for the PIC.</td>
</tr>
<tr>
<td></td>
<td>• Port—Port number</td>
</tr>
<tr>
<td></td>
<td>• Cable type—Type of optical transceiver installed.</td>
</tr>
<tr>
<td></td>
<td>• Fiber type—Type of fiber. SM is single-mode.</td>
</tr>
<tr>
<td></td>
<td>• Xcvr vendor—Transceiver vendor name.</td>
</tr>
<tr>
<td></td>
<td>• Xcvr vendor part number—Transceiver vendor part number.</td>
</tr>
<tr>
<td></td>
<td>• Wavelength—Wavelength of the transmitted signal. Uplinks and downlinks are always 1550 nm. There is a separate fiber for each direction</td>
</tr>
<tr>
<td></td>
<td>• Xcvr Firmware—Transceiver firmware version.</td>
</tr>
<tr>
<td>PIC Port Information (MX960 Router Bidirectional Optics)</td>
<td>Port-level information for the PIC.</td>
</tr>
<tr>
<td></td>
<td>• Port—Port number</td>
</tr>
<tr>
<td></td>
<td>• Cable type—Type of small form-factor pluggable (SFP) optical transceiver installed. Uplink interfaces display -U. Down link interfaces display -D.</td>
</tr>
<tr>
<td></td>
<td>• Fiber type—Type of fiber. SM is single-mode.</td>
</tr>
<tr>
<td></td>
<td>• Xcvr vendor—Transceiver vendor name.</td>
</tr>
<tr>
<td></td>
<td>• Xcvr vendor part number—Transceiver vendor part number.</td>
</tr>
<tr>
<td></td>
<td>• BX10-10-km bidirectional optics.</td>
</tr>
<tr>
<td></td>
<td>• BX40-40-km bidirectional optics.</td>
</tr>
<tr>
<td></td>
<td>• SFP-LX-40-km SFP optics.</td>
</tr>
<tr>
<td></td>
<td>• Wavelength—Wavelength of the transmitted signal. Uplinks are always 1310 nm. Downlinks are either 1490 nm or 1550 nm.</td>
</tr>
<tr>
<td>PIC Port Information (Next-Generation SONET/SDH SFP)</td>
<td>Port-level information for the next-generation SONET/SDH SFP PIC.</td>
</tr>
<tr>
<td></td>
<td>• Port—Port number.</td>
</tr>
<tr>
<td></td>
<td>• Cable type—Type of small form-factor pluggable (SFP) optical transceiver installed.</td>
</tr>
<tr>
<td></td>
<td>• Fiber type—Type of fiber: SM (single-mode) or MM (multimode).</td>
</tr>
<tr>
<td></td>
<td>• Xcvr vendor—Transceiver vendor name.</td>
</tr>
<tr>
<td></td>
<td>• Xcvr vendor part number—Transceiver vendor part number.</td>
</tr>
<tr>
<td></td>
<td>• Wavelength—Wavelength of the transmitted signal. Next-generation SONET/SDH SFPs use 1310 nm.</td>
</tr>
</tbody>
</table>
Table 146: show chassis pic Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIC port information (MX104 router)</td>
<td>Port-level information for the PIC.</td>
</tr>
<tr>
<td>• Port—Port number</td>
<td></td>
</tr>
<tr>
<td>• Cable type—Type of optical transceiver installed.</td>
<td></td>
</tr>
<tr>
<td>• Fiber type—Type of fiber. SM is single-mode.</td>
<td></td>
</tr>
<tr>
<td>• Xcvr vendor—Transceiver vendor name.</td>
<td></td>
</tr>
<tr>
<td>• Xcvr vendor part number—Transceiver vendor part number.</td>
<td></td>
</tr>
<tr>
<td>• Wavelength—Wavelength of the transmitted signal.</td>
<td></td>
</tr>
<tr>
<td>• Xcvr Firmware—Firmware version of the transceiver.</td>
<td></td>
</tr>
<tr>
<td>Port speed information</td>
<td>Information pertaining to port speed:</td>
</tr>
<tr>
<td>• Port—Port number</td>
<td></td>
</tr>
<tr>
<td>• PFE—Packet Forwarding Engine slot number.</td>
<td></td>
</tr>
<tr>
<td>• Capable Port Speed—Speed supported by each port.</td>
<td></td>
</tr>
<tr>
<td>Multirate Mode</td>
<td>Rate-selectability status for the MIC: Enabled or Disabled.</td>
</tr>
<tr>
<td>Channelization</td>
<td>Indicates whether channelization is enabled or disabled on the DS3/E3 MIC.</td>
</tr>
<tr>
<td>Administrative State</td>
<td>Indicates the administrative state of the PIC. Possible values are: In Service (Default) and Out of Service.</td>
</tr>
<tr>
<td>Operational State</td>
<td>Indicates the operational state of the PIC. Possible values are: Normal and Fault.</td>
</tr>
</tbody>
</table>

Sample Output

**show chassis pic fpc-slot pic-slot**

```
user@host> show chassis pic fpc-slot2 pic-slot0
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 Vendor
  Number   Type       Vendor Name      Part Number
  0        GIGE 1000EX  FINISAR CORP.  FTRJ8519P18NL-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-slot1 pic-slot0
PIC fpc slot 1 pic slot 0 information:
  State 1 pic slot 0 information: 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:
<table>
<thead>
<tr>
<th>Port Number</th>
<th>Cable Type</th>
<th>Xcvr Vendor</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>GIGE 1000SX</td>
<td>FINISAR CORP.</td>
<td>FTRJ8519P1BNL-J3</td>
</tr>
<tr>
<td>1</td>
<td>GIGE 1000SX</td>
<td>FINISAR CORP.</td>
<td>FTRJ-8519-7D-JUN</td>
</tr>
</tbody>
</table>

show chassis pic fpc-slot pic-slot (MX150)

user@host> show chassis pic fpc-slot 0 pic-slot 0

FPC slot 0, PIC slot 0 information:
Type Virtual
State Online
PIC version 0.0
Uptime 7 days, 19 hours, 44 minutes, 40 seconds

PIC port information:
<table>
<thead>
<tr>
<th>Port Number</th>
<th>Cable Type</th>
<th>Xcvr Vendor</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>GIGE 1000T</td>
<td>n/a Methode Elec.</td>
<td>SP7041-M1-JN</td>
</tr>
<tr>
<td>11</td>
<td>GIGE 1000T</td>
<td>n/a Methode Elec.</td>
<td>SP7041-M1-JN</td>
</tr>
</tbody>
</table>

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:
<table>
<thead>
<tr>
<th>Type</th>
<th>10x 1GE(LAN) -E SFP</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>Online</td>
</tr>
<tr>
<td>PIC version</td>
<td>1.1</td>
</tr>
<tr>
<td>Uptime</td>
<td>1 hour, 30 minutes, 59 seconds</td>
</tr>
</tbody>
</table>

PIC port information:
<table>
<thead>
<tr>
<th>Fiber</th>
<th>Xcvr vendor</th>
<th>Wave-</th>
<th>Xcvr</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>n/a</td>
<td>Methode Elec.</td>
<td>SP7041-M1-JN</td>
</tr>
<tr>
<td>6</td>
<td>SM</td>
<td>FINISAR CORP.</td>
<td>FTLF1318P2BTL-J1</td>
</tr>
<tr>
<td>8</td>
<td>n/a</td>
<td>Methode Elec.</td>
<td>SP7041-M1-JN</td>
</tr>
<tr>
<td>9</td>
<td>n/a</td>
<td>Methode Elec.</td>
<td>SP7041-M1-JN</td>
</tr>
</tbody>
</table>

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:
<table>
<thead>
<tr>
<th>Type</th>
<th>10x 1GE(LAN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Account Layer2 Overhead</td>
<td>Enabled</td>
</tr>
<tr>
<td>State</td>
<td>Online</td>
</tr>
<tr>
<td>PIC version</td>
<td>0.0</td>
</tr>
<tr>
<td>Uptime</td>
<td>18 days, 5 hours, 41 minutes, 54 seconds</td>
</tr>
</tbody>
</table>

PIC port information:
<table>
<thead>
<tr>
<th>Fiber</th>
<th>Xcvr vendor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>SM</td>
</tr>
<tr>
<td>1</td>
<td>SumitomoElectric</td>
</tr>
<tr>
<td>2</td>
<td>SumitomoElectric</td>
</tr>
<tr>
<td>3</td>
<td>OCP</td>
</tr>
<tr>
<td>4</td>
<td>OCP</td>
</tr>
<tr>
<td>5</td>
<td>SumitomoElectric</td>
</tr>
<tr>
<td>6</td>
<td>SumitomoElectric</td>
</tr>
<tr>
<td>7</td>
<td>OCP</td>
</tr>
<tr>
<td>8</td>
<td>OCP</td>
</tr>
<tr>
<td>9</td>
<td>SumitomoElectric</td>
</tr>
</tbody>
</table>

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:
<table>
<thead>
<tr>
<th>Type</th>
<th>1X100GE CFP</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>Online</td>
</tr>
<tr>
<td>PIC version</td>
<td>2.10</td>
</tr>
<tr>
<td>Uptime</td>
<td>4 minutes, 48 seconds</td>
</tr>
</tbody>
</table>

PIC port information:
<table>
<thead>
<tr>
<th>Fiber</th>
<th>Xcvr vendor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>SM</td>
</tr>
<tr>
<td>1</td>
<td>FINISAR CORP.</td>
</tr>
</tbody>
</table>

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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 Port Cable type  Xcvr vendor Xcvr type Xcvr vendor part number length
  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 Port Cable type  Xcvr vendor Xcvr type Xcvr vendor part number length
  0 100G LH SM Oclaro TRB100AJ-01 1528.77 nm - 1568.36 nm 20.10

show chassis pic fpc-slot pic-slot

user@host> show chassis pic fpc-slot 1 pic-slot 1
FPC slot 1, PIC slot 1 information:
  Type MIC1-MACSEC

Cxcv vendor
firmware version
1.8
show chassis pic fpc-slot pic-slot (MX10003 Routers)

```
user@host > show chassis pic fpc-slot 0 pic-slot 0
```

FPC slot 0, PIC slot 1 information:
- **Type**: MIC1
- **State**: Online
- **Uptime**: 13 hours, 54 minutes, 33 seconds

PIC port information:
- **Fiber**
- **Xcvr vendor**
- **Wave-**
- **Xcvr**

```
Port | Cable type | Xcvr vendor | part number | length
-----|------------|-------------|-------------|-------
0    | 40GBASE SR4 | AVAGO       | AFBR-79EQDZ-JU2 | 850 nm | 0.0
11   | 40GBASE SR4 | AVAGO       | AFBR-79EQDZ-JU2 | 850 nm | 0.0
```

Port speed information:
```
Port | PFE | Capable Port Speeds
-----|-----|---------------------
0    | 0   | 4x10GE, 40GE, 100GE
1    | 0   | 4x10GE, 40GE, 100GE
2    | 0   | 4x10GE, 40GE, 100GE
3    | 0   | 4x10GE, 40GE, 100GE
4    | 1   | 4x10GE, 40GE, 100GE
5    | 1   | 4x10GE, 40GE, 100GE
6    | 1   | 4x10GE, 40GE, 100GE
7    | 1   | 4x10GE, 40GE, 100GE
8    | 0   | 4x10GE, 40GE, 100GE
9    | 0   | 4x10GE, 40GE, 100GE
10   | 0   | 4x10GE, 40GE, 100GE
11   | 0   | 4x10GE, 40GE, 100GE
```
### show chassis pic fpc-slot pic-slot (MX204 Routers)

```
user@host > show chassis pic fpc-slot 0 pic-slot 0

FPC slot 0, PIC slot 0 information:

<table>
<thead>
<tr>
<th>Type</th>
<th>4XQSFP28 PIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>Online</td>
</tr>
<tr>
<td>PIC version</td>
<td>0.0</td>
</tr>
<tr>
<td>Uptime</td>
<td>2 days, 7 hours, 6 minutes, 10 seconds</td>
</tr>
</tbody>
</table>

PIC port information:

<table>
<thead>
<tr>
<th>Fiber</th>
<th>Xcvr vendor</th>
<th>Wave-</th>
<th>Xcyr</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM</td>
<td>JUNIPER-FINISAR</td>
<td>850 nm</td>
<td>0.0</td>
</tr>
<tr>
<td>MM</td>
<td>AVAGO</td>
<td>850 nm</td>
<td>0.0</td>
</tr>
<tr>
<td>SM</td>
<td>JUNIPER-FINISAR</td>
<td>1302 nm</td>
<td>0.0</td>
</tr>
<tr>
<td>SM</td>
<td>JUNIPER-FINISAR</td>
<td>1302 nm</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Port speed information:

<table>
<thead>
<tr>
<th>Port</th>
<th>PFE</th>
<th>Capable Port Speeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>4x10GE, 40GE, 100GE</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>4x10GE, 40GE, 100GE</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>4x10GE, 40GE, 100GE</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>4x10GE, 40GE, 100GE</td>
</tr>
</tbody>
</table>
```

### 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:

<table>
<thead>
<tr>
<th>Type</th>
<th>5X100GE DWDM CFP2-ACO</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>Online</td>
</tr>
<tr>
<td>PIC version</td>
<td>1.17</td>
</tr>
<tr>
<td>Uptime</td>
<td>1 day, 5 hours, 15 minutes, 17 seconds</td>
</tr>
</tbody>
</table>

PIC port information:

<table>
<thead>
<tr>
<th>Fiber</th>
<th>Xcvr vendor</th>
<th>Wave-</th>
<th>Xcyr</th>
</tr>
</thead>
<tbody>
<tr>
<td>SM</td>
<td>MULTILANE SAL</td>
<td>1528.77 nm</td>
<td>1.0</td>
</tr>
<tr>
<td>SM</td>
<td>MULTILANE SAL</td>
<td>1528.77 nm</td>
<td>1.0</td>
</tr>
<tr>
<td>SM</td>
<td>JUNIPER-FUJITSU</td>
<td>1528.77 nm</td>
<td>1.16</td>
</tr>
</tbody>
</table>

Port speed information:

<table>
<thead>
<tr>
<th>Port</th>
<th>PFE</th>
<th>Capable Port Speeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>4x10GE, 40GE, 100GE</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>4x10GE, 40GE, 100GE</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>4x10GE, 40GE, 100GE</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>4x10GE, 40GE, 100GE</td>
</tr>
</tbody>
</table>
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:
  Port Cable type                Fiber      Xcvr vendor       Wave-    Xcvr
  Firmware                       type  Xcvr vendor        part number       length
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 pic 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:
  Port Cable type                Fiber      Xcvr vendor       Wave-    Xcvr
  Firmware                       type  Xcvr vendor        part number       length
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                Xcvr vendor        part number       length
  Firmware                       type  Xcvr vendor        part number       length
```
<table>
<thead>
<tr>
<th>Port Cable type</th>
<th>type</th>
<th>Xcvr vendor</th>
<th>part number</th>
<th>length</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>100GBASE LR4-D</td>
<td>SM</td>
<td>FUJITSU</td>
<td>FIM37300/222</td>
</tr>
<tr>
<td>1</td>
<td>100GBASE SR10</td>
<td>MM</td>
<td>AVAGO</td>
<td>AFBR-8420Z</td>
</tr>
</tbody>
</table>

**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:

<table>
<thead>
<tr>
<th>Port Cable type</th>
<th>type</th>
<th>Xcvr vendor</th>
<th>part number</th>
<th>Wave-</th>
<th>Xcvr</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10GBASE SR</td>
<td>MM</td>
<td>SumitomoElectric</td>
<td>SPP5200SR-J6-M</td>
<td>850 nm</td>
</tr>
<tr>
<td>1</td>
<td>10GBASE SR</td>
<td>MM</td>
<td>SumitomoElectric</td>
<td>SPP5200SR-J6-M</td>
<td>850 nm</td>
</tr>
<tr>
<td>2</td>
<td>10GBASE SR</td>
<td>MM</td>
<td>SumitomoElectric</td>
<td>SPP5200SR-J6-M</td>
<td>850 nm</td>
</tr>
<tr>
<td>3</td>
<td>10GBASE SR</td>
<td>MM</td>
<td>SumitomoElectric</td>
<td>SPP5200SR-J6-M</td>
<td>850 nm</td>
</tr>
</tbody>
</table>
```

**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:

<table>
<thead>
<tr>
<th>Port Cable type</th>
<th>type</th>
<th>Xcvr vendor</th>
<th>part number</th>
<th>Wave-</th>
<th>Xcvr</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>40GBASE SR4</td>
<td>MM</td>
<td>AVAGO</td>
<td>AFBR-79E42-D-JU2</td>
<td>850 nm</td>
</tr>
</tbody>
</table>
```
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
  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    SPP10S1REDFCJNP   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 2 information:
  Type                             4x10GE SFPP
  State                            Online
  PIC version                  0.0
  Uptime                         1 day, 14 hours, 49 minutes, 9 seconds

PIC port information:
  Fiber                    Xcvr vendor       Wave-    Xcvr
  Port Cable type        type  Xcvr vendor        part number       length
  0    10GBASE SR        MM    SumitomoElectric   SPP5100SR-J3      850 nm   0.0
  1    10GBASE SR        MM    SumitomoElectric   SPP5100SR-J3      850 nm   0.0
  3    10GBASE SR        MM    SumitomoElectric   SPP5100SR-J3      850 nm   0.0
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 (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:

<table>
<thead>
<tr>
<th>Port</th>
<th>Cable type</th>
<th>Fiber type</th>
<th>Xcvr vendor</th>
<th>Part number</th>
<th>Wavelength</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>100GBASE LR4</td>
<td>SM</td>
<td>Opnext Inc.</td>
<td>TRC5E20ENFSF000F</td>
<td>1310 nm</td>
</tr>
</tbody>
</table>

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-pc-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:

<table>
<thead>
<tr>
<th>Port</th>
<th>Cable type</th>
<th>Fiber type</th>
<th>Xcvr vendor</th>
<th>Part number</th>
<th>Wavelength</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10GBASE ZR</td>
<td>SM</td>
<td>Opnext Inc.</td>
<td>TRF7061BN-LF150</td>
<td>1550 nm</td>
</tr>
<tr>
<td>0</td>
<td>10GBASE ZR</td>
<td>SM</td>
<td>FINISAR CORP.</td>
<td>FTRX-1811-3-J2</td>
<td>1550 nm</td>
</tr>
</tbody>
</table>
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:
<table>
<thead>
<tr>
<th>Port</th>
<th>Fiber</th>
<th>Xcvr vendor</th>
<th>Part number</th>
<th>Wavelength</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>OC48 short reach SM</td>
<td>FINISAR CORP.</td>
<td>FTRJ1321P1BT-L2</td>
<td>1310 nm</td>
</tr>
<tr>
<td>1</td>
<td>OC3 short reach MM</td>
<td>OCP</td>
<td>TRPA03M38AS-JE</td>
<td>1310 nm</td>
</tr>
<tr>
<td>2</td>
<td>OC3 short reach MM</td>
<td>OCP</td>
<td>TRXA03M38AS-JW</td>
<td>1310 nm</td>
</tr>
<tr>
<td>3</td>
<td>OC12 inter reach SM</td>
<td>FINISAR CORP.</td>
<td>FTLF1322P1BTR</td>
<td>1310 nm</td>
</tr>
</tbody>
</table>

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:
<table>
<thead>
<tr>
<th>Port</th>
<th>Fiber</th>
<th>Xcvr vendor</th>
<th>Part number</th>
<th>Wavelength</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>OC3 short reach MM</td>
<td>AVAGO</td>
<td>HFB8-57E0P-JU2</td>
<td>n/a</td>
</tr>
<tr>
<td>1</td>
<td>OC3 short reach MM</td>
<td>AVAGO</td>
<td>HFB8-57E0P-JU2</td>
<td>n/a</td>
</tr>
<tr>
<td>3</td>
<td>OC3 long reach SM</td>
<td>OPNEXT INC</td>
<td>TRF5456AVLB314</td>
<td>1310 nm</td>
</tr>
</tbody>
</table>
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-8OC30C12-4OC48
  State                            Online
  PIC version                  1.8
  Uptime                         3 days, 22 hours, 3 minutes, 50 seconds

PIC port information:
<table>
<thead>
<tr>
<th>Port</th>
<th>Cave type</th>
<th>type</th>
<th>Xcvr vendor</th>
<th>part number</th>
<th>Wavelength</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>OC12 inter reach</td>
<td>SM</td>
<td>FINISAR CORP.</td>
<td>FTRJ1322P1BTR-J3</td>
<td>1310 nm</td>
</tr>
<tr>
<td>7</td>
<td>OC12 inter reach</td>
<td>SM</td>
<td>FINISAR CORP.</td>
<td>FTRJ1322P1BTR-J3</td>
<td>1310 nm</td>
</tr>
</tbody>
</table>

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:
<table>
<thead>
<tr>
<th>Port</th>
<th>Cable type</th>
<th>type</th>
<th>Xcvr vendor</th>
<th>part number</th>
<th>Wavelength</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>OC12 short reach</td>
<td>SM</td>
<td>FINISAR CORP.</td>
<td>FTRJ1322P1BTR-J3</td>
<td>1310 nm</td>
</tr>
<tr>
<td>1</td>
<td>OC12 short reach</td>
<td>SM</td>
<td>FINISAR CORP.</td>
<td>FTRJ1322P1BTR-J3</td>
<td>1310 nm</td>
</tr>
<tr>
<td>2</td>
<td>OC12 inter reach</td>
<td>SM</td>
<td>FINISAR CORP.</td>
<td>FTRJ1322P1BTR-J2</td>
<td>1310 nm</td>
</tr>
<tr>
<td>4</td>
<td>OC12 short reach</td>
<td>SM</td>
<td>FINISAR CORP.</td>
<td>FTRJ1322P1BTR-J3</td>
<td>1310 nm</td>
</tr>
<tr>
<td>5</td>
<td>OC12 short reach</td>
<td>SM</td>
<td>FINISAR CORP.</td>
<td>FTRJ1322P1BTR-J3</td>
<td>1310 nm</td>
</tr>
<tr>
<td>6</td>
<td>OC12 short reach</td>
<td>SM</td>
<td>FINISAR CORP.</td>
<td>FTRJ1322P1BTR-J3</td>
<td>1310 nm</td>
</tr>
<tr>
<td>7</td>
<td>OC12 short reach</td>
<td>SM</td>
<td>FINISAR CORP.</td>
<td>FTRJ1322P1BTR-J3</td>
<td>1310 nm</td>
</tr>
</tbody>
</table>

Multirate Mode                     Enabled
```

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:
<table>
<thead>
<tr>
<th>Port</th>
<th>Cable type</th>
<th>type</th>
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Multirate Mode                     Enabled
```

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
```

Copyright © 2019, Juniper Networks, Inc.
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

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show chassis pic fpc-slot1 pic-slot2 (8-port DS3/E3 MIC)
user@host> show chassis pic fpc-slot1 pic-slot2

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-slot5 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-slot0 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-slot0 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-slot9 pic-slot 0

FPC slot 9, PIC slot 0 information:
Type                             16x 40G-GE Builtin
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+Builtin
- State: Online
- Uptime: 2 hours, 52 minutes, 37 seconds

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</table>
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-MSM
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 chassis pic transport fpc-slot pic-slot (PTX Series Packet Transport Routers)

user@host> show chassis pic transport fpc-slot 2 pic-slot 0

Administrative State:      In Service
Operational    State:      Normal

show chassis pic transport fpc-slot pic-slot (MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC)

user@host> show chassis pic transport fpc-slot 3 pic-slot 0

Administrative State:      In Service
Operational    State:      Normal

show chassis pic fpc-slot 0 pic-slot 0 (ACX5096 Router)

user@host> show chassis pic fpc-slot 0 pic-slot 0

FPC slot 0, PIC slot 0 information:
Type                             96x10G-8x40G
State                            Online
PIC version                  2.9
Uptime                         21 hours, 28 minutes, 13 seconds
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<td>TRS5021EN-S201</td>
<td>1310</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>86</td>
<td>ER</td>
<td>SM</td>
<td>OPNEXT, INC</td>
<td>TRS7050EN-S201</td>
<td>1550</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>87</td>
<td>LRM</td>
<td>MM</td>
<td>OPNEXT INC</td>
<td>TRS5001EN-0014</td>
<td>1310</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>88</td>
<td>LRM</td>
<td>MM</td>
<td>OPNEXT INC</td>
<td>TRS5001EN-0014</td>
<td>1310</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>89</td>
<td>LRM</td>
<td>MM</td>
<td>OPNEXT INC</td>
<td>TRS5001EN-0014</td>
<td>1310</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>LRM</td>
<td>MM</td>
<td>OPNEXT INC</td>
<td>TRS5001EN-0014</td>
<td>1310</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
show chassis pic fpc-slot 0 pic-slot 0 (ACX5048 Router)

user@host> show chassis pic fpc-slot 0 pic-slot 0

FPC slot 0, PIC slot 0 information:
Type 96x10G-8x40G
State Online
PIC version 2.9
Uptime 1 day, 5 hours, 27 minutes, 25 seconds

PIC port information:
<table>
<thead>
<tr>
<th>Port</th>
<th>Cable type</th>
<th>Firmware</th>
<th>Fiber</th>
<th>Wave-</th>
<th>Xcvr vendor</th>
<th>Xcvr</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10GBASE SR</td>
<td>MM</td>
<td>FINISAR CORP.</td>
<td>FTLX8570D3BCL-J1</td>
<td>850 nm</td>
<td>0.0</td>
</tr>
<tr>
<td>10</td>
<td>GIGE 1000SX</td>
<td>MM</td>
<td>FINISAR CORP.</td>
<td>FTLF8519P3BNL-J1</td>
<td>850 nm</td>
<td>0.0</td>
</tr>
<tr>
<td>14</td>
<td>10GBASE SR</td>
<td>MM</td>
<td>FINISAR CORP.</td>
<td>FTLX8571D3BNL-J1</td>
<td>850 nm</td>
<td>0.0</td>
</tr>
<tr>
<td>20</td>
<td>10GBASE SR</td>
<td>MM</td>
<td>FINISAR CORP.</td>
<td>FTLX8571D3BNL-J1</td>
<td>850 nm</td>
<td>0.0</td>
</tr>
<tr>
<td>30</td>
<td>GIGE 1000SX</td>
<td>MM</td>
<td>FINISAR CORP.</td>
<td>FTLF8519P2BNL-J1</td>
<td>850 nm</td>
<td>0.0</td>
</tr>
<tr>
<td>41</td>
<td>10GBASE SR</td>
<td>MM</td>
<td>OPNEXT, INC.</td>
<td>TRS2001EN-0014</td>
<td>850 nm</td>
<td>0.0</td>
</tr>
<tr>
<td>46</td>
<td>GIGE 1000SX</td>
<td>MM</td>
<td>FINISAR CORP.</td>
<td>FTLF8519P2BNL-J1</td>
<td>850 nm</td>
<td>0.0</td>
</tr>
<tr>
<td>64</td>
<td>10GBASE SR</td>
<td>MM</td>
<td>FINISAR CORP.</td>
<td>FTLX8571D3BNL-J1</td>
<td>850 nm</td>
<td>0.0</td>
</tr>
</tbody>
</table>
show chassis pic fpc-slot 0 pic-slot 0 (ACX500 Router)

```
user@host> show chassis pic fpc-slot 0 pic-slot 0
FPC slot 0, PIC slot 0 information:
    Type                       2x 1GE(LAN) SFP Builtin
    State                      Online
    Uptime                     17 hours, 54 minutes, 45 seconds
```

show chassis pic fpc-slot 0 pic-slot 1 (ACX500 Router)

```
user@host> show chassis pic fpc-slot 0 pic-slot 1
FPC slot 0, PIC slot 1 information:
    Type                       4x 1GE(LAN) RJ45, SFP Builtin
    State                      Online
    Uptime                     17 hours, 54 minutes, 45 seconds
```

show chassis pic transport fpc-slot pic-slot (PTX Series Packet Transport Routers)

```
user@host> show chassis pic transport fpc-slot 2 pic-slot 0
Administrative State:      In Service
Operational    State:      Normal
```

show chassis pic transport fpc-slot pic-slot (MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC)

```
user@host> show chassis pic transport fpc-slot 3 pic-slot 0
Administrative State:      In Service
Operational    State:      Normal
```

show chassis pic fpc-slot 7 pic-slot 1 (MX960 Router MPC10E-15C-MRATE Line Card)

```
user@router> show chassis pic fpc-slot 7 pic-slot 1
FPC slot 7, PIC slot 1 information:
    Type                       MRATE-5xQSFPP
    State                      Online
    PIC version                0.0
    Uptime                     3 hours, 33 minutes, 21 seconds

PIC port information:
    JNPR Port Cable type      Fiber Xcvr vendor Wave- Xcvr
    Firmware Rev              type Xcvr vendor part number length
    0  100GBASE LR4 REV 01     SM JUNIPER-FINISAR FTLC1151RDPL-J3 1302 nm 0.0
```
### Port Speed Information:

<table>
<thead>
<tr>
<th>Port</th>
<th>PFE</th>
<th>Capable Port Speeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>4x10GE, 40GE, 100GE</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>4x10GE, 40GE, 100GE</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>4x10GE, 40GE, 100GE</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>4x10GE, 40GE, 100GE</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>4x10GE, 40GE, 100GE</td>
</tr>
</tbody>
</table>
show ethernet-switching redundancy-groups

Syntax

show ethernet-switching redundancy-groups
<redundancy-group-id [0 to 4294967294]>
arp-statistics
nd-statistics
remote-macs

Release Information

Command introduced in Junos OS Release 13.2.
Command introduced in Junos OS Release 15.1R1 for EX Series switches

Description

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. Note that the Redundancy Group ID is inherited by the bridging domain or VLAN from member AE interfaces.

Options

redundancy-group-id—(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.

arp-statistics—(Optional) Count of ARP packets sent and received by the two MC-AE nodes.

nd-statistics—(Optional) Count of Neighbor Discovery packets sent and received by the two MC-AE nodes.

remote-macs —(Optional) List of remote MAC addresses in the “Installed” state, as learned from the remote MC-AE node.

Required Privilege

view

Related Documentation

• Configuring Multichassis Link Aggregation on EX Series Switches

List of Sample Output

show ethernet-switching redundancy-groups arp-statistics on page 1975
show ethernet-switching redundancy-groups nd-statistics on page 1975
show ethernet-switching redundancy-groups remote-macs on page 1976
show ethernet-switching redundancy-groups group-id on page 1976

Output Fields

Output fields are listed in the approximate order in which they appear.

Table 147: show ethernet-switching redundancy-groups arp-statistics Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redundancy Group ID</td>
<td>Redundancy Group to which the following details apply.</td>
</tr>
</tbody>
</table>
Table 147: show ethernet-switching redundancy-groups arp-statistics Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCLAG ARP Statistics Group ID</td>
<td>ARP statistics for this Multichassis Link Aggregation Group (MC-LAG) instance.</td>
</tr>
<tr>
<td>ARP Rx Count From Line</td>
<td>Total number of ARPs received from the Line.</td>
</tr>
<tr>
<td>ARP Tx Count To Peer</td>
<td>Total number of ARPs sent to the peer.</td>
</tr>
<tr>
<td>ARP Rx Count From Peer</td>
<td>Total number of ARPs received from the peer.</td>
</tr>
<tr>
<td>ARP Drop Count received from line</td>
<td>Total number of ARPs sent by the peer that were received.</td>
</tr>
<tr>
<td>ARP Drop Count received from peer</td>
<td>Total number of ARPs sent by the peer that were dropped</td>
</tr>
<tr>
<td>ARP Install Count</td>
<td>ARP Install Count</td>
</tr>
</tbody>
</table>

Table 148: show ethernet-switching redundancy-groups nd-statistics Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redundancy Group ID</td>
<td>Redundancy Group to which the following details apply.</td>
</tr>
<tr>
<td>MCLAG ND Statistics Group ID</td>
<td>Neighbor Discovery statistics for this Multichassis Link Aggregation Group (MC-LAG) instance.</td>
</tr>
<tr>
<td>ND Rx Count From Line</td>
<td>Total number of Neighbor Discovery packets received from the Line.</td>
</tr>
<tr>
<td>ND Tx Count To Peer</td>
<td>Total number of Neighbor Discovery packets sent to the peer.</td>
</tr>
<tr>
<td>ND Rx Count From Peer</td>
<td>Total number of Neighbor Discovery packets received from the peer.</td>
</tr>
<tr>
<td>ND Drop Count received from line</td>
<td>Total number of Neighbor Discovery packets sent by the peer that were received.</td>
</tr>
<tr>
<td>ND Drop Count received from peer</td>
<td>Total number of Neighbor Discovery packets sent by the peer that were dropped</td>
</tr>
<tr>
<td>ND Install Count</td>
<td>ND Install Count</td>
</tr>
</tbody>
</table>

Table 149: show ethernet-switching redundancy-groups remote-macs Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redundancy Group ID</td>
<td>Redundancy Group to which the following details apply.</td>
</tr>
</tbody>
</table>
Table 149: show ethernet-switching redundancy-groups remote-macs Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service ID</td>
<td>Service ID (configured at the routing instance level).</td>
</tr>
<tr>
<td>Peer-Addr</td>
<td>IP address of the remote peer.</td>
</tr>
<tr>
<td>VLAN</td>
<td>Virtual LAN identifier associated with the redundancy group.</td>
</tr>
<tr>
<td>MAC</td>
<td>Hardware media access control address associated with the redundancy group.</td>
</tr>
<tr>
<td>MCAE-ID</td>
<td>ID number of the MC-AE used by the redundancy group.</td>
</tr>
<tr>
<td>Flags</td>
<td>Connection state: local connect or Remote connect. If no flag is shown, the redundancy group may not be connected.</td>
</tr>
<tr>
<td>Status</td>
<td>Installation state: Installed or Not Installed.</td>
</tr>
</tbody>
</table>

Sample Output

```
show ethernet-switching redundancy-groups arp-statistics

user@host> show ethernet-switching redundancy-groups arp-statistics

Redundancy Group ID : 1       Flags : Local Connect,Remote Connect

MCLAG ARP Statistics
Group ID : 1
ARP Rx Count From Line : 3493
ARP Tx Count To Peer : 647
ARP Rx Count From Peer : 0
ARP Install Count : 0
ARP Drop Count received from line : 2846
ARP Drop Count received from peer : 0
```

```
show ethernet-switching redundancy-groups nd-statistics

user@host> show ethernet-switching redundancy-groups 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 ethernet-switching redundancy-groups remote-macs

```bash
user@host> show ethernet-switching redundancy-groups <redundancy-group-id> remote-macs
```

<table>
<thead>
<tr>
<th>Service-id</th>
<th>Peer-Addr</th>
<th>VLAN</th>
<th>MAC</th>
<th>MCAE-ID</th>
<th>Subunit</th>
<th>Opcode</th>
<th>Flags</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>10.3.3.2</td>
<td>100</td>
<td>80:ac:ac:1f:10:a1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>Installed</td>
<td></td>
</tr>
</tbody>
</table>

### show ethernet-switching redundancy-groups group-id

```bash
user@host> show ethernet-switching redundancy-groups group-id
```

<table>
<thead>
<tr>
<th>Redundancy Group ID : 1</th>
<th>Flags : Local Connect,Remote Connect</th>
</tr>
</thead>
</table>

---

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### show interfaces (Adaptive Services)

**Syntax**

```
show interfaces interface-type
   <brief | detail | extensive | terse>
   <descriptions>
   <media>
   <snmp-index snmp-index>
   <statistics>
```

**Release Information**
Command introduced before Junos OS Release 7.4.

**Description**
Display status information about the specified adaptive services interface.

**Options**

- `interface-type`—On M Series and T Series routers, the interface type is `sp-fpc/pic/port`.
- `brief | detail | extensive | terse`—(Optional) Display the specified level of output.
- `descriptions`—(Optional) Display interface description strings.
- `media`—(Optional) Display media-specific information about network interfaces.
- `snmp-index snmp-index`—(Optional) Display information for the specified SNMP index of the interface.

**Required Privilege Level**
`view`

**List of Sample Output**
- `show interfaces (Adaptive Services) on page 1982`
- `show interfaces brief (Adaptive Services) on page 1982`
- `show interfaces detail (Adaptive Services) on page 1982`
- `show interfaces extensive (Adaptive Services) on page 1983`

**Output Fields**
Table 150 on page 1977 lists the output fields for the `show interfaces` (adaptive services and redundant adaptive services) command. Output fields are listed in the approximate order in which they appear.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Interface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical interface</td>
<td>Name of the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Enabled</td>
<td>State of the interface. Possible values are described in the “Enabled Field” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td>Interface index</td>
<td>Physical interface's index number, which reflects its initialization sequence.</td>
<td><code>detail extensive none</code></td>
</tr>
</tbody>
</table>
### Table 150: Adaptive Services and Redundant Adaptive Services show interfaces Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNMP index</td>
<td>SNMP index number for the physical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Type</td>
<td>Encapsulation being used on the interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Link-level type</td>
<td>Encapsulation being used on the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>MTU</td>
<td>MTU size on the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Clocking</td>
<td>Reference clock source: can be Internal or External.</td>
<td>All levels</td>
</tr>
<tr>
<td>Speed</td>
<td>Speed at which the interface is running.</td>
<td>All levels</td>
</tr>
<tr>
<td>Device flags</td>
<td>Information about the physical device. Possible values are described in the “Device Flags” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td>Interface flags</td>
<td>Information about the interface. Possible values are described in the “Interface Flags” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td>Link type</td>
<td>Physical interface link type: Full-Duplex or Half-Duplex.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Link flags</td>
<td>Information about the link. Possible values are described in the “Link Flags” section under Common Output Fields Description.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Physical info</td>
<td>Information about the physical interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Hold-times</td>
<td>Current interface hold-time up and hold-time down, in milliseconds.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Current address</td>
<td>Configured MAC address.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Hardware address</td>
<td>MAC address of the hardware.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Alternate link address</td>
<td>Backup address of the link.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Last flapped</td>
<td>Date, time, and how long ago the interface went from down to up. The format is Last flapped: year-month-day hour:minute:second timezone (hour:minute:second ago). For example, Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago).</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Input Rate</td>
<td>Input rate in bits per second (bps) and packets per second (pps).</td>
<td>None specified</td>
</tr>
<tr>
<td>Output Rate</td>
<td>Output rate in bps and pps.</td>
<td>None specified</td>
</tr>
<tr>
<td>Statistics last cleared</td>
<td>Time when the statistics for the interface were last set to zero.</td>
<td>detail extensive</td>
</tr>
</tbody>
</table>
### Table 150: Adaptive Services and Redundant Adaptive Services show interfaces Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic statistics</td>
<td>Number and rate of bytes and packets received and transmitted on the physical interface.</td>
<td>detail extensive</td>
</tr>
</tbody>
</table>

**NOTE:** With static NAT configured as basic NAT44 or destination NAT44 on MX Series routers with MS-MICs and MS-MPCs, the Input bytes field might show 16 more bytes than the Output bytes field. This is caused by the accounting of 16 bytes of the Juniper Forwarding Module cookie.

- **Input bytes**—Number of bytes received on the interface.
- **Output bytes**—Number of bytes transmitted on the interface.
- **Input packets**—Number of packets received on the interface.
- **Output packets**—Number of packets transmitted on the interface.

<table>
<thead>
<tr>
<th>Input errors</th>
<th>Input errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:</th>
<th>extensive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Errors</strong>—Sum of the incoming frame aborts and FCS errors.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Drops</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Framing errors</strong>—Number of packets received with an invalid frame checksum (FCS).</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Runts</strong>—Frames received smaller than the runt threshold.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Giants</strong>—Frames received larger than the giant threshold.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Policed discards</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Resource errors</strong>—Sum of transmit drops.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Output errors</th>
<th>Output errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:</th>
<th>extensive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Carrier transitions</strong>—Number of times the interface has gone from <strong>down</strong> to <strong>up</strong>.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Errors</strong>—Sum of the outgoing frame aborts and FCS errors.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Drops</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>MTU errors</strong>—Number of packets larger than the MTU threshold.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Resource errors</strong>—Sum of transmit drops.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Logical Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logical interface</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Index</th>
<th>Logical interface index number, which reflects its initialization sequence.</th>
<th>detail extensive none</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNMP ifindex</td>
<td>SNMP interface index number.</td>
<td>detail extensive none</td>
</tr>
</tbody>
</table>
### Table 150: Adaptive Services and Redundant Adaptive Services show interfaces Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Flags</td>
<td>Information about the logical interface. Possible values are described in the</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>“Logical Interface Flags” section under Common Output Fields Description.</td>
<td></td>
</tr>
<tr>
<td>Encapsulation</td>
<td>Encapsulation on the logical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Input packets</td>
<td>Number of packets received on the logical interface.</td>
<td>None specified</td>
</tr>
<tr>
<td>Output packets</td>
<td>Number of packets transmitted on the logical interface.</td>
<td>None specified</td>
</tr>
<tr>
<td>Traffic statistics</td>
<td>Number and rate of bytes and packets received and transmitted on the logical</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Input bytes</strong>—Number of bytes received on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Output bytes</strong>—Number of bytes transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Input packets</strong>—Number of packets received on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Output packets</strong>—Number of packets transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td>Local statistics</td>
<td>Statistics for traffic received from and transmitted to the Routing Engine. When</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>a burst of traffic is received, the value in the output packet rate field might</td>
<td></td>
</tr>
<tr>
<td></td>
<td>briefly exceed the peak cell rate. It takes awhile (generally, less than 1 second)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>for this counter to stabilize.</td>
<td></td>
</tr>
<tr>
<td>Transit statistics</td>
<td>Statistics for traffic transiting the router. When a burst of traffic is received,</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>the value in the output packet rate field might briefly exceed the peak cell rate.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>It takes generally less than 1 second for the counter to stabilize.</td>
<td></td>
</tr>
<tr>
<td><strong>protocol-family</strong></td>
<td>Protocol family configured on the logical interface. If the protocol is inet, the IP</td>
<td>brief</td>
</tr>
<tr>
<td></td>
<td>address of the interface is also displayed.</td>
<td></td>
</tr>
<tr>
<td>Protocol</td>
<td>Protocol family configured on the logical interface, such as iso, inet6, mplsp.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>MTU</td>
<td>MTU size on the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Route table</td>
<td>Routing table in which the logical interface address is located. For example, 0</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>refers to the routing table inet.0.</td>
<td></td>
</tr>
<tr>
<td>Flags</td>
<td>Information about the protocol family flags. Possible values are described in the</td>
<td>detail extensive none</td>
</tr>
<tr>
<td></td>
<td>“Family Flags” section under Common Output Fields Description.</td>
<td></td>
</tr>
<tr>
<td>Addresses, Flags</td>
<td>Information about the address flags. Possible values are described in the</td>
<td>detail extensive none</td>
</tr>
<tr>
<td></td>
<td>“Addresses Flags” section under Common Output Fields Description.</td>
<td></td>
</tr>
<tr>
<td>Destination</td>
<td>IP address of the remote side of the connection.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Local</td>
<td>IP address of the logical interface.</td>
<td>detail extensive none</td>
</tr>
</tbody>
</table>
Table 150: Adaptive Services and Redundant Adaptive Services show interfaces Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broadcast</td>
<td>Broadcast address.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
</tbody>
</table>
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, 0pps
- **Output packets**: 3048, 0pps

### 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, 0pps
- **Output packets**: 0, 0pps

### 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, 0pps
- **Output packets**: 3052, 0pps
Input errors:
- Errors: 0, Drops: 0, Framing errors: 0, Runts: 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)
```

---

Copyright © 2019, Juniper Networks, Inc.
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)

**Syntax**

```
show interfaces ae
  <number>
  <brief | detail | extensive | terse>
  <descriptions>
  <media>
  <snmp-index snmp-index>
  <statistics>
```

**Release Information**

Command introduced before Junos OS Release 7.4.

**Description**

(M Series, T Series, MX Series, and PTX Series routers) Display status information about the specified aggregated Ethernet interfaces.

**Options**

- **ae**—Display standard information about the specified aggregated Fast Ethernet or Gigabit Ethernet interface.
- **number**—Display the specified level of output.
- **brief | detail | extensive | terse**—(Optional) Display interface description strings.
- **descriptions**—(Optional) Display media-specific information.
- **media**—(Optional) Display information for the specified SNMP index of the interface.
- **statistics**—(Optional) Display static interface statistics.

**NOTE:** On Junos OS Evolved, in untagged aggregated ethernet (ae) interfaces with no logical interface configuration, the ae interface will not be shown as "down" and the speed will not be shown as "unspecified." The speed will be the aggregate speed of all the child member interfaces which are "up." In Junos OS, the speed is shown as "unspecified" in this case.

**Required Privilege Level**

view

**Related Documentation**

- Ethernet Interfaces Feature Guide for Routing Devices

**List of Sample Output**

- show interfaces (Aggregated Ethernet) on page 1990
- show interfaces brief (Aggregated Ethernet) on page 1991
- show interfaces detail (Aggregated Ethernet) on page 1991
- show interfaces extensive (Aggregated Ethernet) on page 1992
- show interfaces extensive (Aggregated Ethernet with VLAN Stacking) on page 1993
**Output Fields**  Table 151 on page 1986 lists the output fields for the `show interfaces` (Aggregated Ethernet) command. Output fields are listed in the approximate order in which they appear.

**Table 151: Aggregated Ethernet show interfaces Output Fields**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Interface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical interface</td>
<td>Name of the physical interface and state of the interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Enabled</td>
<td>State of the physical interface. Possible values are described in the “Enabled Field” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td>Interface index</td>
<td>Index number of the physical interface, which reflects its initialization sequence.</td>
<td>All levels</td>
</tr>
<tr>
<td>SNMP ifIndex</td>
<td>SNMP index number for the physical interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Link-level type</td>
<td>Encapsulation being used on the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>MTU</td>
<td>Maximum transmission unit size on the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Speed</td>
<td>Speed at which the interface is running.</td>
<td>All levels</td>
</tr>
<tr>
<td>Loopback</td>
<td>Loopback status: <strong>Enabled</strong> or <strong>Disabled</strong>. If loopback is enabled, type of loopback: <strong>Local</strong> or <strong>Remote</strong>.</td>
<td>All levels</td>
</tr>
<tr>
<td>Source filtering</td>
<td>Source filtering status: <strong>Enabled</strong> or <strong>Disabled</strong>.</td>
<td>All levels</td>
</tr>
<tr>
<td>Flow control</td>
<td>Flow control status: <strong>Enabled</strong> or <strong>Disabled</strong>.</td>
<td>All levels</td>
</tr>
<tr>
<td>Minimum links needed</td>
<td>Number of child links that must be operational for the aggregate interface to be operational.</td>
<td>All levels</td>
</tr>
<tr>
<td>Device flags</td>
<td>Information about the physical device. Possible values are described in the “Device Flags” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td>Interface flags</td>
<td>Information about the interface. Possible values are described in the “Interfaces Flags” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td>Current address</td>
<td>Configured MAC address.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Hardware address</td>
<td>Hardware MAC address.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Last flapped</td>
<td>Date, time, and how long ago the interface went from down to up or from up to down. The format is Last flapped: year-month-day hours:minutes:seconds timezone (hours:minutes:seconds ago). For example, Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago).</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Input Rate</td>
<td>Input rate in bits per second (bps) and packets per second (pps).</td>
<td>None specified</td>
</tr>
</tbody>
</table>
### Table 151: Aggregated Ethernet show interfaces Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Rate</td>
<td>Output rate in bps and pps.</td>
<td>None specified</td>
</tr>
<tr>
<td>Statistics last cleared</td>
<td>Time when the statistics for the interface were last set to zero.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Traffic statistics</td>
<td>Number and rate of bytes and packets received and transmitted on the physical interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>- <strong>Input bytes</strong>—Number of bytes and rate, in bps, at which bytes are received on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Output bytes</strong>—Number of bytes and rate, in bps, at which bytes are transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Input packets</strong>—Number of packets and rate, in pps, at which packets are received on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Output packets</strong>—Number of packets and rate, in pps, at which packets are transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td>Input errors</td>
<td>Input errors on the interface:</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>- <strong>Errors</strong>—Sum of incoming frame aborts and frame check sequence (FCS) errors.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Drops</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Framing errors</strong>—Number of packets received with an invalid frame checksum (FCS).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Runts</strong>—Number of frames received that are smaller than the runt threshold.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Giants</strong>—Number of frames received that are larger than the giant threshold.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Policed discards</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Resource errors</strong>—Sum of transmit drops.</td>
<td></td>
</tr>
<tr>
<td>Output errors</td>
<td>Output errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>- <strong>Carrier transitions</strong>—Number of times the interface has gone from down to up. 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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Errors</strong>—Sum of the outgoing frame aborts and FCS errors.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Drops</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>MTU errors</strong>—Number of packets whose size exceeded the MTU of the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Resource errors</strong>—Sum of transmit drops.</td>
<td></td>
</tr>
</tbody>
</table>
Table 151: Aggregated Ethernet show interfaces Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPv6 transit</td>
<td>Number of IPv6 transit bytes and packets received and transmitted on the physical interface if IPv6 statistics tracking is enabled.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>statistics</td>
<td>- <strong>Input bytes</strong>—Number of bytes received on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Output bytes</strong>—Number of bytes transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Input packets</strong>—Number of packets received on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Output packets</strong>—Number of packets transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td>IPv6 transit</td>
<td>CoS queue number and its associated user-configured forwarding class name.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>statistics</td>
<td>- <strong>Queued packets</strong>—Number of queued packets.</td>
<td></td>
</tr>
<tr>
<td>Queue counters</td>
<td>- <strong>Transmitted packets</strong>—Number of transmitted packets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Dropped packets</strong>—Number of packets dropped by the ASIC's RED mechanism.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>NOTE:</strong> 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 <code>show interfaces</code> 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.</td>
<td></td>
</tr>
<tr>
<td>Logical Interface</td>
<td>Name of the logical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Logical interface</td>
<td>Index number of the logical interface (which reflects its initialization sequence).</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Index</td>
<td>All levels</td>
<td>none</td>
</tr>
<tr>
<td>SNMP ifIndex</td>
<td>SNMP interface index number of the logical interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>SNMP ifIndex</td>
<td>All levels</td>
<td>none</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Flags</td>
<td>Information about the logical interface. Possible values are described in the “Logical Interface Flags Field” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td>VLAN-Tag</td>
<td>Tag Protocol Identifier (TPID) and VLAN identifier.</td>
<td>All levels</td>
</tr>
<tr>
<td>Demux</td>
<td>IP demultiplexing (demux) value that appears if this interface is used as the demux underlying interface. The output is one of the following:</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>- <strong>Source Family Inet</strong></td>
<td>none</td>
</tr>
<tr>
<td></td>
<td>- <strong>Destination Family Inet</strong></td>
<td></td>
</tr>
<tr>
<td>Encapsulation</td>
<td>Encapsulation on the logical interface.</td>
<td>All levels</td>
</tr>
</tbody>
</table>
Table 151: Aggregated Ethernet show interfaces Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistics</td>
<td>Information about the number of packets, packets per second, number of bytes,</td>
<td>detail extensive none</td>
</tr>
<tr>
<td></td>
<td>and bytes per second on this aggregate interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Bundle—Information about input and output bundle rates. For Junos OS Evolved,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LACP packets on the members of an AE interface are not counted as part of the AE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>bundle input statistics.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Link—(detail and extensive only) Information about specific links in the</td>
<td></td>
</tr>
<tr>
<td></td>
<td>aggregate, including link state and input and output rates.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Adaptive Statistics—(extensive only) Information about adaptive load balancing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>counter statistics.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Adaptive Adjusts—Number of times traffic flow imbalance was corrected by</td>
<td></td>
</tr>
<tr>
<td></td>
<td>implementation of adaptive load balancing.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Adaptive Scans—Number of times the link utilization on each member link</td>
<td></td>
</tr>
<tr>
<td></td>
<td>of the AE bundle was scanned by for adaptive load balancing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Adaptive Tolerance—Tolerance level, in percentage, for load imbalance on</td>
<td></td>
</tr>
<tr>
<td></td>
<td>link utilization on each member link of the AE bundle.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Adaptive Updates—Number of times traffic flow loads have been updated on an AE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>bundle.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Marker Statistics—(detail and extensive only) Information about 802.3ad marker</td>
<td></td>
</tr>
<tr>
<td></td>
<td>protocol statistics on the specified links.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Marker Rx—Number of valid marker protocol data units (PDU) received on</td>
<td></td>
</tr>
<tr>
<td></td>
<td>this aggregation port.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Resp Tx—Number of marker response PDUs transmitted on this aggregation port.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Unknown Rx—Number of frames received that either carry the slow protocols</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ethernet type value (43B.4) but contain an unknown PDU, or are addressed to the</td>
<td></td>
</tr>
<tr>
<td></td>
<td>slow protocols group MAC address (43B.3) but do not carry the slow protocols</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ethernet type.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Illegal Rx—Number of frames received that carry the slow protocols Ethernet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>type value (43B.4) but contain a badly formed PDU or an illegal value of</td>
<td></td>
</tr>
<tr>
<td></td>
<td>protocol subtype (43B.4).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Portkey—Operational key value assigned to the port by the actor or partner,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>encoded as an unsigned integer.</td>
<td></td>
</tr>
<tr>
<td>LACP info</td>
<td>Link Aggregation Control Protocol (LACP) information for each aggregated</td>
<td></td>
</tr>
<tr>
<td></td>
<td>interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Role can be one of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Actor—Local device participating in LACP negotiation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Partner—Remote device participating in LACP negotiation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• System priority—Priority assigned to the system (by management or administrative</td>
<td></td>
</tr>
<tr>
<td></td>
<td>policy), encoded as an unsigned integer.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• System identifier—Actor or partner system ID, encoded as a MAC address.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Port priority—Priority assigned to the port by the actor or partner (by</td>
<td></td>
</tr>
<tr>
<td></td>
<td>management or administrative policy), encoded as an unsigned integer.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Unknown Rx—Number of frames received that either carry the slow protocols</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ethernet type value (43B.4) but contain an unknown protocol data unit (PDU), or</td>
<td></td>
</tr>
<tr>
<td></td>
<td>are addressed to the slow protocols group MAC address (43B.3) but do not carry the</td>
<td></td>
</tr>
<tr>
<td></td>
<td>slow protocols Ethernet type.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Port key—Operational key value assigned to the port by the actor or partner,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>encoded as an unsigned integer.</td>
<td></td>
</tr>
</tbody>
</table>
Table 151: Aggregated Ethernet show interfaces Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>LACP Statistics</td>
<td>LACP statistics for each aggregated interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td></td>
<td>• LACP Rx—LACP received counter that increments for each normal hello.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• LACP Tx—Number of LACP transmit packet errors logged.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Unknown Rx—Number of unrecognized packet errors logged.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Illegal Rx—Number of invalid packets received.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>NOTE:</strong> For LACP Rx and LACP Tx, Packet count is updated only on snmp timer expiry (30 secs).</td>
<td></td>
</tr>
<tr>
<td>protocol-family</td>
<td>Protocol family configured on the logical interface. Possible values are described in the “Protocol Field” section under Common Output Fields Description.</td>
<td>brief</td>
</tr>
<tr>
<td>Protocol</td>
<td>Protocol family configured on the logical interface. Possible values are described in the “Protocol Field” section under Common Output Fields Description.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>MTU</td>
<td>Maximum transmission unit size on the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Maximum labels</td>
<td>Maximum number of MPLS labels configured for the MPLS protocol family on the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Route Table</td>
<td>Routing table in which the logical interface address is located. For example, 0 refers to the routing table inet.0.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Flags</td>
<td>Information about protocol family flags. Possible values are described in the “Family Flags Field” section under Common Output Fields Description.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Mac-Validate Failures</td>
<td>Number of MAC address validation failures for packets and bytes. This field is displayed when MAC address validation is enabled for the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Addresses, Flags</td>
<td>Information about address flags. Possible values are described in the “Addresses Flags” section under Common Output Fields Description.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Destination</td>
<td>IP address of the remote side of the connection.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Local</td>
<td>IP address of the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Broadcast</td>
<td>Broadcast address of the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
</tbody>
</table>

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: 00:00:5e:00:53:f0, Hardware address: 00:00:5e:00:53: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            Packets     pps      Bytes     bps
Bundle:   
Input :       0   0    0    0    0
Output:       0   0    0    0    0
Protocol inet, MTU: 1500
Flags: None
Addresses, Flags: Is-Preferred Is-Primary
  Destination: 203.0.113/24, Local: 203.0.113.2, 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  203.0.113.2/24

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: 00:00:5e:00:53:f0, Hardware address: 00:00:5e:00:53: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
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: 00:00:5e:00:53:f0, Hardware address: 00:00:5e:00:53: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
```
<table>
<thead>
<tr>
<th>Logical interface ae0.0 (Index 72) (SNMP ifIndex 60) (Generation 18)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flags: SNMP-Traps 16384 Encapsulation: ENET2</td>
</tr>
<tr>
<td>Statistics</td>
</tr>
<tr>
<td>Bundle:</td>
</tr>
<tr>
<td>Input:</td>
</tr>
<tr>
<td>Output:</td>
</tr>
<tr>
<td>Adaptive Statistics:</td>
</tr>
<tr>
<td>Adaptive Adjusts: 0</td>
</tr>
<tr>
<td>Adaptive Scans  : 0</td>
</tr>
<tr>
<td>Adaptive Updates: 0</td>
</tr>
<tr>
<td>Link:</td>
</tr>
<tr>
<td>Input:</td>
</tr>
<tr>
<td>Output:</td>
</tr>
<tr>
<td>fe-0/1/2.0</td>
</tr>
<tr>
<td>Output:</td>
</tr>
<tr>
<td>fe-0/1/3.0</td>
</tr>
<tr>
<td>Output:</td>
</tr>
<tr>
<td>LACP info:</td>
</tr>
<tr>
<td>priority</td>
</tr>
<tr>
<td>fe-1/0/3.0</td>
</tr>
<tr>
<td>fe-1/0/3.0</td>
</tr>
<tr>
<td>LACP Statistics: LACP Rx</td>
</tr>
<tr>
<td>fe-1/0/3.0</td>
</tr>
<tr>
<td>Marker Statistics: Marker Rx</td>
</tr>
<tr>
<td>fe-0/1/0.0</td>
</tr>
<tr>
<td>fe-0/1/2.0</td>
</tr>
<tr>
<td>fe-0/1/3.0</td>
</tr>
<tr>
<td>Protocol inet, MTU: 1500, Generation: 37, Route table: 0</td>
</tr>
<tr>
<td>Flags: None</td>
</tr>
<tr>
<td>Addresses, Flags: Is-Preferred Is-Primary</td>
</tr>
<tr>
<td>Destination: 203.0.113/24, Local: 203.0.113.2, Broadcast: 203.0.113.255,</td>
</tr>
<tr>
<td>Generation: 49</td>
</tr>
</tbody>
</table>

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
Device flags : Present Running
Interface flags: SNMP-Traps Internal: 0x4000
Current address: 00:00:5e:00:53:3f, Hardware address: 00:00:5e:00:53:3f
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 Bundle:
  Packets Bytes
  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

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Packets</th>
<th>pps</th>
<th>Bytes</th>
<th>bps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bundle:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input:</td>
<td>293</td>
<td>1</td>
<td>26003</td>
<td>1072</td>
</tr>
<tr>
<td>Output:</td>
<td>1694</td>
<td>3</td>
<td>130057</td>
<td>2400</td>
</tr>
<tr>
<td>Link:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ge-1/2/0.452</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input:</td>
<td>293</td>
<td>1</td>
<td>26003</td>
<td>1072</td>
</tr>
<tr>
<td>Output:</td>
<td>1694</td>
<td>3</td>
<td>130057</td>
<td>2400</td>
</tr>
<tr>
<td>ge-1/2/1.452</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input:</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Output:</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Marker Statistics:
- ge-1/2/0.452: Marker Rx 0, Resp Tx 0, Unknown Rx 0, Illegal Rx 0
- ge-1/2/1.452: Marker Rx 0, Resp Tx 0, Unknown Rx 0, Illegal Rx 0

Protocol vpls, MTU: 1518, Generation: 850, Route table: 3
Flags: None
show interfaces demux0 (Demux Interfaces)

Syntax

```
show interfaces demux0.logical-interface-number
<brief | detail | extensive | terse>
<descriptions>
<media>
<snmp-index snmp-index>
<statistics>
```

Release Information

Command introduced in Junos OS Release 9.0.

Description

(MX Series and M Series routers only) Display status information about the specified demux interface.

Options

- `none`—Display standard information about the specified demux interface.
- `brief | detail | extensive | terse`—(Optional) Display the specified level of output.
- `descriptions`—(Optional) Display interface description strings.
- `media`—(Optional) Display media-specific information about network interfaces.
- `snmp-index snmp-index`—(Optional) Display information for the specified SNMP index of the interface.

Required Privilege

Level

view

Related Documentation

- Verifying and Managing Agent Circuit Identifier-Based Dynamic VLAN Configuration

List of Sample Output

- show interfaces demux0 (Demux) on page 2002
- show interfaces demux0 (PPPoE over Aggregated Ethernet) on page 2003
- show interfaces demux0 extensive (Targeted Distribution for Aggregated Ethernet Links) on page 2004
- show interfaces demux0 (ACI Interface Set Configured) on page 2004

Output Fields

Table 152 on page 1996 lists the output fields for the `show interfaces demux0 (Demux Interfaces)` command. Output fields are listed in the approximate order in which they appear.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Interface</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 152: show interfaces demux0 (Demux Interfaces) Output Fields
Table 152: `show interfaces demux0` (Demux Interfaces) Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical interface</td>
<td>Name of the physical interface.</td>
<td>brief detail extensive none</td>
</tr>
<tr>
<td>Interface index</td>
<td>Index number of the physical interface, which reflects its initialization sequence.</td>
<td>brief detail extensive none</td>
</tr>
<tr>
<td>Enabled</td>
<td>State of the interface. Possible values are described in the “Enabled Field” section under Common Output Fields Description.</td>
<td>brief detail extensive none</td>
</tr>
<tr>
<td>Physical link</td>
<td>Status of the physical link (Up or Down).</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Admin</td>
<td>Administrative state of the interface (Up or Down).</td>
<td>terse</td>
</tr>
<tr>
<td>Interface index</td>
<td>Index number of the physical interface, which reflects its initialization sequence.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Link</td>
<td>Status of the physical link (Up or Down).</td>
<td>terse</td>
</tr>
<tr>
<td>Targeting summary</td>
<td>Status of aggregated Ethernet links that are configured with targeted distribution (primary or backup)</td>
<td>extensive</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>Bandwidth allocated to the aggregated Ethernet links that are configured with targeted distribution.</td>
<td>extensive</td>
</tr>
<tr>
<td>Proto</td>
<td>Protocol family configured on the interface.</td>
<td>terse</td>
</tr>
<tr>
<td>SNMP ifIndex</td>
<td>SNMP index number for the physical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Type</td>
<td>Type of interface. Software-Pseudo indicates a standard software interface with no associated hardware device.</td>
<td>brief detail extensive none</td>
</tr>
<tr>
<td>Link-level type</td>
<td>Encapsulation being used on the physical interface.</td>
<td>brief detail extensive none</td>
</tr>
<tr>
<td>MTU</td>
<td>Maximum transmission unit size on the physical interface.</td>
<td>brief detail extensive none</td>
</tr>
<tr>
<td>Clocking</td>
<td>Reference clock source: Internal (1) or External (2).</td>
<td>brief detail extensive none</td>
</tr>
<tr>
<td>Speed</td>
<td>Speed at which the interface is running.</td>
<td>brief detail extensive none</td>
</tr>
<tr>
<td>Device flags</td>
<td>Information about the physical device. Possible values are described in the “Device Flags” section under Common Output Fields Description.</td>
<td>brief detail extensive none</td>
</tr>
<tr>
<td>Interface flags</td>
<td>Information about the interface. Possible values are described in the “Interface Flags” section under Common Output Fields Description.</td>
<td>brief detail extensive none</td>
</tr>
<tr>
<td>Link type</td>
<td>Data transmission type.</td>
<td>detail extensive none</td>
</tr>
</tbody>
</table>
Table 152: show interfaces demux0 (Demux Interfaces) Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link flags</td>
<td>Information about the link. Possible values are described in the “Link Flags” section under Common Output Fields Description.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Physical info</td>
<td>Information about the physical interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Hold-times</td>
<td>Current interface hold-time up and hold-time down, in milliseconds.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Current address</td>
<td>Configured MAC address.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Hardware address</td>
<td>Hardware MAC address.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Alternate link address</td>
<td>Backup address of the link.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Last flapped</td>
<td>Date, time, and how long ago the interface went from down to up. The format is Last flapped: year-month-day hour:minute:second timezone (hour:minute:second ago). For example, Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago).</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Statistics last cleared</td>
<td>Time when the statistics for the interface were last set to zero.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Traffic statistics</td>
<td>Number and rate of bytes and packets received and transmitted on the physical interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>• Input bytes</td>
<td>Number of bytes received on the interface.</td>
<td></td>
</tr>
<tr>
<td>• Output bytes</td>
<td>Number of bytes transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td>• Input packets</td>
<td>Number of packets received on the interface.</td>
<td></td>
</tr>
<tr>
<td>• Output packets</td>
<td>Number of packets transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td>• IPv6 transit statistics</td>
<td>Number of IPv6 transit bytes and packets received and transmitted on the physical interface if IPv6 statistics tracking is enabled.</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: These fields include dropped traffic and exception traffic, as those fields are not separately defined.

• Input bytes—Number of bytes received on the interface
• Output bytes—Number of bytes transmitted on the interface
• Input packets—Number of packets received on the interface
• Output packets—Number of packets transmitted on the interface.
<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input errors</td>
<td>Input errors on the interface whose definitions are as follows:</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>- <strong>Errors</strong>—Sum of the incoming frame aborts and FCS errors.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Drops</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Framing errors</strong>—Number of packets received with an invalid frame checksum (FCS).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Runt</strong>s—Number of frames received that are smaller than the runt threshold.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Giants</strong>—Number of frames received that are larger than the giant packet threshold.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Policed discards</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Resource errors</strong>—Sum of transmit drops.</td>
<td></td>
</tr>
<tr>
<td>Input Rate</td>
<td>Input rate in bits per second (bps) and packets per second (pps).</td>
<td>none</td>
</tr>
<tr>
<td>Output errors</td>
<td>Output errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>- <strong>Carrier transitions</strong>—Number of times the interface has gone from down to up.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Errors</strong>—Sum of the outgoing frame aborts and FCS errors.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Drops</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>MTU errors</strong>—Number of packets whose size exceeded the MTU of the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Resource errors</strong>—Sum of transmit drops.</td>
<td></td>
</tr>
<tr>
<td>Output Rate</td>
<td>Output rate in bps and pps.</td>
<td>none</td>
</tr>
<tr>
<td>Logical Interface</td>
<td>Name of the logical interface.</td>
<td>brief detail extensive none</td>
</tr>
<tr>
<td>Index</td>
<td>Index number of the logical interface, which reflects its initialization sequence.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>SNMP ifIndex</td>
<td>SNMP Interface index number for the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail</td>
</tr>
<tr>
<td>Flags</td>
<td>Information about the logical interface. Possible values are described in the “Logical Interface Flags” section under Common Output Fields Description.</td>
<td>brief detail extensive none</td>
</tr>
<tr>
<td>Encapsulation</td>
<td>Encapsulation on the logical interface.</td>
<td>brief extensive none</td>
</tr>
</tbody>
</table>
### Table 152: show interfaces demux0 (Demux Interfaces) Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACI VLAN: Dynamic Profile</td>
<td>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.</td>
<td>brief detail extensive</td>
</tr>
<tr>
<td>Demux</td>
<td>Specific IP demultiplexing (demux) values:</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>• Underlying interface—The underlying interface that the demux interface uses.</td>
<td>none</td>
</tr>
<tr>
<td></td>
<td>• Index—Index number of the logical interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Family—Protocol family configured on the logical interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Source prefixes, total—Total number of source prefixes for the underlying interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Destination prefixes, total—Total number of destination prefixes for the underlying interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Prefix—in family prefix.</td>
<td></td>
</tr>
<tr>
<td>protocol-family</td>
<td>Protocol family configured on the logical interface.</td>
<td>brief</td>
</tr>
<tr>
<td>Traffic statistics</td>
<td>Number and rate of bytes and packets received and transmitted on the specified interface set.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>• Input bytes, Output bytes—Number of bytes received and transmitted on the interface set.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Input packets, Output packets—Number of packets received and transmitted on the interface set.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• IPv6 transit statistics—Number of IPv6 transit bytes and packets received and transmitted on the logical interface if IPv6 statistics tracking is enabled.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>NOTE:</strong> The packet and byte counts in these fields include traffic that is dropped and does not leave the router.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Input bytes—Number of bytes received on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Output bytes—Number of bytes transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Input packets—Number of packets received on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Output packets—Number of packets transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td>Local statistics</td>
<td>Number of transit bytes and packets received and transmitted on the local interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>• Input bytes—Number of bytes received on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Output bytes—Number of bytes transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Input packets—Number of packets received on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Output packets—Number of packets transmitted on the interface.</td>
<td></td>
</tr>
</tbody>
</table>
Table 152: show interfaces demux0 (Demux Interfaces) Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transit statistics</td>
<td>Number and rate of bytes and packets transiting the switch.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>NOTE:</td>
<td>The packet and byte counts in these fields include traffic that is dropped and does not leave the router.</td>
<td></td>
</tr>
<tr>
<td>Input bytes</td>
<td>Number of bytes received on the interface.</td>
<td></td>
</tr>
<tr>
<td>Output bytes</td>
<td>Number of bytes transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td>Input packets</td>
<td>Number of packets received on the interface.</td>
<td></td>
</tr>
<tr>
<td>Output packets</td>
<td>Number of packets transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td>IPv6 Transit statistics</td>
<td>Number of IPv6 transit bytes and packets received and transmitted on the logical interface if IPv6 statistics tracking is enabled.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>NOTE:</td>
<td>The packet and byte counts in these fields include traffic that is dropped and does not leave the router.</td>
<td></td>
</tr>
<tr>
<td>Input bytes</td>
<td>Number of bytes received on the interface.</td>
<td></td>
</tr>
<tr>
<td>Output bytes</td>
<td>Number of bytes transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td>Input packets</td>
<td>Number of packets received on the interface.</td>
<td></td>
</tr>
<tr>
<td>Output packets</td>
<td>Number of packets transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td>Input packets</td>
<td>Number of packets received on the interface.</td>
<td>none</td>
</tr>
<tr>
<td>Output packets</td>
<td>Number of packets transmitted on the interface.</td>
<td>none</td>
</tr>
<tr>
<td>Protocol</td>
<td>Protocol family. Possible values are described in the “Protocol Field” section under Common Output Fields Description.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>MTU</td>
<td>Maximum transmission unit size on the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Maximum labels</td>
<td>Maximum number of MPLS labels configured for the MPLS protocol family on the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Route table</td>
<td>Route table in which the logical interface address is located. For example, 0 refers to the routing table inet.0.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Flags</td>
<td>Information about protocol family flags. Possible values are described in the “Family Flags” section under Common Output Fields Description.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Mac-Validate Failures</td>
<td>Number of MAC address validation failures for packets and bytes. This field is displayed when MAC address validation is enabled for the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Addresses, Flags</td>
<td>Information about the address flags. Possible values are described in the “Addresses Flags” section under Common Output Fields Description.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Destination</td>
<td>IP address of the remote side of the connection.</td>
<td>detail extensive statistics none</td>
</tr>
</tbody>
</table>
Table 152: show interfaces demux0 (Demux Interfaces) Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>IP address of the logical interface.</td>
<td>terse</td>
</tr>
<tr>
<td>Remote</td>
<td>IP address of the remote interface.</td>
<td>terse</td>
</tr>
<tr>
<td>Broadcast</td>
<td>Broadcast address of the logical interface.</td>
<td>terse</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>terse</td>
</tr>
<tr>
<td>Link</td>
<td>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.</td>
<td>terse</td>
</tr>
<tr>
<td>Dynamic-profile</td>
<td>Name of the PPPoE dynamic profile assigned to the underlying interface.</td>
<td>terse</td>
</tr>
<tr>
<td>Service Name Table</td>
<td>Name of the PPPoE service name table assigned to the PPPoE underlying interface.</td>
<td>terse</td>
</tr>
<tr>
<td>Max Sessions</td>
<td>Maximum number of dynamic PPPoE logical interfaces that the router can activate on the underlying interface.</td>
<td>terse</td>
</tr>
<tr>
<td>Duplicate Protection</td>
<td>State of duplicate protection: On or Off. 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.</td>
<td>terse</td>
</tr>
<tr>
<td>Direct Connect</td>
<td>State of the configuration to ignore DSL Forum VSAs: On or Off. When configured, the router ignores any of these VSAs received from a directly connected CPE device on the interface.</td>
<td>terse</td>
</tr>
<tr>
<td>AC Name</td>
<td>Name of the access concentrator.</td>
<td>terse</td>
</tr>
</tbody>
</table>

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
```
<table>
<thead>
<tr>
<th>Traffic statistics:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Input bytes</td>
<td>0</td>
<td>0 bps</td>
</tr>
<tr>
<td>Output bytes</td>
<td>0</td>
<td>0 bps</td>
</tr>
<tr>
<td>Input packets</td>
<td>0</td>
<td>0 pps</td>
</tr>
<tr>
<td>Output packets</td>
<td>0</td>
<td>0 pps</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IPv6 transit statistics:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Input bytes</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Output bytes</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Input packets</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Output packets</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input errors:</th>
<th>Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Giants: 0, Policed discards: 0, Resource errors: 0</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Output errors:</th>
<th>Carrier transitions: 0, Errors: 0, Drops: 0, MTU errors: 0, Resource errors: 0</th>
</tr>
</thead>
</table>

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: 203.0.113/24

Traffic statistics:
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Input bytes</td>
<td>0</td>
</tr>
<tr>
<td>Output bytes</td>
<td>1554</td>
</tr>
<tr>
<td>Input packets</td>
<td>0</td>
</tr>
<tr>
<td>Output packets</td>
<td>37</td>
</tr>
</tbody>
</table>

IPv6 transit statistics:
| Input bytes | 0 |
| Output bytes | 0 |
| Input packets | 0 |
| Output packets | 0 |

Local statistics:
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Input bytes</td>
<td>0</td>
</tr>
<tr>
<td>Output bytes</td>
<td>1554</td>
</tr>
<tr>
<td>Input packets</td>
<td>0</td>
</tr>
<tr>
<td>Output packets</td>
<td>37</td>
</tr>
</tbody>
</table>

Transit statistics:
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Input bytes</td>
<td>0</td>
</tr>
<tr>
<td>Output bytes</td>
<td>0</td>
</tr>
<tr>
<td>Input packets</td>
<td>0</td>
</tr>
<tr>
<td>Output packets</td>
<td>0</td>
</tr>
</tbody>
</table>

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: 203.0.113/24, Local: 203.0.113.13, Broadcast: 203.0.113.255,
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

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

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
  Dynamic Profile: aci-vlan-set-profile
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: Sendcast-pkt-to-re, Unnumbered
  Donor interface: lo0.0 (Index 322)
  Preferred source address: 203.0.113.202
  Addresses, Flags: Primary Is-Default Is-Primary
    Local: 203.0.113.119
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)

Syntax

show interfaces diagnostics optics interface-name

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 12.1 for PTX Series routers.

Description

Display diagnostics data, warnings, and alarms for Gigabit Ethernet, 10-Gigabit Ethernet, 40-Gigabit Ethernet, 100-Gigabit Ethernet, or Virtual Chassis port interfaces.

Options

interface-name—Interface name. For example:

| ge-fpc/pic/port      |
| et-fpc/pic/port      |
| et-fpc/pic/port:channel |
| xe-fpc/pic/port      |
| vcp-fpc/pic/port     |

Additional Information

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.

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.

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 measured power 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 about 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 about 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 428.

Required Privilege Level

- view

Related Documentation

- Determining Transceiver Support and Specifications

List of Sample Output

- show interfaces diagnostics optics (DWDM and DWDM OTN) on page 2022
- show interfaces diagnostics optics (MPC6E with OTN MIC) on page 2023
- show interfaces diagnostics optics (Bidirectional SFP) on page 2023
- show interfaces diagnostics optics (SFP) on page 2024
- show interfaces diagnostics optics (SFP) on page 2025
- show interfaces diagnostics optics (XFP and CFP Optics) on page 2026
- show interfaces diagnostics optics for 10-Gigabit Ethernet (PTX 24-10GE-SFPP) on page 2027
- show interfaces diagnostics optics for 40-Gigabit Ethernet on page 2028
- show interfaces diagnostics optics (P1-PTX-2-100G-WDM) on page 2030
- show interfaces diagnostics optics (P1-PTX-24-10G-W-SFPP ) on page 2032
- show interfaces diagnostics optics (P2-10G-40G-QSFPP PIC in 40-Gigabit Ethernet mode) on page 2033
- show interfaces diagnostics optics (P2-10G-40G-QSFPP PIC in 10-Gigabit Ethernet mode) on page 2034
- show interfaces diagnostics optics (MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC) on page 2035
- show interfaces diagnostics optics (PTX3000 Router with 5-port 100-Gigabit DWDM OTN PIC on page 2036
- show interfaces diagnostics optics (for VCP) on page 2038
- show interfaces diagnostics optics (MPC7 with interfaces disabled) on page 2039

Output Fields

Table 153 on page 2007 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 153: show interfaces diagnostics optics Output Fields for 10-Gigabit Ethernet DWDM and DWDM OTN PICs

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical interface</td>
<td>Name of the physical interface.</td>
</tr>
<tr>
<td>Laser bias current</td>
<td>Magnitude of the laser bias power setting current, in milliamperes (mA). The laser bias provides direct modulation of laser diodes and modulates currents.</td>
</tr>
<tr>
<td>Laser output power</td>
<td>Laser output power, in milliwatts (mW) and decibels, referenced to 1.0 mW (dBm). This is a software equivalent to the LsPOWMON pin in hardware.</td>
</tr>
<tr>
<td>Receiver signal average</td>
<td>Average received optical power, in mW and dBm. This indicator is a software equivalent to the RxPOWMON pin in hardware. Average optical power is vendor-specific.</td>
</tr>
</tbody>
</table>
Table 153: show interfaces diagnostics optics Output Fields for 10-Gigabit Ethernet DWDM and DWDM OTN PICs (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser end-of-life alarm</td>
<td>Laser end-of-life alarm: On or Off.</td>
</tr>
<tr>
<td>Laser wavelength alarm</td>
<td>Laser wavelength alarm: On or Off.</td>
</tr>
<tr>
<td>Laser bias current alarm</td>
<td>Laser bias current alarm: On or Off.</td>
</tr>
<tr>
<td>Laser temperature alarm</td>
<td>Laser temperature alarm: On or Off.</td>
</tr>
<tr>
<td>Laser power alarm</td>
<td>Laser power alarm: On or Off.</td>
</tr>
<tr>
<td>Modulator temperature alarm</td>
<td>Modulator temperature alarm: On or Off.</td>
</tr>
<tr>
<td></td>
<td>Transceivers from some vendors do not support this field.</td>
</tr>
<tr>
<td>Modulator bias alarm</td>
<td>Modulator bias alarm: On or Off.</td>
</tr>
<tr>
<td>Tx multiplexer FIFO error alarm</td>
<td>Transmit multiplexer first in, first out (FIFO) error alarm: On or Off.</td>
</tr>
<tr>
<td>Tx loss of PLL lock alarm</td>
<td>Transmit loss of phase-locked loop (PLL) lock alarm: On or Off.</td>
</tr>
<tr>
<td>Rx loss of average optical power alarm</td>
<td>Receive loss of average optical power alarm: On or Off.</td>
</tr>
<tr>
<td>Rx loss of AC power alarm</td>
<td>Receive loss of AC power alarm: On or Off.</td>
</tr>
<tr>
<td></td>
<td>Transceivers from some vendors do not support this field.</td>
</tr>
<tr>
<td>Rx loss of PLL lock alarm</td>
<td>Receive loss of phase-locked loop (PLL) lock alarm: On or Off.</td>
</tr>
</tbody>
</table>

Table 154 on page 2008 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 154: show interfaces diagnostics optics Output Fields for Gigabit Ethernet Bidirectional SFP Optics

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical interface</td>
<td>Name of the physical interface.</td>
</tr>
<tr>
<td>Laser bias current</td>
<td>Magnitude of the laser bias power setting current, in milliamperes (mA). The laser bias provides direct modulation of laser diodes and modulates currents.</td>
</tr>
<tr>
<td>Laser output power</td>
<td>Laser output power, in milliwatts (mW) and decibels, referenced to 1.0 mW (dBm).</td>
</tr>
<tr>
<td>Field Name</td>
<td>Field Description</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>Module temperature</td>
<td>Temperature of the optics module, in Celsius and Fahrenheit.</td>
</tr>
<tr>
<td>Module voltage</td>
<td>Internally measured module voltage.</td>
</tr>
<tr>
<td>Receiver signal average optical power</td>
<td>Average received optical power, in mW and dBm.</td>
</tr>
<tr>
<td>Wavelength Channel number</td>
<td>Wavelength channel number set in the optics module.</td>
</tr>
<tr>
<td>Wavelength setpoint</td>
<td>Wavelength set in the optics module.</td>
</tr>
<tr>
<td>Tx Dither</td>
<td>Transmit dither status. Displays whether transmit dither is enabled or disabled.</td>
</tr>
<tr>
<td>Frequency Error</td>
<td>Frequency error reported from optics module.</td>
</tr>
<tr>
<td>Wavelength Error</td>
<td>Wavelength error reported from optics module.</td>
</tr>
<tr>
<td>Laser bias current high alarm</td>
<td>Laser bias power setting high alarm. Displays on or off.</td>
</tr>
<tr>
<td>Laser bias current low alarm</td>
<td>Laser bias power setting low alarm. Displays on or off.</td>
</tr>
<tr>
<td>Laser bias current high warning</td>
<td>Laser bias power setting high warning. Displays on or off.</td>
</tr>
<tr>
<td>Laser bias current low warning</td>
<td>Laser bias power setting low warning. Displays on or off.</td>
</tr>
<tr>
<td>Laser output power high alarm</td>
<td>Laser output power high alarm. Displays on or off.</td>
</tr>
<tr>
<td>Laser output power low alarm</td>
<td>Laser output power low alarm. Displays on or off.</td>
</tr>
<tr>
<td>Laser output power high warning</td>
<td>Laser output power high warning. Displays on or off.</td>
</tr>
<tr>
<td>Laser output power low warning</td>
<td>Laser output power low warning. Displays on or off.</td>
</tr>
<tr>
<td>Module temperature high alarm</td>
<td>Module temperature high alarm. Displays on or off.</td>
</tr>
<tr>
<td>Module temperature low alarm</td>
<td>Module temperature low alarm. Displays on or off.</td>
</tr>
<tr>
<td>Field Name</td>
<td>Field Description</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Module temperature high warning</td>
<td>Module temperature high warning. Displays on or off.</td>
</tr>
<tr>
<td>Module temperature low warning</td>
<td>Module temperature low warning. Displays on or off.</td>
</tr>
<tr>
<td>Module voltage high alarm</td>
<td>Module voltage high alarm. Displays on or off.</td>
</tr>
<tr>
<td>Module voltage low alarm</td>
<td>Module voltage low alarm. Displays on or off.</td>
</tr>
<tr>
<td>Module voltage high warning</td>
<td>Module voltage high warning. Displays on or off.</td>
</tr>
<tr>
<td>Module voltage low warning</td>
<td>Module voltage high warning. Displays on or off.</td>
</tr>
<tr>
<td>Laser rx power high alarm</td>
<td>Receive laser power high alarm. Displays on or off.</td>
</tr>
<tr>
<td>Laser rx power low alarm</td>
<td>Receive laser power low alarm. Displays on or off.</td>
</tr>
<tr>
<td>Laser rx power high warning</td>
<td>Receive laser power high warning. Displays on or off.</td>
</tr>
<tr>
<td>Laser rx power low warning</td>
<td>Receive laser power low warning. Displays on or off.</td>
</tr>
<tr>
<td>TEC fault alarm</td>
<td>TEC fault alarm. Displays on or off.</td>
</tr>
<tr>
<td>Wavelength unlocked alarm</td>
<td>Wavelength unlocked alarm. Displays on or off.</td>
</tr>
<tr>
<td>TxE Tune</td>
<td>Optical transmit side status. Displays whether optical transmit side is not ready due to tuning.</td>
</tr>
<tr>
<td>Laser bias current high alarm threshold</td>
<td>Vendor-specified threshold for the laser bias current high alarm: 70.000 mA.</td>
</tr>
<tr>
<td>Laser bias current low alarm threshold</td>
<td>Vendor-specified threshold for the laser bias current low alarm: 0.0002 mA.</td>
</tr>
<tr>
<td>Laser bias current high warning threshold</td>
<td>Vendor-specified threshold for the laser bias current high warning: 65.000 mA.</td>
</tr>
<tr>
<td>Laser bias current low warning threshold</td>
<td>Vendor-specified threshold for the laser bias current low warning: 0.0002 mA.</td>
</tr>
</tbody>
</table>
Table 154: show interfaces diagnostics optics Output Fields for Gigabit Ethernet Bidirectional SFP Optics (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser output power high alarm threshold</td>
<td>Vendor-specified threshold for the laser output power high alarm: 1.0000 mW or 0.00 dBm.</td>
</tr>
<tr>
<td>Laser output power low alarm threshold</td>
<td>Vendor-specified threshold for the laser output power low alarm: 0.0560 mW or -12.52 dBm.</td>
</tr>
<tr>
<td>Laser output power high warning threshold</td>
<td>Vendor-specified threshold for the laser output power high warning: 0.6300 mW or -2.01 dBm.</td>
</tr>
<tr>
<td>Laser output power low warning threshold</td>
<td>Vendor-specified threshold for the laser output power low warning: 0.0890 mW or -10.51 dBm.</td>
</tr>
<tr>
<td>Module temperature high alarm threshold</td>
<td>Vendor-specified threshold for the module temperature high alarm: 100°C or 212°F.</td>
</tr>
<tr>
<td>Module temperature low alarm threshold</td>
<td>Vendor-specified threshold for the module temperature low alarm: -50°C or -58°F.</td>
</tr>
<tr>
<td>Module temperature high warning threshold</td>
<td>Vendor-specified threshold for the module temperature high warning: 95°C or 203°F.</td>
</tr>
<tr>
<td>Module temperature low warning threshold</td>
<td>Vendor-specified threshold for the module temperature low warning: -48°C or -54°F.</td>
</tr>
<tr>
<td>Module voltage high alarm threshold</td>
<td>Module voltage high alarm threshold: 3.700 v.</td>
</tr>
<tr>
<td>Module voltage low alarm threshold</td>
<td>Module voltage low alarm threshold: 2.900 v.</td>
</tr>
<tr>
<td>Module voltage high warning threshold</td>
<td>Module voltage high warning threshold: 3.7600 v.</td>
</tr>
<tr>
<td>Module voltage low warning threshold</td>
<td>Module voltage low warning threshold: 3.000 v.</td>
</tr>
<tr>
<td>Laser rx power high alarm threshold</td>
<td>Vendor-specified threshold for the laser Rx power high alarm: 1.9953 mW or 3.00 dBm.</td>
</tr>
<tr>
<td>Laser rx power low alarm threshold</td>
<td>Vendor-specified threshold for the laser Rx power low alarm: 0.0001 mW or -40.00 dBm.</td>
</tr>
<tr>
<td>Laser rx power high warning threshold</td>
<td>Vendor-specified threshold for the laser Rx power high warning: 1.0000 mW or 0.00 dBm.</td>
</tr>
<tr>
<td>Laser rx power low warning threshold</td>
<td>Vendor-specified threshold for the laser Rx power low warning: 0.0010 mW or -30.00 dBm.</td>
</tr>
</tbody>
</table>
Table 155 on page 2012 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 155: show interfaces diagnostics Output Fields for Gigabit Ethernet SFP Transceivers**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical interface</td>
<td>Name of the physical interface.</td>
</tr>
<tr>
<td>Laser bias current</td>
<td>Measured laser bias current in uA.</td>
</tr>
<tr>
<td>Laser output power</td>
<td>Measured laser output power in mW.</td>
</tr>
<tr>
<td>Module temperature</td>
<td>Internally measured module temperature.</td>
</tr>
<tr>
<td>Module voltage</td>
<td>Internally measured module voltage.</td>
</tr>
<tr>
<td>Laser rx power</td>
<td>Measured receive optical power in mW.</td>
</tr>
<tr>
<td>Laser bias current high alarm</td>
<td>Laser bias current high alarm: On or Off. Alarm ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser bias current low alarm</td>
<td>Laser bias current low alarm: On or Off. Alarm ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser output power high alarm</td>
<td>Laser output power high alarm: On or Off. Alarm ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser output power low alarm</td>
<td>Laser output power low alarm: On or Off. Alarm ranges are vendor-specific.</td>
</tr>
<tr>
<td>Module temp high alarm</td>
<td>Module temperature high alarm: On or Off. Alarm ranges are vendor-specific.</td>
</tr>
<tr>
<td>Module temp low alarm</td>
<td>Module temperature low alarm: On or Off. Alarm ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser rx power high alarm</td>
<td>Laser receive power high alarm: On or Off. Alarm ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser rx power low alarm</td>
<td>Laser receive power low alarm: On or Off. Alarm ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser bias current high warning</td>
<td>Laser bias current high warning: On or Off. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser bias current low warning</td>
<td>Laser bias current low warning: On or Off. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser output power high warning</td>
<td>Laser output power high warning: On or Off. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Field Name</td>
<td>Field Description</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Laser output power low warning</td>
<td>Laser output power low warning: <strong>On</strong> or <strong>Off</strong>. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Module temperature high warning</td>
<td>Module temperature high warning: <strong>On</strong> or <strong>Off</strong>. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Module temperature low warning</td>
<td>Module temperature low warning: <strong>On</strong> or <strong>Off</strong>. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser rx power high warning</td>
<td>Laser receive power high warning: <strong>On</strong> or <strong>Off</strong>. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser rx power low warning</td>
<td>Laser receive power low warning: <strong>On</strong> or <strong>Off</strong>. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser bias current high alarm threshold</td>
<td>Laser bias current high alarm threshold. Alarm threshold ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser bias current low alarm threshold</td>
<td>Laser bias current low alarm threshold. Alarm threshold ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser bias current high warning threshold</td>
<td>Laser bias current high warning threshold. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser bias current low warning threshold</td>
<td>Laser bias current low warning threshold. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser output power high alarm threshold</td>
<td>Laser output power high alarm threshold. Alarm threshold ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser output power low alarm threshold</td>
<td>Laser output power low alarm threshold. Alarm threshold ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser output power high warning threshold</td>
<td>Laser output power high warning threshold. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser output power low warning threshold</td>
<td>Laser output power low warning threshold. Warning ranges are vendor-specific.</td>
</tr>
</tbody>
</table>
### Table 155: show interfaces diagnostics Output Fields for Gigabit Ethernet SFP Transceivers (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module temperature low warning threshold</td>
<td>Module temperature low warning threshold. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Module voltage high alarm threshold</td>
<td>Module voltage high alarm threshold. Alarm ranges are vendor-specific.</td>
</tr>
<tr>
<td>Module voltage low alarm threshold</td>
<td>Module voltage low alarm threshold. Alarm ranges are vendor-specific.</td>
</tr>
<tr>
<td>Module voltage high warning threshold</td>
<td>Module voltage high warning threshold. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Module voltage low warning threshold</td>
<td>Module voltage low warning threshold. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser rx power high alarm threshold</td>
<td>Laser receive power high alarm threshold. Alarm threshold ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser rx power low alarm threshold</td>
<td>Laser receive power low alarm threshold. Alarm threshold ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser rx power high warning threshold</td>
<td>Laser receive power high warning threshold. Warning threshold ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser rx power high low threshold</td>
<td>Laser receive power high warning threshold. Warning threshold ranges are vendor-specific.</td>
</tr>
</tbody>
</table>

Table 156 on page 2014 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 156: show interfaces diagnostics optics Output Fields for 10-Gigabit Ethernet Transceivers

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical interface</td>
<td>Name of the physical interface.</td>
</tr>
<tr>
<td>Laser bias current</td>
<td>Measured laser bias current in mA.</td>
</tr>
<tr>
<td>Laser output power</td>
<td>Measured laser output power in mW.</td>
</tr>
<tr>
<td>Module temperature</td>
<td>Internally measured module temperature.</td>
</tr>
<tr>
<td>Laser rx power</td>
<td>Measured receive optical power in mW.</td>
</tr>
<tr>
<td>Laser bias current high alarm</td>
<td>Laser bias current high alarm: On or Off. Alarm ranges are vendor-specific.</td>
</tr>
</tbody>
</table>
Table 156: show interfaces diagnostics optics Output Fields for 10-Gigabit Ethernet Transceivers (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser bias current low alarm</td>
<td>Laser bias current low alarm: <em>On</em> or <em>Off</em>. Alarm ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser output power high alarm</td>
<td>Laser output power high alarm: <em>On</em> or <em>Off</em>. Alarm ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser output power low alarm</td>
<td>Laser output power low alarm: <em>On</em> or <em>Off</em>. Alarm ranges are vendor-specific.</td>
</tr>
<tr>
<td>Module temp high alarm</td>
<td>Module temperature high alarm: <em>On</em> or <em>Off</em>. Alarm ranges are vendor-specific.</td>
</tr>
<tr>
<td>Module temp low alarm</td>
<td>Module temperature low alarm: <em>On</em> or <em>Off</em>. Alarm ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser rx power high alarm</td>
<td>Laser receive power high alarm: <em>On</em> or <em>Off</em>. Alarm ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser rx power low alarm</td>
<td>Laser receive power low alarm: <em>On</em> or <em>Off</em>. Alarm ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser bias current high warning</td>
<td>Laser bias current high warning: <em>On</em> or <em>Off</em>. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser bias current low warning</td>
<td>Laser bias current low warning: <em>On</em> or <em>Off</em>. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser output power high warning</td>
<td>Laser output power high warning: <em>On</em> or <em>Off</em>. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser output power low warning</td>
<td>Laser output power low warning: <em>On</em> or <em>Off</em>. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Module temperature high warning</td>
<td>Module temperature high warning: <em>On</em> or <em>Off</em>. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Module temperature low warning</td>
<td>Module temperature low warning: <em>On</em> or <em>Off</em>. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser rx power high warning</td>
<td>Laser receive power high warning: <em>On</em> or <em>Off</em>. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser rx power low warning</td>
<td>Laser receive power low warning: <em>On</em> or <em>Off</em>. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser bias current high alarm threshold</td>
<td>Laser bias current high alarm threshold. Alarm threshold ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser bias current low alarm threshold</td>
<td>Laser bias current low alarm threshold. Alarm threshold ranges are vendor-specific.</td>
</tr>
</tbody>
</table>
### Table 156: show interfaces diagnostics optics Output Fields for 10-Gigabit Ethernet Transceivers (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser output power high alarm threshold</td>
<td>Laser output power high alarm threshold. Alarm threshold ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser output power low alarm threshold</td>
<td>Laser output power low alarm threshold. Alarm threshold ranges are vendor-specific.</td>
</tr>
<tr>
<td>Module temperature high alarm threshold</td>
<td>Module temperature high alarm threshold. Alarm threshold ranges are vendor-specific.</td>
</tr>
<tr>
<td>Module temperature low alarm threshold</td>
<td>Module temperature low alarm threshold. Alarm threshold ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser rx power high alarm threshold</td>
<td>Laser receive power high alarm threshold. Alarm threshold ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser rx power low alarm threshold</td>
<td>Laser receive power low alarm threshold. Alarm threshold ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser bias current high warning threshold</td>
<td>Laser bias current high warning threshold. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser bias current low warning threshold</td>
<td>Laser bias current low warning threshold. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser output power high warning threshold</td>
<td>Laser output power high warning threshold. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser output power low warning threshold</td>
<td>Laser output power low warning threshold. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Module temperature high warning threshold</td>
<td>Module temperature high warning threshold. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Module temperature low warning threshold</td>
<td>Module temperature low warning threshold. Warning ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser rx power high warning threshold</td>
<td>Laser receive power high warning threshold. Warning threshold ranges are vendor-specific.</td>
</tr>
<tr>
<td>Laser rx power low warning threshold</td>
<td>Laser receive power low warning threshold. Warning threshold ranges are vendor-specific.</td>
</tr>
</tbody>
</table>

Table 157 on page 2017 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 157: `show interfaces diagnostics optics` Output Fields for 10-Gigabit Ethernet XFP Transceivers

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical interface</strong></td>
<td>Name of the physical interface.</td>
</tr>
<tr>
<td><strong>Laser bias current</strong></td>
<td>Magnitude of the laser bias power setting current, in milliamperes (mA). The laser bias provides direct modulation of laser diodes and modulates currents.</td>
</tr>
<tr>
<td><strong>Laser output power</strong></td>
<td>Laser output power, in milliwatts (mW) and decibels, referenced to 1.0 mW (dBm). This is a software equivalent to the <code>LsPOWMON</code> pin in hardware.</td>
</tr>
<tr>
<td><strong>Module temperature</strong></td>
<td>Temperature of the XFP optics module, in Celsius and Fahrenheit.</td>
</tr>
<tr>
<td><strong>Laser rx power</strong></td>
<td>Laser received optical power, in mW and dBm.</td>
</tr>
<tr>
<td><strong>Laser bias current high alarm</strong></td>
<td>Laser bias power setting high alarm. Displays on or off.</td>
</tr>
<tr>
<td><strong>Laser bias current low alarm</strong></td>
<td>Laser bias power setting low alarm. Displays on or off.</td>
</tr>
<tr>
<td><strong>Laser bias current high warning</strong></td>
<td>Laser bias power setting high warning. Displays on or off.</td>
</tr>
<tr>
<td><strong>Laser bias current low warning</strong></td>
<td>Laser bias power setting low warning. Displays on or off.</td>
</tr>
<tr>
<td><strong>Laser output power high alarm</strong></td>
<td>Laser output power high alarm. Displays on or off.</td>
</tr>
<tr>
<td><strong>Laser output power low alarm</strong></td>
<td>Laser output power low alarm. Displays on or off.</td>
</tr>
<tr>
<td><strong>Laser output power high warning</strong></td>
<td>Laser output power high warning. Displays on or off.</td>
</tr>
<tr>
<td><strong>Laser output power low warning</strong></td>
<td>Laser output power low warning. Displays on or off.</td>
</tr>
<tr>
<td><strong>Module temperature high alarm</strong></td>
<td>Module temperature high alarm. Displays on or off.</td>
</tr>
<tr>
<td><strong>Module temperature low alarm</strong></td>
<td>Module temperature low alarm. Displays on or off.</td>
</tr>
<tr>
<td><strong>Module temperature high warning</strong></td>
<td>Module temperature high warning. Displays on or off.</td>
</tr>
<tr>
<td><strong>Module temperature low warning</strong></td>
<td>Module temperature low warning. Displays on or off.</td>
</tr>
</tbody>
</table>
### Table 157: `show interfaces diagnostics optics` Output Fields for 10-Gigabit Ethernet XFP Transceivers (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser rx power high alarm</td>
<td>Receive laser power high alarm. Displays on or off.</td>
</tr>
<tr>
<td>Laser rx power low alarm</td>
<td>Receive laser power low alarm. Displays on or off.</td>
</tr>
<tr>
<td>Laser rx power high warning</td>
<td>Receive laser power high warning. Displays on or off.</td>
</tr>
<tr>
<td>Laser rx power low warning</td>
<td>Receive laser power low warning. Displays on or off.</td>
</tr>
<tr>
<td>Module not ready alarm</td>
<td>Module not ready alarm. When on, indicates the module has an operational fault. Displays on or off.</td>
</tr>
<tr>
<td>Module power down alarm</td>
<td>Module power down alarm. When on, module is in a limited power mode, low for normal operation. Displays on or off.</td>
</tr>
<tr>
<td>Tx data not ready alarm</td>
<td>Any condition leading to invalid data on the transmit path. Displays on or off.</td>
</tr>
<tr>
<td>Tx not ready alarm</td>
<td>Any condition leading to invalid data on the transmit path. Displays on or off.</td>
</tr>
<tr>
<td>Tx laser fault alarm</td>
<td>Laser fault condition. Displays on or off.</td>
</tr>
<tr>
<td>Tx CDR loss of lock alarm</td>
<td>Transmit clock and data recovery (CDR) loss of lock. Loss of lock on the transmit side of the CDR. Displays on or off.</td>
</tr>
<tr>
<td>Rx not ready alarm</td>
<td>Any condition leading to invalid data on the receive path. Displays on or off.</td>
</tr>
<tr>
<td>Rx loss of signal alarm</td>
<td>Receive Loss of Signal alarm. When on, indicates insufficient optical input power to the module. Displays on or off.</td>
</tr>
<tr>
<td>Rx CDR loss of lock alarm</td>
<td>Receive CDR loss of lock. Loss of lock on the receive side of the CDR. Displays on or off.</td>
</tr>
<tr>
<td>Laser bias current high alarm threshold</td>
<td>Vendor-specified threshold for the laser bias current high alarm: 130.000 mA.</td>
</tr>
<tr>
<td>Laser bias current low alarm threshold</td>
<td>Vendor-specified threshold for the laser bias current low alarm: 10.000 mA.</td>
</tr>
<tr>
<td>Laser bias current high warning threshold</td>
<td>Vendor-specified threshold for the laser bias current high warning: 120.000 mA.</td>
</tr>
<tr>
<td>Laser bias current low warning threshold</td>
<td>Vendor-specified threshold for the laser bias current low warning: 12.000 mA.</td>
</tr>
<tr>
<td>Laser output power high alarm threshold</td>
<td>Vendor-specified threshold for the laser output power high alarm: 0.8910 mW or -0.50 dBm.</td>
</tr>
</tbody>
</table>
### Table 157: show interfaces diagnostics optics Output Fields for 10-Gigabit Ethernet XFP Transceivers (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser output power low alarm threshold</td>
<td>Vendor-specified threshold for the laser output power low alarm: 0.2230 mW or -6.52 dBm.</td>
</tr>
<tr>
<td>Laser output power high warning threshold</td>
<td>Vendor-specified threshold for the laser output power high warning: 0.7940 mW or -100 dBm.</td>
</tr>
<tr>
<td>Laser output power low warning threshold</td>
<td>Vendor-specified threshold for the laser output power low warning: 0.2510 mW or -600 dBm.</td>
</tr>
<tr>
<td>Module temperature high alarm threshold</td>
<td>Vendor-specified threshold for the module temperature high alarm: 90° C or 194° F.</td>
</tr>
<tr>
<td>Module temperature low alarm threshold</td>
<td>Vendor-specified threshold for the module temperature low alarm: -5° C or 23° F.</td>
</tr>
<tr>
<td>Module temperature high warning threshold</td>
<td>Vendor-specified threshold for the module temperature high warning: 85° C or 185° F.</td>
</tr>
<tr>
<td>Module temperature low warning threshold</td>
<td>Vendor-specified threshold for the module temperature low warning: 0° C or 32° F.</td>
</tr>
<tr>
<td>Laser rx power high alarm threshold</td>
<td>Vendor-specified threshold for the laser Rx power high alarm: 1.2589 mW or 1.00 dBm.</td>
</tr>
<tr>
<td>Laser rx power low alarm threshold</td>
<td>Vendor-specified threshold for the laser Rx power low alarm: 0.0323 mW or -14.91 dBm.</td>
</tr>
<tr>
<td>Laser rx power high warning threshold</td>
<td>Vendor-specified threshold for the laser Rx power high warning: 1.1220 mW or 0.50 dBm.</td>
</tr>
<tr>
<td>Laser rx power low warning threshold</td>
<td>Vendor-specified threshold for the laser Rx power low warning: 0.0363 mW or -14.40 dBm.</td>
</tr>
</tbody>
</table>

Table 158 on page 2019 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 158: show interfaces diagnostics optics Output for Virtual Chassis Ports

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical interface</td>
<td>Name of the physical interface.</td>
</tr>
<tr>
<td>Laser bias current</td>
<td>Magnitude of the laser bias power setting current, in milliamperes (mA). The laser bias provides direct modulation of laser diodes and modulates currents.</td>
</tr>
<tr>
<td>Laser output power</td>
<td>Laser output power, in milliwatts (mW) and decibels, referenced to 1.0 mW (dBm).</td>
</tr>
<tr>
<td>Module temperature</td>
<td>Temperature of the optics module, in Celsius and Fahrenheit.</td>
</tr>
</tbody>
</table>
Table 158: show interfaces diagnostics optics Output for Virtual Chassis Ports (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module voltage</td>
<td>Internally measured module voltage.</td>
</tr>
<tr>
<td>Receiver signal average</td>
<td>Average received optical power, in mW and dBm.</td>
</tr>
<tr>
<td>optical power</td>
<td></td>
</tr>
<tr>
<td>Laser bias current high alarm</td>
<td>Laser bias power setting high alarm. Displays on or off.</td>
</tr>
<tr>
<td>Laser bias current low alarm</td>
<td>Laser bias power setting low alarm. Displays on or off.</td>
</tr>
<tr>
<td>Laser bias current high warning</td>
<td>Laser bias power setting high warning. Displays on or off.</td>
</tr>
<tr>
<td>Laser bias current low warning</td>
<td>Laser bias power setting low warning. Displays on or off.</td>
</tr>
<tr>
<td>Laser output power high alarm</td>
<td>Laser output power high alarm. Displays on or off.</td>
</tr>
<tr>
<td>Laser output power low alarm</td>
<td>Laser output power low alarm. Displays on or off.</td>
</tr>
<tr>
<td>Laser output power high warning</td>
<td>Laser output power high warning. Displays on or off.</td>
</tr>
<tr>
<td>Laser output power low warning</td>
<td>Laser output power low warning. Displays on or off.</td>
</tr>
<tr>
<td>Module temperature high alarm</td>
<td>Module temperature high alarm. Displays on or off.</td>
</tr>
<tr>
<td>Module temperature low alarm</td>
<td>Module temperature low alarm. Displays on or off.</td>
</tr>
<tr>
<td>Module temperature high warning</td>
<td>Module temperature high warning. Displays on or off.</td>
</tr>
<tr>
<td>Module temperature low warning</td>
<td>Module temperature low warning. Displays on or off.</td>
</tr>
<tr>
<td>Module voltage high alarm</td>
<td>Module voltage high alarm. Displays on or off.</td>
</tr>
<tr>
<td>Module voltage low alarm</td>
<td>Module voltage low alarm. Displays on or off.</td>
</tr>
<tr>
<td>Module voltage high warning</td>
<td>Module voltage high warning. Displays on or off.</td>
</tr>
</tbody>
</table>
Table 158: show interfaces diagnostics optics Output for Virtual Chassis Ports (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module voltage low warning</td>
<td>Module voltage high warning. Displays on or off.</td>
</tr>
<tr>
<td>Laser rx power high alarm</td>
<td>Receive laser power high alarm. Displays on or off.</td>
</tr>
<tr>
<td>Laser rx power low alarm</td>
<td>Receive laser power low alarm. Displays on or off.</td>
</tr>
<tr>
<td>Laser rx power high warning</td>
<td>Receive laser power high warning. Displays on or off.</td>
</tr>
<tr>
<td>Laser rx power low warning</td>
<td>Receive laser power low warning. Displays on or off.</td>
</tr>
<tr>
<td>Laser bias current high alarm threshold</td>
<td>Vendor-specified threshold for the laser bias current high alarm.</td>
</tr>
<tr>
<td>Laser bias current low alarm threshold</td>
<td>Vendor-specified threshold for the laser bias current low alarm.</td>
</tr>
<tr>
<td>Laser bias current high warning threshold</td>
<td>Vendor-specified threshold for the laser bias current high warning.</td>
</tr>
<tr>
<td>Laser bias current low warning threshold</td>
<td>Vendor-specified threshold for the laser bias current low warning.</td>
</tr>
<tr>
<td>Laser output power high alarm threshold</td>
<td>Vendor-specified threshold for the laser output power high alarm.</td>
</tr>
<tr>
<td>Laser output power low alarm threshold</td>
<td>Vendor-specified threshold for the laser output power low alarm.</td>
</tr>
<tr>
<td>Laser output power high warning threshold</td>
<td>Vendor-specified threshold for the laser output power high warning.</td>
</tr>
<tr>
<td>Laser output power low warning threshold</td>
<td>Vendor-specified threshold for the laser output power low warning.</td>
</tr>
<tr>
<td>Module temperature high alarm threshold</td>
<td>Vendor-specified threshold for the module temperature high alarm.</td>
</tr>
<tr>
<td>Module temperature low alarm threshold</td>
<td>Vendor-specified threshold for the module temperature low alarm.</td>
</tr>
<tr>
<td>Module temperature high warning threshold</td>
<td>Vendor-specified threshold for the module temperature high warning.</td>
</tr>
</tbody>
</table>
### Table 158: show interfaces diagnostics optics Output for Virtual Chassis Ports (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module temperature low warning threshold</td>
<td>Vendor-specified threshold for the module temperature low warning.</td>
</tr>
<tr>
<td>Module voltage high alarm threshold</td>
<td>Module voltage high alarm threshold.</td>
</tr>
<tr>
<td>Module voltage low alarm threshold</td>
<td>Module voltage low alarm threshold.</td>
</tr>
<tr>
<td>Module voltage high warning threshold</td>
<td>Module voltage high warning threshold.</td>
</tr>
<tr>
<td>Module voltage low warning threshold</td>
<td>Module voltage low warning threshold.</td>
</tr>
<tr>
<td>Laser rx power high alarm threshold</td>
<td>Vendor-specified threshold for the laser Rx power high alarm.</td>
</tr>
<tr>
<td>Laser rx power low alarm threshold</td>
<td>Vendor-specified threshold for the laser Rx power low alarm.</td>
</tr>
<tr>
<td>Laser rx power high warning threshold</td>
<td>Vendor-specified threshold for the laser Rx power high warning.</td>
</tr>
<tr>
<td>Laser rx power low warning threshold</td>
<td>Vendor-specified threshold for the laser Rx power low warning.</td>
</tr>
</tbody>
</table>

### 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)**

```plaintext
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)**

```plaintext
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-1/0/0

Physical interface: ge-1/0/0

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser bias current</td>
<td>49.010 mA</td>
</tr>
<tr>
<td>Laser output power</td>
<td>1.263 mW / 1.01 dBm</td>
</tr>
<tr>
<td>Module temperature</td>
<td>17 degrees C / 62 degrees F</td>
</tr>
<tr>
<td>Module voltage</td>
<td>4.21 V</td>
</tr>
<tr>
<td>Laser rx power</td>
<td>0.060 mW / -12.21 dBm</td>
</tr>
<tr>
<td>Laser bias current high</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current low</td>
<td>Off</td>
</tr>
<tr>
<td>Laser output power high</td>
<td>Off</td>
</tr>
<tr>
<td>Laser output power low</td>
<td>Off</td>
</tr>
<tr>
<td>Module temperature high</td>
<td>Off</td>
</tr>
<tr>
<td>Module temperature low</td>
<td>Off</td>
</tr>
<tr>
<td>Module voltage high</td>
<td>Off</td>
</tr>
<tr>
<td>Module voltage low</td>
<td>Off</td>
</tr>
<tr>
<td>Laser rx power high</td>
<td>Off</td>
</tr>
<tr>
<td>Laser rx power low</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current high</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current low</td>
<td>Off</td>
</tr>
<tr>
<td>Laser output power high</td>
<td>Off</td>
</tr>
<tr>
<td>Laser output power low</td>
<td>Off</td>
</tr>
<tr>
<td>Module temperature high</td>
<td>Off</td>
</tr>
<tr>
<td>Module temperature low</td>
<td>Off</td>
</tr>
<tr>
<td>Module voltage high</td>
<td>Off</td>
</tr>
<tr>
<td>Module voltage low</td>
<td>Off</td>
</tr>
<tr>
<td>Laser rx power high</td>
<td>Off</td>
</tr>
<tr>
<td>Laser rx power low</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current high</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current low</td>
<td>Off</td>
</tr>
<tr>
<td>Laser output power high</td>
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</tr>
<tr>
<td>Laser output power low</td>
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</tr>
<tr>
<td>Module temperature high</td>
<td>Off</td>
</tr>
<tr>
<td>Module temperature low</td>
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</tr>
<tr>
<td>Module voltage high</td>
<td>Off</td>
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<tr>
<td>Module voltage low</td>
<td>Off</td>
</tr>
<tr>
<td>Laser rx power high</td>
<td>Off</td>
</tr>
<tr>
<td>Laser rx power low</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current high</td>
<td>70.000 mA</td>
</tr>
<tr>
<td>Laser bias current low</td>
<td>20.000 mA</td>
</tr>
<tr>
<td>Laser output power high</td>
<td>65.000 mA</td>
</tr>
<tr>
<td>Laser output power low</td>
<td>25.000 mA</td>
</tr>
</tbody>
</table>
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
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
show interfaces diagnostics optics for 40-Gigabit Ethernet

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 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
Module temperature high alarm threshold   :  2.8180 mW / 4.50 dBm
Module temperature low alarm threshold    :  0.2390 mW / -6.22 dBm
Module temperature high warning threshold :  2.2380 mW / 3.50 dBm
Module temperature low warning threshold  :  0.3010 mW / -5.21 dBm
Module voltage high alarm threshold       :  2.5119 mW / -4.00 dBm
Module voltage low alarm threshold        :  0.3016 mW / -15.00 dBm
Module voltage high warning threshold     :  1.9953 mW / 3.00 dBm
Module voltage low warning threshold      :  0.0631 mW / -12.00 dBm

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
Chapter 41: Operational Commands

```
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
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
```
### Laser and Receiver Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser output power low alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser output power high warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser output power low warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser temperature high alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser temperature low alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser temperature high warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser temperature low warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser receiver power high alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser receiver power low alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser receiver power high warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current high alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current low alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current high warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current low warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser output power high alarm</td>
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</tr>
<tr>
<td>Laser output power low alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser output power high warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser temperature high alarm</td>
<td>Off</td>
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<tr>
<td>Laser temperature low alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser temperature high warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser temperature low warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser receiver power high alarm</td>
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</tr>
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<td>Laser receiver power low alarm</td>
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</tr>
<tr>
<td>Laser receiver power high warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser receiver power low warning</td>
<td>Off</td>
</tr>
<tr>
<td>Tx loss of signal functionality alarm</td>
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<tr>
<td>Tx CDR loss of lock alarm</td>
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<tr>
<td>Rx loss of signal alarm</td>
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<tr>
<td>Rx CDR loss of lock alarm</td>
<td>Off</td>
</tr>
<tr>
<td>APD supply fault alarm</td>
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</tr>
<tr>
<td>TEC fault alarm</td>
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<tr>
<td>Wavelength unlocked alarm</td>
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### Lane 3

#### Laser and Receiver Parameters

<table>
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<th>Parameter</th>
<th>Value</th>
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<td>Laser output power</td>
<td>0.899 mW / -0.46 dBm</td>
</tr>
<tr>
<td>Laser temperature</td>
<td>34 degrees C / 94 degrees F</td>
</tr>
<tr>
<td>Laser receiver power</td>
<td>0.892 mW / -0.50 dBm</td>
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</table>

### Additional Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module temperature</td>
<td>37 degrees C / 98 degrees F</td>
</tr>
<tr>
<td>Module voltage</td>
<td>3.370 V</td>
</tr>
</tbody>
</table>

**show interfaces diagnostics optics et-1/0/0**

```bash
user@host> show interfaces diagnostics optics et-1/0/0
```

### Physical Interface: et-1/0/0

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module temperature</td>
<td>37 degrees C / 98 degrees F</td>
</tr>
<tr>
<td>Module voltage</td>
<td>3.370 V</td>
</tr>
<tr>
<td>Module temperature high alarm</td>
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</tr>
<tr>
<td>Module temperature low alarm</td>
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</tr>
<tr>
<td>Module temperature high warning</td>
<td>Off</td>
</tr>
<tr>
<td>Module temperature low warning</td>
<td>Off</td>
</tr>
<tr>
<td>Module voltage high alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Module voltage low alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Feature</td>
<td>Status</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>---------------</td>
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<tr>
<td>Module voltage high warning</td>
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</tr>
<tr>
<td>Module voltage low warning</td>
<td>Off</td>
</tr>
<tr>
<td>Module not ready alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Module low power alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Module initialization incomplete alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Module fault alarm</td>
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</tr>
<tr>
<td>PLD Flash initialization fault alarm</td>
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</tr>
<tr>
<td>Power supply fault alarm</td>
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</tr>
<tr>
<td>Checksum fault alarm</td>
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</tr>
<tr>
<td>Tx laser disabled alarm</td>
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</tr>
<tr>
<td>Tx loss of signal functionality alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Tx CDR loss of lock alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Rx loss of signal alarm</td>
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<tr>
<td>Rx CDR loss of lock alarm</td>
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<tr>
<td>Module temperature high alarm threshold</td>
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<td>Module temperature low alarm threshold</td>
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<tr>
<td>Module temperature high warning threshold</td>
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<tr>
<td>Module temperature low warning threshold</td>
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<tr>
<td>Module voltage high alarm threshold</td>
<td>3.4640 V</td>
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<tr>
<td>Module voltage low alarm threshold</td>
<td>3.1340 V</td>
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<td>Module voltage high warning threshold</td>
<td>3.4310 V</td>
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<tr>
<td>Module voltage low warning threshold</td>
<td>3.1670 V</td>
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<td>Laser bias current high alarm threshold</td>
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<tr>
<td>Laser bias current high warning threshold</td>
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<tr>
<td>Laser bias current low warning threshold</td>
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<tr>
<td>Laser bias current</td>
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<td>Rx power high alarm threshold</td>
<td>2.8184 mW / 4.50 dBm</td>
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<td>Rx power low alarm threshold</td>
<td>0.0251 mW / -16.00 dBm</td>
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<tr>
<td>Rx power high warning threshold</td>
<td>2.5119 mW / 4.00 dBm</td>
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<td>Rx power low warning threshold</td>
<td>0.0501 mW / -13.00 dBm</td>
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<td>LOS alarm threshold</td>
<td>0.0158 mW / -18.01 dBm</td>
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<tr>
<td>LOS warning threshold</td>
<td>0.0251 mW / -16.00 DBm</td>
</tr>
<tr>
<td>Laser temperature high alarm threshold</td>
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<td>Laser temperature low alarm threshold</td>
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<tr>
<td>Laser temperature high warning threshold</td>
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<td>Laser temperature low warning threshold</td>
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<td>Laser bias current low alarm</td>
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<tr>
<td>Laser bias current high warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current low warning</td>
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</tr>
<tr>
<td>Laser bias current</td>
<td>1.181 mW / 0.72 dBm</td>
</tr>
<tr>
<td>Rx power high alarm</td>
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</tr>
<tr>
<td>Rx power low alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Rx power high warning</td>
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<tr>
<td>Rx power low warning</td>
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<tr>
<td>Laser temperature high alarm</td>
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<tr>
<td>Laser temperature low alarm</td>
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<tr>
<td>Laser temperature high warning</td>
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<tr>
<td>Laser temperature low warning</td>
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</tr>
<tr>
<td>Rx power high alarm</td>
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</tr>
<tr>
<td>Rx power low alarm</td>
<td>Off</td>
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<tr>
<td>Rx power high warning</td>
<td>Off</td>
</tr>
<tr>
<td>Rx power low warning</td>
<td>Off</td>
</tr>
<tr>
<td>Tx loss of signal functionality alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Tx CDR loss of lock alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Rx loss of signal alarm</td>
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</table>
show interfaces diagnostics optics (P1-PTX-24-10G-W-SFPP )

user@host> show interfaces diagnostics optics ge-3/0/6

<table>
<thead>
<tr>
<th>Physical interface: ge-3/0/6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser bias current: 13.356 mA</td>
</tr>
<tr>
<td>Laser output power: 0.2210 mW / -6.56 dBm</td>
</tr>
<tr>
<td>Module temperature: 36 degrees C / 96 degrees F</td>
</tr>
<tr>
<td>Module voltage: 3.2180 V</td>
</tr>
<tr>
<td>Receiver signal average optical power: 0.2429 mW / -6.15 dBm</td>
</tr>
<tr>
<td>Wavelength Channel number: 1</td>
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<tr>
<td>Wavelength setpoint: 1568.80 nm</td>
</tr>
<tr>
<td>Tx Dither: Disabled</td>
</tr>
<tr>
<td>Frequency Error: 0.00 GHz</td>
</tr>
<tr>
<td>Wavelength Error: 0.00 nm</td>
</tr>
<tr>
<td>Laser bias current high alarm: Off</td>
</tr>
<tr>
<td>Laser bias current low alarm: Off</td>
</tr>
<tr>
<td>Laser bias current high warning: Off</td>
</tr>
<tr>
<td>Laser bias current low warning: Off</td>
</tr>
<tr>
<td>Laser output power high alarm: Off</td>
</tr>
<tr>
<td>Laser output power low alarm: Off</td>
</tr>
<tr>
<td>Laser output power high warning: Off</td>
</tr>
<tr>
<td>Laser output power low warning: Off</td>
</tr>
<tr>
<td>Module temperature high alarm: Off</td>
</tr>
<tr>
<td>Module temperature low alarm: Off</td>
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<tr>
<td>Module temperature high warning: Off</td>
</tr>
<tr>
<td>Module temperature low warning: Off</td>
</tr>
<tr>
<td>Module voltage high alarm: Off</td>
</tr>
<tr>
<td>Module voltage low alarm: Off</td>
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<tr>
<td>Module voltage high warning: Off</td>
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<tr>
<td>Module voltage low warning: Off</td>
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<tr>
<td>Laser rx power high alarm: Off</td>
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<td>Laser rx power low alarm: Off</td>
</tr>
<tr>
<td>Laser rx power high warning: Off</td>
</tr>
<tr>
<td>Laser rx power low warning: Off</td>
</tr>
<tr>
<td>TEC fault alarm: Off</td>
</tr>
<tr>
<td>Wavelength unlocked alarm: Off</td>
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<td>Tx Tune: Off</td>
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<td>Laser bias current high alarm threshold: 70.000 mA</td>
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<tr>
<td>Laser bias current high warning threshold: 65.000 mA</td>
</tr>
<tr>
<td>Laser bias current low warning threshold: 0.002 mA</td>
</tr>
<tr>
<td>Laser output power high alarm threshold: 1.0000 mW / 0.00 dBm</td>
</tr>
<tr>
<td>Laser output power low alarm threshold: 0.0560 mW / -12.52 dBm</td>
</tr>
<tr>
<td>Laser output power high warning threshold: 0.6300 mW / -2.01 dBm</td>
</tr>
<tr>
<td>Laser output power low warning threshold: 0.0890 mW / -10.51 dBm</td>
</tr>
<tr>
<td>Module temperature high alarm threshold: 100 degrees C / 212 degrees F</td>
</tr>
<tr>
<td>Module temperature low alarm threshold: -50 degrees C / -58 degrees F</td>
</tr>
<tr>
<td>Module temperature high warning threshold: 95 degrees C / 203 degrees F</td>
</tr>
<tr>
<td>Module temperature low warning threshold: -48 degrees C / -54 degrees F</td>
</tr>
<tr>
<td>Module voltage high alarm threshold: 3.700 V</td>
</tr>
<tr>
<td>Module voltage low alarm threshold: 2.900 V</td>
</tr>
<tr>
<td>Module voltage high warning threshold: 3.600 V</td>
</tr>
<tr>
<td>Module voltage low warning threshold: 3.000 V</td>
</tr>
<tr>
<td>Laser rx power high alarm threshold: 1.9953 mW / 3.00 dBm</td>
</tr>
</tbody>
</table>
show interfaces diagnostics optics (P2-10G-40G-QSFPP 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
```
show interfaces diagnostics optics (P2-10G-40G-QSFPP 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
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser bias current low alarm threshold</td>
<td>0.500 mA</td>
</tr>
<tr>
<td>Laser bias current high warning threshold</td>
<td>9.500 mA</td>
</tr>
<tr>
<td>Laser bias current low warning threshold</td>
<td>1.000 mA</td>
</tr>
<tr>
<td>Laser output power high alarm threshold</td>
<td>0.0000 mW / - Inf dBm</td>
</tr>
<tr>
<td>Laser output power low alarm threshold</td>
<td>0.0000 mW / - Inf dBm</td>
</tr>
<tr>
<td>Laser output power low warning threshold</td>
<td>0.0000 mW / - Inf dBm</td>
</tr>
<tr>
<td>Laser rx power high alarm threshold</td>
<td>2.1878 mW / 3.40 dBm</td>
</tr>
<tr>
<td>Laser rx power low alarm threshold</td>
<td>0.0446 mW / -13.51 dBm</td>
</tr>
<tr>
<td>Laser rx power high warning threshold</td>
<td>1.7378 mW / 2.40 dBm</td>
</tr>
<tr>
<td>Laser rx power low warning threshold</td>
<td>0.1122 mW / -9.50 dBm</td>
</tr>
<tr>
<td>Lane 3</td>
<td></td>
</tr>
<tr>
<td>Laser bias current</td>
<td>6.981 mA</td>
</tr>
<tr>
<td>Laser output power</td>
<td>0.736 mW / -1.33 dBm</td>
</tr>
<tr>
<td>Laser receiver power</td>
<td>0.537 mW / -2.70 dBm</td>
</tr>
<tr>
<td>Laser bias current high alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current low alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current high warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current low warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser receiver power high alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser receiver power low alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser receiver power high warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser receiver power low warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser receiver power high warning alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser receiver power low warning alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Tx loss of signal functionality alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Rx loss of signal alarm</td>
<td>Off</td>
</tr>
</tbody>
</table>

**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
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOS warning threshold</td>
<td>0.0251 mW / -16.00 dBm</td>
</tr>
<tr>
<td>Modem lock state</td>
<td>OK</td>
</tr>
</tbody>
</table>

**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 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
### show interfaces diagnostics optics (for VCP)

```plaintext
user@host> show interfaces diagnostics optics vcp-2/0/1

Physical interface: vcp-2/0/1

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser bias current</td>
<td>5.494 mA</td>
</tr>
<tr>
<td>Laser output power</td>
<td>0.2960 mW / -5.29 dBm</td>
</tr>
<tr>
<td>Module temperature</td>
<td>22 degrees C / 71 degrees F</td>
</tr>
<tr>
<td>Module voltage</td>
<td>3.2810 V</td>
</tr>
<tr>
<td>Receiver signal average optical power</td>
<td>0.2426 mW / -6.15 dBm</td>
</tr>
<tr>
<td>Laser bias current high alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current low alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current high warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current low warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser output power high alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser output power low alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser output power high warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser output power low warning</td>
<td>Off</td>
</tr>
<tr>
<td>Module temperature high alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Module temperature low alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Module temperature high warning</td>
<td>Off</td>
</tr>
<tr>
<td>Module temperature low warning</td>
<td>Off</td>
</tr>
<tr>
<td>Module voltage high alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Module voltage low alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Module voltage high warning</td>
<td>Off</td>
</tr>
<tr>
<td>Module voltage low warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser rx power high alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser rx power low alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser rx power high warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser rx power low warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current high alarm threshold</td>
<td>17.000 mA</td>
</tr>
<tr>
<td>Laser bias current low alarm threshold</td>
<td>1.000 mA</td>
</tr>
<tr>
<td>Laser bias current high warning threshold</td>
<td>14.000 mA</td>
</tr>
<tr>
<td>Laser bias current low warning threshold</td>
<td>2.000 mA</td>
</tr>
<tr>
<td>Laser output power high alarm threshold</td>
<td>0.6310 mW / -2.00 dBm</td>
</tr>
<tr>
<td>Laser output power low alarm threshold</td>
<td>0.0670 mW / -11.74 dBm</td>
</tr>
<tr>
<td>Laser output power high warning threshold</td>
<td>0.6310 mW / -2.00 dBm</td>
</tr>
<tr>
<td>Laser output power low warning threshold</td>
<td>0.0790 mW / -11.02 dBm</td>
</tr>
<tr>
<td>Module temperature high alarm threshold</td>
<td>95 degrees C / 203 degrees F</td>
</tr>
<tr>
<td>Module temperature low alarm threshold</td>
<td>-25 degrees C / -13 degrees F</td>
</tr>
<tr>
<td>Module temperature high warning threshold</td>
<td>90 degrees C / 194 degrees F</td>
</tr>
<tr>
<td>Module temperature low warning threshold</td>
<td>-20 degrees C / -4 degrees F</td>
</tr>
<tr>
<td>Module voltage high alarm</td>
<td>3.900 V</td>
</tr>
<tr>
<td>Module voltage low alarm</td>
<td>2.700 V</td>
</tr>
<tr>
<td>Module voltage high warning</td>
<td>3.700 V</td>
</tr>
<tr>
<td>Module voltage low warning</td>
<td>2.900 V</td>
</tr>
<tr>
<td>Laser rx power high alarm</td>
<td>1.2590 mW / 1.00 dBm</td>
</tr>
<tr>
<td>Laser rx power low alarm</td>
<td>0.0100 mW / -20.00 dBm</td>
</tr>
</tbody>
</table>
```
show interfaces diagnostics optics (MPC7 with interfaces disabled)

user@host> show interfaces diagnostics optics et-3/0/0

Physical interface: et-3/0/0
Module temperature : 34 degrees C / 93 degrees F
Module voltage : 3.2660 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 / 23 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 : 9.999 mA
Laser bias current low alarm threshold : 0.499 mA
Laser bias current high warning threshold : 9.499 mA
Laser bias current low warning threshold : 0.999 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 : 6.697 mA
Laser output power : 0.738 mW / -1.32 dBm
Laser receiver power : 0.790 mW / -1.02 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
Tx laser disabled alarm : Off
Lane 1
Laser bias current : 6.961 mA
Laser output power : 0.908 mW / -0.42 dBm
Laser receiver power : 0.827 mW / -0.83 dBm
Laser bias current high alarm : Off
Laser bias current low alarm : Off
<table>
<thead>
<tr>
<th>Laser bias current high warning</th>
<th>Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser bias current low warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser receiver power high alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser receiver power low alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser receiver power high warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser receiver power low warning</td>
<td>Off</td>
</tr>
<tr>
<td>Tx loss of signal functionality alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Rx loss of signal alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Tx laser disabled alarm</td>
<td>Off</td>
</tr>
</tbody>
</table>

**Lane 2**

<table>
<thead>
<tr>
<th>Laser bias current</th>
<th>6.926 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser output power</td>
<td>0.888 mW / -0.51 dBm</td>
</tr>
<tr>
<td>Laser receiver power</td>
<td>0.820 mW / -0.86 dBm</td>
</tr>
<tr>
<td>Laser bias current high alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current low alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current high warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current low warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser receiver power high alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser receiver power low alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser receiver power high warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser receiver power low warning</td>
<td>Off</td>
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<tr>
<td>Tx loss of signal functionality alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Rx loss of signal alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Tx laser disabled alarm</td>
<td>Off</td>
</tr>
</tbody>
</table>

**Lane 3**

<table>
<thead>
<tr>
<th>Laser bias current</th>
<th>6.817 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser output power</td>
<td>0.846 mW / -0.73 dBm</td>
</tr>
<tr>
<td>Laser receiver power</td>
<td>0.827 mW / -0.82 dBm</td>
</tr>
<tr>
<td>Laser bias current high alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current low alarm</td>
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</tr>
<tr>
<td>Laser bias current high warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser bias current low warning</td>
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</tr>
<tr>
<td>Laser receiver power high alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser receiver power low alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Laser receiver power high warning</td>
<td>Off</td>
</tr>
<tr>
<td>Laser receiver power low warning</td>
<td>Off</td>
</tr>
<tr>
<td>Tx loss of signal functionality alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Rx loss of signal alarm</td>
<td>Off</td>
</tr>
<tr>
<td>Tx laser disabled alarm</td>
<td>Off</td>
</tr>
</tbody>
</table>
show interfaces (far-end-interval)

Syntax

```
show interfaces far-end-interval interface-fpc/pic/port
```

Release Information

Command introduced in Junos OS Release 9.4.

Description

On channelized interfaces, display the far end interval data for the specified interface.

Required Privilege Level

view

List of Sample Output

show interfaces far-end-interval coc12-5/2/0 on page 2041
show interfaces far-end-interval coc1-5/2/1:1 on page 2042

Output Fields

Table 159 on page 2041 lists the output fields for the `show interfaces far-end-interval` command. Output fields are listed in the approximate order in which they appear.

```
Table 159: show interfaces far-end-interval Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical interface</td>
<td>Interface FPC/PIC/port values.</td>
</tr>
<tr>
<td>SNMP ifIndex</td>
<td>SNMP interface index value.</td>
</tr>
<tr>
<td>ES-L/P</td>
<td>Error detection—Errored seconds.</td>
</tr>
<tr>
<td>SES-L/P</td>
<td>Error detection—Severely errored seconds.</td>
</tr>
<tr>
<td>UAS-L/P</td>
<td>Error detection—Unavailable seconds.</td>
</tr>
</tbody>
</table>
```

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
```
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)**

**Syntax**

```plaintext
show interfaces interface-type
  <brief | detail | extensive | terse>
  <descriptions>
  <media>
  <snmp-index snmp-index>
  <statistics>
```

**Release Information**

Command introduced before Junos OS Release 7.4.

**Description**

Display status information about the specified Fast Ethernet interface.

**Options**

- `interface-type`—On M Series and T Series routers, the interface type is `fe-fpc/pic/port`.
- `brief | detail | extensive | terse`—(Optional) Display the specified level of output.
- `descriptions`—(Optional) Display interface description strings.
- `media`—(Optional) Display media-specific information about network interfaces.
- `snmp-index snmp-index`—(Optional) Display information for the specified SNMP index of the interface.

**Required Privilege Level**

`view`

**List of Sample Output**

- `show interfaces (Fast Ethernet)` on page 2056
- `show interfaces brief (Fast Ethernet)` on page 2057
- `show interfaces detail (Fast Ethernet)` on page 2057
- `show interfaces extensive (Fast Ethernet)` on page 2057

**Output Fields**

Table 160 on page 2043 lists the output fields for the `show interfaces` (Fast Ethernet) command. Output fields are listed in the approximate order in which they appear.

### Table 160: show interfaces Fast Ethernet Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical Interface</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical interface</td>
<td>Name of the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Enabled</td>
<td>State of the interface. Possible values are described in the “Enabled Field” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td>Interface index</td>
<td>Index number of the physical interface, which reflects its initialization sequence.</td>
<td>detail extensive none</td>
</tr>
</tbody>
</table>
### Table 160: `show interfaces Fast Ethernet` Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SNMP ifindex</strong></td>
<td>SNMP index number for the physical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td><strong>Generation</strong></td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td><strong>Link-level type</strong></td>
<td>Encapsulation being used on the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>MTU</strong></td>
<td>Maximum transmission unit size on the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Link-mode</strong></td>
<td>Type of link connection configured for the physical interface: Full-duplex or Half-duplex</td>
<td>extensive</td>
</tr>
<tr>
<td><strong>Speed</strong></td>
<td>Speed at which the interface is running.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Loopback</strong></td>
<td>Loopback status: Enabled or Disabled. If loopback is enabled, type of loopback: Local or Remote.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Source filtering</strong></td>
<td>Source filtering status: Enabled or Disabled.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>LAN-PHY mode</strong></td>
<td>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.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>WAN-PHY mode</strong></td>
<td>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.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Unidirectional</strong></td>
<td>Unidirectional link mode status for 10-Gigabit Ethernet interface: Enabled or Disabled for parent interface; Rx-only or Tx-only for child interfaces.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Flow control</strong></td>
<td>Flow control status: Enabled or Disabled.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Auto-negotiation</strong></td>
<td>(Gigabit Ethernet interfaces) Autonegotiation status: Enabled or Disabled.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Remote-fault</strong></td>
<td>(Gigabit Ethernet interfaces) Remote fault status:</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Device flags</strong></td>
<td>Information about the physical device. Possible values are described in the “Device Flags” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Interface flags</strong></td>
<td>Information about the interface. Possible values are described in the “Interface Flags” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Link flags</strong></td>
<td>Information about the link. Possible values are described in the “Links Flags” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Wavelength</strong></td>
<td>(10-Gigabit Ethernet dense wavelength-division multiplexing [DWDM] interfaces) Displays the configured wavelength, in nanometers (nm).</td>
<td>All levels</td>
</tr>
</tbody>
</table>
Table 160: show interfaces Fast Ethernet Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>(10-Gigabit Ethernet DWDM interfaces only) Displays the frequency associated with the configured wavelength, in terahertz (THz).</td>
<td>All levels</td>
</tr>
<tr>
<td>CoS queues</td>
<td>Number of CoS queues configured.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Schedulers</td>
<td>(Gigabit Ethernet intelligent queuing 2 (IQ2) interfaces only) Number of CoS schedulers configured.</td>
<td>extensive</td>
</tr>
<tr>
<td>Hold-times</td>
<td>Current interface hold-time up and hold-time down, in milliseconds.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Current address</td>
<td>Configured MAC address.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Hardware address</td>
<td>Hardware MAC address.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Last flapped</td>
<td>Date, time, and how long ago the interface went from down to up. The format is Last flapped: year-month-day hour:minute:second:timezone (hour:minute:second ago). For example, Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago).</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Input Rate</td>
<td>Input rate in bits per second (bps) and packets per second (pps).</td>
<td>None specified</td>
</tr>
<tr>
<td>Output Rate</td>
<td>Output rate in bps and pps.</td>
<td>None specified</td>
</tr>
<tr>
<td>Statistics last cleared</td>
<td>Time when the statistics for the interface were last set to zero.</td>
<td>detail extensive</td>
</tr>
</tbody>
</table>

Traffic statistics
- **Input bytes**—Number of bytes received on the interface.
- **Output bytes**—Number of bytes transmitted on the interface.
- **Input packets**—Number of packets received on the interface.
- **Output packets**—Number of packets transmitted on the interface.

Gigabit Ethernet and 10-Gigabit Ethernet IQ PICs count the overhead and CRC bytes.

For Gigabit Ethernet IQ PICs, the input byte counts vary by interface type. For more information, see Table 31 under the `show interfaces` command.
### Table 160: show interfaces Fast Ethernet Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input errors</strong></td>
<td>Input errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>• <strong>Errors</strong>—Sum of the incoming frame aborts and FCS errors.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Drops</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Framing errors</strong>—Number of packets received with an invalid frame checksum (FCS).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Runts</strong>—Number of frames received that are smaller than the runt threshold.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Policed discards</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>L3 incompletes</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>L2 channel errors</strong>—Number of times the software did not find a valid logical interface for an incoming frame.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>L2 mismatch timeouts</strong>—Number of malformed or short packets that caused the incoming packet handler to discard the frame as unreadable.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>FIFO errors</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Resource errors</strong>—Sum of transmit drops.</td>
<td></td>
</tr>
</tbody>
</table>
Table 160: show interfaces Fast Ethernet Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output errors</td>
<td>Output errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>• Carrier transitions—Number of times the interface has gone from down to up. 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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Errors—Sum of the outgoing frame aborts and FCS errors.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Drops—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Collisions—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Aged packets—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• FIFO errors—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• HS link CRC errors—Number of errors on the high-speed links between the ASICs responsible for handling the router interfaces.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• MTU errors—Number of packets whose size exceeded the MTU of the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Resource errors—Sum of transmit drops.</td>
<td></td>
</tr>
<tr>
<td>Egress queues</td>
<td>Total number of egress queues supported on the specified interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Queue counters</td>
<td>CoS queue number and its associated user-configured forwarding class name.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>(Egress)</td>
<td>• Queued packets—Number of queued packets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Transmitted packets—Number of transmitted packets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Dropped packets—Number of packets dropped by the ASIC's RED mechanism.</td>
<td></td>
</tr>
</tbody>
</table>
### Table 160: show interfaces Fast Ethernet Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ingress queues</td>
<td>Total number of ingress queues supported on the specified interface. Displayed on IQ2 interfaces.</td>
<td>extensive</td>
</tr>
<tr>
<td>Queue counters (Ingress)</td>
<td>CoS queue number and its associated user-configured forwarding class name. Displayed on IQ2 interfaces.</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>• <strong>Queued packets</strong>—Number of queued packets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Transmitted packets</strong>—Number of transmitted packets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Dropped packets</strong>—Number of packets dropped by the ASIC’s RED mechanism.</td>
<td></td>
</tr>
<tr>
<td>Active alarms and Active defects</td>
<td>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 <strong>None</strong> or <strong>Link</strong>.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>• <strong>None</strong>—There are no active defects or alarms.</td>
<td>none</td>
</tr>
<tr>
<td></td>
<td>• <strong>Link</strong>—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.</td>
<td></td>
</tr>
<tr>
<td>OTN FEC statistics</td>
<td>The forward error correction (FEC) counters provide the following statistics.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Corrected Errors</strong>—The count of corrected errors in the last second.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Corrected Error Ratio</strong>—The corrected error ratio in the last 25 seconds. For example, 1e−7 is 1 error per 10 million bits.</td>
<td></td>
</tr>
<tr>
<td>PCS statistics</td>
<td>(10-Gigabit Ethernet interfaces) Displays Physical Coding Sublayer (PCS) fault conditions from the WAN PHY or the LAN PHY device.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Bit errors</strong>—The number of seconds during which at least one bit error rate (BER) occurred while the PCS receiver is operating in normal mode.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Errored blocks</strong>—The number of seconds when at least one errored block occurred while the PCS receiver is operating in normal mode.</td>
<td></td>
</tr>
</tbody>
</table>
Table 160: show interfaces Fast Ethernet Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAC statistics</td>
<td>Receive and Transmit statistics reported by the PIC's MAC subsystem, including</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Total octets and total packets—Total number of octets and packets. For Gigabit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ethernet IQ PICs, the received octets count varies by interface type. For more</td>
<td></td>
</tr>
<tr>
<td></td>
<td>information, see Table 31 under the show interfaces command.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Unicast packets, Broadcast packets, and Multicast packets—Number of unicast,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>broadcast, and multicast packets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• CRC/Align errors—Total number of packets received that had a length (excluding</td>
<td></td>
</tr>
<tr>
<td></td>
<td>framing bits, but including FCS octets) of between 64 and 1518 octets, inclusive,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and had either a bad FCS with an integral number of octets (FCS Error) or a bad</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FCS with a nonintegral number of octets (Alignment Error).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• FIFO error—Number of FIFO errors that are reported by the ASIC on the PIC. If</td>
<td></td>
</tr>
<tr>
<td></td>
<td>this value is ever nonzero, the PIC or a cable is probably malfunctioning.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• MAC control frames—Number of MAC control frames.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• MAC pause frames—Number of MAC control frames with pause operational code.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Oversized frames—Number of frames that exceed 1518 octets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Jabber frames—Number of frames that were longer than 1518 octets (excluding</td>
<td></td>
</tr>
<tr>
<td></td>
<td>framing bits, but including FCS octets), and had either an FCS error or an</td>
<td></td>
</tr>
<tr>
<td></td>
<td>alignment error. This definition of jabber is different from the definition in</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IEEE-802.3 section 8.2.1.5 (10BASE5) and section 10.3.1.4 (10BASE2). These</td>
<td></td>
</tr>
<tr>
<td></td>
<td>documents define jabber as the condition in which any packet exceeds 20 ms. The</td>
<td></td>
</tr>
<tr>
<td></td>
<td>allowed range to detect jabber is from 20 ms to 150 ms.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Fragment frames—Total number of packets that were less than 64 octets in</td>
<td></td>
</tr>
<tr>
<td></td>
<td>length (excluding framing bits, but including FCS octets), and had either an FCS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>error or an alignment error. Fragment frames normally increment because both</td>
<td></td>
</tr>
<tr>
<td></td>
<td>runs (which are normal occurrences caused by collisions) and noise hits are</td>
<td></td>
</tr>
<tr>
<td></td>
<td>counted.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• VLAN tagged frames—Number of frames that are VLAN tagged. The system uses the</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TPID of 0x8100 in the frame to determine whether a frame is tagged or not.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Code violations—Number of times an event caused the PHY to indicate “Data</td>
<td></td>
</tr>
<tr>
<td></td>
<td>reception error” or “invalid data symbol error.”</td>
<td></td>
</tr>
</tbody>
</table>

| OTN Received  | APS/PCC0: 0x02, APS/PCC1: 0x11, APS/PCC2: 0x47, APS/PCC3: 0x58 Payload Type: 0x08 | extensive       |
| Overhead Bytes|                                                                                     |                 |

| OTN Transmitted| APS/PCC0: 0x00, APS/PCC1: 0x00, APS/PCC2: 0x00, APS/PCC3: 0x00 Payload Type: 0x08 | extensive       |
| Overhead Bytes |                                                                                     |                 |
### Table 160: show interfaces Fast Ethernet Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Filter statistics</strong></td>
<td><strong>Receive and Transmit</strong> 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.</td>
<td></td>
</tr>
<tr>
<td><strong>Input packet count</strong></td>
<td>Number of packets received from the MAC hardware that the filter processed.</td>
<td>extensive</td>
</tr>
<tr>
<td><strong>Input packet rejects</strong></td>
<td>Number of packets that the filter rejected because of either the source MAC address or the destination MAC address.</td>
<td></td>
</tr>
<tr>
<td><strong>Input DA rejects</strong></td>
<td>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).</td>
<td></td>
</tr>
<tr>
<td><strong>Input SA rejects</strong></td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td><strong>Output packet count</strong></td>
<td>Number of packets that the filter has given to the MAC hardware.</td>
<td></td>
</tr>
<tr>
<td><strong>Output packet pad count</strong></td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td><strong>Output packet error count</strong></td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td><strong>CAM destination filters, CAM source filters</strong></td>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>

**PMA PHY** (10-Gigabit Ethernet interfaces, WAN PHY mode) SONET error information:  
- **Seconds**—Number of seconds the defect has been active.  
- **Count**—Number of times that the defect has gone from inactive to active.  
- **State**—State of the error. Any state other than **OK** indicates a problem.  

Subfields are:  
- **PHY Lock**—Phase-locked loop  
- **PHY Light**—Loss of optical signal
Table 160: show interfaces Fast Ethernet Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WIS section</strong></td>
<td>(10-Gigabit Ethernet interfaces, WAN PHY mode) SONET error information:</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>• <strong>Seconds</strong>—Number of seconds the defect has been active.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Count</strong>—Number of times that the defect has gone from inactive to active.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>State</strong>—State of the error. Any state other than OK indicates a problem.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subfields are:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>BIP-B1</strong>—Bit interleaved parity for SONET section overhead</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>SEF</strong>—Severely errored framing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>LOL</strong>—Loss of light</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>LOF</strong>—Loss of frame</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>ES-S</strong>—Errored seconds (section)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>SEFS-S</strong>—Severely errored framing seconds (section)</td>
<td></td>
</tr>
<tr>
<td><strong>WIS line</strong></td>
<td>(10-Gigabit Ethernet interfaces, WAN PHY mode) Active alarms and defects, plus counts of specific SONET errors with detailed information.</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>• <strong>Seconds</strong>—Number of seconds the defect has been active.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Count</strong>—Number of times that the defect has gone from inactive to active.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>State</strong>—State of the error. State other than OK indicates a problem.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subfields are:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>BIP-B2</strong>—Bit interleaved parity for SONET line overhead</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>REI-L</strong>—Remote error indication (near-end line)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>RDI-L</strong>—Remote defect indication (near-end line)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>AIS-L</strong>—Alarm indication signal (near-end line)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>BERR-SF</strong>—Bit error rate fault (signal failure)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>BERR-SD</strong>—Bit error rate defect (signal degradation)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>ES-L</strong>—Errored seconds (near-end line)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>SES-L</strong>—Severely errored seconds (near-end line)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>UAS-L</strong>—Unavailable seconds (near-end line)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>ES-LFE</strong>—Errored seconds (far-end line)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>SES-LFE</strong>—Severely errored seconds (far-end line)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>UAS-LFE</strong>—Unavailable seconds (far-end line)</td>
<td></td>
</tr>
</tbody>
</table>
### Table 160: `show interfaces Fast Ethernet Output Fields` (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WIS path</strong></td>
<td>(10-Gigabit Ethernet interfaces, WAN PHY mode) Active alarms and defects, plus counts of specific SONET errors with detailed information.</td>
<td>extensive</td>
</tr>
<tr>
<td><strong>Seconds</strong></td>
<td>Number of seconds the defect has been active.</td>
<td></td>
</tr>
<tr>
<td><strong>Count</strong></td>
<td>Number of times that the defect has gone from inactive to active.</td>
<td></td>
</tr>
<tr>
<td><strong>State</strong></td>
<td>State of the error. Any state other than <strong>OK</strong> indicates a problem.</td>
<td></td>
</tr>
</tbody>
</table>

Subfields are:
- **BIP-B3**—Bit interleaved parity for SONET section overhead
- **REI-P**—Remote error indication
- **LOP-P**—Loss of pointer (path)
- **AIS-P**—Path alarm indication signal
- **RDI-P**—Path remote defect indication
- **UNEQ-P**—Path unequipped
- **PLM-P**—Path payload (signal) label mismatch
- **ES-P**—Errored seconds (near-end STS path)
- **SES-P**—Severely errored seconds (near-end STS path)
- **UAS-P**—Unavailable seconds (near-end STS path)
- **SES-PFE**—Severely errored seconds (far-end STS path)
- **UAS-PFE**—Unavailable seconds (far-end STS path)
Table 160: show interfaces Fast Ethernet Output Fields (continued)

| Field Name                        | Field Description                                                                 || Level of Output |
|-----------------------------------|-----------------------------------------------------------------------------------|-----------------|
| Autonegotiation information       | Information about link autonegotiation.                                           | extensive       |
| • Negotiation status:             |                                                                                   |                 |
| • Incomplete—Ethernet interface   | Ethernet interface has the speed or link mode configured.                          |                 |
| • No autonegotiation—Remote       | Remote Ethernet interface has the speed or link mode configured, or does not      |                 |
| • Complete—Ethernet interface     | perform autonegotiation.                                                           |                 |
| • Link partner status—OK          | when Ethernet interface is connected to a device that performs autonegotiation and |                 |
| • Link partner:                   | the autonegotiation process is successful.                                         |                 |
| • Link mode—Depending on the      | path control supported by the remote Ethernet device.                              |                 |
| • Flow control—Types of flow      | For Fast Ethernet interfaces, the type is None. For Gigabit Ethernet devices,      |                 |
| • Remote fault—Remote fault       | types are Symmetric (link partner supports PAUSE on receive and transmit),        |                 |
| • Local resolution—Information   | Asymmetric (link partner supports PAUSE on transmit), and Symmetric/Asymmetric     |                 |
| • Received path trace, Transmitted | (10-Gigabit Ethernet interfaces, WAN PHY mode) SONET/SDH interfaces allow path     | extensive       |
| path trace                        | 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.                                                         |                 |
| Packet Forwarding Engine          | Information about the configuration of the Packet Forwarding Engine:              | extensive       |
| configuration                     | • Destination slot—FPC slot number.                                               |                 |
### Table 160: show interfaces Fast Ethernet Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CoS information</strong></td>
<td>Information about the CoS queue for the physical interface.</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>• <strong>CoS transmit queue</strong>—Queue number and its associated user-configured</td>
<td></td>
</tr>
<tr>
<td></td>
<td>forwarding class name.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Bandwidth %</strong>—Percentage of bandwidth allocated to the queue.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Bandwidth bps</strong>—Bandwidth allocated to the queue (in bps).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Buffer %</strong>—Percentage of buffer space allocated to the queue.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Buffer usec</strong>—Amount of buffer space allocated to the queue, in microseconds.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>This value is nonzero only if the buffer size is configured in terms of time.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Priority</strong>—Queue priority: low or high.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Limit</strong>—Displayed if rate limiting is configured for the queue. Possible</td>
<td></td>
</tr>
<tr>
<td></td>
<td>values are none and exact. If exact is configured, the queue transmits only</td>
<td></td>
</tr>
<tr>
<td></td>
<td>up to the configured bandwidth, even if excess bandwidth is available. If</td>
<td></td>
</tr>
<tr>
<td></td>
<td>none is configured, the queue transmits beyond the configured bandwidth if</td>
<td></td>
</tr>
<tr>
<td></td>
<td>bandwidth is available.</td>
<td></td>
</tr>
</tbody>
</table>

**Logical Interface**

<table>
<thead>
<tr>
<th>Logical interface</th>
<th>Name of the logical interface.</th>
<th>All levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index</td>
<td>Index number of the logical interface, which reflects its initialization sequence.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>SNMP ifIndex</td>
<td>SNMP interface index number for the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Flags</td>
<td>Information about the logical interface. Possible values are described in the</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>“Logical Interface Flags” section under Common Output Fields Description.</td>
<td></td>
</tr>
</tbody>
</table>

**VLAN-Tag**

<table>
<thead>
<tr>
<th>Rewrite profile applied to incoming or outgoing frames on the outer (Out) VLAN tag or for both the outer and inner (In) VLAN tags.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• <strong>push</strong>—An outer VLAN tag is pushed in front of the existing VLAN tag.</td>
</tr>
<tr>
<td>• <strong>pop</strong>—The outer VLAN tag of the incoming frame is removed.</td>
</tr>
<tr>
<td>• <strong>swap</strong>—The outer VLAN tag of the incoming frame is overwritten with the user specified VLAN tag information.</td>
</tr>
<tr>
<td>• <strong>push</strong>—An outer VLAN tag is pushed in front of the existing VLAN tag.</td>
</tr>
<tr>
<td>• <strong>push-push</strong>—Two VLAN tags are pushed in from the incoming frame.</td>
</tr>
<tr>
<td>• <strong>swap-push</strong>—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.</td>
</tr>
<tr>
<td>• <strong>swap-swap</strong>—Both the inner and the outer VLAN tags of the incoming frame are replaced by the user specified VLAN tag value.</td>
</tr>
<tr>
<td>• <strong>pop-swap</strong>—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.</td>
</tr>
<tr>
<td>• <strong>pop-pop</strong>—Both the outer and inner VLAN tags of the incoming frame are removed.</td>
</tr>
</tbody>
</table>
Table 160: show interfaces Fast Ethernet Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demux:</td>
<td>IP demultiplexing (demux) value that appears if this interface is used as the demux underlying interface. The output is one of the following:</td>
<td>detail extensive none</td>
</tr>
<tr>
<td></td>
<td>• Source Family Inet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Destination Family Inet</td>
<td></td>
</tr>
<tr>
<td>Encapsulation</td>
<td>Encapsulation on the logical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Protocol</td>
<td>Protocol family. Possible values are described in the “Protocol Field” section under Common Output Fields Description.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>MTU</td>
<td>Maximum transmission unit size on the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Maximum labels</td>
<td>Maximum number of MPLS labels configured for the MPLS protocol family on the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Traffic statistics</td>
<td>Number and rate of bytes and packets received and transmitted on the specified interface set.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>• Input bytes, Output bytes—Number of bytes received and transmitted on the interface set</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Input packets, Output packets—Number of packets received and transmitted on the interface set.</td>
<td></td>
</tr>
<tr>
<td>IPv6 transit statistics</td>
<td>Number of IPv6 transit bytes and packets received and transmitted on the logical interface if IPv6 statistics tracking is enabled.</td>
<td>extensive</td>
</tr>
<tr>
<td>Local statistics</td>
<td>Number and rate of bytes and packets destined to the routing device.</td>
<td>extensive</td>
</tr>
<tr>
<td>Transit statistics</td>
<td>Number and rate of bytes and packets transiting the switch.</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td><strong>NOTE:</strong> 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 Output bytes and Output packets 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.</td>
<td></td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Route Table</td>
<td>Route table in which the logical interface address is located. For example, 0 refers to the routing table inet.0.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Flags</td>
<td>Information about protocol family flags. Possible values are described in the “Family Flags” section under Common Output Fields Description.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Donor interface</td>
<td>(Unnumbered Ethernet) Interface from which an unnumbered Ethernet interface borrows an IPv4 address.</td>
<td>detail extensive none</td>
</tr>
</tbody>
</table>
Table 160: show interfaces Fast Ethernet Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preferred source address</td>
<td>(Unnumbered Ethernet) Secondary IPv4 address of the donor loopback interface that acts as the preferred source address for the unnumbered Ethernet interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Input Filters</td>
<td>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.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Output Filters</td>
<td>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.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Mac-Validate Failures</td>
<td>Number of MAC address validation failures for packets and bytes. This field is displayed when MAC address validation is enabled for the logical interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Addresses, Flags</td>
<td>Information about the address flags. Possible values are described in the “Addresses Flags” section under Common Output Fields Description.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>protocol-family</td>
<td>Protocol family configured on the logical interface. If the protocol is inet, the IP address of the interface is also displayed.</td>
<td>brief</td>
</tr>
<tr>
<td>Flags</td>
<td>Information about address flag (possible values are described in the “Addresses Flags” section under Common Output Fields Description.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Destination</td>
<td>IP address of the remote side of the connection.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Local</td>
<td>IP address of the logical interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Broadcast</td>
<td>Broadcast address of the logical interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
</tbody>
</table>

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: 00:00:5e:00:53:38, Hardware address: 00:00:5e:00:53:38
  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)
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  203.0.113.1/24

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: 00:00:5e:00:53:38, Hardware address: 00:00:5e:00:53:3f:38
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: 203.0.113/24, Local: 203.0.113.1, Broadcast: 203.0.113.255,
  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: 00:00:5e:00:53:38, Hardware address: 00:00:5e:00:53:38
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: Receive Transmit
- Total octets 0 64
- 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 0
- Jabber frames 0 0
- Fragment frames 0 0
- VLAN tagged frames 0 0
- Code violations 0 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:

<table>
<thead>
<tr>
<th>CoS</th>
<th>Bandwidth %</th>
<th>Buffer Priority bps</th>
<th>Limit %</th>
<th>Limit usec</th>
<th>Link</th>
<th>Native</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>best-effort</td>
<td>95</td>
<td>950000000</td>
<td>0</td>
<td>low</td>
<td>none</td>
</tr>
<tr>
<td>3</td>
<td>network-control</td>
<td>500000000</td>
<td>5</td>
<td>0</td>
<td>low</td>
<td>none</td>
</tr>
</tbody>
</table>

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: 203.0.113/24, Local: 203.0.113.1, Broadcast: 203.0.113.255,
  Generation: 136
show interfaces

| List of Syntax | Syntax (Gigabit Ethernet) on page 2060  
|                | Syntax (10 Gigabit Ethernet) on page 2060  
|                | Syntax (SRX Series Devices) on page 2060  
| Syntax (Gigabit Ethernet) | show interfaces ge-fpc/pic/port  
|                    | <brief | detail | extensive | terse>  
|                    | <descriptions>  
|                    | <media>  
|                    | <snmp-index snmp-index>  
|                    | <statistics>  
| Syntax (10 Gigabit Ethernet) | show interfaces xe-fpc/pic/port  
|                    | <brief | detail | extensive | terse>  
|                    | <descriptions>  
|                    | <media>  
|                    | <snmp-index snmp-index>  
|                    | <statistics>  
| Syntax (SRX Series Devices) | show interfaces (  
|                    | <interface-name>  
|                    | <brief | detail | extensive | terse>  
|                    | <controller interface-name>|  
|                    | <descriptions interface-name>|  
|                    | <destination-class (all | destination-class-name logical-interface-name)>|  
|                    | <diagnostics optics interface-name>|  
|                    | <far-end-interval interface-fpc/pic/port>|  
|                    | <filters interface-name>|  
|                    | <flow-statistics interface-name>|  
|                    | <interval interface-name>|  
|                    | <load-balancing (detail | interface-name)>|  
|                    | <mac-database mac-address mac-address>|  
|                    | <mc-ae id identifier unit number revertive-info>|  
|                    | <media interface-name>|  
|                    | <policers interface-name>|  
|                    | <queue both-ingress-egress ingress forwarding-class forwarding-class ingress l2-statistics>|  
|                    | <redundancy (detail | interface-name)>|  
|                    | <routing brief detail summary interface-name>|  
|                    | <routing-instance (all | instance-name)>|  
|                    | <snmp-index snmp-index>|  
|                    | <source-class (all | destination-class-name logical-interface-name)>|  
|                    | <statistics interface-name>|  
|                    | <switch-port switch-port number>|  
|                    | <transport pm (all | optics | otn) (all | current | currentday | interval | previousday) (all | interface-name)>|  
|                    | <zone interface-name>|  
)
Release Information
Command introduced before Junos OS Release 7.4 for Gigabit interfaces.
Command introduced in Junos OS Release 8.0 for 10 Gigabit interfaces.
Command modified in Junos OS Release 9.5 for SRX Series devices.
Command introduced in Junos OS Release 18.1 for Gigabit interfaces.

Description
Display status information about the specified Gigabit Ethernet interface.

(M320, M120, MX Series, and T Series routers only) Display status information about the specified 10-Gigabit Ethernet interface.

Display the IPv6 interface traffic statistics about the specified Gigabit Ethernet interface for MX Series routers. The input and output bytes (bps) and packets (pps) rates are not displayed for IFD and local traffic.

Display status information and statistics about interfaces on SRX Series appliance running Junos OS.

NOTE: On SRX Series appliances, on configuring identical IPs on a single interface, you will not see a warning message; instead, you will see a syslog message.

Starting in Junos OS Release 18.4R1, Output fields Next-hop and vpls-status is displayed in the show interfaces interface name detail command, only for Layer 2 protocols on MX480 routers.

Options
For Gigabit interfaces:

ge-fpc/pic/port—Display standard information about the specified Gigabit Ethernet interface.

brief | detail | extensive | terse—(Optional) Display the specified level of output.

descriptions—(Optional) Display interface description strings.

media—(Optional) Display media-specific information about network interfaces.

snmp-index snmp-index—(Optional) Display information for the specified SNMP index of the interface.

statistics—(Optional) Display static interface statistics.

For 10 Gigabit interfaces:

xe-fpc/pic/port—Display standard information about the specified 10-Gigabit Ethernet interface.

brief | detail | extensive | terse—(Optional) Display the specified level of output.

descriptions—(Optional) Display interface description strings.
media—(Optional) Display media-specific information about network interfaces.

snmp-index—(Optional) Display information for the specified SNMP index of the interface.

statistics—(Optional) Display static interface statistics.

For SRX interfaces:

- interface-name—(Optional) Display standard information about the specified interface. Following is a list of typical interface names. Replace pim with the PIM slot and port with the port number.
  - at-pim/0/port—ATM-over-ADSL or ATM-over-SHDSL interface.
  - ce1-pim/0/port—Channelized E1 interface.
  - cl-0/0/8—3G wireless modem interface for SRX320 devices.
  - ct1-pim/0/port—Channelized T1 interface.
  - dl0—Dialer Interface for initiating ISDN and USB modem connections.
  - e1-pim/0/port—E1 interface.
  - e3-pim/0/port—E3 interface.
  - fe-pim/0/port—Fast Ethernet interface.
  - ge-pim/0/port—Gigabit Ethernet interface.
  - se-pim/0/port—Serial interface.
  - t1-pim/0/port—T1 (also called DS1) interface.
  - t3-pim/0/port—T3 (also called DS3) interface.
  - wx-slot/0/0—WAN acceleration interface, for the WXC Integrated Services Module (ISM 200).

- interface-name—(Optional) Display standard information about the specified interface. Following is a list of typical interface names. Replace pim with the PIM slot and port with the port number.
  - at-pim/0/port—ATM-over-ADSL or ATM-over-SHDSL interface.
  - ce1-pim/0/port—Channelized E1 interface.
  - cl-0/0/8—3G wireless modem interface for SRX320 devices.
  - ct1-pim/0/port—Channelized T1 interface.
  - dl0—Dialer Interface for initiating ISDN and USB modem connections.
  - e1-pim/0/port—E1 interface.
  - e3-pim/0/port—E3 interface.
  - fe-pim/0/port—Fast Ethernet interface.
  - ge-pim/0/port—Gigabit Ethernet interface.
- **se-pim/0/port**—Serial interface.
- **t1-pim/0/port**—T1 (also called DS1) interface.
- **t3-pim/0/port**—T3 (also called DS3) interface.
- **wx-slot/0/0**—WAN acceleration interface, for the WXC Integrated Services Module (ISM 200).

**Additional Information**
In a logical system, this command displays information only about the logical interfaces and not about the physical interfaces.

**Required Privilege Level**
view

**Release History Table**

<table>
<thead>
<tr>
<th>Release</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.4R1</td>
<td>Starting in Junos OS Release 18.4R1, Output fields Next-hop and vpls-status is displayed in the show interfaces interface name detail command, only for Layer 2 protocols on MX480 routers.</td>
</tr>
</tbody>
</table>

**Related Documentation**
- Understanding Layer 2 Interfaces on Security Devices
- Verifying and Managing Agent Circuit Identifier-Based Dynamic VLAN Configuration
- Verifying and Managing Configurations for Dynamic VLANs Based on Access-Line Identifiers

**List of Sample Output**
- show interfaces (Gigabit Ethernet) on page 2100
- show interfaces (Gigabit Ethernet on MX Series Routers) on page 2100
- show interfaces (link degrade status) on page 2101
- show interfaces extensive (Gigabit Ethernet on MX Series Routers showing interface transmit statistics configuration) on page 2101
- show interfaces brief (Gigabit Ethernet) on page 2102
- show interfaces detail (Gigabit Ethernet) on page 2102
- show interfaces extensive (Gigabit Ethernet IQ2) on page 2104
- show interfaces (Gigabit Ethernet Unnumbered Interface) on page 2107
- show interfaces (ACI Interface Set Configured) on page 2107
- show interfaces (ALI Interface Set) on page 2108
- show interfaces extensive (10-Gigabit Ethernet, LAN PHY Mode, IQ2) on page 2108
- show interfaces extensive (10-Gigabit Ethernet, WAN PHY Mode) on page 2110
- show interfaces extensive (10-Gigabit Ethernet, DWDM OTN PIC) on page 2112
- show interfaces extensive (10-Gigabit Ethernet, LAN PHY Mode, Unidirectional Mode) on page 2115
- show interfaces extensive (10-Gigabit Ethernet, LAN PHY Mode, Unidirectional Mode, Transmit-Only) on page 2115
- show interfaces extensive (10-Gigabit Ethernet, LAN PHY Mode, Unidirectional Mode, Receive-Only) on page 2116
Sample Output SRX Gigabit Ethernet on page 2117
Sample Output SRX Gigabit Ethernet on page 2118
show interfaces detail (Gigabit Ethernet) on page 2118
show interfaces statistics st0.0 detail on page 2120
show interfaces extensive (Gigabit Ethernet) on page 2121
show interfaces terse on page 2124
show interfaces controller (Channelized E1 IQ with Logical E1) on page 2124
show interfaces controller (Channelized E1 IQ with Logical DS0) on page 2125
show interfaces descriptions on page 2125
show interfaces destination-class all on page 2125
show interfaces diagnostics optics on page 2125
show interfaces far-end-interval coc12-5/2/0 on page 2126
show interfaces far-end-interval coc1-5/2/1:1 on page 2127
show interfaces filters on page 2127
show interfaces flow-statistics (Gigabit Ethernet) on page 2127
show interfaces interval (Channelized OC12) on page 2128
show interfaces interval (E3) on page 2129
show interfaces interval (SONET/SDH) (SRX devices) on page 2129
show interfaces load-balancing (SRX devices) on page 2129
show interfaces load-balancing detail (SRX devices) on page 2130
show interfaces mac-database (All MAC Addresses on a Port SRX devices) on page 2130
show interfaces mac-database (All MAC Addresses on a Service SRX devices) on page 2130
show interfaces mac-database mac-address on page 2131
show interfaces mc-ae (SRX devices) on page 2131
show interfaces media (SONET/SDH) on page 2132
show interfaces policers (SRX devices) on page 2132
show interfaces policers interface-name (SRX devices) on page 2132
show interfaces queue (SRX devices) on page 2133
show interfaces redundancy (SRX devices) on page 2134
show interfaces redundancy (Aggregated Ethernet SRX devices) on page 2134
show interfaces redundancy detail (SRX devices) on page 2134
show interfaces routing brief (SRX devices) on page 2134
show interfaces routing detail (SRX devices) on page 2135
show interfaces routing-instance all (SRX devices) on page 2135
show interfaces snmp-index (SRX devices) on page 2136
show interfaces source-class all (SRX devices) on page 2136
show interfaces statistics (Fast Ethernet SRX devices) on page 2136
show interfaces switch-port (SRX devices) on page 2137
show interfaces transport pm (SRX devices) on page 2137
show security zones (SRX devices) on page 2139

**Output Fields**  
Table 161 on page 2065 describes the output fields for the `show interfaces` (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 Table 162 on page 2092.
### Table 161: show interfaces (Gigabit Ethernet) Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical Interface</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical interface</td>
<td>Name of the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Enabled</td>
<td>State of the interface. Possible values are described in the &quot;Enabled Field&quot; section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td>Interface index</td>
<td>Index number of the physical interface, which reflects its initialization sequence.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>SNMP ifIndex</td>
<td>SNMP index number for the physical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Link-level type</td>
<td>Encapsulation being used on the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>MTU</td>
<td>Maximum transmission unit size on the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Speed</td>
<td>Speed at which the interface is running.</td>
<td>All levels</td>
</tr>
<tr>
<td>Loopback</td>
<td>Loopback status: <strong>Enabled</strong> or <strong>Disabled</strong>. If loopback is enabled, type of loopback: <strong>Local</strong> or <strong>Remote</strong>.</td>
<td>All levels</td>
</tr>
<tr>
<td>Source filtering</td>
<td>Source filtering status: <strong>Enabled</strong> or <strong>Disabled</strong>.</td>
<td>All levels</td>
</tr>
<tr>
<td>LAN-PHY mode</td>
<td>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.</td>
<td>All levels</td>
</tr>
<tr>
<td>WAN-PHY mode</td>
<td>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.</td>
<td>All levels</td>
</tr>
<tr>
<td>Unidirectional</td>
<td>Unidirectional link mode status for 10-Gigabit Ethernet interface: <strong>Enabled</strong> or <strong>Disabled</strong> for parent interface; <strong>Rx-only</strong> or <strong>Tx-only</strong> for child interfaces.</td>
<td>All levels</td>
</tr>
<tr>
<td>Flow control</td>
<td>Flow control status: <strong>Enabled</strong> or <strong>Disabled</strong>.</td>
<td>All levels</td>
</tr>
<tr>
<td>Auto-negotiation</td>
<td>(Gigabit Ethernet interfaces) Autonegotiation status: <strong>Enabled</strong> or <strong>Disabled</strong>.</td>
<td>All levels</td>
</tr>
<tr>
<td>Remote-fault</td>
<td>(Gigabit Ethernet interfaces) Remote fault status:</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>• <strong>Online</strong>—Autonegotiation is manually configured as online.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Offline</strong>—Autonegotiation is manually configured as offline.</td>
<td></td>
</tr>
<tr>
<td>Device flags</td>
<td>Information about the physical device. Possible values are described in the &quot;Device Flags&quot; section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td>Interface flags</td>
<td>Information about the interface. Possible values are described in the &quot;Interface Flags&quot; section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
</tbody>
</table>
### Table 161: show interfaces (Gigabit Ethernet) Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link flags</td>
<td>Information about the link. Possible values are described in the “Links Flags” section under <strong>Common Output Fields Description</strong>.</td>
<td>All levels</td>
</tr>
<tr>
<td>Wavelength</td>
<td>(10-Gigabit Ethernet dense wavelength-division multiplexing [DWDM] interfaces) Displays the configured wavelength, in nanometers (nm).</td>
<td>All levels</td>
</tr>
<tr>
<td>Frequency</td>
<td>(10-Gigabit Ethernet DWDM interfaces only) Displays the frequency associated with the configured wavelength, in terahertz (THz).</td>
<td>All levels</td>
</tr>
<tr>
<td>CoS queues</td>
<td>Number of CoS queues configured.</td>
<td>extensive</td>
</tr>
<tr>
<td>Schedulers</td>
<td>(Gigabit Ethernet intelligent queuing 2 [IQ2] interfaces only) Number of CoS schedulers configured.</td>
<td>extensive</td>
</tr>
<tr>
<td>Hold-times</td>
<td>Current interface hold-time up and hold-time down, in milliseconds (ms).</td>
<td>extensive</td>
</tr>
<tr>
<td>Current address</td>
<td>Configured MAC address.</td>
<td>extensive</td>
</tr>
<tr>
<td>Hardware address</td>
<td>Hardware MAC address.</td>
<td>extensive</td>
</tr>
<tr>
<td>Last flapped</td>
<td>Date, time, and how long ago the interface went from down to up. The format is <strong>Last flapped: year-month-day hour:minute:second timezone (hour:minute:second ago)</strong>. For example, <strong>Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago)</strong>.</td>
<td>extensive</td>
</tr>
<tr>
<td>Input Rate</td>
<td>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.</td>
<td>None</td>
</tr>
<tr>
<td>Output Rate</td>
<td>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.</td>
<td>None</td>
</tr>
<tr>
<td>Statistics last cleared</td>
<td>Time when the statistics for the interface were last set to zero.</td>
<td>extensive</td>
</tr>
<tr>
<td>Egress account overhead</td>
<td>Layer 2 overhead in bytes that is accounted in the interface statistics for egress traffic.</td>
<td>extensive</td>
</tr>
<tr>
<td>Ingress account overhead</td>
<td>Layer 2 overhead in bytes that is accounted in the interface statistics for ingress traffic.</td>
<td>extensive</td>
</tr>
</tbody>
</table>
### Table 161: `show interfaces (Gigabit Ethernet)` Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Traffic statistics</strong></td>
<td>Number and rate of bytes and packets received and transmitted on the physical interface.</td>
<td><em>detail extensive</em></td>
</tr>
<tr>
<td></td>
<td>• <strong>Input bytes</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Output bytes</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Input packets</strong>—Number of packets received on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Output packets</strong>—Number of packets transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gigabit Ethernet and 10-Gigabit Ethernet IQ PICs count the overhead and CRC bytes.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>For more information, see Table 31 under the <code>show interfaces</code> command.</td>
<td></td>
</tr>
<tr>
<td><strong>Input errors</strong></td>
<td>Input errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:</td>
<td><em>extensive</em></td>
</tr>
<tr>
<td></td>
<td>• <strong>Errors</strong>—Sum of the incoming frame aborts and FCS errors.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Drops</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Framing errors</strong>—Number of packets received with an invalid frame checksum (FCS).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Runt</strong>—Number of frames received that are smaller than the runt threshold.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Policed discards</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>L3 incompletes</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>L2 channel errors</strong>—Number of times the software did not find a valid logical interface for an incoming frame.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>L2 mismatch timeouts</strong>—Number of malformed or short packets that caused the incoming packet handler to discard the frame as unreadable.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>FIFO errors</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Resource errors</strong>—Sum of transmit drops.</td>
<td></td>
</tr>
</tbody>
</table>
Table 161: show interfaces (Gigabit Ethernet) Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output errors</td>
<td>Output errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>• Carrier transitions—Number of times the interface has gone from down to up. 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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Errors—Sum of the outgoing frame aborts and FCS errors.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Drops—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>NOTE: Due to accounting space limitations on certain Type 3 FPCs (which are supported in M320 and T640 routers), the Drops field does not always use the correct value for queue 6 or queue 7 for interfaces on 10-port 1-Gigabit Ethernet PICs.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Collisions—Number of Ethernet collisions. The Gigabit Ethernet PIC supports only full-duplex operation, so for Gigabit Ethernet PICs, this number must always be 0. If it is nonzero, there is a software bug.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Aged packets—Number of packets that remained in shared packet SDRAM so long that the system automatically purged them. The value in this field must never increment. If it does, it is most likely a software bug or possibly malfunctioning hardware.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• FiFO errors—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• HS link CRC errors—Number of errors on the high-speed links between the ASICs responsible for handling the router interfaces.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• MTU errors—Number of packets whose size exceeded the MTU of the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Resource errors—Sum of transmit drops.</td>
<td></td>
</tr>
<tr>
<td>Egress queues</td>
<td>Total number of egress queues supported on the specified interface.</td>
<td>detail extensive</td>
</tr>
</tbody>
</table>

NOTE: 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 `show interfaces` 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.
Table 161: show interfaces (Gigabit Ethernet) Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
</table>
| Queue counters (Egress)     | CoS queue number and its associated user-configured forwarding class name.  
  • Queued packets—Number of queued packets.  
  • Transmitted packets—Number of transmitted packets.  
  • Dropped packets—Number of packets dropped by the ASIC’s RED mechanism.  
  **NOTE:** Due to accounting space limitations on certain Type 3 FPCs (which are supported in M320 and T640 routers), the Dropped packets field does not always display the correct value for queue 6 or queue 7 for interfaces on 10-port 1-Gigabit Ethernet PICs. | detail extensive |
| Ingress queues              | Total number of ingress queues supported on the specified interface. Displayed on IQ2 interfaces.                                                                                                            | extensive       |
| Queue counters (Ingress)    | CoS queue number and its associated user-configured forwarding class name. Displayed on IQ2 interfaces.  
  • Queued packets—Number of queued packets.  
  • Transmitted packets—Number of transmitted packets.  
  • Dropped packets—Number of packets dropped by the ASIC’s RED mechanism. | extensive       |
| Active alarms and Active defects | 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 None or Link.  
  • None—There are no active defects or alarms.  
  • Link—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. | detail extensive none |
| Interface transmit statistics | (On MX Series devices) Status of the interface-transmit-statistics configuration: Enabled or Disabled.  
  • Enabled—When the interface-transmit-statistics statement is included in the configuration. If this is configured, the interface statistics show the actual transmitted load on the interface.  
  • Disabled—When the interface-transmit-statistics statement is not included in the configuration. If this is not configured, the interface statistics show the offered load on the interface. | detail extensive |
| OTN FEC statistics          | The forward error correction (FEC) counters provide the following statistics:  
  • Corrected Errors—Count of corrected errors in the last second.  
  • Corrected Error Ratio—Corrected error ratio in the last 25 seconds. For example, 1e-7 is 1 error per 10 million bits. | detail extensive |
### Table 161: show interfaces (Gigabit Ethernet) Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PCS statistics</strong></td>
<td>(10-Gigabit Ethernet interfaces) Displays Physical Coding Sublayer (PCS) fault conditions from the WAN PHY or the LAN PHY device.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>• <strong>Bit errors</strong>—Number of seconds during which at least one bit error rate (BER) occurred while the PCS receiver is operating in normal mode.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Errored blocks</strong>—Number of seconds when at least one errored block occurred while the PCS receiver is operating in normal mode.</td>
<td></td>
</tr>
<tr>
<td><strong>Link Degrade</strong></td>
<td>Shows the link degrade status of the physical link and the estimated bit error rates (BERs). This field is available only for the PICs supporting the physical link monitoring feature.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>• <strong>Link Monitoring</strong>—Indicates if physical link degrade monitoring is enabled on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Enable</strong>—Indicates that link degrade monitoring has been enabled (using the link-degrade-monitor statement) on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Disable</strong>—Indicates that link degrade monitoring has not been enabled on the interface. If link degrade monitoring has not been enabled, the output does not show any related information, such as BER values and thresholds.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Link Degrade Set Threshold</strong>—The BER threshold value at which the link is considered degraded and a corrective action is triggered.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Link Degrade Clear Threshold</strong>—The BER threshold value at which the degraded link is considered recovered and the corrective action applied to the interface is reverted.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Estimated BER</strong>—The estimated bit error rate.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Link-degrade event</strong>—Shows link degrade event information.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Seconds</strong>—Time (in seconds) elapsed after a link degrade event occurred.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Count</strong>—The number of link degrade events recorded.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>State</strong>—Shows the link degrade status (example: Defect Active).</td>
<td></td>
</tr>
</tbody>
</table>
Table 161: show interfaces (Gigabit Ethernet) Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAC statistics</td>
<td><strong>Receive and Transmit</strong> statistics reported by the PIC's MAC subsystem, including the following:</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>• <strong>Total octets and total packets</strong>—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 <code>show interfaces</code> command.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Unicast packets, Broadcast packets, and Multicast packets</strong>—Number of unicast, broadcast, and multicast packets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>CRC/Align errors</strong>—Total number of packets received that had a length (exceeding 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).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>FIFO error</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>MAC control frames</strong>—Number of MAC control frames.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>MAC pause frames</strong>—Number of MAC control frames with <strong>pause</strong> operational code.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Oversized frames</strong>—There are two possible conditions regarding the number of oversized frames:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Packet length exceeds interface MTU, or</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Packet length exceeds MRU</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Jabber frames</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Fragment frames</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>VLAN tagged frames</strong>—Number of frames that are VLAN tagged. The system uses the TPID of 0xb100 in the frame to determine whether a frame is tagged or not.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>NOTE:</strong> The 20-port Gigabit Ethernet MIC (MIC-3D-20GE-SFP) does not have hardware counters for VLAN frames. Therefore, the VLAN tagged frames field displays 0 when the <code>show interfaces</code> 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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Code violations</strong>—Number of times an event caused the PHY to indicate “Data reception error” or “invalid data symbol error.”</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OTN Received</th>
<th>APS/PCC0: 0x02, APS/PCC1: 0x11, APS/PCC2: 0x47, APS/PCC3: 0x58 Payload Type: 0x08</th>
<th>extensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overhead Bytes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OTN Transmitted</td>
<td>APS/PCC0: 0x00, APS/PCC1: 0x00, APS/PCC2: 0x00, APS/PCC3: 0x00 Payload Type: 0x08</td>
<td>extensive</td>
</tr>
<tr>
<td>Overhead Bytes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 161: show interfaces (Gigabit Ethernet) Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter statistics</td>
<td>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 may enter the system or be rejected.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Input packet count</strong>—Number of packets received from the MAC hardware that the filter processed.</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>• <strong>Input packet rejects</strong>—Number of packets that the filter rejected because of either the source MAC address or the destination MAC address.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Input DA rejects</strong>—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).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Input SA rejects</strong>—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 must 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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Output packet count</strong>—Number of packets that the filter has given to the MAC hardware.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Output packet pad count</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Output packet error count</strong>—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 FPCh hardware. On a normal system, the value of this field must not increment.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>CAM destination filters, CAM source filters</strong>—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 must be 0.</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td><strong>PMA PHY</strong> (10-Gigabit Ethernet interfaces, WAN PHY mode) SONET error information:</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>• <strong>Seconds</strong>—Number of seconds the defect has been active.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Count</strong>—Number of times that the defect has gone from inactive to active.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>State</strong>—State of the error. Any state other than <strong>OK</strong> indicates a problem.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subfields are:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>PHY Lock</strong>—Phase-locked loop</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>PHY Light</strong>—Loss of optical signal</td>
<td></td>
</tr>
</tbody>
</table>
### Table 161: show interfaces (Gigabit Ethernet) Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
</table>
| **WIS section** | (10-Gigabit Ethernet interfaces, WAN PHY mode) SONET error information:  
  - **Seconds**—Number of seconds the defect has been active.  
  - **Count**—Number of times that the defect has gone from inactive to active.  
  - **State**—State of the error. Any state other than **OK** indicates a problem.  
  Subfields are:  
    - **BIP-B1**—Bit interleaved parity for SONET section overhead  
    - **SEF**—Severely errored framing  
    - **LOL**—Loss of light  
    - **LOF**—Loss of frame  
    - **ES-S**—Errored seconds (section)  
    - **SES-S**—Severely errored seconds (section)  
    - **SEFS-S**—Severely errored framing seconds (section) | extensive |
| **WIS line** | (10-Gigabit Ethernet interfaces, WAN PHY mode) Active alarms and defects, plus counts of specific SONET errors with detailed information:  
  - **Seconds**—Number of seconds the defect has been active.  
  - **Count**—Number of times that the defect has gone from inactive to active.  
  - **State**—State of the error. Any state other than **OK** indicates a problem.  
  Subfields are:  
    - **BIP-B2**—Bit interleaved parity for SONET line overhead  
    - **REI-L**—Remote error indication (near-end line)  
    - **RDI-L**—Remote defect indication (near-end line)  
    - **AIS-L**—Alarm indication signal (near-end line)  
    - **BERR-SF**—Bit error rate fault (signal failure)  
    - **BERR-SD**—Bit error rate defect (signal degradation)  
    - **ES-L**—Errored seconds (near-end line)  
    - **SES-L**—Severely errored seconds (near-end line)  
    - **UAS-L**—Unavailable seconds (near-end line)  
    - **ES-LFE**—Errored seconds (far-end line)  
    - **SES-LFE**—Severely errored seconds (far-end line)  
    - **UAS-LFE**—Unavailable seconds (far-end line) | extensive |
Table 161: show interfaces (Gigabit Ethernet) Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIS path</td>
<td>(10-Gigabit Ethernet interfaces, WAN PHY mode) Active alarms and defects, plus counts of specific SONET errors with detailed information:</td>
<td>extensive</td>
</tr>
</tbody>
</table>

- **Seconds**—Number of seconds the defect has been active.
- **Count**—Number of times that the defect has gone from inactive to active.
- **State**—State of the error. Any state other than **OK** indicates a problem.

Subfields are:

- **BIP-B3**—Bit interleaved parity for SONET section overhead
- **REI-P**—Remote error indication
- **LOP-P**—Loss of pointer (path)
- **AIS-P**—Path alarm indication signal
- **RDI-P**—Path remote defect indication
- **UNEQ-P**—Path unequipped
- **PLM-P**—Path payload (signal) label mismatch
- **ES-P**—Errored seconds (near-end STS path)
- **SES-P**—Severely errored seconds (near-end STS path)
- **UAS-P**—Unavailable seconds (near-end STS path)
- **SES-PFE**—Severely errored seconds (far-end STS path)
- **UAS-PFE**—Unavailable seconds (far-end STS path)
### Table 161: show interfaces (Gigabit Ethernet) Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonegotiation information</td>
<td>Information about link autonegotiation.</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>- <strong>Negotiation status:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Incomplete</strong>—Ethernet interface has the speed or link mode configured.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>No autonegotiation</strong>—Remote Ethernet interface has the speed or link mode</td>
<td></td>
</tr>
<tr>
<td></td>
<td>configured, or does not perform autonegotiation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Complete</strong>—Ethernet interface is connected to a device that performs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>autonegotiation and the autonegotiation process is successful.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Link partner status</strong>—OK when Ethernet interface is connected to a device</td>
<td></td>
</tr>
<tr>
<td></td>
<td>that performs autonegotiation and the autonegotiation process is successful.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Link partner</strong>—Information from the remote Ethernet device:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Link mode</strong>—Depending on the capability of the link partner, either</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Full-duplex or Half-duplex.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Flow control</strong>—Types of flow control supported by the link partner. For</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gigabit Ethernet interfaces, types are <strong>Symmetric</strong> (link partner supports</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PAUSE on receive and transmit), <strong>Asymmetric</strong> (link partner supports PAUSE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>on transmit), <strong>Symmetric/Asymmetric</strong> (link partner supports PAUSE on</td>
<td></td>
</tr>
<tr>
<td></td>
<td>receive and transmit or only PAUSE on transmit), and <strong>None</strong> (link partner</td>
<td></td>
</tr>
<tr>
<td></td>
<td>does not support flow control).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Remote fault</strong>—Remote fault information from the link partner—<strong>Failure</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>indicates a receive link error. <strong>OK</strong> indicates that the link partner is</td>
<td></td>
</tr>
<tr>
<td></td>
<td>receiving. <strong>Negotiation error</strong> indicates a negotiation error. <strong>Offline</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>indicates that the link partner is going offline.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Local resolution</strong>—Information from the local Ethernet device:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Flow control</strong>—Types of flow control supported by the local device. For</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gigabit Ethernet interfaces, advertised capabilities are <strong>Symmetric/Asymmetric</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(local device supports PAUSE on receive and transmit or only PAUSE on receive)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and <strong>None</strong> (local device does not support flow control). Depending on the</td>
<td></td>
</tr>
<tr>
<td></td>
<td>result of the negotiation with the link partner, local resolution flow control</td>
<td></td>
</tr>
<tr>
<td></td>
<td>type will display <strong>Symmetric</strong> (local device supports PAUSE on receive and</td>
<td></td>
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<tr>
<td></td>
<td>transmit), <strong>Asymmetric</strong> (local device supports PAUSE on receive), and <strong>None</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(local device does not support flow control).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Remote fault</strong>—Remote fault information. <strong>Link OK</strong> (no error detected on</td>
<td></td>
</tr>
<tr>
<td></td>
<td>receive), <strong>Offline</strong> (local interface is offline), and <strong>Link Failure</strong> (link</td>
<td></td>
</tr>
<tr>
<td></td>
<td>error detected on receive).</td>
<td></td>
</tr>
<tr>
<td>Received path trace, Transmitted path trace</td>
<td>(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.</td>
<td>extensive</td>
</tr>
<tr>
<td>Packet Forwarding Engine configuration</td>
<td>Information about the configuration of the Packet Forwarding Engine:</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>- <strong>Destination slot</strong>—FPC slot number.</td>
<td></td>
</tr>
</tbody>
</table>
### Table 161: show interfaces (Gigabit Ethernet) Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CoS information</strong></td>
<td>Information about the CoS queue for the physical interface.</td>
<td>extensive</td>
</tr>
<tr>
<td>• <strong>CoS transmit queue</strong></td>
<td>Queue number and its associated user-configured forwarding class name.</td>
<td></td>
</tr>
<tr>
<td>• <strong>Bandwidth %</strong></td>
<td>Percentage of bandwidth allocated to the queue.</td>
<td></td>
</tr>
<tr>
<td>• <strong>Bandwidth bps</strong></td>
<td>Bandwidth allocated to the queue (in bps).</td>
<td></td>
</tr>
<tr>
<td>• <strong>Buffer %</strong></td>
<td>Percentage of buffer space allocated to the queue.</td>
<td></td>
</tr>
<tr>
<td>• <strong>Buffer usec</strong></td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>• <strong>Priority</strong></td>
<td>Queue priority: low or high.</td>
<td></td>
</tr>
<tr>
<td>• <strong>Limit</strong></td>
<td>Displayed if rate limiting is configured for the queue. Possible values are none and exact. If exact is configured, the queue transmits only up to the configured bandwidth, even if excess bandwidth is available. If none is configured, the queue transmits beyond the configured bandwidth if bandwidth is available.</td>
<td></td>
</tr>
</tbody>
</table>

**Logical Interface**

<table>
<thead>
<tr>
<th>Logical interface</th>
<th>Name of the logical interface.</th>
<th>All levels</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Index</strong></td>
<td>Index number of the logical interface, which reflects its initialization sequence.</td>
<td>detail</td>
</tr>
<tr>
<td><strong>SNMP ifIndex</strong></td>
<td>SNMP interface index number for the logical interface.</td>
<td>extensive</td>
</tr>
<tr>
<td><strong>Generation</strong></td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail</td>
</tr>
<tr>
<td><strong>Flags</strong></td>
<td>Information about the logical interface. Possible values are described in the “Logical Interface Flags” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>VLAN-Tag</strong></td>
<td>Rewrite profile applied to incoming or outgoing frames on the outer (Out) VLAN tag or for both the outer and inner (In) VLAN tags.</td>
<td>brief</td>
</tr>
<tr>
<td>• <strong>push</strong></td>
<td>An outer VLAN tag is pushed in front of the existing VLAN tag.</td>
<td>detail</td>
</tr>
<tr>
<td>• <strong>pop</strong></td>
<td>The outer VLAN tag of the incoming frame is removed.</td>
<td>none</td>
</tr>
<tr>
<td>• <strong>swap</strong></td>
<td>The outer VLAN tag of the incoming frame is overwritten with the user-specified VLAN tag information.</td>
<td>none</td>
</tr>
<tr>
<td>• <strong>push-push</strong></td>
<td>Two VLAN tags are pushed in from the incoming frame.</td>
<td>none</td>
</tr>
<tr>
<td>• <strong>swap-push</strong></td>
<td>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.</td>
<td>none</td>
</tr>
<tr>
<td>• <strong>swap-swap</strong></td>
<td>Both the inner and the outer VLAN tags of the incoming frame are replaced by the user-specified VLAN tag value.</td>
<td>none</td>
</tr>
<tr>
<td>• <strong>pop-swap</strong></td>
<td>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.</td>
<td>none</td>
</tr>
<tr>
<td>• <strong>pop-pop</strong></td>
<td>Both the outer and inner VLAN tags of the incoming frame are removed.</td>
<td>none</td>
</tr>
<tr>
<td>Field Name</td>
<td>Field Description</td>
<td>Level of Output</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------------------------------------------------------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Demux</td>
<td>IP demultiplexing (demux) value that appears if this interface is used as the demux underlying interface. The output is one of the following:</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>• Source Family Inet</td>
<td>none</td>
</tr>
<tr>
<td></td>
<td>• Destination Family Inet</td>
<td></td>
</tr>
<tr>
<td>Encapsulation</td>
<td>Encapsulation on the logical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>ACI VLAN</td>
<td>Information displayed for agent circuit identifier (ACI) interface set configured with the agent-circuit-id autoconfiguration stanza.</td>
<td>brief detail extensive</td>
</tr>
<tr>
<td></td>
<td>Dynamic Profile—Name of the dynamic profile that defines the ACI interface set.</td>
<td>none</td>
</tr>
<tr>
<td></td>
<td>If configured, the ACI interface set enables the underlying Ethernet interface to create dynamic VLAN subscriber interfaces based on ACI information.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>NOTE: The ACI VLAN field is replaced with the Line Identity field when an ALI interface set is configured with the line-identity autoconfiguration stanza.</td>
<td></td>
</tr>
<tr>
<td>Line Identity</td>
<td>Information displayed for access-line-identifier (ALI) interface sets configured with the line-identity autoconfiguration stanza.</td>
<td>detail</td>
</tr>
<tr>
<td></td>
<td>• Dynamic Profile—Name of the dynamic profile that defines the ALI interface set.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Trusted option used to create the ALI interface set: Circuit-id, Remote-id, or Accept-no-ids.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>More than one option can be configured.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>If configured, the ALI interface set enables the underlying Ethernet interface to create dynamic VLAN subscriber interfaces based on ALI information.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>NOTE: The Line Identity field is replaced with the ACI VLAN field when an ACI interface set is configured with the agent-circuit-id autoconfiguration stanza.</td>
<td></td>
</tr>
<tr>
<td>Protocol</td>
<td>Protocol family. Possible values are described in the “Protocol Field” section under Common Output Fields Description.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>MTU</td>
<td>Maximum transmission unit size on the logical interface.</td>
<td>none</td>
</tr>
<tr>
<td>Neighbor Discovery Protocol (NDP) Queue Statistics</td>
<td>NDP statistics for protocol inet6 under logical interface statistics.</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>• Max nh cache—Maximum interface neighbor discovery nexthop cache size.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• New hold nh limit—Maximum number of new unresolved nexthops.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Curr rh cnt—Current number of resolved nexthops in the NDP queue.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Curr new hold cnt—Current number of unresolved nexthops in the NDP queue.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• NH drop cnt—Number of NDP requests not serviced.</td>
<td></td>
</tr>
<tr>
<td>Dynamic Profile</td>
<td>Name of the dynamic profile that was used to create this interface configured with a Point-to-Point Protocol over Ethernet (PPPoE) family.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Service Name Table</td>
<td>Name of the service name table for the interface configured with a PPPoE family.</td>
<td>detail extensive</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Sessions</td>
<td>Maximum number of PPPoE logical interfaces that can be activated on the underlying interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Duplicate Protection</td>
<td>State of PPPoE duplicate protection: <strong>On</strong> or <strong>Off</strong>. 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.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Direct Connect</td>
<td>State of the configuration to ignore DSL Forum VSAs: <strong>On</strong> or <strong>Off</strong>. When configured, the router ignores any of these VSAs received from a directly connected CPE device on the interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>AC Name</td>
<td>Name of the access concentrator.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Maximum labels</td>
<td>Maximum number of MPLS labels configured for the MPLS protocol family on the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Traffic statistics</td>
<td>Number and rate of bytes and packets received and transmitted on the specified interface set.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>• <strong>Input bytes, Output bytes</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Input packets, Output packets</strong>—Number of packets received and transmitted on the interface set.</td>
<td></td>
</tr>
<tr>
<td>IPv6 transit statistics</td>
<td>Number of IPv6 transit bytes and packets received and transmitted on the logical interface if IPv6 statistics tracking is enabled.</td>
<td>extensive</td>
</tr>
<tr>
<td>Local statistics</td>
<td>Number and rate of bytes and packets destined to the router.</td>
<td>extensive</td>
</tr>
<tr>
<td>Transit statistics</td>
<td>Number and rate of bytes and packets transiting the switch.</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td><strong>NOTE:</strong> 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 <strong>Output bytes</strong> and <strong>Output packets</strong> 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.</td>
<td></td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Route Table</td>
<td>Route table in which the logical interface address is located. For example, 0 refers to the routing table inet.0.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Flags</td>
<td>Information about protocol family flags. Possible values are described in the “Family Flags” section under Common Output Fields Description.</td>
<td>detail extensive</td>
</tr>
</tbody>
</table>
Table 161: show interfaces (Gigabit Ethernet) Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Donor interface</td>
<td>(Unnumbered Ethernet) Interface from which an unnumbered Ethernet interface borrows an IPv4 address.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Preferred source address</td>
<td>(Unnumbered Ethernet) Secondary IPv4 address of the donor loopback interface that acts as the preferred source address for the unnumbered Ethernet interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Input Filters</td>
<td>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.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Output Filters</td>
<td>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.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Mac-Validate Failures</td>
<td>Number of MAC address validation failures for packets and bytes. This field is displayed when MAC address validation is enabled for the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Addresses, Flags</td>
<td>Information about the address flags. Possible values are described in the &quot;Addresses Flags&quot; section under Common Output Fields Description.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>protocol-family</td>
<td>Protocol family configured on the logical interface. If the protocol is inet, the IP address of the interface is also displayed.</td>
<td>brief</td>
</tr>
<tr>
<td>Flags</td>
<td>Information about the address flag. Possible values are described in the &quot;Addresses Flags&quot; section under Common Output Fields Description.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Destination</td>
<td>IP address of the remote side of the connection.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Local</td>
<td>IP address of the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Broadcast</td>
<td>Broadcast address of the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
</tbody>
</table>

The following table describes the output fields for the show interfaces (10-Gigabit Ethernet) command.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical interface</td>
<td>Name of the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Enabled</td>
<td>State of the interface. Possible values are described in the &quot;Enabled Field&quot; section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td>Interface index</td>
<td>Index number of the physical interface, which reflects its initialization sequence.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Feature</td>
<td>Description</td>
<td>Levels</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td><strong>SNMP ifIndex</strong></td>
<td>SNMP index number for the physical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td><strong>Generation</strong></td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td><strong>Link-level type</strong></td>
<td>Encapsulation being used on the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>MTU</strong></td>
<td>Maximum transmission unit size on the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Speed</strong></td>
<td>Speed at which the interface is running.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Loopback</strong></td>
<td>Loopback status: <strong>Enabled</strong> or <strong>Disabled</strong>. If loopback is enabled, type of loopback: <strong>Local</strong> or <strong>Remote</strong>.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Source filtering</strong></td>
<td>Source filtering status: <strong>Enabled</strong> or <strong>Disabled</strong>.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>LAN-PHY mode</strong></td>
<td>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.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>WAN-PHY mode</strong></td>
<td>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.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Unidirectional</strong></td>
<td>Unidirectional link mode status for 10-Gigabit Ethernet interface: <strong>Enabled</strong> or <strong>Disabled</strong> for parent interface; <strong>Rx-only</strong> or <strong>Tx-only</strong> for child interfaces.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Flow control</strong></td>
<td>Flow control status: <strong>Enabled</strong> or <strong>Disabled</strong>.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Auto-negotiation</strong></td>
<td>(Gigabit Ethernet interfaces) Autonegotiation status: <strong>Enabled</strong> or <strong>Disabled</strong>.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Remote-fault</strong></td>
<td>(Gigabit Ethernet interfaces) Remote fault status:</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>• <strong>Online</strong>—Autonegotiation is manually configured as online.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Offline</strong>—Autonegotiation is manually configured as offline.</td>
<td></td>
</tr>
<tr>
<td><strong>Device flags</strong></td>
<td>Information about the physical device. Possible values are described in the “Device Flags” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Interface flags</strong></td>
<td>Information about the interface. Possible values are described in the “Interface Flags” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Link flags</strong></td>
<td>Information about the link. Possible values are described in the “Links Flags” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Wavelength</strong></td>
<td>(10-Gigabit Ethernet dense wavelength-division multiplexing [DWDM] interfaces) Displays the configured wavelength, in nanometers (nm).</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Frequency</strong></td>
<td>(10-Gigabit Ethernet DWDM interfaces only) Displays the frequency associated with the configured wavelength, in terahertz (THz).</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>CoS queues</strong></td>
<td>Number of CoS queues configured.</td>
<td>detail extensive none</td>
</tr>
</tbody>
</table>
### Schedulers

(Gigabit Ethernet intelligent queuing 2 (IQ2) interfaces only) Number of CoS schedulers configured.

### Hold-times

Current interface hold-time up and hold-time down, in milliseconds.

### Current address

Configured MAC address.

### Hardware address

Hardware MAC address.

### Last flapped

Date, time, and how long ago the interface went from down to up. The format is Last flapped: year-month-day hour:minute:second:timezone (hour:minute:second ago). For example, Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago).

### Input Rate

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.

### Output Rate

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.

### Statistics last cleared

Time when the statistics for the interface were last set to zero.

### Egress account overhead

Layer 2 overhead in bytes that is accounted in the interface statistics for egress traffic.

### Ingress account overhead

Layer 2 overhead in bytes that is accounted in the interface statistics for ingress traffic.

### Traffic statistics

Number and rate of bytes and packets received and transmitted on the physical interface.

- **Input bytes**—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.
- **Output bytes**—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.
- **Input packets**—Number of packets received on the interface.
- **Output packets**—Number of packets transmitted on the interface.
## Input Errors

Input errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:

- **Errors**—Sum of the incoming frame aborts and FCS errors.
- **Drops**—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.
- **Framing errors**—Number of packets received with an invalid frame checksum (FCS).
- **Runts**—Number of frames received that are smaller than the runt threshold.
- **Policing discards**—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.
- **L3 incompletes**—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 `ignore-l3-incompletes` statement.
- **L2 channel errors**—Number of times the software did not find a valid logical interface for an incoming frame.
- **L2 mismatch timeouts**—Number of malformed or short packets that caused the incoming packet handler to discard the frame as unreadable.
- **FIFO errors**—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.
- **Resource errors**—Sum of transmit drops.

## Output Errors

Output errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:

- **Carrier transitions**—Number of times the interface has gone from **down** to **up**. 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.
- **Errors**—Sum of the outgoing frame aborts and FCS errors.
- **Drops**—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.
- **Collisions**—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.
- **Aged packets**—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.
- **FIFO errors**—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.
- **HS link CRC errors**—Number of errors on the high-speed links between the ASICs responsible for handling the router interfaces.
- **MTU errors**—Number of packets whose size exceeded the MTU of the interface.
- **Resource errors**—Sum of transmit drops.
**Egress queues** | Total number of egress queues supported on the specified interface. | detail extensive

**NOTE:** 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 `show interfaces` 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.

<table>
<thead>
<tr>
<th>Queue counters (Egress)</th>
<th>CoS queue number and its associated user-configured forwarding class name.</th>
<th>detail extensive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Queued packets—Number of queued packets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Transmitted packets—Number of transmitted packets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Dropped packets—Number of packets dropped by the ASIC’s RED mechanism.</td>
<td></td>
</tr>
</tbody>
</table>

| Ingress queues | Total number of ingress queues supported on the specified interface. Displayed on IQ2 interfaces. | extensive |

<table>
<thead>
<tr>
<th>Queue counters (Ingress)</th>
<th>CoS queue number and its associated user-configured forwarding class name. Displayed on IQ2 interfaces.</th>
<th>extensive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Queued packets—Number of queued packets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Transmitted packets—Number of transmitted packets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Dropped packets—Number of packets dropped by the ASIC’s RED mechanism.</td>
<td></td>
</tr>
</tbody>
</table>

**Active alarms and Active defects** | 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 None or Link. | detail extensive |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• None—There are no active defects or alarms.</td>
<td>none</td>
</tr>
<tr>
<td></td>
<td>• Link—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.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OTN alarms</th>
<th>Active OTN alarms identified on the interface.</th>
<th>detail extensive</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>OTN defects</th>
<th>OTN defects received on the interface.</th>
<th>detail extensive</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>OTN FEC Mode</th>
<th>The FEC mode configured on the interface.</th>
<th>detail extensive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• efec—Enhanced forward error correction (EFEC) is configured to detect and correct bit errors.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• gfec—G.709 Forward error correction (GFEC) mode is configured to detect and correct bit errors.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• none—FEC mode is not configured.</td>
<td></td>
</tr>
</tbody>
</table>
### OTN Rate
- **fixed-stuff-bytes**—Fixed stuff bytes 11.0957 Gbps.
- **no-fixed-stuff-bytes**—No fixed stuff bytes 11.0491 Gbps.
- **pass-through**—Enable OTN passthrough mode.
- **no-pass-through**—Do not enable OTN passthrough mode.

### OTN Line Loopback
- Status of the line loopback, if configured for the DWDM OTN PIC. Its value can be: **enabled** or **disabled**.

### OTN FEC statistics
- **Corrected Errors**—The count of corrected errors in the last second.
- **Corrected Error Ratio**—The corrected error ratio in the last 25 seconds. For example, 1e-7 is 1 error per 10 million bits.

### OTN FEC alarms
- OTN FEC excessive or degraded error alarms triggered on the interface.
  - **FEC Degraded**—OTU FEC Degraded defect.
  - **FEC Excessive**—OTU FEC Excessive Error defect.

### OTN OC
- OTN OC defects triggered on the interface.
  - **LOS**—OC Loss of Signal defect.
  - **LOF**—OC Loss of Frame defect.
  - **LOM**—OC Loss of Multiframe defect.
  - **Wavelength Lock**—OC Wavelength Lock defect.

### OTN OTU
- OTN OTU defects detected on the interface.
  - **AIS**—OTN AIS alarm.
  - **BDI**—OTN OTU BDI alarm.
  - **IAE**—OTN OTU IAE alarm.
  - **TTIM**—OTN OTU TTIM alarm.
  - **SF**—OTN ODU bit error rate fault alarm.
  - **SD**—OTN ODU bit error rate defect alarm.
  - **TCA-ES**—OTN ODU ES threshold alarm.
  - **TCA-SES**—OTN ODU SES threshold alarm.
  - **TCA-UAS**—OTN ODU UAS threshold alarm.
  - **TCA-BBE**—OTN ODU BBE threshold alarm.
  - **BIP**—OTN ODU BIP threshold alarm.
  - **BBE**—OTN ODU BBE threshold alarm.
  - **ES**—OTN OTU ES threshold alarm.
  - **SES**—OTN OTU SES threshold alarm.
  - **UAS**—OTN OTU UAS threshold alarm.

### Received DAPI
- Destination Access Port Interface (DAPI) from which the packets were received.

### Received SAPI
- Source Access Port Interface (SAPI) from which the packets were received.

### Transmitted DAPI
- Destination Access Port Interface (DAPI) to which the packets were transmitted.
### Transmitted SAPI
Source Access Port Interface (SAPI) to which the packets were transmitted.

### PCS statistics
(10-Gigabit Ethernet interfaces) Displays Physical Coding Sublayer (PCS) fault conditions from the WAN PHY or the LAN PHY device.

- **Bit errors**—The number of seconds during which at least one bit error rate (BER) occurred while the PCS receiver is operating in normal mode.
- **Errored blocks**—The number of seconds when at least one errored block occurred while the PCS receiver is operating in normal mode.

### MAC statistics
Receive and Transmit statistics reported by the PIC’s MAC subsystem, including the following:

- **Total octets and total packets**—Total number of octets and packets. For Gigabit Ethernet IQ PICs, the received octets count varies by interface type.
- **Unicast packets, Broadcast packets, and Multicast packets**—Number of unicast, broadcast, and multicast packets.
- **CRC/Align errors**—Total number of packets received that had a length (excluding framing bits, but including FCSoctets) 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).
- **FIFO error**—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.
- **MAC control frames**—Number of MAC control frames.
- **MAC pause frames**—Number of MAC control frames with pause operational code.
- **Oversized frames**—Number of frames that exceed 1518 octets.
- **Jabber frames**—Number of frames that were longer than 1518 octets (excluding framing bits, but including FCSoctets), 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.
- **Fragment frames**—Total number of packets that were less than 64 octets in length (excluding framing bits, but including FCSoctets), 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.
- **VLAN tagged frames**—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.
- **Code violations**—Number of times an event caused the PHY to indicate “Data reception error” or “invalid data symbol error.”

### 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  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.

- **Input packet count**—Number of packets received from the MAC hardware that the filter processed.
- **Input packet rejects**—Number of packets that the filter rejected because of either the source MAC address or the destination MAC address.
- **Input DA rejects**—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).
- **Input SA rejects**—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.
- **Output packet count**—Number of packets that the filter has given to the MAC hardware.
- **Output packet pad count**—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.
- **Output packet error count**—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.
- **CAM destination filters, CAM source filters**—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.

**PMA PHY**  (10-Gigabit Ethernet interfaces, WAN PHY mode) SONET error information:

- **Seconds**—Number of seconds the defect has been active.
- **Count**—Number of times that the defect has gone from inactive to active.
- **State**—State of the error. Any state other than **OK** indicates a problem.
<table>
<thead>
<tr>
<th>WIS section</th>
<th>Extensive (10-Gigabit Ethernet interfaces, WAN PHY mode) SONET error information: extensive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Seconds—Number of seconds the defect has been active.</td>
</tr>
<tr>
<td></td>
<td>Count—Number of times that the defect has gone from inactive to active.</td>
</tr>
<tr>
<td></td>
<td>State—State of the error. Any state other than OK indicates a problem.</td>
</tr>
<tr>
<td></td>
<td>Subfields are:</td>
</tr>
<tr>
<td></td>
<td>BIP-B1—Bit interleaved parity for SONET section overhead</td>
</tr>
<tr>
<td></td>
<td>SEF—Severely errored framing</td>
</tr>
<tr>
<td></td>
<td>LOL—Loss of light</td>
</tr>
<tr>
<td></td>
<td>LOF—Loss of frame</td>
</tr>
<tr>
<td></td>
<td>ES-S—Errored seconds (section)</td>
</tr>
<tr>
<td></td>
<td>SES-S—Severely errored seconds (section)</td>
</tr>
<tr>
<td></td>
<td>SEFS-S—Severely errored framing seconds (section)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WIS line</th>
<th>Extensive (10-Gigabit Ethernet interfaces, WAN PHY mode) Active alarms and defects, plus counts of specific SONET errors with detailed information. extensive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Seconds—Number of seconds the defect has been active.</td>
</tr>
<tr>
<td></td>
<td>Count—Number of times that the defect has gone from inactive to active.</td>
</tr>
<tr>
<td></td>
<td>State—State of the error. State other than OK indicates a problem.</td>
</tr>
<tr>
<td></td>
<td>Subfields are:</td>
</tr>
<tr>
<td></td>
<td>BIP-B2—Bit interleaved parity for SONET line overhead</td>
</tr>
<tr>
<td></td>
<td>REI-L—Remote error indication (near-end line)</td>
</tr>
<tr>
<td></td>
<td>RDI-L—Remote defect indication (near-end line)</td>
</tr>
<tr>
<td></td>
<td>AIS-L—Alarm indication signal (near-end line)</td>
</tr>
<tr>
<td></td>
<td>BERR-SF—Bit error rate fault (signal failure)</td>
</tr>
<tr>
<td></td>
<td>BERR-SD—Bit error rate defect (signal degradation)</td>
</tr>
<tr>
<td></td>
<td>ES-L—Errored seconds (near-end line)</td>
</tr>
<tr>
<td></td>
<td>SES-L—Severely errored seconds (near-end line)</td>
</tr>
<tr>
<td></td>
<td>UAS-L—Unavailable seconds (near-end line)</td>
</tr>
<tr>
<td></td>
<td>ES-LFE—Errored seconds (far-end line)</td>
</tr>
<tr>
<td></td>
<td>SES-LFE—Severely errored seconds (far-end line)</td>
</tr>
<tr>
<td></td>
<td>UAS-LFE—Unavailable seconds (far-end line)</td>
</tr>
</tbody>
</table>
**WIS path**

(10-Gigabit Ethernet interfaces, WAN PHY mode) Active alarms and defects, plus counts of specific SONET errors with detailed information.

- **Seconds**—Number of seconds the defect has been active.
- **Count**—Number of times that the defect has gone from inactive to active.
- **State**—State of the error. Any state other than **OK** indicates a problem.

Subfields are:

- **BIP-B3**—Bit interleaved parity for SONET section overhead
- **REI-P**—Remote error indication
- **LOP-P**—Loss of pointer (path)
- **AIS-P**—Path alarm indication signal
- **RDI-P**—Path remote defect indication
- **UNEQ-P**—Path unequipped
- **PLM-P**—Path payload label mismatch
- **ES-P**—Errored seconds (near-end STS path)
- **SES-P**—Severely errored seconds (near-end STS path)
- **UAS-P**—Unavailable seconds (near-end STS path)
- **SES-PFE**—Severely errored seconds (far-end STS path)
- **UAS-PFE**—Unavailable seconds (far-end STS path)

---

**Autonegotiation information**

Information about link autonegotiation.

- **Negotiation status:**
  - **Incomplete**—Ethernet interface has the speed or link mode configured.
  - **No autonegotiation**—Remote Ethernet interface has the speed or link mode configured, or does not perform autonegotiation.
  - **Complete**—Ethernet interface is connected to a device that performs autonegotiation and the autonegotiation process is successful.

- **Link partner status**—**OK** when Ethernet interface is connected to a device that performs autonegotiation and the autonegotiation process is successful.

- **Link partner:**
  - **Link mode**—Depending on the capability of the attached Ethernet device, either **Full-duplex** or **Half-duplex**.
  - **Flow control**—Types of flow control supported by the remote Ethernet device. For Fast Ethernet interfaces, the type is **None**. For Gigabit Ethernet interfaces, types are **Symmetric** (link partner supports **PAUSE** on receive and transmit), **Asymmetric** (link partner supports **PAUSE** on transmit), and **Symmetric/Asymmetric** (link partner supports both **PAUSE** on receive and transmit or only **PAUSE** receive).
  - **Remote fault**—Remote fault information from the link partner—**Failure** indicates a receive link error. **OK** indicates that the link partner is receiving. **Negotiation error** indicates a negotiation error. **Offline** indicates that the link partner is going offline.

- **Local resolution**—Information from the link partner:
  - **Flow control**—Types of flow control supported by the remote Ethernet device. For Gigabit Ethernet interfaces, types are **Symmetric** (link partner supports **PAUSE** on receive and transmit), **Asymmetric** (link partner supports **PAUSE** on transmit), and **Symmetric/Asymmetric** (link partner supports both **PAUSE** on receive and transmit or only **PAUSE** receive).
  - **Remote fault**—Remote fault information. **Link OK** (no error detected on receive), **Offline** (local interface is offline), and **Link Failure** (link error detected on receive).
Extensive Information about the configuration of the Packet Forwarding Engine:

- **Destination slot**—FPC slot number.

Extensive Information about the CoS queue for the physical interface.

- **CoS transmit queue**—Queue number and its associated user-configured forwarding class name.
- **Bandwidth %**—Percentage of bandwidth allocated to the queue.
- **Bandwidth bps**—Bandwidth allocated to the queue (in bps).
- **Buffer %**—Percentage of buffer space allocated to the queue.
- **Buffer usec**—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.
- **Priority**—Queue priority: **low** or **high**.
- **Limit**—Displayed if rate limiting is configured for the queue. Possible values are **none** and **exact**. If **exact** is configured, the queue transmits only up to the configured bandwidth, even if excess bandwidth is available. If **none** is configured, the queue transmits beyond the configured bandwidth if bandwidth is available.

<table>
<thead>
<tr>
<th>Logical Interface</th>
<th>Logical interface</th>
<th>Name of the logical interface.</th>
<th>All levels</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Index</strong></td>
<td>Index</td>
<td>Index number of the logical interface, which reflects its initialization sequence.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td><strong>SNMP ifIndex</strong></td>
<td>SNMP ifIndex</td>
<td>SNMP interface index number for the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td><strong>Generation</strong></td>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td><strong>Flags</strong></td>
<td>Flags</td>
<td>Information about the logical interface. Possible values are described in the “Logical Interface Flags” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
</tbody>
</table>
**VLAN-Tag**
Rewrite profile applied to incoming or outgoing frames on the outer (Out) VLAN tag or for both the outer and inner (In) VLAN tags.

- **push**—An outer VLAN tag is pushed in front of the existing VLAN tag.
- **pop**—The outer VLAN tag of the incoming frame is removed.
- **swap**—The outer VLAN tag of the incoming frame is overwritten with the user specified VLAN tag information.
- **push**—An outer VLAN tag is pushed in front of the existing VLAN tag.
- **push-push**—Two VLAN tags are pushed in from the incoming frame.
- **swap-push**—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.
- **swap-swap**—Both the inner and the outer VLAN tags of the incoming frame are replaced by the user specified VLAN tag value.
- **pop-swap**—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.
- **pop-pop**—Both the outer and inner VLAN tags of the incoming frame are removed.

**Demux:**
IP demultiplexing (demux) value that appears if this interface is used as the demux underlying interface. The output is one of the following:

- Source Family Inet
- Destination Family Inet

**Encapsulation**
Encapsulation on the logical interface. All levels

**Protocol**
Protocol family. Possible values are described in the “Protocol Field” section under Common Output Fields Description.

**MTU**
Maximum transmission unit size on the logical interface.

**Maximum labels**
Maximum number of MPLS labels configured for the MPLS protocol family on the logical interface.

**Traffic statistics**
Number and rate of bytes and packets received and transmitted on the specified interface set.

- **Input bytes, Output bytes**—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.
- **Input packets, Output packets**—Number of packets received and transmitted on the interface set.

**IPv6 transit statistics**
Number of IPv6 transit bytes and packets received and transmitted on the logical interface if IPv6 statistics tracking is enabled.

**Local statistics**
Number and rate of bytes and packets destined to the routing device.
**Transit statistics**  Number and rate of bytes and packets transiting the switch.  

**NOTE:** 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 **Output bytes** and **Output packets** 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.

<table>
<thead>
<tr>
<th>Table Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Generation</strong></td>
<td>Unique number for use by Juniper Networks technical support only.</td>
</tr>
<tr>
<td><strong>Route Table</strong></td>
<td>Route table in which the logical interface address is located. For example, 0 refers to the routing table inet.0.</td>
</tr>
<tr>
<td><strong>Flags</strong></td>
<td>Information about protocol family flags. Possible values are described in the “Family Flags” section under Common Output Fields Description.</td>
</tr>
<tr>
<td><strong>Donor interface</strong></td>
<td>(Unnumbered Ethernet) Interface from which an unnumbered Ethernet interface borrows an IPv4 address.</td>
</tr>
<tr>
<td><strong>Preferred source address</strong></td>
<td>(Unnumbered Ethernet) Secondary IPv4 address of the donor loopback interface that acts as the preferred source address for the unnumbered Ethernet interface.</td>
</tr>
<tr>
<td><strong>Input Filters</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Output Filters</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Mac-Validate Failures</strong></td>
<td>Number of MAC address validation failures for packets and bytes. This field is displayed when MAC address validation is enabled for the logical interface.</td>
</tr>
<tr>
<td><strong>Addresses, Flags</strong></td>
<td>Information about the address flags. Possible values are described in the “Addresses Flags” section under Common Output Fields Description.</td>
</tr>
<tr>
<td><strong>protocol-family</strong></td>
<td>Protocol family configured on the logical interface. If the protocol is inet, the IP address of the interface is also displayed.</td>
</tr>
<tr>
<td><strong>Flags</strong></td>
<td>Information about address flag (possible values are described in the “Addresses Flags” section under Common Output Fields Description.</td>
</tr>
<tr>
<td><strong>Destination</strong></td>
<td>IP address of the remote side of the connection.</td>
</tr>
<tr>
<td><strong>Local</strong></td>
<td>IP address of the logical interface.</td>
</tr>
<tr>
<td><strong>Broadcast</strong></td>
<td>Broadcast address of the logical interface.</td>
</tr>
<tr>
<td><strong>Generation</strong></td>
<td>Unique number for use by Juniper Networks technical support only.</td>
</tr>
</tbody>
</table>
For Gigabit Ethernet IQ PICs, traffic and MAC statistics output varies. The following table 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). 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 162: Gigabit and 10 Gigabit Ethernet IQ PIC Traffic and MAC Statistics by Interface Type**

<table>
<thead>
<tr>
<th>Interface Type</th>
<th>Sample Command</th>
<th>Byte and Octet Counts Include</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inbound physical interface</td>
<td>show interfaces ge-0/3/0 extensive</td>
<td>Traffic statistics:</td>
<td>The additional 4 bytes are for the CRC.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Input bytes: 496 bytes per packet, representing the Layer 2 packet</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>MAC statistics:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Received octets: 500 bytes per packet, representing the Layer 2 packet + 4 bytes</td>
<td></td>
</tr>
<tr>
<td>Inbound logical interface</td>
<td>show interfaces ge-0/3/0.50 extensive</td>
<td>Traffic statistics:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Input bytes: 478 bytes per packet, representing the Layer 3 packet</td>
<td></td>
</tr>
<tr>
<td>Outbound physical interface</td>
<td>show interfaces ge-0/0/0 extensive</td>
<td>Traffic statistics:</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Input bytes: 490 bytes per packet, representing the Layer 3 packet + 12 bytes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>MAC statistics:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Received octets: 478 bytes per packet, representing the Layer 3 packet</td>
<td></td>
</tr>
<tr>
<td>Outbound logical interface</td>
<td>show interfaces ge-0/0/0.50 extensive</td>
<td>Traffic statistics:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Input bytes: 478 bytes per packet, representing the Layer 3 packet</td>
<td></td>
</tr>
</tbody>
</table>

*Table 163 on page 2093* lists the output fields for the `show interfaces` command. Output fields are listed in the approximate order in which they appear.
Table 163: show interfaces Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical Interface</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical interface</td>
<td>Name of the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Enabled</td>
<td>State of the interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Interface index</td>
<td>Index number of the physical interface, which reflects its initialization sequence.</td>
<td><strong>detail extensive</strong> none</td>
</tr>
<tr>
<td>SNMP ifIndex</td>
<td>SNMP index number for the physical interface.</td>
<td><strong>detail extensive</strong> none</td>
</tr>
<tr>
<td>Link-level type</td>
<td>Encapsulation being used on the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td><strong>detail extensive</strong></td>
</tr>
<tr>
<td>MTU</td>
<td>Maximum transmission unit size on the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Link mode</td>
<td>Link mode: Full-duplex or Half-duplex.</td>
<td>All levels</td>
</tr>
<tr>
<td>Speed</td>
<td>Speed at which the interface is running.</td>
<td>All levels</td>
</tr>
<tr>
<td>BPDU error</td>
<td>Bridge protocol data unit (BPDU) error: Detected or None</td>
<td></td>
</tr>
<tr>
<td>Loopback</td>
<td>Loopback status: <strong>Enabled</strong> or <strong>Disabled</strong>. If loopback is enabled, type of loopback: <strong>Local</strong> or <strong>Remote</strong>.</td>
<td>All levels</td>
</tr>
<tr>
<td>Source filtering</td>
<td>Source filtering status: <strong>Enabled</strong> or <strong>Disabled</strong>.</td>
<td>All levels</td>
</tr>
<tr>
<td>Flow control</td>
<td>Flow control status: <strong>Enabled</strong> or <strong>Disabled</strong>.</td>
<td>All levels</td>
</tr>
<tr>
<td>Auto-negotiation</td>
<td>(Gigabit Ethernet interfaces) Autonegotiation status: <strong>Enabled</strong> or <strong>Disabled</strong>.</td>
<td>All levels</td>
</tr>
<tr>
<td>Remote-fault</td>
<td>(Gigabit Ethernet interfaces) Remote fault status:</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>• <strong>Online</strong>—Autonegotiation is manually configured as online.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Offline</strong>—Autonegotiation is manually configured as offline.</td>
<td></td>
</tr>
<tr>
<td>Device flags</td>
<td>Information about the physical device.</td>
<td>All levels</td>
</tr>
<tr>
<td>Interface flags</td>
<td>Information about the interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Link flags</td>
<td>Information about the physical link.</td>
<td>All levels</td>
</tr>
<tr>
<td>CoS queues</td>
<td>Number of CoS queues configured.</td>
<td><strong>detail extensive</strong> none</td>
</tr>
<tr>
<td>Current address</td>
<td>Configured MAC address.</td>
<td><strong>detail extensive</strong> none</td>
</tr>
</tbody>
</table>
Table 163: show interfaces Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last flapped</td>
<td>Date, time, and how long ago the interface went from down to up. The format is Last flapped: year-month-day hour:minute:second:timezone (hour:minute:second ago). For example, Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago).</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Input Rate</td>
<td>Input rate in bits per second (bps) and packets per second (pps).</td>
<td>None</td>
</tr>
<tr>
<td>Output Rate</td>
<td>Output rate in bps and pps.</td>
<td>None</td>
</tr>
<tr>
<td>Active alarms and</td>
<td>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. These fields can contain the value None or Link.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Active defects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• None</td>
<td>There are no active defects or alarms.</td>
<td></td>
</tr>
<tr>
<td>• Link</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>Statistics last cleared</td>
<td>Time when the statistics for the interface were last set to zero.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Traffic statistics</td>
<td>Number and rate of bytes and packets received and transmitted on the physical interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>• Input bytes</td>
<td>Number of bytes received on the interface.</td>
<td></td>
</tr>
<tr>
<td>• Output bytes</td>
<td>Number of bytes transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td>• Input packets</td>
<td>Number of packets received on the interface.</td>
<td></td>
</tr>
<tr>
<td>• Output packets</td>
<td>Number of packets transmitted on the interface.</td>
<td></td>
</tr>
</tbody>
</table>
Table 163: show interfaces Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input errors</strong></td>
<td>Input errors on the interface.</td>
<td>extensive</td>
</tr>
<tr>
<td>Errors</td>
<td>Sum of the incoming frame aborts and FCS errors.</td>
<td></td>
</tr>
<tr>
<td>Drops</td>
<td>Number of packets dropped by the input queue of the I/O Manager ASIC. If the</td>
<td></td>
</tr>
<tr>
<td></td>
<td>interface is saturated, this number increments once for every packet that is</td>
<td></td>
</tr>
<tr>
<td></td>
<td>dropped by the ASIC's RED mechanism.</td>
<td></td>
</tr>
<tr>
<td>Framing errors</td>
<td>Number of packets received with an invalid frame checksum (FCS).</td>
<td></td>
</tr>
<tr>
<td>Runtss</td>
<td>Number of frames received that are smaller than the runt threshold.</td>
<td></td>
</tr>
<tr>
<td>Policed discards</td>
<td>Number of frames that the incoming packet match code discarded because they were</td>
<td></td>
</tr>
<tr>
<td></td>
<td>not recognized or not of interest. Usually, this field reports protocols that</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Junos OS does not handle.</td>
<td></td>
</tr>
<tr>
<td>L3 incompleteds</td>
<td>Number of incoming packets discarded because they failed Layer 3 (usually IPv4)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>sanity checks of the header. For example, a frame with less than 20 bytes of</td>
<td></td>
</tr>
<tr>
<td></td>
<td>available IP header is discarded. L3 incomplete errors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>can be ignored by configuring the <code>ignore-l3-incompletes</code>.</td>
<td></td>
</tr>
<tr>
<td>L2 channel errors</td>
<td>Number of times the software did not find a valid logical interface for an incoming</td>
<td></td>
</tr>
<tr>
<td></td>
<td>frame.</td>
<td></td>
</tr>
<tr>
<td>L2 mismatch timeouts</td>
<td>Number of malformed or short packets that caused the incoming packet handler to</td>
<td></td>
</tr>
<tr>
<td></td>
<td>discard the frame as unreadable.</td>
<td></td>
</tr>
<tr>
<td>FIFO errors</td>
<td>Number of FIFO errors in the receive direction that are reported by the ASIC on</td>
<td></td>
</tr>
<tr>
<td></td>
<td>the PIC. If this value is ever nonzero, the PIC is probably malfunctioning.</td>
<td></td>
</tr>
<tr>
<td>Resource errors</td>
<td>Sum of transmit drops.</td>
<td></td>
</tr>
<tr>
<td><strong>Output errors</strong></td>
<td>Output errors on the interface.</td>
<td>extensive</td>
</tr>
<tr>
<td>Carrier transitions</td>
<td>Number of times the interface has gone from down to up.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>This number does not normally increment quickly, increasing only when the cable is</td>
<td></td>
</tr>
<tr>
<td></td>
<td>unplugged, the far-end system is powered down and then up, or another problem</td>
<td></td>
</tr>
<tr>
<td></td>
<td>occurs. If the number of carrier transitions increments quickly (perhaps once</td>
<td></td>
</tr>
<tr>
<td></td>
<td>every 10 seconds), the cable, the far-end system, or the PIC or PIM is</td>
<td></td>
</tr>
<tr>
<td></td>
<td>malfunctioning.</td>
<td></td>
</tr>
<tr>
<td>Errors</td>
<td>Sum of the outgoing frame aborts and FCS errors.</td>
<td></td>
</tr>
<tr>
<td>Drops</td>
<td>Number of packets dropped by the output queue of the I/O Manager ASIC. If the</td>
<td></td>
</tr>
<tr>
<td></td>
<td>interface is saturated, this number increments once for every packet that is</td>
<td></td>
</tr>
<tr>
<td></td>
<td>dropped by the ASIC's RED mechanism.</td>
<td></td>
</tr>
<tr>
<td>Collisions</td>
<td>Number of Ethernet collisions. The Gigabit Ethernet PIC supports full-duplex</td>
<td></td>
</tr>
<tr>
<td></td>
<td>operation; therefore, for Gigabit Ethernet PICs, this number must always remain</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0. If it is nonzero, there is a software bug.</td>
<td></td>
</tr>
<tr>
<td>Aged packets</td>
<td>Number of packets that remained in shared packet SDRAM so long that the system</td>
<td></td>
</tr>
<tr>
<td></td>
<td>automatically purged them. The value in this field</td>
<td></td>
</tr>
<tr>
<td></td>
<td>must never increment. If it does, it is most likely a software bug or possibly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>malfunctioning hardware.</td>
<td></td>
</tr>
<tr>
<td>FIFO errors</td>
<td>Number of FIFO errors in the send direction as reported by the ASIC on the PIC.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>If this value is ever nonzero, the PIC is probably malfunctioning.</td>
<td></td>
</tr>
<tr>
<td>HS link CRC errors</td>
<td>Number of errors on the high-speed links between the ASICs responsible for</td>
<td></td>
</tr>
<tr>
<td></td>
<td>handling the interfaces.</td>
<td></td>
</tr>
<tr>
<td>MTU errors</td>
<td>Number of packets whose size exceeded the MTU of the interface.</td>
<td></td>
</tr>
<tr>
<td>Resource errors</td>
<td>Sum of transmit drops.</td>
<td></td>
</tr>
<tr>
<td>Field Name</td>
<td>Field Description</td>
<td>Level of Output</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Ingress queues</td>
<td>Total number of ingress queues supported on the specified interface.</td>
<td>extensive</td>
</tr>
<tr>
<td>Queue counters and queue number</td>
<td>CoS queue number and its associated user-configured forwarding class name.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>• Queued packets—Number of queued packets.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Transmitted packets—Number of transmitted packets.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Dropped packets—Number of packets dropped by the ASIC’s RED mechanism.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAC statistics</td>
<td>Receive and Transmit statistics reported by the PIC’s MAC subsystem, including the following:</td>
<td>extensive</td>
</tr>
<tr>
<td>• Total octets and total packets—Total number of octets and packets.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Unicast packets, Broadcast packets, and Multicast packets—Number of unicast, broadcast, and multicast packets.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• CRC/Align errors—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).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• FIFO error—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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• MAC control frames—Number of MAC control frames.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• MAC pause frames—Number of MAC control frames with pause operational code.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Oversized frames—There are two possible conditions regarding the number of oversized frames:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Packet length exceeds 1518 octets, or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Packet length exceeds MRU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Jabber frames—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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Fragment frames—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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• VLAN tagged frames—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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Code violations—Number of times an event caused the PHY to indicate “Data reception error” or “invalid data symbol error.”</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 163: show interfaces Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter statistics</td>
<td><strong>Receive</strong> and <strong>Transmit</strong> 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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Input packet count</strong>—Number of packets received from the MAC hardware that the filter processed.</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>- <strong>Input packet rejects</strong>—Number of packets that the filter rejected because of either the source MAC address or the destination MAC address.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Input DA rejects</strong>—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 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 device (which the router is rejecting).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Input SA rejects</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Output packet count</strong>—Number of packets that the filter has given to the MAC hardware.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Output packet pad count</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Output packet error count</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>CAM destination filters, CAM source filters</strong>—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 must be 0.</td>
<td></td>
</tr>
<tr>
<td>Autonegotiation information</td>
<td>Information about link autonegotiation.</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>- <strong>Negotiation status:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Incomplete</strong>—Ethernet interface has the speed or link mode configured.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>No autonegotiation</strong>—Remote Ethernet interface has the speed or link mode configured, or does not perform autonegotiation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <strong>Complete</strong>—Ethernet interface is connected to a device that performs autonegotiation and the autonegotiation process is successful.</td>
<td></td>
</tr>
<tr>
<td>Packet Forwarding Engine configuration</td>
<td>Information about the configuration of the Packet Forwarding Engine:</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>- <strong>Destination slot</strong>—FPC slot number.</td>
<td></td>
</tr>
<tr>
<td>Field Name</td>
<td>Field Description</td>
<td>Level of Output</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td><strong>CoS information</strong></td>
<td>Information about the CoS queue for the physical interface.</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>• <strong>CoS transmit queue</strong>—Queue number and its associated user-configured forwarding class name.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Bandwidth %</strong>—Percentage of bandwidth allocated to the queue.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Bandwidth bps</strong>—Bandwidth allocated to the queue (in bps).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Buffer %</strong>—Percentage of buffer space allocated to the queue.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Buffer usec</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Priority</strong>—Queue priority: low or high.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Limit</strong>—Displayed if rate limiting is configured for the queue. Possible values are none and exact. If exact is configured, the queue transmits only up to the configured bandwidth, even if excess bandwidth is available. If none is configured, the queue transmits beyond the configured bandwidth if bandwidth is available.</td>
<td></td>
</tr>
<tr>
<td><strong>Interface transmit statistics</strong></td>
<td>Status of the interface-transmit-statistics configuration: Enabled or Disabled.</td>
<td>detail extensive</td>
</tr>
<tr>
<td><strong>Queue counters (Egress)</strong></td>
<td>CoS queue number and its associated user-configured forwarding class name.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>• <strong>Queued packets</strong>—Number of queued packets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Transmitted packets</strong>—Number of transmitted packets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Dropped packets</strong>—Number of packets dropped by the ASIC’s RED mechanism.</td>
<td></td>
</tr>
<tr>
<td><strong>Logical Interface</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Logical interface</strong></td>
<td>Name of the logical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Index</strong></td>
<td>Index number of the logical interface, which reflects its initialization sequence.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td><strong>SNMP ifIndex</strong></td>
<td>SNMP interface index number for the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td><strong>Generation</strong></td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td><strong>Flags</strong></td>
<td>Information about the logical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Encapsulation</strong></td>
<td>Encapsulation on the logical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Traffic statistics</strong></td>
<td>Number and rate of bytes and packets received and transmitted on the specified interface set.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>• <strong>Input bytes, Output bytes</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Input packets, Output packets</strong>—Number of packets received and transmitted on the interface set.</td>
<td></td>
</tr>
</tbody>
</table>
Table 163: show interfaces Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local statistics</td>
<td>Number and rate of bytes and packets destined to the device.</td>
<td>extensive</td>
</tr>
<tr>
<td>Transit statistics</td>
<td>Number and rate of bytes and packets transiting the switch.</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td><strong>NOTE</strong>: 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 <strong>Output bytes</strong> and <strong>Output packets</strong> 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.</td>
<td></td>
</tr>
<tr>
<td>Security</td>
<td>Security zones that interface belongs to.</td>
<td>extensive</td>
</tr>
<tr>
<td>Flow Input statistics</td>
<td>Statistics on packets received by flow module.</td>
<td>extensive</td>
</tr>
<tr>
<td>Flow Output statistics</td>
<td>Statistics on packets sent by flow module.</td>
<td>extensive</td>
</tr>
<tr>
<td>Flow error statistics</td>
<td>Statistics on errors in the flow module.</td>
<td>extensive</td>
</tr>
<tr>
<td>(Packets dropped due to)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protocol</td>
<td>Protocol family.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>MTU</td>
<td>Maximum transmission unit size on the logical interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Route Table</td>
<td>Route table in which the logical interface address is located. For example, 0 refers to the routing table inet.0.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Addresses, Flags</td>
<td>Information about the address flags.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Destination</td>
<td>IP address of the remote side of the connection.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Local</td>
<td>IP address of the logical interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Broadcast</td>
<td>Broadcast address of the logical interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
</tbody>
</table>
Sample Output Gigabit Ethernet

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,
  Remote fault: Online
  Device flags : Present Running
  Interface flags: SNMP-Traps Internal: 0x4000
  CoS queues   : 4 supported, 4 maximum usable queues
  Current address: 00:00:5e:00:53:7c, Hardware address: 00:00:5e:00:53:7c
  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: 00:00:5e:00:53:c0, Hardware address: 00:00:5e:00:53:76
  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
```
show interfaces (link degrade status)

user@host> show interfaces et-3/0/0

Physical interface: et-3/0/0, Enabled, Physical link is Down
  Interface index: 157, SNMP ifIndex: 537
  Link-level type: Ethernet, MTU: 1514, MRU: 0, Speed: 100Gbps, BPDU 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
  CoS queues     : 8 supported, 8 maximum usable queues
  Current address: 54:e0:32:23:9d:38, Hardware address: 54:e0:32:23:9d:38
  Last flapped   : 2014-06-18 02:36:38 PDT (02:50:50 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   : 0
  Link Degraded:     Enable
  Link Monitoring:   : 1E-7
  Link Degraded Set Threshold:   : 1E-12
  Link Degraded Clear Threshold: : 1E-7
  Estimated BER:     : 782
  Link-degrade event: Seconds Count State
                      : 782 1 Defect Active

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)
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 0 bps
Output bytes : 16681118 0 bps
Input packets:  0 0 pps
Output packets:  362633 0 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: 00:00:5e:00:53:7c, Hardware address: 00:00:5e:00:53:7c
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
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: 00:00:5e:00:53:74, Hardware address: 00:00:5e:00:53:74
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:

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Value</th>
<th>Rate (bps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input bytes</td>
<td>38910799145</td>
<td>7952</td>
</tr>
<tr>
<td>Input packets</td>
<td>418397956</td>
<td>11</td>
</tr>
<tr>
<td>Drop bytes</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Drop packets</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Queue Type</th>
<th>Queued Packets</th>
<th>Transmitted Packets</th>
<th>Dropped Packets</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 best-effort</td>
<td>418390823</td>
<td>418390823</td>
<td>0</td>
</tr>
<tr>
<td>1 expedited-fo</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2 assured-forw</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3 network-cont</td>
<td>7133</td>
<td>7133</td>
<td>0</td>
</tr>
</tbody>
</table>

Egress queues: 4 supported, 4 in use

<table>
<thead>
<tr>
<th>Queue Type</th>
<th>Queued Packets</th>
<th>Transmitted Packets</th>
<th>Dropped Packets</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 best-effort</td>
<td>1031</td>
<td>1031</td>
<td>0</td>
</tr>
<tr>
<td>1 expedited-fo</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2 assured-forw</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3 network-cont</td>
<td>77872</td>
<td>77872</td>
<td>0</td>
</tr>
</tbody>
</table>

Active alarms: None
Active defects: None

MAC statistics:

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Receive</th>
<th>Transmit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total octets</td>
<td>38910844056</td>
<td>7174605</td>
</tr>
<tr>
<td>Total packets</td>
<td>418398473</td>
<td>78903</td>
</tr>
<tr>
<td>Unicast packets</td>
<td>408021893366</td>
<td>1026</td>
</tr>
<tr>
<td>Broadcast packets</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Multicast packets</td>
<td>418398217</td>
<td>77865</td>
</tr>
<tr>
<td>CRC/Align errors</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>FIFO errors</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MAC control frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MAC pause frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Oversized frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Jabber frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fragment frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>VLAN tagged frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Code violations</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>OTN Received Overhead Bytes:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>APS/PCC0: 0x02, APS/PCC1: 0x11, APS/PCC2: 0x47, APS/PCC3: 0x58</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Payload Type: 0x08</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OTN Transmitted Overhead Bytes:
- APS/PCC0: 0x00, APS/PCC1: 0x00, APS/PCC2: 0x00, APS/PCC3: 0x00
- Payload Type: 0x08

Filter statistics:

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input packet count</td>
<td>418398473</td>
</tr>
<tr>
<td>Input packet rejects</td>
<td>479</td>
</tr>
</tbody>
</table>
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
Auto negotiation 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       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 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: 203.0.113/24, Local: 203.0.113.2, Broadcast: 203.0.113.255,
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 161 on page 2065.

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: 00:00:5e:00:53:f8, Hardware address: 00:00:5e:00:53: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: 203.0.113.22

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 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 (ALI Interface Set)

user@host> show interfaces ge-1/0/0.10
Logical interface ge-1/0/0.10 (Index 346) (SNMP ifIndex 554) (Generation 155)
Flags: Up SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.10 ] Encapsulation: ENET2
Line Identity:
  Dynamic Profile: ali-set-profile
  Circuit-id Remote-id Accept-no-ids
PPPoE:
  Dynamic Profile: ali-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

Sample Output Gigabit Ethernet

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: 00:00:5e:00:53:f6, Hardware address: 00:00:5e:00:53: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:

<table>
<thead>
<tr>
<th>Input bytes</th>
<th>6970299398</th>
<th>0 bps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input packets</td>
<td>81049992</td>
<td>0</td>
</tr>
<tr>
<td>Drop bytes</td>
<td>0</td>
<td>0 bps</td>
</tr>
<tr>
<td>Drop packets</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Queue counters</th>
<th>Queued packets</th>
<th>Transmitted packets</th>
<th>Dropped packets</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 best-effort</td>
<td>81049992</td>
<td>81049992</td>
<td>0</td>
</tr>
<tr>
<td>1 expedited-fo</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2 assured-forw</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3 network-cont</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Egress queues: 4 supported, 4 in use

<table>
<thead>
<tr>
<th>Queue counters</th>
<th>Queued packets</th>
<th>Transmitted packets</th>
<th>Dropped packets</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 best-effort</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1 expedited-fo</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2 assured-forw</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3 network-cont</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Active alarms: None
Active defects: None

PCS statistics
- Bit errors: 0
- Errored blocks: 0

MAC statistics
- Receive: 6970332384
- Transmit: 0

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
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: 00:00:5e:00:53:9d, Hardware address: 00:00:5e:00:53:9d
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 0
  Jabber frames 0 0
  Fragment frames 0 0
  VLAN tagged frames 0 0
  Code violations 0 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
  Dec flags 0
  Output packet error count 0
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, BPDUs 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: Ox4000
Link flags : None
Wavelength : 1550.12 nm, Frequency: 193.40 THz
Hold-times : Up 0 ms, Down 0 ms
Current address: 00:00:5e:00:53:72, Hardware address: 00:00:5e:00:53:72
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 incompatibilities: 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: 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 0
Jabber frames 0 0
Fragment frames 0 0
VLAN tagged frames 0 0
Code violations 0 0
Total octets 0 0
Header errors 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 00 00 00 00

Received SAPI:
00 00 00 00 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 00 00 00 00

Transmitted SAPI:
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

OTN Received Overhead Bytes:
APSF/PCC0: 0x02, APSF/PCC1: 0x42, APSF/PCC2: 0xa2, APSF/PCC3: 0x48
Payload Type: 0x03

OTN Transmitted Overhead Bytes:
APSF/PCC0: 0x00, APSF/PCC1: 0x00, APSF/PCC2: 0x00, APSF/PCC3: 0x00
Payload Type: 0x03

Filter statistics:
Input packet count 0
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: 00:00:5e:00:53:83, Hardware address: 00:00:5e:00:53:83
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
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
  Output bytes : 322891152287160
  Input packets: 0
  Output packets: 328809727380
IPv6 transit statistics:
  Input bytes : 0
  Output bytes : 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: 00:00:5e:00:53:83, Hardware address: 00:00:5e:00:53:83
  Last flapped : 2007-06-01 09:08:22 PDT (3d 02:31 ago)
  Statistics last cleared: Never
  Traffic statistics:
  Input bytes : 322857456303482
  Output bytes : 0

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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: 192.0.2/24, Local: 192.0.2.1, Broadcast: 192.0.2.255,
  Generation: 139
  Protocol multiservice, MTU: Unlimited, Generation: 146, Route table: 0
  Flags: None
  Policer: Input: __default_arp_policer__

Sample Output
Sample Output SRX Gigabit Ethernet

user@host> show interfaces ge-0/0/1
Physical interface: ge-0/0/1, Enabled, Physical link is Down
  Interface index: 135, SNMP ifIndex: 510
  Link-level type: Ethernet, MTU: 1514, Link-mode: Full-duplex, 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 Down
Interface flags: Hardware-Down SNMP-Traps Internal: 0x0
Link flags     : None
CoS queues     : 8 supported, 8 maximum usable queues
Current address: 00:00:5e:00:53:01, Hardware address: 00:00:5e:00:53:01
Last flapped   : 2015-05-12 08:36:59 UTC (1w1d 22:42 ago)
Input rate     : 0 bps (0 pps)
Output rate    : 0 bps (0 pps)
Active alarms  : LINK
Active defects  : LINK
Interface transmit statistics: Disabled

Logical interface ge-0/0/1.0 (Index 71) (SNMP ifIndex 514)
  Flags: Device-Down SNMP-Traps 0x0 Encapsulation: ENET2
  Input packets : 0
  Output packets: 0
  Security: Zone: public
  Protocol inet, MTU: 1500
  Flags: Sendbcast-pkt-to-re
  Addresses, Flags: Dest-route-down Is-Preferred Is-Primary
  Destination: 1.1.1/24, Local: 1.1.1.1, Broadcast: 1.1.1.255

Sample Output SRX Gigabit Ethernet

```
user@host> show interfaces ge-0/0/1

Physical interface: ge-0/0/1, Enabled, Physical link is Down
  Interface index: 135, SNMP ifIndex: 510
  Link-level type: Ethernet, MTU: 1514, Link-mode: Full-duplex, 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 Down
  Interface flags: Hardware-Down SNMP-Traps Internal: 0x0
  Link flags     : None
  CoS queues     : 8 supported, 8 maximum usable queues
  Current address: 00:00:5e:00:53:01, Hardware address: 00:00:5e:00:53:01
  Last flapped   : 2015-05-12 08:36:59 UTC (1w1d 22:42 ago)
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)
  Active alarms  : LINK
  Active defects  : LINK
  Interface transmit statistics: Disabled

Logical interface ge-0/0/1.0 (Index 71) (SNMP ifIndex 514)
  Flags: Device-Down SNMP-Traps 0x0 Encapsulation: ENET2
  Input packets : 0
  Output packets: 0
  Security: Zone: public
  Protocol inet, MTU: 1500
  Flags: Sendbcast-pkt-to-re
  Addresses, Flags: Dest-route-down Is-Preferred Is-Primary
  Destination: 1.1.1/24, Local: 1.1.1.1, Broadcast: 1.1.1.255
```

**show interfaces detail (Gigabit Ethernet)**

```
user@host> show interfaces ge-0/0/1 detail
```
Physical interface: ge-0/0/1, Enabled, Physical link is Down
Interface index: 135, SNMP ifIndex: 510, Generation: 138
Link-level type: Ethernet, MTU: 1514, Link-mode: Full-duplex, 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 Down
Interface flags: Hardware-Down SNMP-Traps Internal: 0x0
Link flags : None
CoS queues : 8 supported, 8 maximum usable queues
Hold-times : Up 0 ms, Down 0 ms
Current address: 00:00:5e:00:53:01, Hardware address: 00:00:5e:00:53:01
Last flapped : 2015-05-12 08:36:59 UTC (1w2d 00:00 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 |
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 : LINK
Active defects : LINK
Interface transmit statistics: Disabled
Logical interface ge-0/0/1.0 (Index 71) (SNMP ifIndex 514) (Generation 136)
Flags: Device-Down SNMP-Traps 0x0 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 |
Security: Zone: public
Flow Statistics:
Flow Input statistics :
<p>| Self packets | 0 |</p>
<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICMP packets</td>
<td>0</td>
</tr>
<tr>
<td>VPN packets</td>
<td>0</td>
</tr>
<tr>
<td>Multicast packets</td>
<td>0</td>
</tr>
<tr>
<td>Bytes permitted by policy</td>
<td>0</td>
</tr>
<tr>
<td>Connections established</td>
<td>0</td>
</tr>
<tr>
<td>Flow Output statistics:</td>
<td></td>
</tr>
<tr>
<td>Multicast packets</td>
<td>0</td>
</tr>
<tr>
<td>Bytes permitted by policy</td>
<td>0</td>
</tr>
<tr>
<td>Flow error statistics (Packets dropped due to):</td>
<td></td>
</tr>
<tr>
<td>Address spoofing</td>
<td>0</td>
</tr>
<tr>
<td>Authentication failed</td>
<td>0</td>
</tr>
<tr>
<td>Incoming NAT errors</td>
<td>0</td>
</tr>
<tr>
<td>Invalid zone received packet</td>
<td>0</td>
</tr>
<tr>
<td>Multiple user authentications</td>
<td>0</td>
</tr>
<tr>
<td>Multiple incoming NAT</td>
<td>0</td>
</tr>
<tr>
<td>No parent for a gate</td>
<td>0</td>
</tr>
<tr>
<td>No one interested in self packets</td>
<td>0</td>
</tr>
<tr>
<td>No minor session</td>
<td>0</td>
</tr>
<tr>
<td>No more sessions</td>
<td>0</td>
</tr>
<tr>
<td>No NAT gate</td>
<td>0</td>
</tr>
<tr>
<td>No route present</td>
<td>0</td>
</tr>
<tr>
<td>No SA for incoming SPI</td>
<td>0</td>
</tr>
<tr>
<td>No tunnel found</td>
<td>0</td>
</tr>
<tr>
<td>No session for a gate</td>
<td>0</td>
</tr>
<tr>
<td>No zone or NULL zone binding</td>
<td>0</td>
</tr>
<tr>
<td>Policy denied</td>
<td>0</td>
</tr>
<tr>
<td>Security association not active</td>
<td>0</td>
</tr>
<tr>
<td>TCP sequence number out of window</td>
<td>0</td>
</tr>
<tr>
<td>Syn-attack protection</td>
<td>0</td>
</tr>
<tr>
<td>User authentication errors</td>
<td>0</td>
</tr>
</tbody>
</table>

Protocol inet, MTU: 1500, Generation: 150, Route table: 0

Example:
```
show interfaces statistics st0.0 detail
```

Logical interface st0.0 (Index 71) (SNMP ifIndex 609) (Generation 136)
Flags: Up Point-To-Point SNMP-Traps Encapsulation: Secure-Tunnel
Traffic statistics:
- Input bytes: 528152756774
- Output bytes: 575950643520
- Input packets: 11481581669
- Output packets: 12520666095
Local statistics:
- Input bytes: 0
- Output bytes: 0
- Input packets: 0
- Output packets: 0
Transit statistics:
- Input bytes: 0 121859888 bps
- Output bytes: 0 128104112 bps
- Input packets: 0 331141 pps
- Output packets: 0 348108 pps
Security: Zone: untrust
Allowed host-inbound traffic: any-service bfd bgp dvmrp igmp ldp msdp nhrp ospf ospf3 pim rip ripng router-discovery rsvp
sap vrrp
Flow Statistics :
Flow Input statistics :
Self packets :                     0
ICMP packets :                     0
VPN packets :                      0
Multicast packets :                0
Bytes permitted by policy :        525984295844
Connections established :          7
Flow Output statistics:
Multicast packets :                0
Bytes permitted by policy :        576003290222
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:                  2000280
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: 9192
Max nh cache: 0, New hold nh limit: 0, Curr nh cnt: 0, Curr new hold cnt: 0, NH drop cnt: 0
Generation: 155, Route table: 0
Flags: Sendbcast-pkt-to-re

show interfaces extensive (Gigabit Ethernet)

user@host> show interfaces ge-0/0/1.0 extensive

Physical interface: ge-0/0/1, Enabled, Physical link is Down
  Interface index: 135, SNMP ifIndex: 510, Generation: 138
  Link-level type: Ethernet, MTU: 1514, Link-mode: Full-duplex, 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 Down
  Interface flags: Hardware-Down SNMP-Traps Internal: 0x0
  Link flags : None
  CoS queues : 8 supported, 8 maximum usable queues
  Hold-times : Up 0 ms, Down 0 ms
  Current address: 00:00:5e:00:53:01, Hardware address: 00:00:5e:00:53:01
  Last flapped : 2015-05-12 08:36:59 UTC (1w1d 22:57 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, 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 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 : LINK
Active defects : LINK
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 0
Jabber frames 0 0
Fragment frames 0 0
VLAN tagged frames 0 0
Code violations 0 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: 2, CAM source filters: 0
Autonegotiation information:
    Negotiation status: Incomplete
Packet Forwarding Engine configuration:
    Destination slot: 0
CoS information:
<table>
<thead>
<tr>
<th>Direction</th>
<th>Output CoS transmit queue</th>
<th>Bandwidth</th>
<th>Buffer Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit</td>
<td>%</td>
<td>bps</td>
<td>%</td>
</tr>
<tr>
<td>0 best-effort</td>
<td>95</td>
<td>950000000</td>
<td>95</td>
</tr>
<tr>
<td>none</td>
<td>3 network-control</td>
<td>5</td>
<td>50000000</td>
</tr>
</tbody>
</table>

Interface transmit statistics: Disabled

Logical interface ge-0/0/1.0 (Index 71) (SNMP ifIndex 514) (Generation 136)
Flags: Device-Down SNMP-Traps 0x0 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
Security: Zone: public
Flow Statistics:
Flow Input statistics:
- Self packets : 0
- ICMP packets : 0
- VPN packets : 0
- Multicast packets : 0
- Bytes permitted by policy : 0
- Connections established : 0
Flow Output statistics:
- Multicast packets : 0
- Bytes permitted by policy : 0
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: 0
- 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: 150, Route table: 0
Flags: Sendbcast-pkt-to-re
Addresses, Flags: Dest-route-down Is-Preferred Is-Primary
Destination: 1.1.1/24, Local: 1.1.1.1, Broadcast: 1.1.1.255,
Generation: 150

show interfaces terse

user@host> show interfaces terse

<table>
<thead>
<tr>
<th>Interface</th>
<th>Admin</th>
<th>Link</th>
<th>Proto</th>
<th>Local</th>
<th>Remote</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-0/0/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ge-0/0/0.0</td>
<td>up</td>
<td>up</td>
<td>inet</td>
<td>10.209.4.61/18</td>
<td></td>
</tr>
<tr>
<td>gr-0/0/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ip-0/0/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>st0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>st0.1</td>
<td>up</td>
<td>up</td>
<td>ready</td>
<td>inet</td>
<td></td>
</tr>
<tr>
<td>ls-0/0/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lt-0/0/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mt-0/0/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pd-0/0/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pe-0/0/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e3-1/0/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t3-2/0/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e1-3/0/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>se-4/0/0</td>
<td>up</td>
<td>down</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>tl-5/0/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>br-6/0/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dc-6/0/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dc-6/0/0.32767</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bc-6/0/0:1</td>
<td>down</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bc-6/0/0:1.0</td>
<td>up</td>
<td>down</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d10</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d10.0</td>
<td>up</td>
<td>up</td>
<td>inet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dsc</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>gre</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ipip</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lo0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lo0.16385</td>
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<td>up</td>
<td>inet</td>
<td>10.0.0.1</td>
<td>10.0.0.17</td>
</tr>
<tr>
<td>lsi</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mtun</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pimd</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pime</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pp0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

show interfaces controller (Channelized E1 IQ with Logical E1)

user@host> show interfaces controller cel-1/2/6

<table>
<thead>
<tr>
<th>Controller</th>
<th>Admin</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>cel-1/2/6</td>
<td>up</td>
<td>up</td>
</tr>
<tr>
<td>el-1/2/6</td>
<td>up</td>
<td>up</td>
</tr>
</tbody>
</table>
show interfaces controller (Channelized E1 IQ with Logical DS0)

user@host> show interfaces controller ce1-1/2/3

<table>
<thead>
<tr>
<th>Controller</th>
<th>Admin Link</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ce1-1/2/3</td>
<td>up</td>
<td>up</td>
</tr>
<tr>
<td>ds-1/2/3:1</td>
<td>up</td>
<td>up</td>
</tr>
<tr>
<td>ds-1/2/3:2</td>
<td>up</td>
<td>up</td>
</tr>
</tbody>
</table>

show interfaces descriptions

user@host> show interfaces descriptions

<table>
<thead>
<tr>
<th>Interface</th>
<th>Admin Link</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>so-1/0/0</td>
<td>up</td>
<td>up M20-3#1</td>
</tr>
<tr>
<td>so-2/0/0</td>
<td>up</td>
<td>up GSR-12#1</td>
</tr>
<tr>
<td>ge-3/0/0</td>
<td>up</td>
<td>up SMB-OSPF_Area300</td>
</tr>
<tr>
<td>so-3/3/0</td>
<td>up</td>
<td>up GSR-13#1</td>
</tr>
<tr>
<td>so-3/3/1</td>
<td>up</td>
<td>up GSR-13#2</td>
</tr>
<tr>
<td>ge-4/0/0</td>
<td>up</td>
<td>up T320-7#1</td>
</tr>
<tr>
<td>ge-5/0/0</td>
<td>up</td>
<td>up T320-7#2</td>
</tr>
<tr>
<td>so-7/1/0</td>
<td>up</td>
<td>up M160-6#1</td>
</tr>
<tr>
<td>ge-8/0/0</td>
<td>up</td>
<td>up T320-7#3</td>
</tr>
<tr>
<td>ge-9/0/0</td>
<td>up</td>
<td>up T320-7#4</td>
</tr>
<tr>
<td>so-10/0/0</td>
<td>up</td>
<td>up M160-6#2</td>
</tr>
<tr>
<td>so-13/0/0</td>
<td>up</td>
<td>up M20-3#2</td>
</tr>
<tr>
<td>so-14/0/0</td>
<td>up</td>
<td>up GSR-12#2</td>
</tr>
<tr>
<td>ge-15/0/0</td>
<td>up</td>
<td>up SMB-OSPF_Area100</td>
</tr>
<tr>
<td>ge-15/0/1</td>
<td>up</td>
<td>up GSR-13#3</td>
</tr>
</tbody>
</table>

show interfaces destination-class all

user@host> show interfaces destination-class all

<table>
<thead>
<tr>
<th>Logical interface</th>
<th>Packets (packet-per-second)</th>
<th>Bytes (bits-per-second)</th>
</tr>
</thead>
<tbody>
<tr>
<td>so-4/0/0.0</td>
<td>gold 0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0)</td>
</tr>
<tr>
<td></td>
<td>silver 0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0)</td>
</tr>
<tr>
<td>so-0/1/3.0</td>
<td>gold 0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0)</td>
</tr>
<tr>
<td></td>
<td>silver 0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0)</td>
</tr>
</tbody>
</table>

show interfaces diagnostics optics

user@host> show interfaces diagnostics optics ge-2/0/0

<table>
<thead>
<tr>
<th>Physical interface: ge-2/0/0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser bias current</td>
</tr>
<tr>
<td>Laser output power</td>
</tr>
<tr>
<td>Module temperature</td>
</tr>
<tr>
<td>Parameter</td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
</tr>
<tr>
<td>Module voltage</td>
</tr>
<tr>
<td>Receiver signal average optical power</td>
</tr>
<tr>
<td>Laser bias current high alarm</td>
</tr>
<tr>
<td>Laser bias current low alarm</td>
</tr>
<tr>
<td>Laser bias current high warning</td>
</tr>
<tr>
<td>Laser bias current low warning</td>
</tr>
<tr>
<td>Laser output power high alarm</td>
</tr>
<tr>
<td>Laser output power low alarm</td>
</tr>
<tr>
<td>Laser output power high warning</td>
</tr>
<tr>
<td>Laser output power low warning</td>
</tr>
<tr>
<td>Module temperature high alarm</td>
</tr>
<tr>
<td>Module temperature low alarm</td>
</tr>
<tr>
<td>Module temperature high warning</td>
</tr>
<tr>
<td>Module temperature low warning</td>
</tr>
<tr>
<td>Module voltage high alarm</td>
</tr>
<tr>
<td>Module voltage low alarm</td>
</tr>
<tr>
<td>Module voltage high warning</td>
</tr>
<tr>
<td>Module voltage low warning</td>
</tr>
<tr>
<td>Laser rx power high alarm</td>
</tr>
<tr>
<td>Laser rx power low alarm</td>
</tr>
<tr>
<td>Laser rx power high warning</td>
</tr>
<tr>
<td>Laser rx power low warning</td>
</tr>
<tr>
<td>Laser bias current high alarm threshold</td>
</tr>
<tr>
<td>Laser bias current low alarm threshold</td>
</tr>
<tr>
<td>Laser bias current high warning threshold</td>
</tr>
<tr>
<td>Laser bias current low warning threshold</td>
</tr>
<tr>
<td>Laser output power high alarm threshold</td>
</tr>
<tr>
<td>Laser output power low alarm threshold</td>
</tr>
<tr>
<td>Laser output power high warning threshold</td>
</tr>
<tr>
<td>Laser output power low warning threshold</td>
</tr>
<tr>
<td>Module temperature high alarm threshold</td>
</tr>
<tr>
<td>Module temperature low alarm threshold</td>
</tr>
<tr>
<td>Module temperature high warning threshold</td>
</tr>
<tr>
<td>Module temperature low warning threshold</td>
</tr>
<tr>
<td>Module voltage high alarm</td>
</tr>
<tr>
<td>Module voltage low alarm</td>
</tr>
<tr>
<td>Module voltage high warning</td>
</tr>
<tr>
<td>Module voltage low warning</td>
</tr>
<tr>
<td>Laser rx power high alarm threshold</td>
</tr>
<tr>
<td>Laser rx power low alarm threshold</td>
</tr>
<tr>
<td>Laser rx power high warning threshold</td>
</tr>
<tr>
<td>Laser rx power low warning threshold</td>
</tr>
<tr>
<td>Laser rx power high warning threshold</td>
</tr>
</tbody>
</table>

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:
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 filters

user@host> show interfaces filters

<table>
<thead>
<tr>
<th>Interface</th>
<th>Admin</th>
<th>Link</th>
<th>Proto</th>
<th>Input Filter</th>
<th>Output Filter</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-0/0/0</td>
<td>up</td>
<td>up</td>
<td>up</td>
<td>inet</td>
<td></td>
</tr>
<tr>
<td>ge-0/0/0.0</td>
<td>up</td>
<td>up</td>
<td></td>
<td>iso</td>
<td></td>
</tr>
<tr>
<td>ge-5/0/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td>any</td>
<td>f-any</td>
</tr>
<tr>
<td>ge-5/0/0.0</td>
<td>up</td>
<td>up</td>
<td>inet</td>
<td>multiservice</td>
<td>f-inet</td>
</tr>
<tr>
<td>gr-0/3/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ip-0/3/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mt-0/3/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pd-0/3/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pe-0/3/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>vt-0/3/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>at-1/0/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>at-1/0/0.0</td>
<td>up</td>
<td>up</td>
<td>inet</td>
<td>iso</td>
<td></td>
</tr>
<tr>
<td>at-1/1/0</td>
<td>up</td>
<td>down</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>at-1/1/0.0</td>
<td>up</td>
<td>down</td>
<td>inet</td>
<td>iso</td>
<td></td>
</tr>
</tbody>
</table>

show interfaces flow-statistics (Gigabit Ethernet)

user@host> show interfaces flow-statistics ge-0/0/1.0

Logical interface ge-0/0/1.0 (Index 70) (SNMP ifIndex 49)
Flags: SNMP-Traps Encapsulation: ENET2
Input packets: 5161
Output packets: 83
Security: Zone: zone2
Allowed host-inbound traffic: bootp bfd bgp dns dvmrp ldp msdp nhrp ospf
Flow Statistics:
Flow Input statistics:
  Self packets:                     0
  ICMP packets:                     0
  VPN packets:                      2564
  Bytes permitted by policy:        3478
  Connections established:          1
Flow Output statistics:
  Multicast packets:                0
  Bytes permitted by policy:        16994
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:                  0
  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
Flags: None
Addresses, Flags: Is-Preferred Is-Primary
  Destination: 203.0.113.1/24, Local: 203.0.113.2, Broadcast: 2.2.2.255
show interfaces interval (E3)

```
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,
  SEFS: 0, UAS: 0

Interval Total:
  LCV: 230, PCV: 1145859, CCV: 455470, LES: 0, PES: 230, PSES: 230,
```

show interfaces interval (SONET/SDH) (SRX devices)

```
show interfaces interval so-0/1/0

Physical interface: so-0/1/0, SNMP ifIndex: 19
20:02-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
19:47-20:02:
  ES-S: 267, SES-S: 267, SEFS-S: 267, ES-L: 267, SES-L: 267, UAS-L: 267,
  ES-P: 267, SES-P: 267, UAS-P: 267
19:32-19:47:
  ES-S: 56, SES-S: 56, SEFS-S: 56, ES-L: 56, SES-L: 56, UAS-L: 56, ES-P: 56,
  SES-P: 56, UAS-P: 56
19:17-19:32:
  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
19:02-19:17:
...
```

show interfaces load-balancing (SRX devices)

```
show interfaces load-balancing

<table>
<thead>
<tr>
<th>Interface</th>
<th>State</th>
<th>Last change</th>
<th>Member count</th>
</tr>
</thead>
<tbody>
<tr>
<td>ams0</td>
<td>Up</td>
<td>1d 00:50</td>
<td>2</td>
</tr>
<tr>
<td>ams1</td>
<td>Up</td>
<td>00:00:59</td>
<td>2</td>
</tr>
</tbody>
</table>
```
show interfaces load-balancing detail (SRX devices)

```
user@host> show interfaces load-balancing detail
Load-balancing interfaces detail
Interface        : ams0
State          : Up
Last change    : 1d 00:51
Member count   : 2
Members        :
   Interface    Weight   State
   mams-2/0/0    10        Active
   mams-2/1/0    10        Active
```

show interfaces mac-database (All MAC Addresses on a Port SRX devices)

```
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:a0       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      30424783     1399540018       37448597     1722635462
   00:00:c8:01:01:07      30424783     1399540018       37448597     1722635462
   00:00:c8:01:01:08      30424712     1399536752       37448521     1722631966
   00:00:c8:01:01:09      30424715     1399536890       37448523     1722632058
   Number of MAC addresses : 21
```
Logical interface xe-0/3/3.0 (Index 364) (SNMP ifIndex 829)

Flags: SNMP-Traps 0x4004000 Encapsulation: ENET2

<table>
<thead>
<tr>
<th>MAC address</th>
<th>Input frames</th>
<th>Input bytes</th>
<th>Output frames</th>
<th>Output bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:00:00:00:00:00</td>
<td>1</td>
<td>56</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>00:00:00:01:01:02</td>
<td>7023810</td>
<td>323095260</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>00:00:00:01:01:03</td>
<td>7023810</td>
<td>323095260</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>00:00:00:01:01:04</td>
<td>7023810</td>
<td>323095260</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>00:00:00:01:01:05</td>
<td>7023810</td>
<td>323095260</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>00:00:00:01:01:06</td>
<td>7023810</td>
<td>323095260</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>00:00:00:01:01:07</td>
<td>7023810</td>
<td>323095260</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>00:00:00:01:01:08</td>
<td>7023809</td>
<td>323095214</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>00:00:00:01:01:09</td>
<td>7023809</td>
<td>323095214</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>00:00:00:01:01:0a</td>
<td>7023809</td>
<td>323095214</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>00:00:00:01:01:0b</td>
<td>7023809</td>
<td>323095214</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>00:00:00:01:01:02</td>
<td>31016568</td>
<td>1426762128</td>
<td>38040381</td>
<td>1749857526</td>
</tr>
<tr>
<td>00:00:00:01:01:03</td>
<td>31016568</td>
<td>1426762128</td>
<td>38040382</td>
<td>1749857572</td>
</tr>
<tr>
<td>00:00:00:01:01:04</td>
<td>31016499</td>
<td>1426758954</td>
<td>38040306</td>
<td>1749854076</td>
</tr>
<tr>
<td>00:00:00:01:01:05</td>
<td>31016573</td>
<td>1426762358</td>
<td>38040381</td>
<td>1749857526</td>
</tr>
<tr>
<td>00:00:00:01:01:06</td>
<td>31016573</td>
<td>1426762358</td>
<td>38040381</td>
<td>1749857526</td>
</tr>
<tr>
<td>00:00:00:01:01:07</td>
<td>31016567</td>
<td>1426762082</td>
<td>38040380</td>
<td>1749857480</td>
</tr>
<tr>
<td>00:00:00:01:01:08</td>
<td>31016567</td>
<td>1426762082</td>
<td>38040379</td>
<td>1749857434</td>
</tr>
<tr>
<td>00:00:00:01:01:09</td>
<td>9428580</td>
<td>433714680</td>
<td>9428580</td>
<td>433714680</td>
</tr>
<tr>
<td>00:00:00:01:01:0a</td>
<td>9428580</td>
<td>433714680</td>
<td>9428580</td>
<td>433714680</td>
</tr>
<tr>
<td>00:00:00:01:01:0b</td>
<td>31016498</td>
<td>1426758816</td>
<td>38040304</td>
<td>1749853984</td>
</tr>
</tbody>
</table>

show interfaces mac-database mac-address

user@host> show interfaces mac-database xe-0/3/3 mac-address (SRX devices)

00:00:01:01:09

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 (SRX devices)

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 media (SONET/SDH)

The following example displays the output fields unique to the `show interfaces media` command for a SONET interface (with no level of output specified):

```
user@host> show interfaces media so-4/1/2
Physical interface: so-4/1/2, Enabled, Physical link is Up
Interface index: 168, SNMP ifIndex: 495
Link-level type: PPP, MTU: 4474, Clocking: Internal, SONET mode, Speed: OC48,
Loopback: None, FCS: 16, Payload scrambler: Enabled
Device flags : Present Running
Interface flags: Point-To-Point SNMP-Traps 16384
Link flags : Keepalives
Keepalive settings: Interval 10 seconds, Up-count 1, Down-count 3
Keepalive: Input: 1783 (00:00:00 ago), Output: 1786 (00:00:08 ago)
LCP state: Opened
NCP state: inet: Not-configured, inet6: Not-configured, iso: Not-configured,
mpls: Not-configured
CHAP state: Not-configured
CoS queues : 8 supported
Input rate : 0 bps (0 pps)
Output rate : 0 bps (0 pps)
SONET alarms : None
SONET defects : None
SONET errors:
Received path trace: routerb so-1/1/2
Transmitted path trace: routera so-4/1/2
```

show interfaces policers (SRX devices)

```
user@host> show interfaces policers
Interface       Admin Link Proto Input Policer         Output Policer
ge-0/0/0        up    up
ge-0/0/0.0      up    up   inet
iso
gr-0/3/0        up    up
ip-0/3/0        up    up
mt-0/3/0        up    up
pd-0/3/0        up    up
pe-0/3/0        up    up
...
so-2/0/0        up    up
so-2/0/0.0      up    up   inet so-2/0/0.0-in-policer so-2/0/0.0-out-policer
iso
so-2/1/0        up    down
...
```

show interfaces policers interface-name (SRX devices)

```
user@host> show interfaces policers so-2/1/0
```
show interfaces queue (SRX devices)

The following truncated example shows the CoS queue sizes for queues 0, 1, and 3. Queue 1 has a queue buffer size (guaranteed allocated memory) of 9192 bytes.

user@host> show interfaces queue

Physical interface: ge-0/0/0, Enabled, Physical link is Up
  Interface index: 134, SNMP ifIndex: 509
  Forwarding classes: 8 supported, 8 in use
  Egress queues: 8 supported, 8 in use
  Queue: 0, Forwarding classes: class0
    Queued:
      Packets : 0 0 pps
      Bytes : 0 0 bps
    Transmitted:
      Packets : 0 0 pps
      Bytes : 0 0 bps
      Tail-dropped packets : 0 0 pps
      RL-dropped packets : 0 0 pps
      RL-dropped bytes : 0 0 bps
      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 Buffer Usage:
  Reserved buffer : 118750000 bytes
  Queue-depth bytes :
    Current : 0

Queue: 1, Forwarding classes: class1

Queue Buffer Usage:
  Reserved buffer : 9192 bytes
  Queue-depth bytes :
    Current : 0

Queue: 3, Forwarding classes: class3
  Queued:
    Queue Buffer Usage:
      Reserved buffer : 6250000 bytes
Queue-depth bytes  
Current              :                     0
..  
..  

show interfaces redundancy (SRX devices)

```
user@host> show interfaces redundancy

Interface  State         Last change  Primary    Secondary  Current status
rsp0       Not present                sp-1/0/0   sp-0/2/0    both down
rsp1       On secondary  1d 23:56     sp-1/2/0   sp-0/3/0    primary down
rsp2       On primary    10:10:27     sp-1/3/0   sp-0/2/0    secondary down
rlsq0      On primary    00:06:24     lsq-0/3/0  lsq-1/0/0  both up
```

show interfaces redundancy (Aggregated Ethernet SRX devices)

```
user@host> show interfaces redundancy

Interface  State            Last change  Primary      Secondary    Current status
rlsq0      On secondary     00:56:12     lsq-4/0/0    lsq-3/0/0    both up
```

show interfaces redundancy detail (SRX devices)

```
user@host> show interfaces redundancy detail

Interface        : rlsq0
State          : On primary
Last change    : 00:45:47
Primary        : lsq-0/2/0
Secondary      : lsq-1/2/0
Current status : both up
Mode           : hot-standby

Interface        : rlsq0:0
State          : On primary
Last change    : 00:45:46
Primary        : lsq-0/2/0:0
Secondary      : lsq-1/2/0:0
Current status : both up
Mode           : warm-standby
```

show interfaces routing brief (SRX devices)

```
user@host> show interfaces routing brief

Interface        State Abbreviated Addresses
so-5/0/3.0       Down ISO  enabled
so-5/0/2.0       Up   MPLS enabled
                  ISO  enabled
                  INET 192.168.2.120
                  INET  enabled
so-5/0/1.0       Up   MPLS enabled
```
show interfaces routing detail (SRX devices)

user@host> show interfaces routing detail

so-5/0/3.0
  Index: 15, Refcount: 2, State: Up <Broadcast PointToPoint Multicast> Change:<>
  Metric: 0, Up/down transitions: 0, Full-duplex
  Link layer: HDLC serial line Encapsulation: PPP Bandwidth: 155Mbps
  ISO address (null)
  State: <Broadcast PointToPoint Multicast> Change: <>
  Preference: 0 (120 down), Metric: 0, MTU: 4470 bytes

so-5/0/2.0
  Index: 14, Refcount: 7, State: <Up Broadcast PointToPoint Multicast> Change:<>
  Metric: 0, Up/down transitions: 0, Full-duplex
  Link layer: HDLC serial line Encapsulation: PPP Bandwidth: 155Mbps
  MPLS address (null)
  State: <Up Broadcast PointToPoint Multicast> Change: <>
  Preference: 0 (120 down), Metric: 0, MTU: 4470 bytes
  ISO address (null)
  State: <Up Broadcast PointToPoint Multicast> Change: <>
  Preference: 0 (120 down), Metric: 0, MTU: 4470 bytes
  INET address 192.168.2.120
  State: <Up Broadcast PointToPoint Multicast Localup> Change: <>
  Preference: 0 (120 down), Metric: 0, MTU: 4470 bytes
  Local address: 192.168.2.120
  Destination: 192.168.2.110/32
  INET address (null)
  State: <Up Broadcast PointToPoint Multicast> Change: <>
  Preference: 0 (120 down), Metric: 0, MTU: 4470 bytes
...

show interfaces routing-instance all (SRX devices)

user@host> show interfaces terse routing-instance all

<table>
<thead>
<tr>
<th>Interface</th>
<th>Admin</th>
<th>Link</th>
<th>Proto</th>
<th>Local</th>
<th>Remote Instance</th>
</tr>
</thead>
<tbody>
<tr>
<td>at-0/0/1</td>
<td>up</td>
<td>up</td>
<td>inet</td>
<td>10.0.0.1/24</td>
<td></td>
</tr>
<tr>
<td>ge-0/0/0.0</td>
<td>up</td>
<td>up</td>
<td>inet</td>
<td>192.168.4.28/24</td>
<td>sample-a</td>
</tr>
<tr>
<td>at-0/1/0.0</td>
<td>up</td>
<td>up</td>
<td>inet6</td>
<td>fe80::a:0:0:4/64</td>
<td>sample-b</td>
</tr>
<tr>
<td>so-0/0/0.0</td>
<td>up</td>
<td>up</td>
<td>inet</td>
<td>10.0.0.1/32</td>
<td></td>
</tr>
</tbody>
</table>
show interfaces snmp-index (SRX devices)

user@host> show interfaces snmp-index 33

Physical interface: so-2/1/1, Enabled, Physical link is Down
Interface index: 149, SNMP ifIndex: 33
Link-level type: PPP, MTU: 4474, Clocking: Internal, SONET mode, Speed: OC48,
Loopback: None, FCS: 16, Payload scrambler: Enabled
Device flags : Present Running Down
Interface flags: Hardware-Down Point-To-Point SNMP-Traps 16384
Link flags : Keepalives
CoS queues : 8 supported
Input rate : 0 bps (0 pps)
Output rate : 0 bps (0 pps)
SONET alarms : LOL, PLL, LOS
SONET defects : LOL, PLL, LOF, LOS, SEF, AIS-L, AIS-P

show interfaces source-class all (SRX devices)

user@host> show interfaces source-class all

Logical interface so-0/1/0.0

Packets (packet-per-second) (bits-per-second)
Source class

<table>
<thead>
<tr>
<th>Source class</th>
<th>Packets</th>
<th>Bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>gold</td>
<td>1928095</td>
<td>161959980</td>
</tr>
<tr>
<td>bronze</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>silver</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Logical interface so-0/1/3.0

Packets (packet-per-second) (bits-per-second)
Source class

<table>
<thead>
<tr>
<th>Source class</th>
<th>Packets</th>
<th>Bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>gold</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>bronze</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>silver</td>
<td>116113</td>
<td>9753492</td>
</tr>
</tbody>
</table>

show interfaces statistics (Fast Ethernet SRX devices)

user@host> show interfaces fe-1/3/1 statistics

Physical interface: fe-1/3/1, Enabled, Physical link is Up
Interface index: 144, SNMP ifIndex: 1042
Description: ford fe-1/3/1
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: 00:90:69:93:04:dc, Hardware address: 00:90:69:93:04:dc
Last flapped : 2006-04-18 03:08:59 PDT (00:01:24 ago)
Statistics last cleared: Never
Input rate : 0 bps (0 pps)
Output rate : 0 bps (0 pps)
Input errors: 0, Output errors: 0
Active alarms : None
Active defects: None
Logical interface fe-1/3/1.0 (Index 69) (SNMP ifIndex 50)
Flags: SNMP-Traps Encapsulation: ENET2
Protocol inet, MTU: 1500
Flags: Is-Primary, DCU, SCU-in

<table>
<thead>
<tr>
<th>Destination class</th>
<th>Packets (packet-per-second)</th>
<th>Bytes (bits-per-second)</th>
</tr>
</thead>
<tbody>
<tr>
<td>silver1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0)</td>
</tr>
<tr>
<td>silver2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0)</td>
</tr>
<tr>
<td>silver3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0)</td>
</tr>
</tbody>
</table>

Addresses, Flags: Is-Default Is-Preferred Is-Primary
Destination: 10.27.245/24, Local: 10.27.245.2,
Broadcast: 10.27.245.255
Protocol iso, MTU: 1497
Flags: Is-Primary

show interfaces switch-port (SRX devices)

user@host# show interfaces ge-slot/0/0 switch-port port-number

Port 0, Physical link is Up
Speed: 100mbps, Auto-negotiation: Enabled

<table>
<thead>
<tr>
<th>Statistics:</th>
<th>Receive</th>
<th>Transmit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total bytes</td>
<td>28437086</td>
<td>21792250</td>
</tr>
<tr>
<td>Total packets</td>
<td>409145</td>
<td>88008</td>
</tr>
<tr>
<td>Unicast packets</td>
<td>9987</td>
<td>83817</td>
</tr>
<tr>
<td>Multicast packets</td>
<td>145002</td>
<td>0</td>
</tr>
<tr>
<td>Broadcast packets</td>
<td>254156</td>
<td>4191</td>
</tr>
<tr>
<td>Multiple collisions</td>
<td>23</td>
<td>10</td>
</tr>
<tr>
<td>FIFO/CRC/Align errors</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MAC pause frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Oversized frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Runt frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Jabber frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fragment frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Discarded frames</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Autonegotiation information:
Negotiation status: Complete
Link partner:
Link mode: Full-duplex, Flow control: None, Remote fault: OK, Link partner Speed: 100 Mbps
Local resolution:
Flow control: None, Remote fault: Link OK

show interfaces transport pm (SRX devices)

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 PM Suspect Flag: False COUNT THRESHOLD TCA-ENABLED TCA-RAISED

<table>
<thead>
<tr>
<th>PM</th>
<th>COUNT</th>
<th>THRESHOLD</th>
<th>Enabled</th>
<th>Raised</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTU-BBE</td>
<td>0</td>
<td>800</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>OTU-ES</td>
<td>0</td>
<td>135</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>OTU-SES</td>
<td>0</td>
<td>90</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>COUNT</td>
<td>THRESHOLD</td>
<td>TCA-ENABLED</td>
<td>TCA-RAISED</td>
</tr>
<tr>
<td>-------------</td>
<td>-------</td>
<td>-----------</td>
<td>-------------</td>
<td>------------</td>
</tr>
<tr>
<td>OTU-UAS</td>
<td>427</td>
<td>90</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Far End PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OTU-BBE</td>
<td>0</td>
<td>800</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>OTU-ES</td>
<td>0</td>
<td>135</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>OTU-SES</td>
<td>0</td>
<td>90</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>OTU-UAS</td>
<td>0</td>
<td>90</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Near End PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ODU-BBE</td>
<td>0</td>
<td>800</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>ODU-ES</td>
<td>0</td>
<td>135</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>ODU-SES</td>
<td>0</td>
<td>90</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>ODU-UAS</td>
<td>0</td>
<td>90</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>FEC PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FEC-CorrectedErr</td>
<td>2008544300</td>
<td>0</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>FEC-UncorrectedWords</td>
<td>0</td>
<td>0</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>BER PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BER</td>
<td>3.6e-5</td>
<td>5.8e-5</td>
<td>3.6e-5</td>
<td>10.0e-3</td>
</tr>
<tr>
<td>Physical interface: et-0/1/0, SNMP ifIndex 515</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:45-current</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspect Flag: True</td>
<td>Reason: Object Disabled</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lane chromatic dispersion</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lane differential group delay</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>q Value</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>SNR</td>
<td>28</td>
<td>28</td>
<td>29</td>
<td>28</td>
</tr>
<tr>
<td>Tx output power(0.01dBm)</td>
<td>-5000</td>
<td>-5000</td>
<td>-5000</td>
<td>-5000</td>
</tr>
<tr>
<td>Rx input power(0.01dBm)</td>
<td>-3642</td>
<td>-3665</td>
<td>-3626</td>
<td>-3637</td>
</tr>
<tr>
<td>Module temperature(Celsius)</td>
<td>46</td>
<td>46</td>
<td>46</td>
<td>46</td>
</tr>
<tr>
<td>Tx laser bias current(0.1mA)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rx laser bias current(0.1mA)</td>
<td>1270</td>
<td>1270</td>
<td>1270</td>
<td>1270</td>
</tr>
<tr>
<td>Carrier frequency offset(MHz)</td>
<td>-186</td>
<td>-186</td>
<td>-186</td>
<td>-186</td>
</tr>
</tbody>
</table>
### show security zones (SRX devices)

```
user@host> show security zones

Functional zone: management
  Description: This is the management zone.
  Policy configurable: No
  Interfaces bound: 1
  Interfaces:
    ge-0/0/0.0

Security zone: Host
  Description: This is the host zone.
  Send reset for non-SYN session TCP packets: Off
  Policy configurable: Yes
  Interfaces bound: 1
  Interfaces:
    fxp0.0

Security zone: abc
  Description: This is the abc zone.
  Send reset for non-SYN session TCP packets: Off
  Policy configurable: Yes
  Interfaces bound: 1
  Interfaces:
    ge-0/0/1.0

Security zone: def
  Description: This is the def zone.
  Send reset for non-SYN session TCP packets: Off
  Policy configurable: Yes
  Interfaces bound: 1
  Interfaces:
    ge-0/0/2.0
```
show interfaces (M Series, MX Series, T Series Routers, and PTX Series Management and Internal Ethernet)

**List of Syntax**

Syntax (M Series, MX Series, T Series, and PTX Series Routers Management Ethernet Interface) on page 2140
Syntax (M Series, MX Series, T Series, and PTX Series Routers Internal Ethernet Interface) on page 2140

**Syntax (M Series, MX Series, T Series, and PTX Series Routers Management Ethernet Interface)**

show interfaces em0 | fxp0 | mgmtre0
<brief | detail | extensive | terse>
<descriptions>
<media>
<snmp-index snmp-index>
<statistics>

**Syntax (M Series, MX Series, T Series, and PTX Series Routers Internal Ethernet Interface)**

show interfaces bcm0 | em0 | em1 | fxp1 | fxp2 | ixgbe0 | ixgbe1
<brief | detail | extensive | terse>
<descriptions>
<media>
<snmp-index snmp-index>
<statistics>

**Release Information**

Command introduced before Junos OS Release 7.4.

**Description**

(M Series, T Series, TX Matrix Plus, and PTX Series devices only) Display status information about the management Ethernet and internal Ethernet interfaces.

**Options**

em0 | fxp0 | mgmtre0—(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 Supported Routing Engines by Router.

bcm0 | em0 | em1 | fxp1 | fxp2 | ixgbe0 | ixgbe1—(M Series, MX Series, T Series, and PTX Series) Display standard information about the internal Ethernet interfaces. See Supported Routing Engines by Router for the internal Ethernet interface names for each Routing Engine by hardware platform.

**NOTE:** On Junos OS Evolved, the ixgbe0 and ixgbe1 internal interfaces are deprecated.

**brief | detail | extensive | terse**—(Optional) Display the specified level of output.

**descriptions**—(Optional) Display interface description strings.
media—(Optional) Display media-specific information.

snmp-index snmp-index—(Optional) Display information for the specified SNMP index of the interface.

statistics—(Optional) Display static interface statistics.

Required Privilege
Level view

List of Sample Output
show interfaces brief (Management Ethernet) on page 2144
show interfaces (Management Ethernet) on page 2144
show interfaces (Management Ethernet [TX Matrix Plus Router]) on page 2145
show interfaces (Management Ethernet [PTX Series Packet Transport Routers]) on page 2145
show interfaces detail (Management Ethernet) on page 2146
show interfaces detail (Management Ethernet [TX Matrix Plus Router]) on page 2146
show interfaces detail (Management Ethernet [PTX Packet Transport Routers]) on page 2147
show interfaces extensive (Management Ethernet) on page 2148
show interfaces extensive (Management Ethernet [TX Matrix Plus Router]) on page 2148
show interfaces extensive (Management Ethernet [PTX Series Packet Transport Routers]) on page 2149
show interfaces mgmtre0 (Management Ethernet [PTX5000 Router]) on page 2150
show interfaces brief (Management Ethernet) on page 2151
show interfaces brief (Management Ethernet [TX Matrix Plus Router]) on page 2151
show interfaces brief (Management Ethernet [PTX Series Packet Transport Routers]) on page 2151
show interfaces (Internal Ethernet) on page 2151
show interfaces (Internal Ethernet [TX Matrix Plus Router]) on page 2152
show interfaces detail (Internal Ethernet) on page 2153
show interfaces detail (Internal Ethernet [TX Matrix Plus Router]) on page 2153
show interfaces extensive (Internal Ethernet) on page 2154
show interfaces extensive (internal Ethernet [TX Matrix Plus Router]) on page 2155

Output Fields
Table 164 on page 2141 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 164: show interfaces Output Fields for M Series, MX Series, T Series, and PTX Series Routers Management Ethernet Interface

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Interface</td>
<td>Name of the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Physical interface</td>
<td>Name of the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Enabled</td>
<td>State of the interface. Possible values are described in the &quot;Enabled Field&quot; section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
</tbody>
</table>
**Table 164: show interfaces Output Fields for M Series, MX Series, T Series, and PTX Series Routers Management**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface index</td>
<td>Physical interface index number, which reflects its initialization sequence.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>SNMP ifIndex</td>
<td>SNMP index number for the physical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Type</td>
<td>Type of interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Link-level type</td>
<td>Encapsulation type used on the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>MTU</td>
<td>Maximum transmission unit (MTU)—Size of the largest packet to be transmitted.</td>
<td>All levels</td>
</tr>
<tr>
<td>Clocking</td>
<td>Reference clock source of the interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Speed</td>
<td>Network speed on the interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Device flags</td>
<td>Information about the physical device. Possible values are described in the “Device Flags” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td>Interface flags</td>
<td>Information about the interface. Possible values are described in the “Interface Flags” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td>Link type</td>
<td>Data transmission type.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Link flags</td>
<td>Information about the link. Possible values are described in the “Link Flags” section under Common Output Fields Description.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Physical info</td>
<td>Information about the physical interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Hold-times</td>
<td>Current interface hold-time up and hold-time down. Value is in milliseconds.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Current address</td>
<td>Configured MAC address.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Hardware address</td>
<td>Media access control (MAC) address of the interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Alternate link address</td>
<td>Backup link address.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Last flapped</td>
<td>Date, time, and how long ago the interface went from down to up. The format is Last flapped: year-month-day hour:minute:second timezone (hour:minute:second ago). For example, Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago).</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Input packets</td>
<td>Number of packets received on the physical interface.</td>
<td>None specified</td>
</tr>
<tr>
<td>Output packets</td>
<td>Number of packets transmitted on the physical interface.</td>
<td>None specified</td>
</tr>
</tbody>
</table>
Table 164: show interfaces Output Fields for M Series, MX Series, T Series, and PTX Series Routers Management Ethernet Interface (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistics last cleared</td>
<td>Time when the statistics for the interface were last set to zero.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Traffic statistics</td>
<td>Number and rate of bytes and packets received and transmitted on the logical and physical interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>• Input bytes, Output bytes—Number of bytes received and transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Input packets, Output packets—Number of packets received and transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td>Input errors</td>
<td>• Errors—Input errors on the interface.</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>• Drops—Number of packets dropped by the output queue of the I/O Manager ASIC.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Framing errors—Number of packets received with an invalid frame checksum (FCS).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Runts—Frames received smaller than the runt threshold.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Giants—Frames received larger than the giant threshold.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Policed Discards—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Resource errors—Sum of transmit drops.</td>
<td></td>
</tr>
<tr>
<td>Output errors</td>
<td>• Carrier transitions—Number of times the interface has gone from down to up. 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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Errors—Sum of outgoing frame aborts and FCS errors.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Drops—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Resource errors—Sum of transmit drops.</td>
<td></td>
</tr>
</tbody>
</table>

Logical Interface

<table>
<thead>
<tr>
<th>Logical interface</th>
<th>Name of the logical interface</th>
<th>All levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index</td>
<td>Logical interface index number, which reflects its initialization sequence.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>SNMP ifIndex</td>
<td>Logical interface SNMP interface index number.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Flags</td>
<td>Information about the logical interface; values are described in the “Device Flags” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td>Encapsulation</td>
<td>Encapsulation on the logical interface.</td>
<td>detail extensive none</td>
</tr>
</tbody>
</table>
Table 164: show interfaces Output Fields for M Series, MX Series, T Series, and PTX Series Routers Management Ethernet Interface (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>inet</td>
<td>IP address of the logical interface.</td>
<td>brief</td>
</tr>
<tr>
<td>Protocol</td>
<td>Protocol family configured on the logical interface (such as iso or inet6).</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>MTU</td>
<td>MTU size on the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Route table</td>
<td>Route table in which this address exists. For example, Route table:0 refers to inet.0.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Flags</td>
<td>Information about the protocol family flags. Possible values are described in the “Family Flags” section under Common Output Fields Description.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Addresses, Flags</td>
<td>Information about address flags. Possible values are described in the “Addresses Flags” section under Common Output Fields Description.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Destination</td>
<td>IP address of the remote side of the connection.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Local</td>
<td>IP address of the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Broadcast</td>
<td>Broadcast address.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
</tbody>
</table>

Sample Output

show interfaces brief (Management Ethernet)

```
user@host> show interfaces ffx0 brief

  Physical interface: ffx0, 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 ffx0.0 
    Flags: SNMP-Traps Encapsulation: ENET2 
    inet  192.168.70.143/21
```

show interfaces (Management Ethernet)

```
user@host> show interfaces ffx0

  Physical interface: ffx0, 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 
```
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: 00:00:5E:00:53:c0, Hardware address: 00:00:5E:00:53: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

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: 00:00:5E:00:53:1b, Hardware address: 00:00:5E:00:53:1b
  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
show interfaces detail (Management Ethernet)

show interfaces detail (Management Ethernet [TX Matrix Plus Router])

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: 00:00:5E:00:53:c0, Hardware address: 00:00:5E:00:53: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: 00:00:5E:00:53:1b, Hardware address: 00:00:5E:00:53:1b
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)

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: 00:00:5E:00:53:89, Hardware address: 00:00:5E:00:53:89
   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: 192.168.3.255, Generation: 1

show interfaces extensive (Management Ethernet [TX Matrix Plus Router])

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
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: 00:00:5E:00:53:1b, Hardware address: 00:00:5E:00:53:1b
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 mgmtre0 (Management Ethernet [PTX5000 Router])

user@host> show interfaces mgmtre0 extensive

Physical interface: mgmtre0, Enabled, Physical link is Up
- Interface index: 1001, SNMP ifIndex: 501
- Link-level type: Ethernet, MTU: 1500
- Device flags: Present
- Interface flags: None
- Link flags: None
- Current address: ec:9e:cd:06:30:da, Hardware address: ec:9e:cd:06:30:da
- Last flapped: Never

Logical interface mgmtre0.0 (Index 1001) (SNMP ifIndex 503)
- Flags: Encapsulation: ENET2
- Protocol inet, MTU: 1486
- Flags: None
- Addresses, Flags: Is-Preferred Is-Primary
  - Destination: 10.92.248/23, Local: 10.92.248.22
  - Broadcast: 10.92.249.255
- Protocol multiservice, MTU: Unlimited
- Flags: None
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
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: 00:00:5E:00:53:04, Hardware address: 00:00:5E:00:53:04
Last flapped   : Never
Input packets : 2301738
Output packets: 3951155

Logical interface ixgbe0.0 (Index 4) (SNMP ifIndex 117)
Flags: SNMP-Traps Encapsulation: ENET2
Protocol inet, MTU: 1500
Flags: Is-Primary
Addresses, Flags: Is-Preferred Is-Primary
   Destination: 10.34.0.4, Local: 192.168.0.4, Broadcast: 192.168.0.4
Protocol inet6, MTU: 1500
Flags: Is-Primary
Addresses, Flags: Is-Preferred
   Destination: fe80::/64, Local: fec0::a22:0:4
Protocol tnp, MTU: 1500
Flags: Primary, Is-Primary
Addresses
   Local: 0x22000004

Link type : Full-Duplex
Current address: 00:00:5E:00:53:04, Hardware address: 00:00:5E:00:53:04
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::a22:0:4
Protocol tnp, MTU: 1500
Flags: Primary, Is-Primary
Addresses
   Local: 4
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: 00:00:5E:00:53:04, Hardware address: 00:00:5E:00:53:04
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: 00:00:5E:00:53:04, Hardware address: 00:00:5E:00:53:04
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
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: 00:00:5E:00:53:04, Hardware address: 00:00:5E:00:53:04
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: 00:00:5E:00:53:04, Hardware address: 00:00:5E:00:53:04
  Alternate link address: Unspecified
  Last flapped: Never
  Statistics last cleared: Never
  Traffic statistics:
    Input bytes: 242730780

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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
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)**

**Syntax**

```
show interfaces pp0.logical
<brief | detail | extensive | terse>
<descriptions>
<media>
<snmp-index snmp-index>
<statistics>
```

**Release Information**
Command introduced before Junos OS Release 7.4.

**Description**
(M120 routers, M320 routers, and MX Series routers only). Display status information about the PPPoE interface.

**Options**
- `pp0.logical`—Display standard status information about the PPPoE interface.
- `brief | detail | extensive | terse`—(Optional) Display the specified level of output.
- `descriptions`—(Optional) Display interface description strings.
- `media`—(Optional) Display media-specific information about PPPoE interfaces.
- `snmp-index snmp-index`—(Optional) Display information for the specified SNMP index of the interface.
- `statistics`—(Optional) Display PPPoE interface statistics.

**Required Privilege Level**
view

**List of Sample Output**
- `show interfaces (PPPoE) on page 2163`
- `show interfaces (PPPoE over Aggregated Ethernet) on page 2163`
- `show interfaces brief (PPPoE) on page 2164`
- `show interfaces detail (PPPoE) on page 2164`
- `show interfaces extensive (PPPoE on M120 and M320 Routers) on page 2165`

**Output Fields**
Table 165 on page 2157 lists the output fields for the `show interfaces (PPPoE)` command. Output fields are listed in the approximate order in which they appear.

**Table 165: show interfaces (PPPoE) Output Fields**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Interface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical interface</td>
<td>Name of the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Enabled</td>
<td>State of the interface. Possible values are described in the &quot;Enabled Field&quot; section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
</tbody>
</table>
### Table 165: show interfaces (PPPoE) Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface index</td>
<td>Physical interface index number, which reflects its initialization sequence.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>SNMP ifIndex</td>
<td>SNMP index number for the physical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Type</td>
<td>Physical interface type (PPPoE).</td>
<td>All levels</td>
</tr>
<tr>
<td>Link-level type</td>
<td>Encapsulation on the physical interface (PPPoE).</td>
<td>All levels</td>
</tr>
<tr>
<td>MTU</td>
<td>MTU size on the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Clocking</td>
<td>Reference clock source. It can be Internal or External.</td>
<td>All levels</td>
</tr>
<tr>
<td>Speed</td>
<td>Speed at which the interface is running.</td>
<td>All levels</td>
</tr>
<tr>
<td>Device flags</td>
<td>Information about the physical device. Possible values are described in the “Device Flags” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td>Interface flags</td>
<td>Information about the interface. Possible values are described in the “Interface Flags” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td>Link type</td>
<td>Physical interface link type: full duplex or half duplex.</td>
<td>All levels</td>
</tr>
<tr>
<td>Link flags</td>
<td>Information about the interface. Possible values are described in the “Link Flags” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td>Input rate</td>
<td>Input rate in bits per second (bps) and packets per second (pps).</td>
<td>None specified</td>
</tr>
<tr>
<td>Output rate</td>
<td>Output rate in bps and pps.</td>
<td>None specified</td>
</tr>
<tr>
<td>Physical Info</td>
<td>Physical interface information.</td>
<td>All levels</td>
</tr>
<tr>
<td>Hold-times</td>
<td>Current interface hold-time up and hold-time down, in milliseconds.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Current address</td>
<td>Configured MAC address.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Hardware address</td>
<td>MAC address of the hardware.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Alternate link address</td>
<td>Backup address of the link.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Statistics last cleared</td>
<td>Time when the statistics for the interface were last set to zero.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Field Name</td>
<td>Field Description</td>
<td>Level of Output</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Traffic statistics</td>
<td>Number and rate of bytes and packets received and transmitted on the physical interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>• Input bytes—Number of bytes received on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Output bytes—Number of bytes transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Input packets—Number of packets received on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Output packets—Number of packets transmitted on the interface.</td>
<td></td>
</tr>
</tbody>
</table>

| Traffic statistics | Number of IPv6 transit bytes and packets received and transmitted on the physical interface if IPv6 statistics tracking is enabled. | detail extensive |
| NOTE: | These fields include dropped traffic and exception traffic, as those fields are not separately defined. | |
|            | • Input bytes—Number of bytes received on the interface. | |
|            | • Output bytes—Number of bytes transmitted on the interface. | |
|            | • Input packets—Number of packets received on the interface. | |
|            | • Output packets—Number of packets transmitted on the interface. | |

| IPv6 transit statistics | Input errors on the interface: | extensive |
|                        | • Errors—Sum of incoming frame aborts and FCS errors. | |
|                        | • Drops—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. | |
|                        | • Framing errors—Number of packets received with an invalid frame checksum (FCS). | |
|                        | • Runts—Number of frames received that are smaller than the runt threshold. | |
|                        | • Giants—Number of frames received that are larger than the giant threshold. | |
|                        | • Policed discards—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. | |
|                        | • Resource errors—Sum of B chip Tx drops and IXP Tx net transmit drops. | |

| Output errors | Output errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious: | extensive |
|              | • Carrier transitions —Number of times the interface has gone from down to up. 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. | |
|              | • Errors—Sum of the outgoing frame aborts and FCS errors. | |
|              | • Drops—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. | |
|              | • MTUErrors—Number of packets whose size exceeded the MTU of the interface. | |
|              | • Resource errors—Sum of B chip Tx drops and IXP Tx net transmit drops. | |
### Table 165: show interfaces (PPPoE) Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logical interface</td>
<td>Name of the logical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Index</td>
<td>Logical interface index number (which reflects its initialization sequence).</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>SNMP ifIndex</td>
<td>Logical interface SNMP interface index number.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Flags</td>
<td>Information about the logical interface. Possible values are described in the “Logical Interface Flags” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td>Encapsulation</td>
<td>Type of encapsulation configured on the logical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>PPP parameters</td>
<td>PPP status:</td>
<td>detail</td>
</tr>
<tr>
<td></td>
<td>• LCP restart timer—Length of time (in milliseconds) between successive Link Control Protocol (LCP) configuration requests.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• NCP restart timer—Length of time (in milliseconds) between successive Network Control Protocol (NCP) configuration requests.</td>
<td></td>
</tr>
<tr>
<td>PPPoE</td>
<td>PPPoE status:</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>• State—State of the logical interface (up or down).</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>• Session ID—PPPoE session ID.</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>• Service name—Type of service required. Can be used to indicate an Internet service provider (ISP) name or a class or quality of service.</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>• Configured AC name—Configured access concentrator name.</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>• Auto-reconnect timeout—Time after which to try to reconnect after a PPPoE session is terminated, in seconds.</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>• Idle Timeout—Length of time (in seconds) that a connection can be idle before disconnecting.</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>• Underlying interface—Interface on which PPPoE is running.</td>
<td>All levels</td>
</tr>
<tr>
<td>Link</td>
<td>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.</td>
<td>All levels</td>
</tr>
<tr>
<td>Traffic statistics</td>
<td>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.</td>
<td>detail extensive</td>
</tr>
</tbody>
</table>
Table 165: `show interfaces (PPPoE)` Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPv6 transit</td>
<td>Number of IPv6 transit bytes and packets received and transmitted on the logical interface if IPv6 statistics tracking is enabled.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>statistics</td>
<td><em>NOTE:</em> The packet and byte counts in these fields include traffic that is dropped and does not leave the router.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Input bytes</strong>—Number of bytes received on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Output bytes</strong>—Number of bytes transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Input packets</strong>—Number of packets received on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Output packets</strong>—Number of packets transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td>Local statistics</td>
<td>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.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Transit statistics</td>
<td>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.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td><em>NOTE:</em> The packet and byte counts in these fields include traffic that is dropped and does not leave the router.</td>
<td></td>
</tr>
<tr>
<td>Keepalive settings</td>
<td>(PPP and HDLC) Configured settings for keepalives.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>• <strong>interval</strong> <em>(seconds)</em>—The time in seconds between successive keepalive requests. The range is 10 seconds through 32,767 seconds, with a default of 10 seconds.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>down-count</strong> <em>(number)</em>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>up-count</strong> <em>(number)</em>—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.</td>
<td></td>
</tr>
<tr>
<td>Keepalive statistics</td>
<td>(PPP and HDLC) Information about keepalive packets.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>• <strong>Input</strong>—Number of keepalive packets received by PPP.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <em>(last seen 00:00:00 ago)</em>—Time the last keepalive packet was received, in the format <code>hh:mm:ss</code>.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Output</strong>—Number of keepalive packets sent by PPP and how long ago the last keepalive packets were sent and received.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <em>(last seen 00:00:00 ago)</em>—Time the last keepalive packet was sent, in the format <code>hh:mm:ss</code>.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(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.</td>
<td></td>
</tr>
<tr>
<td>Input packets</td>
<td>Number of packets received on the logical interface.</td>
<td>None specified</td>
</tr>
<tr>
<td>Output packets</td>
<td>Number of packets transmitted on the logical interface.</td>
<td>None specified</td>
</tr>
<tr>
<td>Field Name</td>
<td>Description</td>
<td>Level of Output</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>LCP state</td>
<td>(PPP) Link Control Protocol state.</td>
<td>none detail extensive</td>
</tr>
<tr>
<td></td>
<td>• <strong>Conf-ack-received</strong>—Acknowledgement was received.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Conf-ack-sent</strong>—Acknowledgement was sent.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Conf-req-sent</strong>—Request was sent.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Down</strong>—LCP negotiation is incomplete (not yet completed or has failed).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Not-configured</strong>—LCP is not configured on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Opened</strong>—LCP negotiation is successful.</td>
<td></td>
</tr>
<tr>
<td>NCP state</td>
<td>(PPP) Network Control Protocol state.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td></td>
<td>• <strong>Conf-ack-received</strong>—Acknowledgement was received.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Conf-ack-sent</strong>—Acknowledgement was sent.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Conf-req-sent</strong>—Request was sent.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Down</strong>—NCP negotiation is incomplete (not yet completed or has failed).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Not-configured</strong>—NCP is not configured on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Opened</strong>—NCP negotiation is successful.</td>
<td></td>
</tr>
<tr>
<td>CHAP state</td>
<td>(PPP) Displays the state of the Challenge Handshake Authentication Protocol (CHAP) during its transaction.</td>
<td>none detail extensive</td>
</tr>
<tr>
<td></td>
<td>• <strong>Chap-Chal-received</strong>—Challenge was received but response not yet sent.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Chap-Chal-sent</strong>—Challenge was sent.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Chap-Resp-received</strong>—Response was received for the challenge sent, but CHAP has not yet moved into the Success state. (Most likely with RADIUS authentication.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Chap-Resp-sent</strong>—Response was sent for the challenge received.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Closed</strong>—CHAP authentication is incomplete.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Failure</strong>—CHAP authentication failed.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Not-configured</strong>—CHAP is not configured on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Success</strong>—CHAP authentication was successful.</td>
<td></td>
</tr>
<tr>
<td>Protocol</td>
<td>Protocol family configured on the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>protocol-family</td>
<td>Protocol family configured on the logical interface. If the protocol is <strong>inet</strong>, the IP address of the interface is also displayed.</td>
<td>brief</td>
</tr>
<tr>
<td>MTU</td>
<td>MTU size on the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Route table</td>
<td>Routing table in which the logical interface address is located. For example, <strong>0</strong> refers to the routing table inet.0.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Flags</td>
<td>Information about the protocol family flags. Possible values are described in the “Family Flags” section under <strong>Common Output Fields Description</strong>.</td>
<td>detail extensive none</td>
</tr>
</tbody>
</table>
Table 165: show interfaces (PPPoE) Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addresses, Flags</td>
<td>Information about the addresses configured for the protocol family. Possible values are described in the “Addresses Flags” section under Common Output Fields Description.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Destination</td>
<td>IP address of the remote side of the connection.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Local</td>
<td>IP address of the logical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Broadcast</td>
<td>Broadcast address.</td>
<td>detail extensive none</td>
</tr>
</tbody>
</table>

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: 00:00:5e:00:53:01,
    Underlying interface: demux0.100 (Index 88)
  Link:
```

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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,
```
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 0pps
  Output packets: 1473 0pps
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: 00:00:5e:00:53:12,
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
CHAP state: Closed
PAP state: Closed
  Protocol inet, MTU: 1492, Generation: 171, Route table: 0
  Flags: None
  Addresses, Flags: Is-Preferred Is-Primary
    Destination: 203.0.113.2, Local: 203.0.113.1, Broadcast: Unspecified,
    Generation: 206
show interfaces interface-set (Ethernet Interface Set)

Syntax

```
show interfaces interface-set interface-set-name
  <detail | terse>
```

Release Information

Command introduced in Junos OS Release 8.5.

Description

Display information about the specified gigabit or 10-Gigabit Ethernet interface set.

You can also use the `show interfaces interface-set` command to display information about agent circuit identifier (ACI) interface sets.

Options

- `interface-set interface-set-name`—Display information about the specified Gigabit Ethernet, 10-Gigabit Ethernet, ACI, or ALI interface set.
- `detail | terse`—(Optional) Display the specified level of output.

Required Privilege

View

Related Documentation

- Verifying and Managing Agent Circuit Identifier-Based Dynamic VLAN Configuration
- Verifying and Managing Configurations for Dynamic VLANs Based on Access-Line Identifiers

List of Sample Output

- show interfaces interface-set terse on page 2169
- show interfaces interface-set detail on page 2169
- show interfaces interface-set (ACI Interface Set based on ACI) on page 2169
- show interfaces interface-set (ACI Interface Set based on ACI Trusted Option) on page 2170
- show interfaces interface-set (ACI Interface Set based on ARI Trusted Option) on page 2170
- show interfaces interface-set (ACI Interface Set based on Accept-No-IDs Trusted Option when both ACI and ARI are received) on page 2170
- show interfaces interface-set (ACI Interface Set based on Accept-No-IDs Trusted Option when neither ACI nor ARI is received) on page 2170
- show interfaces interface-set (L2BSA and PPPoE Subscribers) on page 2171

Output Fields

Table 166 on page 2167 describes the information for the `show interfaces interface-set` command. Output fields are listed in the approximate order in which they appear.

**Table 166: Ethernet show interfaces interface-set Output Fields**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Interface</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 166: Ethernet show interfaces interface-set Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interface set</strong></td>
<td>Name of the interface set or sets.</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>For ACI interface sets, the set name is prefixed with <code>aci-</code>.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>For ALI interface sets, the set name is prefixed with the trusted option that the interface set is based on:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+ aci— The ACI is configured as the trusted option.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+ ari— The ARI is configured as the trusted option.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+ aci+ari— Both ACI and ARI are configured as the trusted option.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+ noids— Neither the ACI nor the ARI is configured as the trusted option and neither ACI nor ARI is received.</td>
<td></td>
</tr>
<tr>
<td><strong>Interface set index</strong></td>
<td>Index number of the interface set.</td>
<td>detail none</td>
</tr>
<tr>
<td><strong>ACI VLAN</strong></td>
<td>For ACI interface sets, the string received in DHCP or PPPoE control packets that uniquely identifies the subscriber's access node and the DSL line on the access node. Only the Agent Circuit ID can be used to create the interface set.</td>
<td>detail none</td>
</tr>
<tr>
<td></td>
<td><strong>NOTE:</strong> The ACI VLAN field is replaced with the Line Identity field when an ALI interface set is configured with the line-identity autoconfiguration stanza.</td>
<td></td>
</tr>
<tr>
<td><strong>Line Identity</strong></td>
<td>For ALI interface sets, the trusted option received in DHCP or PPPoE control packets that uniquely identifies the subscriber's access node and the DSL line on the access node. The trusted option can be either or both of the following:</td>
<td>detail none</td>
</tr>
<tr>
<td></td>
<td>+ Agent Circuit ID—The ACI value</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+ Agent Remote ID—The ARI value.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>NOTE:</strong> When only accept-no-ids is configured as the trusted option, this field is not displayed.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>NOTE:</strong> The Line Identity field is replaced with the ACI VLAN field when an ACI interface set is configured with the agent-circuit-id autoconfiguration stanza.</td>
<td></td>
</tr>
<tr>
<td><strong>PPPoE</strong></td>
<td>Dynamic PPPoE subscriber interface that the router creates using the ACI or ALI interface set.</td>
<td>detail none</td>
</tr>
<tr>
<td><strong>Max Sessions</strong></td>
<td>For dynamic PPPoE subscriber interfaces, maximum number of PPPoE logical interfaces that can be activated on the underlying interface.</td>
<td>detail none</td>
</tr>
<tr>
<td><strong>Max Sessions VSA Ignore</strong></td>
<td>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 max-sessions statement: Off (default) or On.</td>
<td>detail none</td>
</tr>
</tbody>
</table>
### Table 166: Ethernet show interfaces interface-set Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Traffic statistics</strong></td>
<td>Number and rate of bytes and packets received and transmitted on the specified interface set.</td>
<td>detail</td>
</tr>
<tr>
<td></td>
<td>• Input bytes, Output bytes—Number of bytes and number of bytes per second received and transmitted on the interface set.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Input packets, Output packets—Number of packets and number of packets per second received and transmitted on the interface set.</td>
<td></td>
</tr>
<tr>
<td><strong>Egress queues supported</strong></td>
<td>Total number of egress queues supported on the specified interface set.</td>
<td>detail</td>
</tr>
<tr>
<td><strong>Egress queues in use</strong></td>
<td>Total number of egress queues used on the specified interface set.</td>
<td>detail</td>
</tr>
<tr>
<td><strong>Queue counters</strong></td>
<td>Queued packets, Transmitted packets, and Dropped packets statistics for the four forwarding classes.</td>
<td>detail</td>
</tr>
<tr>
<td><strong>Members</strong></td>
<td>List of all interface sets or, for ACI interface sets, list of all subscriber interfaces belonging to the specified ACI interface set.</td>
<td>detail none</td>
</tr>
</tbody>
</table>

### 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 211091327 11044380 199995746
    1 0 0 0
    2 0 0 0
    3 0 0 0
Members:
    xe-11/3/0.0
```

**show interfaces interface-set (ACI Interface Set based on ACI)**

```
user@host> show interfaces interface-set
```
show interfaces interface-set (ACI Interface Set based on ACI Trusted Option)

user@host> show interfaces interface-set

Interface set: aci-1001-demux0.3221225472
Interface set index: 2
Interface set snmp index: 67108866
Line Identity:
  Agent Circuit ID: circuit0
PPPoE:
  Max Sessions: 32000, Max Sessions VSA Ignore: Off
Members:
demux0.3221225472

show interfaces interface-set (ACI Interface Set based on ARI Trusted Option)

user@host> show interfaces interface-set

Interface set: ari-1002-demux0.3221225472
Interface set index: 2
Interface set snmp index: 67108866
Line Identity:
  Agent Remote ID: remote20
PPPoE:
  Max Sessions: 32000, Max Sessions VSA Ignore: Off
Members:
demux0.3221225472

show interfaces interface-set (ACI Interface Set based on ARI Trusted Option when both ACI and ARI are received)

user@host> show interfaces interface-set

Interface set: ari-1002-demux0.3221225472
Interface set index: 2
Interface set snmp index: 67108866
Line Identity:
  Agent Remote ID: remote20
PPPoE:
  Max Sessions: 32000, Max Sessions VSA Ignore: Off
Members:
demux0.3221225472

show interfaces interface-set (ACI Interface Set based on Accept-No-IDs Trusted Option when neither ACI nor ARI is received)

user@host> show interfaces interface-set

show interfaces interface-set (L2BSA and PPPoE Subscribers)

user@host> show interfaces interface-set

Interface set: ge-1/0/4
  Interface set index: 6
  Members:
    ge-1/0/4.1073741908
    pp0.1073741907
show interfaces interface-set queue

Syntax

```
show interfaces interface-set queue interface-set-name
<aggregate | remaining-traffic>
<forwarding-class class-name>
```

Release Information

Command introduced in Junos OS Release 8.5.

Description

Display information about the gigabit or 10-Gigabit Ethernet interface set queue. Supported in MX Series routers with enhanced queuing DPCs.

Options

- **interface-set-name**—(Optional) Display information about the specified gigabit or 10-Gigabit Ethernet interface set. Wildcard values can be used in the interface set name.
- **aggregate**—(Optional) Display the aggregated queuing statistics of all member logical interfaces for interface sets that have traffic-control profiles configured.
- **both-ingress-egress**—(Optional) On Gigabit Ethernet Intelligent Queuing 2 (IQ2) PICs, display both ingress and egress queue statistics.
- **egress**—(Optional) Display egress queue statistics.
- **forwarding-class class-name**—(Optional) Display queuing statistics for the specified forwarding class.
- **ingress**—(Optional) On Gigabit Ethernet IQ2 PICs, display ingress queue statistics.
- **remaining-traffic**—(Optional) Display the queuing statistics of all member logical interfaces for interface sets that do not have traffic-control profiles configured.

Required Privilege

```
view
```

List of Sample Output

- show interfaces interface-set queue (Gigabit Ethernet) on page 2173
- show interfaces interface-set queue both-ingress-egress (Enhanced DPC) on page 2174
- show interfaces interface-set queue egress (Enhanced DPC) on page 2176
- show interfaces interface-set queue forwarding-class (Gigabit Ethernet) on page 2177
- show interfaces interface-set queue (Enhanced DPC) on page 2178
- show interfaces interface-set queue remaining-traffic (Gigabit Ethernet) on page 2179

Output Fields

Table 167 on page 2172 describes the information for the `show interfaces interface-set queue` command.

**Table 167: Ethernet show interfaces interface-set queue Output Fields**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Interface</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Table 167: Ethernet show interfaces interface-set queue Output Fields (continued)**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface set</td>
<td>Name of the interface set.</td>
<td>All levels</td>
</tr>
<tr>
<td>Interface set index</td>
<td>Index number of the interface set.</td>
<td>All levels</td>
</tr>
<tr>
<td>Forwarding classes supported</td>
<td>Total number of forwarding classes supported on the specified interface set.</td>
<td>All levels</td>
</tr>
<tr>
<td>Forwarding classes in use</td>
<td>Total number of forwarding classes used on the specified interface set.</td>
<td>All levels</td>
</tr>
<tr>
<td>Egress queues supported</td>
<td>Total number of egress queues supported on the specified interface set.</td>
<td>All levels</td>
</tr>
<tr>
<td>Egress queues in use</td>
<td>Total number of egress queues used on the specified interface set.</td>
<td>All levels</td>
</tr>
<tr>
<td>Ingress queues supported</td>
<td>Total number of ingress queues supported on the specified interface set.</td>
<td>All levels</td>
</tr>
<tr>
<td>Ingress queues in use</td>
<td>Total number of ingress queues used on the specified interface set.</td>
<td>All levels</td>
</tr>
<tr>
<td>Queue</td>
<td>Egress or ingress queue number for the statistics being displayed.</td>
<td>All levels</td>
</tr>
<tr>
<td>Forwarding classes</td>
<td>Forwarding class name for the statistics being displayed.</td>
<td>All levels</td>
</tr>
<tr>
<td>Queued</td>
<td>Packet and Byte statistics for the specified queue.</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td><em>Packets</em>—Number of packets queued and input rate in packets per second.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Bytes</em>—Number of bytes queued and input rate in bytes per second.</td>
<td></td>
</tr>
<tr>
<td>Transmitted</td>
<td>Packet and Byte statistics for the specified forwarding class.</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td><em>Packets</em>—Number of packets transmitted and transmit rate in packets per second.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Bytes</em>—Number of bytes transmitted and transmit rate in bytes per second.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Tail-dropped packets</em>—Number of packets tail dropped.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>RED-dropped packets</em>—Number of RED-dropped packets for the low, medium-low, medium-high, and high loss priorities.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>RED-dropped bytes</em>—Number of RED-dropped bytes for the low, medium-low, medium-high, and high loss priorities.</td>
<td></td>
</tr>
</tbody>
</table>

**Sample Output**

show interfaces interface-set queue (Gigabit Ethernet)

```
user@host> show interfaces interface-set queue ge-2/2/0-0
```
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: 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:
  Packets : 522021472 473602 pps
  Bytes : 9748446282 198451512 bps

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 : 1004231352 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
<table>
<thead>
<tr>
<th>Bytes</th>
<th>Transmitted:</th>
<th>Queue: 3, Forwarding classes: network-control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitted:</td>
<td></td>
<td>Queued:</td>
</tr>
<tr>
<td>Packets</td>
<td>Packets: 5791772</td>
<td>Packets: 0</td>
</tr>
<tr>
<td>Bytes</td>
<td>Bytes: 312755688</td>
<td>Bytes: 0</td>
</tr>
<tr>
<td>Tail-dropped packets</td>
<td>0</td>
<td>Tail-dropped packets: 0</td>
</tr>
<tr>
<td>RED-dropped packets</td>
<td>516227139</td>
<td>RED-dropped packets: 0</td>
</tr>
<tr>
<td>RED-dropped bytes</td>
<td>27876265560</td>
<td>RED-dropped bytes: 0</td>
</tr>
<tr>
<td>Queue: 3</td>
<td></td>
<td>Forwarding classes: network-control</td>
</tr>
<tr>
<td>Queued:</td>
<td></td>
<td>Queued:</td>
</tr>
<tr>
<td>Packets</td>
<td>Packets: 0</td>
<td>Packets: 0</td>
</tr>
<tr>
<td>Bytes</td>
<td>Bytes: 0</td>
<td>Bytes: 0</td>
</tr>
<tr>
<td>Tail-dropped packets</td>
<td>0</td>
<td>Tail-dropped packets: 0</td>
</tr>
<tr>
<td>RED-dropped packets</td>
<td>0</td>
<td>RED-dropped packets: 0</td>
</tr>
<tr>
<td>RED-dropped bytes</td>
<td>0</td>
<td>RED-dropped bytes: 0</td>
</tr>
<tr>
<td>Queue: 3</td>
<td></td>
<td>Forwarding classes: network-control</td>
</tr>
<tr>
<td>Queued:</td>
<td></td>
<td>Queued:</td>
</tr>
<tr>
<td>Packets</td>
<td>Packets: 5417304</td>
<td>Packets: 0</td>
</tr>
<tr>
<td>Bytes</td>
<td>Bytes: 368429508</td>
<td>Bytes: 0</td>
</tr>
<tr>
<td>Tail-dropped packets</td>
<td>0</td>
<td>Tail-dropped packets: 0</td>
</tr>
<tr>
<td>RED-dropped packets</td>
<td>402189</td>
<td>RED-dropped packets: 0</td>
</tr>
<tr>
<td>RED-dropped bytes</td>
<td>27348852</td>
<td>RED-dropped bytes: 0</td>
</tr>
<tr>
<td>Queue: 3</td>
<td></td>
<td>Forwarding classes: best-effort</td>
</tr>
<tr>
<td>Queued:</td>
<td></td>
<td>Queued:</td>
</tr>
<tr>
<td>Packets</td>
<td>Packets: 5014996</td>
<td>Packets: 0</td>
</tr>
<tr>
<td>Bytes</td>
<td>Bytes: 341019728</td>
<td>Bytes: 0</td>
</tr>
<tr>
<td>Tail-dropped packets</td>
<td>0</td>
<td>Tail-dropped packets: 0</td>
</tr>
<tr>
<td>RED-dropped packets</td>
<td>402189</td>
<td>RED-dropped packets: 0</td>
</tr>
<tr>
<td>RED-dropped bytes</td>
<td>27348852</td>
<td>RED-dropped bytes: 0</td>
</tr>
<tr>
<td>Queue: 3</td>
<td></td>
<td>Forwarding classes: best-effort</td>
</tr>
<tr>
<td>Queued:</td>
<td></td>
<td>Queued:</td>
</tr>
<tr>
<td>Packets</td>
<td>Packets: 0</td>
<td>Packets: 0</td>
</tr>
<tr>
<td>Bytes</td>
<td>Bytes: 0</td>
<td>Bytes: 0</td>
</tr>
<tr>
<td>Tail-dropped packets</td>
<td>0</td>
<td>Tail-dropped packets: 0</td>
</tr>
<tr>
<td>RED-dropped packets</td>
<td>0</td>
<td>RED-dropped packets: 0</td>
</tr>
<tr>
<td>RED-dropped bytes</td>
<td>0</td>
<td>RED-dropped bytes: 0</td>
</tr>
<tr>
<td>Queue: 1</td>
<td></td>
<td>Queue: 1, Forwarding classes: expedited-forwarding</td>
</tr>
<tr>
<td>Queued:</td>
<td></td>
<td>Queued:</td>
</tr>
<tr>
<td>Packets</td>
<td>Packets: 0</td>
<td>Packets: 0</td>
</tr>
<tr>
<td>Bytes</td>
<td>Bytes: 0</td>
<td>Bytes: 0</td>
</tr>
<tr>
<td>Tail-dropped packets</td>
<td>0</td>
<td>Tail-dropped packets: 0</td>
</tr>
<tr>
<td>RED-dropped packets</td>
<td>0</td>
<td>RED-dropped packets: 0</td>
</tr>
<tr>
<td>RED-dropped bytes</td>
<td>0</td>
<td>RED-dropped bytes: 0</td>
</tr>
<tr>
<td>Queue: 1</td>
<td></td>
<td>Queue: 1, Forwarding classes: expedited-forwarding</td>
</tr>
<tr>
<td>Queued:</td>
<td></td>
<td>Queued:</td>
</tr>
<tr>
<td>Packets</td>
<td>Packets: 5770534</td>
<td>Packets: 0</td>
</tr>
<tr>
<td>Bytes</td>
<td>Bytes: 396943252</td>
<td>Bytes: 0</td>
</tr>
<tr>
<td>Tail-dropped packets</td>
<td>0</td>
<td>Tail-dropped packets: 0</td>
</tr>
<tr>
<td>RED-dropped packets</td>
<td>0</td>
<td>RED-dropped packets: 0</td>
</tr>
<tr>
<td>RED-dropped bytes</td>
<td>0</td>
<td>RED-dropped bytes: 0</td>
</tr>
<tr>
<td>Queue: 2</td>
<td></td>
<td>Queue: 2, Forwarding classes: assured-forwarding</td>
</tr>
<tr>
<td>Queued:</td>
<td></td>
<td>Queued:</td>
</tr>
<tr>
<td>Packets</td>
<td>Packets: 0</td>
<td>Packets: 0</td>
</tr>
<tr>
<td>Bytes</td>
<td>Bytes: 0</td>
<td>Bytes: 0</td>
</tr>
</tbody>
</table>
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:
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**

<table>
<thead>
<tr>
<th>Queued:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Packets</td>
<td>101857694</td>
<td>1420083 pps</td>
</tr>
<tr>
<td>Bytes</td>
<td>6927234456</td>
<td>772532320 bps</td>
</tr>
</tbody>
</table>

**Transmitted:**

<table>
<thead>
<tr>
<th>Packets</th>
<th>3984693</th>
<th>55500 pps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bytes</td>
<td>270959592</td>
<td>30192512 bps</td>
</tr>
<tr>
<td>Tail-dropped packets</td>
<td>0</td>
<td>0 pps</td>
</tr>
<tr>
<td>RED-dropped packets</td>
<td>97870952</td>
<td>1364583 pps</td>
</tr>
<tr>
<td>Low</td>
<td>97870952</td>
<td>1364583 pps</td>
</tr>
<tr>
<td>Medium-low</td>
<td>0</td>
<td>0 pps</td>
</tr>
<tr>
<td>Medium-high</td>
<td>0</td>
<td>0 pps</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0 pps</td>
</tr>
<tr>
<td>RED-dropped bytes</td>
<td>6655225776</td>
<td>742339808 bps</td>
</tr>
<tr>
<td>Low</td>
<td>6655225776</td>
<td>742339808 bps</td>
</tr>
<tr>
<td>Medium-low</td>
<td>0</td>
<td>0 bps</td>
</tr>
<tr>
<td>Medium-high</td>
<td>0</td>
<td>0 bps</td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>0 bps</td>
</tr>
</tbody>
</table>

### show interfaces interface-set queue (Enhanced DPC)

```
user@host> show interfaces interface-set queue ge-2/0-0 ingress
```

**Interface set: foo**

<table>
<thead>
<tr>
<th>Interface set index: 3</th>
<th>Forwarding classes: 16 supported, 4 in use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ingress queues: 4 supported, 4 in use</td>
<td></td>
</tr>
</tbody>
</table>

**Queue: 0, Forwarding classes: best-effort**

<table>
<thead>
<tr>
<th>Queued:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Packets</td>
<td>149036817</td>
<td>473711 pps</td>
</tr>
<tr>
<td>Bytes</td>
<td>8048003934</td>
<td>204642936 bps</td>
</tr>
</tbody>
</table>

**Transmitted:**

<table>
<thead>
<tr>
<th>Packets</th>
<th>4360749</th>
<th>13891 pps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bytes</td>
<td>235480446</td>
<td>6000912 bps</td>
</tr>
<tr>
<td>Tail-dropped packets</td>
<td>0</td>
<td>0 pps</td>
</tr>
<tr>
<td>RED-dropped packets</td>
<td>144676035</td>
<td>459820 pps</td>
</tr>
<tr>
<td>RED-dropped bytes</td>
<td>7812506922</td>
<td>198642024 bps</td>
</tr>
</tbody>
</table>

**Queue: 1, Forwarding classes: expedited-forwarding**

<table>
<thead>
<tr>
<th>Queued:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Packets</td>
<td>0</td>
<td>0 pps</td>
</tr>
<tr>
<td>Bytes</td>
<td>0</td>
<td>0 bps</td>
</tr>
</tbody>
</table>

**Transmitted:**

<table>
<thead>
<tr>
<th>Packets</th>
<th>0</th>
<th>0 pps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bytes</td>
<td>0</td>
<td>0 bps</td>
</tr>
<tr>
<td>Tail-dropped packets</td>
<td>0</td>
<td>0 pps</td>
</tr>
<tr>
<td>RED-dropped packets</td>
<td>0</td>
<td>0 pps</td>
</tr>
<tr>
<td>RED-dropped bytes</td>
<td>0</td>
<td>0 bps</td>
</tr>
</tbody>
</table>

**Queue: 2, Forwarding classes: assured-forwarding**

<table>
<thead>
<tr>
<th>Queued:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Packets</td>
<td>485089207</td>
<td>473605 pps</td>
</tr>
<tr>
<td>Bytes</td>
<td>26195987476</td>
<td>204597576 bps</td>
</tr>
</tbody>
</table>

**Transmitted:**

<table>
<thead>
<tr>
<th>Packets</th>
<th>5480799</th>
<th>3959 pps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bytes</td>
<td>295963146</td>
<td>1710504 bps</td>
</tr>
<tr>
<td>Tail-dropped packets</td>
<td>0</td>
<td>0 pps</td>
</tr>
<tr>
<td>RED-dropped packets</td>
<td>479605853</td>
<td>469646 pps</td>
</tr>
<tr>
<td>RED-dropped bytes</td>
<td>25898716170</td>
<td>202887072 bps</td>
</tr>
</tbody>
</table>

**Queue: 3, Forwarding classes: network-control**

<table>
<thead>
<tr>
<th>Queued:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Packets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bytes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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   :   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
  RED-dropped bytes   :     0  0 bps
  Medium-low          :   0  0 bps
  Medium-high         :   0  0 bps
  High                :   0  0 bps
show interfaces interval

Syntax

```
show interfaces interval
<interface-name>
```

Release Information

Command introduced before Junos OS Release 7.4.

Description

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.

Options

```
interface-name—(Optional) Name of a particular interface.
```

Required Privilege

view

Related Documentation

- clear interfaces interval on page 1633

List of Sample Output

- show interfaces interval (Channelized OC12) on page 2182
- show interfaces interval (E3) on page 2182
- show interfaces interval (SONET/SDH) on page 2182

Output Fields

Table 168 on page 2180 lists the output fields for the show interfaces interval command. Output fields are listed in the approximate order in which they appear.

### Table 168: show interfaces interval Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical interface</td>
<td>Name of the interface.</td>
</tr>
<tr>
<td>SNMP ifindex</td>
<td>SNMP index number for the physical interface.</td>
</tr>
<tr>
<td>hh:mm-current</td>
<td>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.</td>
</tr>
<tr>
<td>hh:mm-hh:mm</td>
<td>Time of day (in hours and minutes) at the beginning and end of each 15-minute interval.</td>
</tr>
<tr>
<td>alarm or event: n</td>
<td>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 interface-type media field (for example, T1 media) under the show interfaces command for the particular interface type in which you are interested.</td>
</tr>
<tr>
<td>Interval Total</td>
<td>Sum of all the alarm and defect counters for the last 24-hour period.</td>
</tr>
</tbody>
</table>
### Table 168: show interfaces interval Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interval Total</strong></td>
<td>Sum of all the alarm and defect counters for the last 24-hour period.</td>
</tr>
<tr>
<td><strong>Current Day Interval Total</strong></td>
<td>Sum of all the alarm and defect counters in the current day.</td>
</tr>
<tr>
<td></td>
<td><strong>NOTE:</strong> The <strong>Current Day Interval</strong> output field is reset after 24 hours.</td>
</tr>
<tr>
<td><strong>Previous Day Interval Total</strong></td>
<td>Sum of all the alarm and defect counters in the previous day.</td>
</tr>
</tbody>
</table>
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,
    SEFS: 0, UAS: 0
... Interval Total:
    LCV: 230, PCV: 1145859, CCV: 455470, LES: 0, PES: 230, PSES: 230,
```

**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,
    SEFS: 0, UAS: 0
... Interval Total:
    LCV: 230, PCV: 1145859, CCV: 455470, LES: 0, PES: 230, PSES: 230,
```

**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:
```

---

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<table>
<thead>
<tr>
<th>Time Interval</th>
<th>ES-S</th>
<th>SES-S</th>
<th>SEFS-S</th>
<th>ES-L</th>
<th>SES-L</th>
<th>UAS-L</th>
<th>ES-P</th>
<th>SES-P</th>
<th>UAS-P</th>
</tr>
</thead>
<tbody>
<tr>
<td>02:23-02:38:</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>02:08-02:23:</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>01:53-02:08:</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>01:38-01:53:</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>01:23-01:38:</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>01:08-01:23:</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>00:53-01:08:</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>00:38-00:53:</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Current Day Interval Total:</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Previous Day Interval Total (Last updated at 02:23):</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
show interfaces irb

Syntax

show interfaces irb
  <brief | detail | extensive | terse>
  <descriptions>
  <media>
  <snmp-index snmp-index>
  <statistics>

Release Information

Command introduced in Junos OS Release 8.4.

Description

Display integrated routing and bridging interfaces information.

Options

  brief | detail | extensive | terse—(Optional) Display the specified level of output.
  descriptions—(Optional) Display interface description strings.
  mac—Display hardware MAC address
  media—(Optional) Display media-specific information about network interfaces.
  snmp-index snmp-index—(Optional) Display information for the interface with the specified SNMP index.
  statistics—(Optional) Display static interface statistics.

Additional Information

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.

Required Privilege Level

view

List of Sample Output

  show interfaces irb extensive on page 2188
  show interfaces irb snmp-index on page 2189

Output Fields

Table 169 on page 2184 lists the output fields for the show interfaces irb command. Output fields are listed in the approximate order in which they appear.

Table 169: show interfaces irb Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Interface</td>
<td>Name of the physical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Physical interface</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enabled</td>
<td>State of the physical interface. Possible values are described in the “Enabled Field” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td>Proto</td>
<td>Protocol configured on the interface.</td>
<td>terse</td>
</tr>
<tr>
<td>Interface index</td>
<td>Physical interface index number, which reflects its initialization sequence.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>SNMP ifIndex</td>
<td>SNMP index number for the physical interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Type</td>
<td>Physical interface type.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Link-level type</td>
<td>Encapsulation being used on the physical interface.</td>
<td>detail extensive brief none</td>
</tr>
<tr>
<td>MTU</td>
<td>MTU size on the physical interface.</td>
<td>detail extensive brief none</td>
</tr>
<tr>
<td>Clocking</td>
<td>Reference clock source: Internal or External. Always unspecified on IRB interfaces.</td>
<td>detail extensive brief</td>
</tr>
<tr>
<td>Speed</td>
<td>Speed at which the interface is running. Always unspecified on IRB interfaces.</td>
<td>detail extensive brief</td>
</tr>
<tr>
<td>Device flags</td>
<td>Information about the physical device. Possible values are described in the “Device Flags” section under Common Output Fields Description.</td>
<td>detail extensive brief none</td>
</tr>
<tr>
<td>Interface flags</td>
<td>Information about the interface. Possible values are described in the “Interface Flags” section under Common Output Fields Description.</td>
<td>detail extensive brief none</td>
</tr>
<tr>
<td>Link type</td>
<td>Physical interface link type: full duplex or half duplex.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Link flags</td>
<td>Information about the link. Possible values are described in the “Links Flags” section under Common Output Fields Description.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Physical info</td>
<td>Physical interface information.</td>
<td>All levels</td>
</tr>
<tr>
<td>Hold-times</td>
<td>Current interface hold-time up and hold-time down, in milliseconds.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Current address</td>
<td>Configured MAC address.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Hardware address</td>
<td>MAC address of the hardware.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Alternate link address</td>
<td>Backup address of the link.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Last flapped</td>
<td>Date, time, and how long ago the interface went from down to up. The format is Last flapped: year-month-day hours:minutes:seconds timezone (hours:minutes:seconds ago). For example, Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago).</td>
<td>detail extensive none</td>
</tr>
<tr>
<td>Field Name</td>
<td>Field Description</td>
<td>Level of Output</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Statistics last</td>
<td>Time when the statistics for the interface were last set to zero.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>cleared</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic statistics</td>
<td>Number and rate of bytes and packets received and transmitted on the physical interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>- Input bytes—Number of bytes received on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Output bytes—Number of bytes transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Input packets—Number of packets received on the interface</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Output packets—Number of packets transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td>IPv6 transit</td>
<td>Number of IPv6 transit bytes and packets received and transmitted on the physical interface if IPv6 statistics tracking is enabled.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>statistics</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Input bytes—Number of bytes received on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Output bytes—Number of bytes transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Input packets—Number of packets received on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Output packets—Number of packets transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td>Input errors</td>
<td>Input errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>- Errors—Sum of the incoming frame aborts and FCS errors.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Drops—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Framing errors—Number of packets received with an invalid frame checksum (FCS).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Runts—Number of frames received that are smaller than the runt threshold.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Giants—Number of frames received that are larger than the giant threshold.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Policed discards—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Resource errors—Sum of transmit drops.</td>
<td></td>
</tr>
<tr>
<td>Output errors</td>
<td>Output errors on the interface. The following paragraphs explain the counters whose meaning might not be obvious:</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>- Carrier transitions—Number of times the interface has gone from down to up. 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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Errors—Sum of the outgoing frame aborts and FCS errors.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Drops—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- MTU errors—Number of packets whose size exceeded the MTU of the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Resource errors—Sum of transmit drops.</td>
<td></td>
</tr>
</tbody>
</table>
Table 169: show interfaces irb Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logical Interface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logical Interface</td>
<td>Name of the logical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Index</td>
<td>Index number of the logical interface (which reflects its initialization sequence).</td>
<td>detail extensive</td>
</tr>
<tr>
<td>SNMP ifIndex</td>
<td>SNMP interface index number of the logical interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Flags</td>
<td>Information about the logical interface. Possible values are described in the</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>&quot;Logical Interface Flags&quot; section under Common Output Fields Description.</td>
<td></td>
</tr>
<tr>
<td>Encapsulation</td>
<td>Encapsulation on the logical interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>Dummy value that is ignored by an IRB interface. IRB interfaces are pseudo</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>interfaces and do not have physical bandwidth associated with them.</td>
<td></td>
</tr>
<tr>
<td>Routing Instance</td>
<td>Routing instance IRB is configured under.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Bridging Domain</td>
<td>Bridging domain IRB is participating in.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Traffic statistics</td>
<td>Number and rate of bytes and packets received and transmitted on the logical</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Input bytes—Number of bytes received on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Output bytes—Number of bytes transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Input packets—Number of packets received on the interface</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Output packets—Number of packets transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td>IPv6 transit statistics</td>
<td>Number of IPv6 transit bytes and packets received and transmitted on the logical interface if IPv6 statistics tracking is enabled.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>• Input bytes—Number of bytes received on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Output bytes—Number of bytes transmitted on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Input packets—Number of packets received on the interface</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Output packets—Number of packets transmitted on the interface</td>
<td></td>
</tr>
<tr>
<td>Local statistics</td>
<td>Statistics for traffic received from and transmitted to the Routing Engine.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Transit statistics</td>
<td>Statistics for traffic transiting the router.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Protocol</td>
<td>Protocol family configured on the local interface. Possible values are described</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>in the &quot;Protocol Field&quot; section under Common Output Fields Description.</td>
<td></td>
</tr>
<tr>
<td>MTU</td>
<td>Maximum transmission unit size on the logical interface.</td>
<td>detail extensive</td>
</tr>
</tbody>
</table>
Table 169: show interfaces irb Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum labels</td>
<td>Maximum number of MPLS labels configured for the MPLS protocol family on the logical interface.</td>
<td>detail extensive, none</td>
</tr>
<tr>
<td>Generation</td>
<td>Unique number for use by Juniper Networks technical support only.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Route table</td>
<td>Routing table in which the logical interface address is located. For example, 0 refers to the routing table inet.0.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Addresses, Flags</td>
<td>Information about address flags. Possible values are described in the “Addresses Flags” section under Common Output Fields Description.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Policer</td>
<td>The policer that is to be evaluated when packets are received or transmitted on the interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Flags</td>
<td>Information about the logical interface. Possible values are described in the “Logical Interface Flags” section under Common Output Fields Description.</td>
<td>detail extensive</td>
</tr>
</tbody>
</table>

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, 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 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
<table>
<thead>
<tr>
<th>Protocol</th>
<th>MTU</th>
<th>Addresses, Flags</th>
<th>Destination</th>
<th>Local</th>
<th>Broadcast</th>
</tr>
</thead>
<tbody>
<tr>
<td>inet</td>
<td>1500</td>
<td>Dest-route-down Is-Preferred Is-Primary</td>
<td>10.51.1/24</td>
<td>10.51.1.2</td>
<td>10.51.1.255</td>
</tr>
<tr>
<td>Multiservice</td>
<td>1500</td>
<td>Is-Primary</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**show interfaces mac-database**

**Syntax**
```
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) <mac-address mac-address>
```

**Release Information**
- Command introduced before Junos OS Release 7.4.
- Support for statement with the aex option introduced in Junos OS Release 15.1.

**Description**
(M Series, T Series, MX Series routers, and PTX Series Packet Transport Routers only)
Display media access control (MAC) address information for the specified interface.

**Options**
- `ge-fpc/pic/port`—Display MAC addresses that have been learned on all logical interfaces on a particular physical interface.
- `ge-fpc/pic/port.n`—Display MAC addresses that have been learned on a particular logical interface.
- `aex`—Display MAC addresses that have been learned on a particular aggregated Ethernet interface.
- `xe-fpc/pic/port`—Display MAC addresses that have been learned on all logical interfaces on a particular physical interface.
- `xe-fpc/pic/port.n`—Display MAC addresses that have been learned on a particular logical interface.
- `et-fpc/pic/port`—Display MAC addresses that have been learned on all logical interfaces on a particular physical interface.
- `et-fpc/pic/port.n`—Display MAC addresses that have been learned on a particular logical interface.
- `mac-address mac-address`—(Optional) Display detailed MAC address statistics, including policer information for ge, xe, and et interfaces.

**Additional Information**
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.

**Required Privilege Level**
view

**List of Sample Output**
- show interfaces mac-database (All MAC Addresses on a Port) on page 2193
- show interfaces mac-database (All MAC Addresses on an Aggregated Ethernet Interface) on page 2194
show interfaces mac-database (All MAC Addresses on a Service) on page 2195
show interfaces mac-database mac-address on page 2195

Output Fields

Table 170 on page 2192 lists the output fields for the `show interfaces mac-database` command. Output fields are listed in the approximate order in which they appear.

Table 170: show interfaces mac-database Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Interface</td>
<td></td>
</tr>
<tr>
<td>Physical interface</td>
<td>Name of the physical interface.</td>
</tr>
<tr>
<td>Enabled</td>
<td>State of the physical interface. Possible values are described in the “Enabled Field” section under Common Output Fields Description.</td>
</tr>
<tr>
<td>Interface index</td>
<td>Physical interface index number, which reflects its initialization sequence.</td>
</tr>
<tr>
<td>SNMP ifIndex</td>
<td>SNMP index number for the physical interface.</td>
</tr>
<tr>
<td>Description</td>
<td>Description and name of the interface.</td>
</tr>
<tr>
<td>Link-level type</td>
<td>Encapsulation being used on the physical interface.</td>
</tr>
<tr>
<td>MTU</td>
<td>MTU size on the physical interface.</td>
</tr>
<tr>
<td>Speed</td>
<td>Speed at which the interface is running.</td>
</tr>
<tr>
<td>Loopback</td>
<td>Whether loopback is enabled and the type of loopback: local or remote.</td>
</tr>
<tr>
<td>Source filtering</td>
<td>Whether source filtering is configured.</td>
</tr>
<tr>
<td>Flow control</td>
<td>Whether flow control is enabled or disabled.</td>
</tr>
<tr>
<td>Minimum links needed</td>
<td>(Aggregated Ethernet interfaces only) Number of child links that must be operational for the aggregated interface to be operational.</td>
</tr>
<tr>
<td>Minimum bandwidth needed</td>
<td>(Aggregated Ethernet interfaces only) Minimum amount of bandwidth of child links that must be operational for the aggregated interface to be operational.</td>
</tr>
<tr>
<td>Device flags</td>
<td>Information about the physical device. Possible values are described in the “Device Flags” section under Common Output Fields Description.</td>
</tr>
<tr>
<td>Current address</td>
<td>(Aggregated Ethernet interfaces only) Configured MAC address.</td>
</tr>
<tr>
<td>Hardware address</td>
<td>(Aggregated Ethernet interfaces only) Hardware MAC address.</td>
</tr>
<tr>
<td>Last flapped</td>
<td>(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 Last flapped: year-month-day hours:minutes:seconds timezone (wweeksddays hours:minutes ago). For example, Last flapped: 2013-12-18 04:33:22 PST (1w5d 22:23 ago).</td>
</tr>
</tbody>
</table>
### Table 170: show interfaces mac-database Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input Rate</strong></td>
<td>(Aggregated Ethernet interfaces only) Input rate in bits per second (bps) and packets per second (pps).</td>
</tr>
<tr>
<td><strong>Output Rate</strong></td>
<td>(Aggregated Ethernet interfaces only) Output rate in bps and pps.</td>
</tr>
<tr>
<td><strong>Interface flags</strong></td>
<td>Information about the interface. Possible values are described in the “Links Flags” section under Common Output Fields Description.</td>
</tr>
<tr>
<td><strong>Link flags</strong></td>
<td>Information about the link. Possible values are described in the “Device Flags” section under Common Output Fields Description.</td>
</tr>
<tr>
<td><strong>Logical Interface</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Logical interface</strong></td>
<td>Name of the logical interface.</td>
</tr>
<tr>
<td><strong>Index</strong></td>
<td>Logical interface index number, which reflects its initialization sequence.</td>
</tr>
<tr>
<td><strong>SNMP ifIndex</strong></td>
<td>Logical interface SNMP interface index number.</td>
</tr>
<tr>
<td><strong>Flags</strong></td>
<td>Information about the logical interface (possible values are described in the “Logical Interface Flags” section under Common Output Fields Description.</td>
</tr>
<tr>
<td><strong>Encapsulation</strong></td>
<td>Encapsulation on the logical interface.</td>
</tr>
<tr>
<td><strong>MAC address, Input frames, Input bytes, Output frames, Output bytes</strong></td>
<td>MAC address and corresponding number of input frames, input bytes, output frames, and output bytes.</td>
</tr>
<tr>
<td><strong>Number of MAC addresses</strong></td>
<td>Number of MAC addresses configured.</td>
</tr>
<tr>
<td><strong>Policer Statistics</strong></td>
<td>(Displayed for mac-address option for ge, xe, and et interface types only) Display information about policers applied to a logical interface-MAC pair.</td>
</tr>
<tr>
<td>• <strong>Policer type</strong></td>
<td>Type of policer that is out of spec with respect to the configuration. It can be one or more of the following:</td>
</tr>
<tr>
<td>• <strong>Input premium</strong></td>
<td>Number of high-priority rating out-of-spec frames or bytes received.</td>
</tr>
<tr>
<td>• <strong>Output premium</strong></td>
<td>Number of high-priority rating out-of-spec frames or bytes sent.</td>
</tr>
<tr>
<td>• <strong>Input aggregate</strong></td>
<td>Total number of out-of-spec frames or bytes received.</td>
</tr>
<tr>
<td>• <strong>Output aggregate</strong></td>
<td>Total number of out-of-spec frames or bytes sent.</td>
</tr>
<tr>
<td>• <strong>Discarded Frames</strong></td>
<td>Number of discarded frames.</td>
</tr>
<tr>
<td>• <strong>Discarded Bytes</strong></td>
<td>Number of discarded bytes.</td>
</tr>
</tbody>
</table>

**Sample Output**

**show interfaces mac-database (All MAC Addresses on a Port)**

```
user@host> show interfaces mac-database xe-0/3/3
```
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: 9388, 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
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 262758118 300 22200

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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          
00:00:00:00:00:04     0           0             0             0          

Number of MAC addresses: 3

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**

**Syntax**

```
show interfaces mc-ae
extensive
revertive-info
<id identifier unit number>
```

**Release Information**

- `revertive-info` statement introduced in Junos OS Release 13.3
- `extensive` statement introduced in Junos OS Release 16.1R1

**Description**

On MX Series routers with multichassis aggregated Ethernet (aeX) interfaces, displays information about the aeX interfaces.

**Options**

- `extensive`—(Optional) Display extensive information for multichassis aggregated Ethernet interface.
- `revertive-info`—(Optional) Display revertive mode information for multichassis aggregated Ethernet interface.
- `identifier`—(Optional) Identifier of the multichassis aggregated Ethernet interface.
- `number`—(Optional) Specify the logical interface by unit number.

**Required Privilege Level**

`view`

**Related Documentation**

- Configuring Multichassis Link Aggregation on MX Series Routers

**List of Sample Output**

- `show interfaces mc-ae` on page 2198
- `show interfaces mc-ae (Active/Active Bridging and VRRP over IRB on MX Series Routers)` on page 2199
- `show interfaces mc-ae revertive-info` on page 2199
- `show interfaces mc-ae extensive` on page 2199
- `show interfaces mc-ae extensive (MX Series Router after a configuration exchange error)` on page 2200

**Output Fields**

Table 171 on page 2197 lists the output fields for the `show interfaces mc-ae` command. Output fields are listed in the approximate order in which they appear.

*Table 171: show interfaces mc-ae Output Fields*

<table>
<thead>
<tr>
<th>Output Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Member Link</td>
<td>Identifiers of the configured multichassis link aggregate interfaces configured interfaces.</td>
</tr>
</tbody>
</table>
Table 171: show interfaces mc-ae Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Description</th>
<th>Output Field Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status of the local link: active or standby.</td>
<td>Local Status</td>
</tr>
<tr>
<td>Status of the peer link: active or standby.</td>
<td>Peer Status</td>
</tr>
<tr>
<td>Up or down state of the local device.</td>
<td>Local State</td>
</tr>
<tr>
<td>Status of the local and peer links in an active/active bridge or VRRP over integrated routing and bridging (IRB) configuration on MX Series routers, including: Logical Interface—Aggregated Ethernet (AE) aggregate number and unit number.</td>
<td>Peer State</td>
</tr>
<tr>
<td>Topology Type—The bridge or VRRP topology type configured on the AE.</td>
<td></td>
</tr>
<tr>
<td>Local State—Up or down state of the local device.</td>
<td></td>
</tr>
<tr>
<td>Peer State—Up or down state of the peer device.</td>
<td></td>
</tr>
<tr>
<td>Peer Ip/ICL-PL/State—Address, interface and state of the peer device.</td>
<td></td>
</tr>
<tr>
<td>Identifier and unit of the multichassis aggregated Ethernet interface.</td>
<td>Logical Interface</td>
</tr>
<tr>
<td>Label: pseudowire interface or Ethernet interface.</td>
<td>Core Facing Interface</td>
</tr>
<tr>
<td>Label: pseudowire interface or Ethernet interface.</td>
<td>ICL-PL</td>
</tr>
<tr>
<td>The configured switchover mode for the multichassis aggregated Ethernet interface: revertive or non-revertive.</td>
<td>switchover mode</td>
</tr>
<tr>
<td>Status of the switchover if the revert-time statement is configured at the [edit interfaces aeX mc-ae] hierarchy level.</td>
<td>switchover status</td>
</tr>
<tr>
<td>Revert time configured for the multichassis aggregated Ethernet interface.</td>
<td>revert time</td>
</tr>
<tr>
<td>Seconds left to trigger the switchover if the switchover is in progress.</td>
<td>switchover time remaining</td>
</tr>
<tr>
<td>Reason for the configuration error.</td>
<td>Configuration Error Status</td>
</tr>
</tbody>
</table>

Sample Output

```
show interfaces mc-ae

user@host>  show interfaces mc-ae ae0 unit 512
```
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 mc-ae extensive

user@host> show interfaces mc-ae extensive
Member Link                  : ae2
Current State Machine's State: mcae active state
Local Status                 : active
Local State                  : up
Peer Status                  : active
Peer State                   : up
Logical Interface        : ae2.1
Topology Type            : bridge
Local State              : up
Peer State               : up
Peer Ip/MCP/State        : 192.168.143.17 ae0.1 up
### MCAE Configuration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redundancy Group</td>
<td>1</td>
</tr>
<tr>
<td>MCAE ID</td>
<td>2</td>
</tr>
<tr>
<td>MCAE Mode</td>
<td>active_active</td>
</tr>
<tr>
<td>Status Control</td>
<td>active</td>
</tr>
<tr>
<td>Chassis ID</td>
<td>0</td>
</tr>
</tbody>
</table>

### LACP Configuration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>System ID</td>
<td>00:00:00:00:00:02</td>
</tr>
<tr>
<td>Admin Key</td>
<td>10</td>
</tr>
</tbody>
</table>

```
show interfaces mc-ae extensive (MX Series Router after a configuration exchange error)
```

```
user@host> show interfaces mc-ae extensive

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Member Link</td>
<td>ae2</td>
</tr>
<tr>
<td>Current State</td>
<td>mcae config exchange error</td>
</tr>
<tr>
<td>Configuration</td>
<td>same chassis-id</td>
</tr>
<tr>
<td>Local Status</td>
<td>active</td>
</tr>
<tr>
<td>Local State</td>
<td>up</td>
</tr>
<tr>
<td>Peer Status</td>
<td>Unknown</td>
</tr>
<tr>
<td>Peer State</td>
<td>Unknown</td>
</tr>
<tr>
<td>Logical Interface</td>
<td>ae2.1</td>
</tr>
<tr>
<td>Topology Type</td>
<td>bridge</td>
</tr>
<tr>
<td>Local State</td>
<td>up</td>
</tr>
<tr>
<td>Peer State</td>
<td>up</td>
</tr>
<tr>
<td>Peer IP/MCP/State</td>
<td>192.168.143.17 ae0.1 up</td>
</tr>
</tbody>
</table>

### MCAE Configuration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redundancy Group</td>
<td>1</td>
</tr>
<tr>
<td>MCAE ID</td>
<td>2</td>
</tr>
<tr>
<td>MCAE Mode</td>
<td>active_active</td>
</tr>
<tr>
<td>Status Control</td>
<td>active</td>
</tr>
<tr>
<td>Chassis ID</td>
<td>1</td>
</tr>
</tbody>
</table>

### LACP Configuration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>System ID</td>
<td>00:00:00:00:00:02</td>
</tr>
<tr>
<td>Admin Key</td>
<td>10</td>
</tr>
</tbody>
</table>
show interfaces transport pm

Syntax

```
show interfaces transport pm (all | optics | otn) (all | current | currentday | interval | previousday) (all | interface-name)
```

Release Information

Command introduced in Junos OS Release 14.2 on the PTX Series.
Command introduced in Junos OS Release 16.1 on the MX Series.

Description

Display diagnostic data, warnings, and alarms for transport performance monitoring interfaces.

Options

(all | optics | otn)—Display both optics and OTN information or either only optics or only OTN information.

(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.

(all | interface-name)—Display information for all interfaces or only for the specified interface (for example, et-fpc/pic/port).

Required Privilege Level

view

Related Documentation

- clear interfaces transport pm on page 1638
- tca on page 1114
- transport-monitoring on page 1116

List of Sample Output

- show interfaces transport pm on page 2203
- show interfaces transport (MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC) on page 2204
- show interfaces transport pm (MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC) on page 2204
- show interfaces transport (PTX3000 router with 5-port 100-Gigabit DWDM OTN PIC) on page 2205
- show interfaces transport pm optics (PTX3000 router with 5-port 100-Gigabit DWDM OTN PIC) on page 2206
- show interfaces transport pm otn (PTX3000 router with 5-port 100-Gigabit DWDM OTN PIC) on page 2206

Output Fields

Table 172 on page 2202 lists the output fields for the show interfaces transport pm optics command. Fields are listed in the approximate order in which they appear.
### Table 172: show interfaces transport pm Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical interface</td>
<td>Name of the physical interface.</td>
</tr>
<tr>
<td>Interval</td>
<td>The 15 minute interval for performance monitoring.</td>
</tr>
<tr>
<td>Suspect Flag</td>
<td>TRUE if the performance monitoring data for the interval appears to be inaccurate.</td>
</tr>
<tr>
<td>Reason</td>
<td>Reason for setting the suspect flag.</td>
</tr>
<tr>
<td>COUNT</td>
<td>Measured value.</td>
</tr>
<tr>
<td>THRESHOLD</td>
<td>Threshold value set.</td>
</tr>
<tr>
<td>TCA-ENABLED</td>
<td>Threshold crossing alert. Set to TRUE if enabled.</td>
</tr>
<tr>
<td>TCA-RAISED</td>
<td>TRUE if enabled and the value crosses the threshold.</td>
</tr>
<tr>
<td>Near End PM</td>
<td>Near end threshold crossing defect trigger. For more information about TCA, see tca.</td>
</tr>
<tr>
<td>Far End PM</td>
<td>Far end threshold crossing defect trigger. For more information about TCA, see tca.</td>
</tr>
<tr>
<td>FEC PM</td>
<td>Forwarding equivalence class threshold crossing defect trigger. For more information about TCA, see tca.</td>
</tr>
<tr>
<td>BER PM</td>
<td>Bit error rate threshold crossing defect trigger. For more information about TCA, see tca.</td>
</tr>
<tr>
<td>CURRENT</td>
<td>Current value measured.</td>
</tr>
<tr>
<td>PM</td>
<td>Performance monitor.</td>
</tr>
<tr>
<td>MIN</td>
<td>Minimum value measured.</td>
</tr>
<tr>
<td>MAX</td>
<td>Maximum value measured.</td>
</tr>
<tr>
<td>AVG</td>
<td>Average value.</td>
</tr>
<tr>
<td>Lane Chromatic dispersion</td>
<td>Residual chromatic dispersion measured.</td>
</tr>
<tr>
<td>Lane differential group delay</td>
<td>Measured differential group delay.</td>
</tr>
<tr>
<td>q Value</td>
<td>Measured Quality factor value.</td>
</tr>
<tr>
<td>SNR</td>
<td>Signal to noise ratio.</td>
</tr>
<tr>
<td>Tx output power</td>
<td>The transmit laser output power.</td>
</tr>
</tbody>
</table>
### Table 172: `show interfaces transport pm` Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rx input power</td>
<td>The laser's received optical power.</td>
</tr>
<tr>
<td>Module temperature (Celsius)</td>
<td>The laser's temperature.</td>
</tr>
<tr>
<td>Tx Laser bias current (0.1mA)</td>
<td>Magnitude of the laser bias power setting current. The laser bias provides direct modulation of laser diodes and modulates currents.</td>
</tr>
<tr>
<td>Rx Laser bias current (0.1mA)</td>
<td>Magnitude of the laser bias power setting current.</td>
</tr>
<tr>
<td>Carrier frequency offset (MHz)</td>
<td>Measured carrier frequency offset.</td>
</tr>
</tbody>
</table>

### Sample Output

**show interfaces transport pm**

```bash
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 PM
Suspect Flag:False Count
Reason:None 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 PM
Suspect Flag:True Count
Reason:Unknown 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 PM
Suspect Flag:False Count
Reason:None 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 PM
Suspect Flag:True Count
Reason:Unknown 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 PM
Suspect Flag:False Count
Reason:None Threshold TCA-ENABLED TCA-RAISED
FEC-CorrectedErr 2008544300 0 NA NA
FEC-UncorrectedWords 0 0 NA NA
BER
```

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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 PM
Suspect Flag:False 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 PM
Suspect Flag:False 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
<table>
<thead>
<tr>
<th>Near End</th>
<th>Suspect Flag: False</th>
<th>Reason: Not Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM</td>
<td>COUNT</td>
<td>THRESHOLD</td>
</tr>
<tr>
<td>ODU-BBE</td>
<td>0</td>
<td>800</td>
</tr>
<tr>
<td>ODU-ES</td>
<td>0</td>
<td>135</td>
</tr>
<tr>
<td>ODU-SES</td>
<td>0</td>
<td>90</td>
</tr>
<tr>
<td>ODU-UAS</td>
<td>0</td>
<td>90</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Far End</th>
<th>Suspect Flag: False</th>
<th>Reason: Not Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM</td>
<td>COUNT</td>
<td>THRESHOLD</td>
</tr>
<tr>
<td>ODU-BBE</td>
<td>0</td>
<td>800</td>
</tr>
<tr>
<td>ODU-ES</td>
<td>0</td>
<td>135</td>
</tr>
<tr>
<td>ODU-SES</td>
<td>0</td>
<td>90</td>
</tr>
<tr>
<td>ODU-UAS</td>
<td>0</td>
<td>90</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FEC</th>
<th>Suspect Flag: False</th>
<th>Reason: Not Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM</td>
<td>COUNT</td>
<td>THRESHOLD</td>
</tr>
<tr>
<td>FEC-CorrectedErr</td>
<td>30865849</td>
<td>0</td>
</tr>
<tr>
<td>FEC-UncorrectedWords</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BER</th>
<th>Suspect Flag: False</th>
<th>Reason: Not Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM</td>
<td>MIN</td>
<td>MAX</td>
</tr>
<tr>
<td>BER</td>
<td>4.0e-7</td>
<td>5.9e-7</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>PM</th>
<th>TCA-ENABLED</th>
<th>TCA-RAISED</th>
</tr>
</thead>
<tbody>
<tr>
<td>(MAX)</td>
<td>(MIN)</td>
<td>(MAX)</td>
</tr>
<tr>
<td>Lane chromatic dispersion(ps/nm)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lane differential group delay(ps)</td>
<td>-13</td>
<td>0</td>
</tr>
<tr>
<td>q Value(0.1dB)</td>
<td>0</td>
<td>-1</td>
</tr>
<tr>
<td>SNR(0.1dB)</td>
<td>137</td>
<td>138</td>
</tr>
<tr>
<td>Tx output power(0.01dBm)</td>
<td>83</td>
<td>95</td>
</tr>
<tr>
<td>Rx input power(0.01dBm)</td>
<td>141</td>
<td>142</td>
</tr>
<tr>
<td>Module temperature(Celsius)</td>
<td>106</td>
<td>109</td>
</tr>
<tr>
<td>Tx laser bias current(0.1mA)</td>
<td>-31</td>
<td>0</td>
</tr>
<tr>
<td>Rx laser bias current(0.1mA)</td>
<td>38</td>
<td>38</td>
</tr>
<tr>
<td>Carrier frequency offset(MHz)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

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 TCA-ENABLED TCA-RAISED
(TCA-RAISED) (MIN) (MAX) (MIN) (MAX)
Lane chromatic dispersion (ps/nm)  -6 -32 45 -1 0
Lane differential group delay (ps) 3 2 4 3 0
Lane Q2 factor (0.1dB) 154 154 155 154 0
SNR (0.1dB) 167 164 171 165 0
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 TCA-ENABLED TCA-RAISED
(TCA-RAISED) (MIN) (MAX) (MIN) (MAX)
Lane chromatic dispersion (ps/nm)  -6 -32 45 -1 0
Lane differential group delay (ps) 3 2 4 3 0
Lane Q2 factor (0.1dB) 154 154 155 154 0
SNR (0.1dB) 167 164 171 165 0
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**

<table>
<thead>
<tr>
<th>Syntax</th>
<th>show l2-learning instance</th>
</tr>
</thead>
</table>

**Release Information**  
(MX Series routers only) Command introduced in Junos OS Release 8.4.

**Description**  
Display Layer 2 learning properties for all the configured routing instances.

**Options**  
This command has no options.

**Required Privilege**  
Level  
view

**List of Sample Output**  
show l2-learning instance on page 2208

**Output Fields**  
Table 173 on page 2207 describes the output fields for the **show l2-learning instance** command. Output fields are listed in the approximate order in which they appear.

**Table 173: show l2-learning instance Output Fields**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Routing Instance</strong></td>
<td>Name of routing instance.</td>
</tr>
<tr>
<td><strong>Bridging Domain</strong></td>
<td>Name of bridging domain.</td>
</tr>
<tr>
<td></td>
<td>On MX Series routers you can use the <strong>show l2-learning instance &lt;extensive&gt;</strong> command option to display the Bridge Service-id information which includes the Config Service ID and the Active Service ID.</td>
</tr>
<tr>
<td><strong>Index</strong></td>
<td>Number associated with the routing instance or bridging domain.</td>
</tr>
<tr>
<td><strong>Logical System</strong></td>
<td>Name of logical system or <strong>Default</strong> if no logical system is configured.</td>
</tr>
<tr>
<td><strong>Routing instance flags</strong></td>
<td>Status of Layer 2 learning properties for each routing instance:</td>
</tr>
<tr>
<td></td>
<td>• <strong>DL</strong>—MAC learning is disabled.</td>
</tr>
<tr>
<td></td>
<td>• <strong>SE</strong>—MAC accounting is enabled.</td>
</tr>
<tr>
<td></td>
<td>• <strong>AD</strong>—Packets are dropped after MAC address limit is reached.</td>
</tr>
<tr>
<td></td>
<td>• <strong>LH</strong>—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.</td>
</tr>
<tr>
<td><strong>MAC limit</strong></td>
<td>Maximum number of MAC addresses that can be learned from each interface in the routing instance or bridging domain.</td>
</tr>
</tbody>
</table>
### 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)

<table>
<thead>
<tr>
<th>Routing Instance</th>
<th>Bridging Domain</th>
<th>Index</th>
<th>Logical System</th>
<th>Routing flags</th>
<th>MAC limit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>juniper_private1</strong></td>
<td></td>
<td>1</td>
<td>Default</td>
<td>5000</td>
<td></td>
</tr>
<tr>
<td>vs1</td>
<td>vlan100</td>
<td>3</td>
<td>Default</td>
<td>5120</td>
<td></td>
</tr>
<tr>
<td>vs1</td>
<td>vlan200</td>
<td>4</td>
<td>Default</td>
<td>5120</td>
<td></td>
</tr>
</tbody>
</table>
```
**show l2-learning redundancy-groups**

**Syntax**
```
show l2-learning redundancy-groups
  logical-system [system-name | all]
  <redundancy-group-id [0 to 4294967294]>
  arp-statistics
  nd-statistics
  remote-macs
```

**Release Information**
- Command introduced in Junos OS Release 13.2.
- Support for logical systems added in Junos OS Release 14.1.
- Command introduced in Junos OS Release 15.1R1 for EX Series switches

**Description**
(MX Series routers 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.

**Options**
- `logical-system [system-name | all]` — (Optional) Display information for a specified logical system or all systems.
- `redundancy-group-id` — (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.
- `arp-statistics` — (Optional) Count of ARP packets sent and received by the two MC-AE nodes.
- `nd-statistics` — (Optional) Count of Neighbor Discovery packets sent and received by the two MC-AE nodes.
- `remote-macs` — (Optional) List of remote MAC addresses in the “Installed” state, as learned from the remote MC-AE node.

**Required Privilege Level**
view

**Related Documentation**
- Configuring Multichassis Link Aggregation on MX Series Routers
- show interfaces mc-aе on page 2197
- Configuring Active-Active Bridging and VRRP over IRB in Multichassis Link Aggregation on MX Series Routers and QFX Series Switches
- Configuring Multichassis Link Aggregation on EX Series Switches

**List of Sample Output**
- show l2-learning redundancy-groups arp-statistics on page 2211
### Table 174: show l2-learning redundancy-groups arp-statistics Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redundancy Group ID</td>
<td>Redundancy Group to which the following details apply.</td>
</tr>
<tr>
<td>MCLAG ARP Statistics Group ID</td>
<td>ARP statistics for this Multichassis Link Aggregation Group (MC-LAG) instance.</td>
</tr>
<tr>
<td>ARP Rx Count From Line</td>
<td>Total number of ARPs received from the Line.</td>
</tr>
<tr>
<td>ARP Tx Count To Peer</td>
<td>Total number of ARPs sent to the peer.</td>
</tr>
<tr>
<td>ARP Rx Count From Peer</td>
<td>Total number of ARPs received from the peer.</td>
</tr>
<tr>
<td>ARP Drop Count received from line</td>
<td>Total number of ARPs sent by the peer that were received.</td>
</tr>
<tr>
<td>ARP Drop Count received from peer</td>
<td>Total number of ARPs sent by the peer that were dropped</td>
</tr>
<tr>
<td>Service-id</td>
<td>Service ID (configured at the routing instance level).</td>
</tr>
</tbody>
</table>

### Table 175: show l2-learning redundancy-groups nd-statistics Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redundancy Group ID</td>
<td>Redundancy Group to which the following details apply.</td>
</tr>
<tr>
<td>MCLAG ND Statistics Group ID</td>
<td>Neighbor Discovery statistics for this Multichassis Link Aggregation Group (MC-LAG) instance.</td>
</tr>
<tr>
<td>ND Rx Count From Line</td>
<td>Total number of Neighbor Discovery packets received from the Line.</td>
</tr>
<tr>
<td>ND Tx Count To Peer</td>
<td>Total number of Neighbor Discovery packets sent to the peer.</td>
</tr>
<tr>
<td>ND Rx Count From Peer</td>
<td>Total number of Neighbor Discovery packets received from the peer.</td>
</tr>
</tbody>
</table>
Table 175: show l2-learning redundancy-groups nd-statistics Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ND Drop Count received from line</td>
<td>Total number of Neighbor Discovery packets sent by the peer that were received.</td>
</tr>
<tr>
<td>ND Drop Count received from peer</td>
<td>Total number of Neighbor Discovery packets sent by the peer that were dropped</td>
</tr>
<tr>
<td>Service-id</td>
<td>Service ID (configured at the routing instance level).</td>
</tr>
</tbody>
</table>

Table 176: show l2-learning redundancy-groups remote-macs Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redundancy Group ID</td>
<td>Redundancy Group to which the following details apply.</td>
</tr>
<tr>
<td>Peer-Addr</td>
<td>IP address of the remote peer.</td>
</tr>
<tr>
<td>VLAN</td>
<td>Virtual LAN identifier associated with the redundancy group.</td>
</tr>
<tr>
<td>MAC</td>
<td>Hardware media access control address associated with the redundancy group.</td>
</tr>
<tr>
<td>MCAE-ID</td>
<td>ID number of the MC-AE used by the redundancy group.</td>
</tr>
<tr>
<td>Flags</td>
<td>Connection state: local connect or Remote connect. If no flag is shown, the redundancy group may not be connected.</td>
</tr>
<tr>
<td>Status</td>
<td>Installation state: Installed or Not Installed.</td>
</tr>
</tbody>
</table>

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

show l2-learning redundancy-groups logical-system arp-statistics (for Logical Systems)

user@host> show l2-learning redundancy-groups logical-system LS1 arp-statistics

show l2-learning redundancy-groups logical-system nd-statistics (for Logical Systems)

user@host> show l2-learning redundancy-groups logical-system LS1 nd-statistics

show l2-learning redundancy-groups group-id

user@host> show l2-learning redundancy-groups 1
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.

```extensive```
statement introduced in Junos OS Release 16.1R1

Command introduced in Junos OS Release 10.0 for EX Series switches.

Command introduced in Junos OS Release 11.1 for the QFX Series.

Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Command introduced in Junos OS Release 14.2R3

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`
  - 10 Gigabit Ethernet—`xe-fpc/pic/port`
- **extensive**—Display LACP information for the interface in detail.

**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`

Related Documentation

- Configuring Aggregated Ethernet Links (CLI Procedure)
- Configuring Link Aggregation
- Configuring Aggregated Ethernet LACP (CLI Procedure)
- Configuring Aggregated Ethernet LACP (CLI Procedure)
- Configuring LACP Link Protection of Aggregated Ethernet Interfaces for Switches
Understanding Aggregated Ethernet Interfaces and LACP for Switches

Junos OS Interfaces Fundamentals Configuration Guide

List of Sample Output
show lACP interfaces (Aggregated Ethernet) on page 2217
show lACP interfaces (Gigabit Ethernet) on page 2217
show lACP interfaces (10 Gigabit Ethernet) on page 2218

Output Fields
Table 177 on page 2215 lists the output fields for the show lACP interfaces command. Output fields are listed in the approximate order in which they appear.

Table 177: show lACP interfaces Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>LACP State</td>
<td>For a child interface configured with the force-up statement, LACP state displays FUP along with the interface name.</td>
<td>All Levels</td>
</tr>
<tr>
<td></td>
<td>Aggregated interface value.</td>
<td>All Levels</td>
</tr>
</tbody>
</table>

LACP State

- **Role**—Role played by the interface. It can be one of the following:
  - **Actor**—Local device participating in LACP negotiation.
  - **Partner**—Remote device participating in LACP negotiation.

- **Exp**—Expired state. **Yes** indicates the actor or partner is in an expired state. **No** indicates the actor or partner is not in an expired state.

- **Def**—Default. **Yes** indicates that the actor’s receive machine is using the default operational partner information, administratively configured for the partner. **No** indicates the operational partner information in use has been received in an LACP PDU.

- **Dist**—Distribution of outgoing frames. **No** indicates distribution of outgoing frames on the link is currently disabled and is not expected to be enabled. Otherwise, the value is **Yes**.

- **Col**—Collection of incoming frames. **Yes** indicates collection of incoming frames on the link is currently enabled and is not expected to be disabled. Otherwise, the value is **No**.

- **Syn**—Synchronization. If the value is **Yes**, 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 **No**, the link is not synchronized. It is currently not in the right aggregation.

- **Aggr**—Ability of aggregation port to aggregate (**Yes**) or to operate only as an individual link (**No**).

- **Timeout**—LACP timeout preference. Periodic transmissions of LACP PDUs occur at either a slow or fast transmission rate, depending upon the expressed LACP timeout preference (**Long Timeout** or **Short Timeout**).

- **Activity**—Actor or partner’s port activity. **Passive** indicates the port’s preference for not transmitting LAC PDUs unless its partner’s control value is **Active**. **Active** indicates the port’s preference to participate in the protocol regardless of the partner’s control value.

- **Core isolation state down (CDN)**—LACP interface state. Down indicates the LACP interface is down because all the eBGP sessions for Ethernet VPN (EVPN) are down.
### Table 177: show lACP interfaces Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>LACP Protocol</td>
<td>LACP protocol information for each aggregated interface:</td>
<td>All Levels</td>
</tr>
<tr>
<td></td>
<td>• Link state (active or standby) indicated in parentheses next to the interface when link protection is configured.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Receive State</strong>—One of the following values:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Current</strong>—The state machine receives an LACP PDU and enters the <strong>Current</strong> state.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Defaulted</strong>—If no LACP PDU is received before the timer for the <strong>Current</strong> state expires a second time, the state machine enters the <strong>Defaulted</strong> state.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Expired</strong>—If no LACP PDU is received before the timer for the <strong>Current</strong> state expires once, the state machine enters the <strong>Expired</strong> state.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Initialize</strong>—When the physical connectivity of a link changes or a Begin event occurs, the state machine enters the <strong>Initialize</strong> state.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>LACP Disabled</strong>—If the port is operating in half duplex, the operation of LACP is disabled on the port, forcing the state to <strong>LACP Disabled</strong>. This state is similar to the <strong>Defaulted</strong> state, except that the port is forced to operate as an individual port.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Port Disabled</strong>—If the port becomes inoperable and a Begin event has not occurred, the state machine enters the <strong>Port Disabled</strong> state.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Transmit State</strong>—Transmit state of state machine. One of the following values:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Fast Periodic</strong>—Periodic transmissions are enabled at a fast transmission rate.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>No Periodic</strong>—Periodic transmissions are disabled.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Periodic Timer</strong>—Transitory state entered when the periodic timer expires.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Slow Periodic</strong>—Periodic transmissions are enabled at a slow transmission rate.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Mux State</strong>—State of the multiplexer state machine for the aggregation port. The state is one of the following values:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Attached</strong>—Multiplexer state machine initiates the process of attaching the port to the selected aggregator.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Collecting</strong>—<strong>Yes</strong> 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. <strong>No</strong> indicates the receive function of this link is not enabled.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Collecting Distributing</strong>—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Detached</strong>—Process of detaching the port from the aggregator is in progress.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Distributing</strong>—<strong>Yes</strong> 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. <strong>No</strong> indicates the transmit function of this link is not enabled.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Waiting</strong>—Multiplexer state machine is in a holding process, awaiting an outcome.</td>
<td></td>
</tr>
</tbody>
</table>
Table 177: show lacp interfaces Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LACP info</strong></td>
<td></td>
<td>Extensive</td>
</tr>
<tr>
<td>• Role</td>
<td>can be one of the following:</td>
<td></td>
</tr>
<tr>
<td>• Actor</td>
<td>— Local device participating in LACP negotiation.</td>
<td></td>
</tr>
<tr>
<td>• Partner</td>
<td>— Remote device participating in LACP negotiation.</td>
<td></td>
</tr>
<tr>
<td>• System priority</td>
<td>— Priority assigned to the system (by management or administrative policy), encoded as an unsigned integer.</td>
<td></td>
</tr>
<tr>
<td>• System identifier</td>
<td>— Actor or partner system ID, encoded as a MAC address.</td>
<td></td>
</tr>
<tr>
<td>• Port priority</td>
<td>— Priority assigned to the port by the actor or partner (by management or administrative policy), encoded as an unsigned integer.</td>
<td></td>
</tr>
<tr>
<td>• Port number</td>
<td>— Port number assigned to the port by the actor or partner, encoded as an unsigned integer.</td>
<td></td>
</tr>
<tr>
<td>• Port key</td>
<td>— Operational key value assigned to the port by the actor or partner, encoded as an unsigned integer.</td>
<td></td>
</tr>
</tbody>
</table>

Sample Output

*show lacp interfaces (Aggregated Ethernet)*

```
user@host> show lacp interfaces ae0 extensive
```

```
LACP state:       Role   Exp   Def  Dist  Col  Syn  Aggr  Timeout  Activity
ge-0/0/1       Actor    No    No   Yes  Yes  Yes   Yes     Fast    Active
ge-0/0/1     Partner    No    No   Yes  Yes  Yes   Yes     Fast    Active
ge-0/0/2       Actor    No    No   Yes  Yes  Yes   Yes     Fast    Active
ge-0/0/2     Partner    No    No   Yes  Yes  Yes   Yes     Fast    Active
ge-0/0/3       Actor    No    No   Yes  Yes  Yes   Yes     Fast    Active
ge-0/0/3     Partner    No    No   Yes  Yes  Yes   Yes     Fast    Active

LACP protocol:        Receive State  Transmit State          Mux State
ge-0/0/1                  Current   Fast periodic Collecting distributing
ge-0/0/2                  Current   Fast periodic Collecting distributing
ge-0/0/3                  Current   Fast periodic Collecting distributing

LACP info:        Role     System             System       Port     Port
key priority     identifier   priority   number
ge-0/0/1       Actor        127  00:05:86:4e:b6:c0        127        1
ge-0/0/1     Partner        127  00:05:86:7e:d3:c0        127        1
ge-0/0/2       Actor        127  00:05:86:4e:b6:c0        127        2
ge-0/0/2     Partner        127  00:05:86:7e:d3:c0        127        2
ge-0/0/3       Actor        127  00:05:86:4e:b6:c0        127        3
ge-0/0/3     Partner        127  00:05:86:7e:d3:c0        127        3
```

*show lacp interfaces (Gigabit Ethernet)*

```
user@host> show lacp interfaces ge-0/3/0
```

Copyright © 2019, Juniper Networks, Inc.
show lacp interfaces (10 Gigabit Ethernet)

user@host> show lacp interfaces xe-1/0/2

Aggregated interface: ae0
LACP State:       Role   Exp   Def  Dist  Col  Syn  Aggr  Timeout  Activity
xe-1/0/2       Actor    No    No   Yes  Yes  Yes   Yes     Fast    Active
xe-1/0/2     Partner    No    No   Yes  Yes  Yes   Yes     Fast    Active
LACP Protocol:   Receive State    Transmit State           Mux State
xe-1/0/2             Current     Fast periodic  Collecting  distributing
**show lldp**

**Syntax**

```
show lldp <detail>
```

**Release Information**


**Description**

Display information about the Link Layer Discovery Protocol (LLDP).

**Options**

- `detail`—(Optional) Display the detailed output level.

**Required Privilege Level**

`view`

**List of Sample Output**

- `show lldp` on page 2221
- `show lldp detail` on page 2221

**Output Fields**

Table 178 on page 2219 describes the output fields for the `show lldp` command. Output fields are listed in the approximate order in which they appear.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LLDP</td>
<td>Status of LLDP: Enabled or Disabled.</td>
</tr>
<tr>
<td>Advertisement interval</td>
<td>Value of the advertisement interval parameter.</td>
</tr>
<tr>
<td>Transmit delay</td>
<td>Value of the transmit delay parameter.</td>
</tr>
<tr>
<td>Hold timer</td>
<td>Value of the hold timer parameter.</td>
</tr>
<tr>
<td>Notification interval</td>
<td>Value of the notification interval parameter.</td>
</tr>
<tr>
<td>Config Trap interval</td>
<td>Value of the configuration trap parameter.</td>
</tr>
<tr>
<td>Connection Hold timer</td>
<td>Value of the connection hold timer parameter.</td>
</tr>
<tr>
<td>Port ID TLV subtype</td>
<td><code>interface-name</code>—Indicates the interface name as the port information for the local device.</td>
</tr>
<tr>
<td></td>
<td><code>locally-assigned</code>—Indicates that the sub-type for port ID TLV generation is locally assigned value of SNMP index of the interface.</td>
</tr>
</tbody>
</table>

For more information about port ID TLV subtype, see `port-id-subtype`.
#### Table 178: show lldp Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Port Description TLV type</strong></td>
<td>Following value used for port description TLV:</td>
</tr>
<tr>
<td>- interface-alias (ifAlias)</td>
<td>Indicates that the ifAlias MIB object value is used to generate the port description TLV.</td>
</tr>
<tr>
<td>- interface-description (ifDescr)</td>
<td>Indicates that the ifDescr MIB object value is used to generate the port description TLV.</td>
</tr>
<tr>
<td>For more information about port description TLV type, see <a href="#">port-description-type</a>.</td>
<td></td>
</tr>
<tr>
<td><strong>Interface</strong></td>
<td>Name of the interface for which LLDP configuration information is being reported.</td>
</tr>
<tr>
<td>For information about interface names, see <a href="#">Interface Naming Overview</a>. For information about interface names for TX Matrix routers, see <a href="#">TX Matrix Router Chassis and Interface Names</a>. For information about FPC numbering on TX Matrix routers, see <a href="#">Routing Matrix with a TX Matrix Router FPC Numbering</a>.</td>
<td></td>
</tr>
<tr>
<td><strong>Parent Interface</strong></td>
<td>Name of the aggregated Ethernet interface, if any, to which the interface belongs.</td>
</tr>
<tr>
<td><strong>LLDP</strong></td>
<td>LLDP operating state. The state can be Enabled or Disabled.</td>
</tr>
<tr>
<td><strong>LLDP-MED</strong></td>
<td>LLDP-MED operating state. The state can be Enabled or Disabled.</td>
</tr>
<tr>
<td><strong>Power Negotiation</strong></td>
<td>LLDP power negotiation operating state. The state can be Enabled or Disabled.</td>
</tr>
<tr>
<td><strong>LLDP basic TLVs supported</strong></td>
<td>List of basic LLDP TLVs supported by this device <strong>(detail only)</strong>.</td>
</tr>
<tr>
<td><strong>LLDP 802 TLVs supported</strong></td>
<td>List of IEEE 802.1 LLDP TLVs supported by this device <strong>(detail only)</strong>.</td>
</tr>
</tbody>
</table>
Sample Output

**show lldp**

```bash
cruser@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)

<table>
<thead>
<tr>
<th>Interface</th>
<th>Parent Interface</th>
<th>LLDP</th>
<th>LLDP-MED</th>
<th>Power Negotiation</th>
</tr>
</thead>
<tbody>
<tr>
<td>all</td>
<td>-</td>
<td>Enabled</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

**Sample Output**

**show lldp detail**

```bash
cruser@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)

<table>
<thead>
<tr>
<th>Interface</th>
<th>Parent Interface</th>
<th>Vlan-id</th>
<th>Vlan-name</th>
</tr>
</thead>
<tbody>
<tr>
<td>xe-0/0/0</td>
<td>-</td>
<td>4080</td>
<td>vlan-4080</td>
</tr>
<tr>
<td>xe-0/0/1</td>
<td>-</td>
<td>4080</td>
<td>vlan-4080</td>
</tr>
</tbody>
</table>

Basic Management TLVs supported:
- End Of LLDPDU, Chassis ID, Port ID, Time To Live, Port Description, System Name,
- System Description, System Capabilities, Management Address

Organizational Specific TLVs supported:
- Port VLAN tag, VLAN Name, MAC/PHY Configuration/Status, Link Aggregation, Maximum Frame Size
show lldp local-information

**Syntax**
show lldp local-information

**Release Information**

**Description**
Display local Link Layer Discovery Protocol (LLDP) information.

**Options**
This command has no options.

**Required Privilege**
Level view

**List of Sample Output**
- show lldp local-information (Management Information Address Subtype is IPv4) on page 2224
- show lldp local-information (Management Information Address Subtype is IPv6) on page 2224

**Output Fields**
Table 179 on page 2222 describes the output fields for the `show lldp local-information` command. Output fields are listed in the approximate order in which they appear.

**Table 179: show lldp local-information Output Fields**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LLDP Local Information details</td>
<td>Information that follows pertains to the local system.</td>
</tr>
<tr>
<td>Chassis ID</td>
<td>List of chassis identifiers for local information.</td>
</tr>
<tr>
<td>System name</td>
<td>Local system name reported by LLDP.</td>
</tr>
<tr>
<td>System descr</td>
<td>Local system description reported by LLDP.</td>
</tr>
<tr>
<td>System Capabilities</td>
<td>Capabilities (such as Bridge or Router) that are Supported or Enabled by system on the interface.</td>
</tr>
<tr>
<td>Management Information</td>
<td>Listed by Interface Name, Address Subtype (such as ipv4, ipv6), Address (such as 192.168.168.229, 1fd:1a10), Interface Number, and Interface Numbering Subtype.</td>
</tr>
<tr>
<td>Interface Name</td>
<td>List of local interfaces.</td>
</tr>
<tr>
<td>Parent Interface</td>
<td>Name of the ae interface to which the interface belongs.</td>
</tr>
</tbody>
</table>
Table 179: show lldp local-information Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface ID</td>
<td>List of local interface identifiers.</td>
</tr>
<tr>
<td>Interface Description</td>
<td>List of local interface descriptions.</td>
</tr>
<tr>
<td>Status</td>
<td>List of interface conditions: UP or DOWN.</td>
</tr>
</tbody>
</table>
### 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 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)

<table>
<thead>
<tr>
<th>Interface name</th>
<th>Parent Interface</th>
<th>Interface ID</th>
<th>Interface description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>fxp0</td>
<td>-</td>
<td>1</td>
<td>fxp0</td>
<td>Up</td>
</tr>
<tr>
<td>me0</td>
<td>-</td>
<td>33</td>
<td>me0</td>
<td>Up</td>
</tr>
<tr>
<td>ge-2/0/0</td>
<td>ae0</td>
<td>1475</td>
<td>ge-2/0/0</td>
<td>Up</td>
</tr>
<tr>
<td>ge-2/0/1</td>
<td>ae0</td>
<td>1476</td>
<td>ge-2/0/1</td>
<td>Up</td>
</tr>
</tbody>
</table>
```

**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)

<table>
<thead>
<tr>
<th>Interface name</th>
<th>Parent Interface</th>
<th>Interface ID</th>
<th>Interface description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-1/2/4</td>
<td>-</td>
<td>530</td>
<td>-</td>
<td>Down</td>
</tr>
<tr>
<td>ge-1/2/5</td>
<td>-</td>
<td>531</td>
<td>-</td>
<td>Down</td>
</tr>
<tr>
<td>ge-1/2/2</td>
<td>-</td>
<td>528</td>
<td>ge-1/2/2</td>
<td>Up</td>
</tr>
<tr>
<td>ge-1/2/3</td>
<td>-</td>
<td>529</td>
<td>ge-1/2/3</td>
<td>Up</td>
</tr>
</tbody>
</table>
```
**show lldp neighbors**

**Syntax**

```
show lldp neighbors
<interface interface-name>
```

**Release Information**


**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 1639

**List of Sample Output**

- show lldp neighbors on page 2228
- show lldp neighbors interface ge-0/0/4 (Management Address is IPv4) on page 2228
- show lldp neighbors interface ge-0/0/4 (Management Address is IPv6) on page 2229
- show lldp neighbors (Management Ethernet Interfaces) on page 2230

**Output Fields**

Table 180 on page 2225 describes the output fields for the `show lldp neighbors` command. Output fields are listed in the approximate order in which they appear.

**Table 180: show lldp neighbors Output Fields**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LLDP Remote Devices Information</td>
<td>Information about remote devices.</td>
</tr>
</tbody>
</table>
### Table 180: show lldp neighbors Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LocalInterface</td>
<td>List of local interfaces for which neighbor information is available.</td>
</tr>
<tr>
<td>ChassisId</td>
<td>List of chassis identifiers for neighbors.</td>
</tr>
<tr>
<td>PortInfo</td>
<td>List of port information gathered from neighbors. This could be the port identifier or port description.</td>
</tr>
<tr>
<td>SysName</td>
<td>List of system names gathered from neighbors.</td>
</tr>
<tr>
<td>LLDP Neighbor Information</td>
<td>Information about both local and neighbor systems on the interface (appears when the interface option is used).</td>
</tr>
<tr>
<td>Local Information</td>
<td>Information about local systems on the interface (appears when the interface option is used).</td>
</tr>
<tr>
<td>Neighbor Information</td>
<td>Information about both local and neighbor system on the interface (appears when the interface option is used).</td>
</tr>
<tr>
<td>Index</td>
<td>Local interface index (appears when the interface option is used).</td>
</tr>
<tr>
<td>Time Mark</td>
<td>Date and timestamp of information (appears when the interface option is used).</td>
</tr>
<tr>
<td>Time To Live</td>
<td>Number of seconds for which this information is valid (appears when the interface option is used).</td>
</tr>
<tr>
<td>Local Interface</td>
<td>Name of the local physical interface (appears when the interface option is used).</td>
</tr>
<tr>
<td>Parent Interface</td>
<td>Name of the ae interface to which the interface belongs</td>
</tr>
<tr>
<td>Local Port ID</td>
<td>Local port identifier (appears when the interface option is used).</td>
</tr>
<tr>
<td>Neighbor Information</td>
<td>Information about neighbor systems on the interface (appears when the interface option is used).</td>
</tr>
<tr>
<td>Chassis type</td>
<td>Type of chassis identifier supplied, such as MAC address (appears when the interface option is used).</td>
</tr>
<tr>
<td>Chassis ID</td>
<td>Chassis identifier of type listed (appears when the interface option is used).</td>
</tr>
<tr>
<td>Port type</td>
<td>Type of port identifier supplied, such as local (appears when the interface option is used).</td>
</tr>
<tr>
<td>Port ID</td>
<td>Port identifier of type listed (appears when the interface option is used).</td>
</tr>
<tr>
<td>Port description</td>
<td>Port description (appears when the interface option is used).</td>
</tr>
<tr>
<td>Field Name</td>
<td>Field Description</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>System name</td>
<td>Name supplied by the system on the interface (appears when the interface option is used).</td>
</tr>
<tr>
<td>System Description</td>
<td>Description supplied by the system on the interface (appears when the interface option is used).</td>
</tr>
<tr>
<td>System Capabilities</td>
<td>Capabilities (such as bridge or router) that are Supported or Enabled by the system on the interface (appears when the interface option is used).</td>
</tr>
<tr>
<td>Management address</td>
<td>Details of the management address: Address Type (such as ipv4 and ipv6), Address (such as 10.204.34.35, 1fd::1a10), Interface Number, Interface Subtype, and Organization Identifier (OID) (appears when the interface option is used).</td>
</tr>
<tr>
<td>Organization Info</td>
<td>One or more entries listing remote information by Organizationally Unique Identifier (OUI), Subtype, Index, and Info (appears when the interface option is used).</td>
</tr>
</tbody>
</table>
Sample Output

show lldp neighbors

user@host> show lldp neighbors

<table>
<thead>
<tr>
<th>Local Interface</th>
<th>Parent Interface</th>
<th>Chassis Id</th>
<th>Port info</th>
<th>System Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-2/0/0</td>
<td>ae0</td>
<td>ac:4b:c8:92:67:c0</td>
<td>528</td>
<td>apg-hp</td>
</tr>
<tr>
<td>ge-2/0/1</td>
<td>ae0</td>
<td>ac:4b:c8:92:67:c0</td>
<td>529</td>
<td>apg-hp</td>
</tr>
</tbody>
</table>

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
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

<table>
<thead>
<tr>
<th>Local Interface</th>
<th>Parent Interface</th>
<th>Chassis Id</th>
<th>Port info</th>
</tr>
</thead>
<tbody>
<tr>
<td>fxp0</td>
<td>-</td>
<td>78:fe:3d:ee:4e:00</td>
<td>151</td>
</tr>
<tr>
<td>x2-sw35</td>
<td>-</td>
<td>a8:d0:e5:50:26:c0</td>
<td>512</td>
</tr>
<tr>
<td>xe-0/0/0</td>
<td>-</td>
<td>a8:d0:e5:50:26:c0</td>
<td>513</td>
</tr>
<tr>
<td>sitara</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>xe-0/0/1</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sitara</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```
show lldp remote-global-statistics

Syntax

show lldp remote-global-statistics

Release Information


Description

Display remote Link Layer Discovery Protocol (LLDP) global statistics.

Options

This command has no options.

Required Privilege Level

view

List of Sample Output

show lldp remote-global-statistics on page 2232

Output Fields

Table 181 on page 2231 describes the output fields for the show lldp remote-global-statistics command. Output fields are listed in the approximate order in which they appear.

Table 181: show lldp remote-global-statistics Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LLDP Remote Database Table Counters</td>
<td>Information about remote database table counters.</td>
</tr>
<tr>
<td>LastchangeTime</td>
<td>Time elapsed between LLDP agent startup and the last change to the remote database table information.</td>
</tr>
<tr>
<td>Inserts</td>
<td>Number of insertions made in the remote database table.</td>
</tr>
<tr>
<td>Deletes</td>
<td>Number of deletions made in the remote database table.</td>
</tr>
<tr>
<td>Drops</td>
<td>Number of LLDP frames dropped from the remote database table because of errors.</td>
</tr>
<tr>
<td>Ageouts</td>
<td>Number of remote database table entries that have aged out of the table.</td>
</tr>
</tbody>
</table>
Sample Output

```
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


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

view

Related Documentation

• clear lldp statistics on page 1640

List of Sample Output

show lldp statistics on page 2235
show lldp statistics interface ge-0/1/1 on page 2235

Output Fields

Table 182 on page 2233 describes the output fields for the show lldp statistics command. Output fields are listed in the approximate order in which they appear.

Table 182: show lldp statistics Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>Interface name.</td>
</tr>
<tr>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>Received</td>
<td>Number of LLDP frames received on this interface.</td>
</tr>
<tr>
<td>Transmitted</td>
<td>Number of LLDP frames sent on this interface.</td>
</tr>
</tbody>
</table>
Table 182: show lldp statistics Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown-TLVs</td>
<td>Number of LLDP frames with unsupported content received on this interface.</td>
</tr>
<tr>
<td>With-Errors</td>
<td>Number of LLDP frames with errors received on this interface.</td>
</tr>
<tr>
<td>Discarded</td>
<td>Number of LLDP frames received on this interface that were discarded because of problems.</td>
</tr>
<tr>
<td>Transmitted</td>
<td>Total number of LLDP frames that were transmitted on an interface.</td>
</tr>
<tr>
<td>Untransmitted</td>
<td>Total number of LLDP frames that were untransmitted on an interface.</td>
</tr>
</tbody>
</table>
### Sample Output

**show lldp statistics**

```plaintext
user@host> show lldp statistics

<table>
<thead>
<tr>
<th>Interface</th>
<th>Parent Interface</th>
<th>Received</th>
<th>Unknown TLVs</th>
<th>With Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>xe-3/0/0.0</td>
<td>ae31.0</td>
<td>1564</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>xe-3/0/1.0</td>
<td>ae31.0</td>
<td>1564</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>xe-3/0/2.0</td>
<td>ae31.0</td>
<td>1565</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>xe-3/0/3.0</td>
<td>ae31.0</td>
<td>1566</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>xe-3/0/4.0</td>
<td>ae31.0</td>
<td>1598</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>xe-3/0/5.0</td>
<td>ae31.0</td>
<td>1598</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>xe-3/0/6.0</td>
<td>ae31.0</td>
<td>1596</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>xe-3/0/7.0</td>
<td>ae31.0</td>
<td>1597</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>xe-5/0/6.0</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>xe-5/0/7.0</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Discarded TLVs</th>
<th>Transmitted</th>
<th>Untransmitted</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3044</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>3044</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>3044</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>3044</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>3075</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>3075</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>17312</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>17312</td>
<td>0</td>
</tr>
</tbody>
</table>
```

### Sample Output

**show lldp statistics interface ge-0/1/1**

```plaintext
user@host> show lldp statistics interface ge-0/1/1

<table>
<thead>
<tr>
<th>Interface</th>
<th>Received</th>
<th>Transmitted</th>
<th>Unknown TLVs</th>
<th>With-Errors</th>
<th>Discarded</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-0/1/1</td>
<td>544</td>
<td>540</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
```
show oam ethernet connectivity-fault-management delay-statistics

Syntax

```
show oam ethernet connectivity-fault-management delay-statistics
<count entry-count>
<local-mep mep-id>
<maintenance-association ma-name>
<maintenance-domain md-name>
<remote-mep remote-mep-id>
```

Release Information

Command introduced in Junos OS Release 9.5.
Command introduced in Junos OS Release 11.4 for EX Series switches.

Description

On MX Series routers with Ethernet interfaces on Dense Port Concentrators (DPCs),
display ETH-DM delay statistics.

On EX Series switches, display delay measurement results.

Options

- `count entry-count`—(Optional) Number of entries to display from the statistics table. The
  range of values is 1 through 100. The default value is 100 entries.

- `local-mep mep-id`—(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.

- `maintenance-association ma-name`—Name of an existing CFM maintenance association.

- `maintenance-domain md-name`—Name of an existing connectivity fault management
  (CFM) maintenance domain.

- `remote-mep remote-mep-id`—(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.

Required Privilege Level

`view`

Related Documentation

- clear oam ethernet connectivity-fault-management statistics on page 1645
- clear oam ethernet connectivity-fault-management delay-statistics
- show oam ethernet connectivity-fault-management interfaces on page 2244
- show oam ethernet connectivity-fault-management mep-database on page 2262
- show oam ethernet connectivity-fault-management mep-statistics on page 2274

List of Sample Output

show oam ethernet connectivity-fault-management delay-statistics on page 2238
show oam ethernet connectivity-fault-management delay-statistics remote-mep on page 2238
### Output Fields

Table 183 on page 2237 lists the output fields for the `show oam ethernet connectivity-fault-management delay-statistics` command and the `show oam ethernet connectivity-fault-management mep-statistics` command. Output fields are listed in the approximate order in which they appear.

**Table 183: show oam ethernet connectivity-fault-management delay-statistics and mep-statistics Output Fields**

<table>
<thead>
<tr>
<th>Output Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEP identifier</td>
<td>Maintenance association end point (MEP) numeric identifier.</td>
</tr>
<tr>
<td>MAC address</td>
<td>Unicast MAC address configured for the MEP.</td>
</tr>
<tr>
<td>Remote MEP count</td>
<td>Number of remote MEPs (unless you specify the <code>remote-mep</code> option).</td>
</tr>
<tr>
<td>Remote MEP identifier</td>
<td>Numeric identifier of the remote MEP.</td>
</tr>
<tr>
<td>Remote MAC address</td>
<td>Unicast MAC address of the remote MEP.</td>
</tr>
<tr>
<td>Index</td>
<td>Index number that corresponds to the ETH-DM entry in the CFM database.</td>
</tr>
<tr>
<td>One-way delay (usec)</td>
<td>For a one-way ETH-DM session, the frame delay time, in microseconds, measured at the receiver MEP.</td>
</tr>
<tr>
<td></td>
<td>For a detailed description of one-way Ethernet frame delay measurement, see the <a href="https://www.juniper.net">ITU-T Y.1731 Ethernet Service OAM topics</a> in the Junos OS Network Interfaces Library for Routing Devices.</td>
</tr>
<tr>
<td>Two-way delay (usec)</td>
<td>For a two-way ETH-DM session, the frame delay time, in microseconds, measured at the initiator MEP.</td>
</tr>
<tr>
<td></td>
<td>For a detailed description of two-way Ethernet frame delay measurement, see the <a href="https://www.juniper.net">ITU-T Y.1731 Ethernet Service OAM topics</a> in the Junos OS Network Interfaces Library for Routing Devices.</td>
</tr>
<tr>
<td>Average one-way delay</td>
<td>Average one-way frame delay for the statistics displayed.</td>
</tr>
<tr>
<td>Average one-way delay variation</td>
<td>Average one-way “frame jitter” for the statistics displayed.</td>
</tr>
<tr>
<td>Best-case one-way delay</td>
<td>Lowest one-way frame delay for the statistics displayed.</td>
</tr>
<tr>
<td>Worst-case one-way delay</td>
<td>Highest one-way frame delay for the statistics displayed.</td>
</tr>
<tr>
<td>Average two-way delay</td>
<td>Average two-way frame delay for the statistics displayed.</td>
</tr>
<tr>
<td>Average two-way delay variation</td>
<td>Average two-way “frame jitter” for the statistics displayed.</td>
</tr>
<tr>
<td>Best-case two-way delay</td>
<td>Lowest two-way frame delay for the statistics displayed.</td>
</tr>
<tr>
<td>Worst-case two-way delay</td>
<td>Highest two-way frame delay calculated in this session.</td>
</tr>
</tbody>
</table>
### 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:
<table>
<thead>
<tr>
<th>Index</th>
<th>One-way delay (usec)</th>
<th>Two-way delay (usec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>259</td>
<td>519</td>
</tr>
<tr>
<td>2</td>
<td>273</td>
<td>550</td>
</tr>
<tr>
<td>3</td>
<td>287</td>
<td>571</td>
</tr>
<tr>
<td>4</td>
<td>299</td>
<td>610</td>
</tr>
<tr>
<td>5</td>
<td>313</td>
<td>650</td>
</tr>
</tbody>
</table>
  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:
<table>
<thead>
<tr>
<th>Index</th>
<th>One-way delay (usec)</th>
<th>Two-way delay (usec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>29</td>
<td>58</td>
</tr>
<tr>
<td>2</td>
<td>23</td>
<td>59</td>
</tr>
<tr>
<td>3</td>
<td>27</td>
<td>56</td>
</tr>
<tr>
<td>4</td>
<td>29</td>
<td>62</td>
</tr>
<tr>
<td>5</td>
<td>33</td>
<td>68</td>
</tr>
</tbody>
</table>
  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 remote-mep
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:
```
<table>
<thead>
<tr>
<th>Index</th>
<th>One-way delay (usec)</th>
<th>Two-way delay (usec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>259</td>
<td>519</td>
</tr>
<tr>
<td>2</td>
<td>273</td>
<td>550</td>
</tr>
<tr>
<td>3</td>
<td>287</td>
<td>571</td>
</tr>
<tr>
<td>4</td>
<td>299</td>
<td>610</td>
</tr>
<tr>
<td>5</td>
<td>313</td>
<td>650</td>
</tr>
</tbody>
</table>

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

**Syntax**
```
show oam ethernet connectivity-fault-management forwarding-state
  interface interface-name | instance instance-name
  <brief | detail | extensive>
```

**Release Information**
Command introduced in Junos OS Release 8.4.

**Description**
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.

**Options**
- `interface interface-name`—Display forwarding state information for the specified Ethernet interface only.
- `instance instance-name`—Display forwarding state information for the specified forwarding instance only.
- `brief | detail | extensive`—(Optional) Display the specified level of output.

**Required Privilege Level**
view

**List of Sample Output**
- `show oam ethernet connectivity-fault-management forwarding-state instance on page 2241`
- `show oam ethernet connectivity-fault-management forwarding-state interface on page 2241`
- `show oam ethernet connectivity-fault-management forwarding-state interface detail on page 2242`
- `show oam ethernet connectivity-fault-management forwarding-state interface-name on page 2243`

**Output Fields**
Table 184 on page 2240 lists the output fields for the `show oam ethernet connectivity-fault-management forwarding-state` command. Output fields are listed in the approximate order in which they appear.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface name</td>
<td>Interface identifier.</td>
<td>All levels</td>
</tr>
<tr>
<td>Link (Status)</td>
<td>Local link status.</td>
<td>All levels</td>
</tr>
<tr>
<td>Filter action</td>
<td>Filter action for messages at the level.</td>
<td>All levels</td>
</tr>
<tr>
<td>Next hop type</td>
<td>Next-hop type.</td>
<td>All levels</td>
</tr>
</tbody>
</table>
Table 184: `show oam ethernet connectivity-fault-management forwarding-state` Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Next index</td>
<td>Next-hop index number.</td>
<td>brief</td>
</tr>
<tr>
<td>Level</td>
<td>Maintenance domain (MD) level.</td>
<td>detail</td>
</tr>
<tr>
<td>Direction</td>
<td>MEP direction configured.</td>
<td>none</td>
</tr>
<tr>
<td>Instance name</td>
<td>Forwarding instance name.</td>
<td>All levels</td>
</tr>
<tr>
<td>CEs</td>
<td>Number of customer edge (CE) interfaces.</td>
<td>All levels</td>
</tr>
<tr>
<td>VEs</td>
<td>Number of VPN endpoint (VE) interfaces.</td>
<td>All levels</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Level</th>
<th>Direction</th>
<th>Filter action</th>
<th>Nexthop type</th>
<th>Nexthop index</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Drop</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Drop</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Drop</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Drop</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Drop</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Drop</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Drop</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Drop</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
</tbody>
</table>
```

```
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:

<table>
<thead>
<tr>
<th>Level</th>
<th>Direction</th>
<th>Filter action</th>
<th>Nexthop type</th>
<th>Nexthop index</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Drop</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Drop</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
</tbody>
</table>
```
## Maintenance domain forwarding state:

<table>
<thead>
<tr>
<th>Level</th>
<th>Direction</th>
<th>Filter action</th>
<th>Nexthop type</th>
<th>Nexthop index</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Drop</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Drop</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Drop</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Drop</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Drop</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Drop</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Drop</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>down</td>
<td>Receive</td>
<td>none</td>
<td></td>
</tr>
</tbody>
</table>

Interface name: xe-0/0/0.0
Instance name: __+bd1__

## show oam ethernet connectivity-fault-management forwarding-state interface detail

```
user@host> show oam ethernet connectivity-fault-management forwarding-state interface detail

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

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
```
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

Interface name: ge-3/0/0.0
Instance name: __+bd1__

  Maintenance domain forwarding state:

<table>
<thead>
<tr>
<th>Level</th>
<th>Direction</th>
<th>Filter action</th>
<th>Nexthop type</th>
<th>Nexthop index</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td>Drop</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>Drop</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Drop</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Drop</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Drop</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Drop</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Drop</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>down</td>
<td>Receive</td>
<td>none</td>
<td></td>
</tr>
</tbody>
</table>
**show oam ethernet connectivity-fault-management interfaces**

**Syntax**

```
show oam ethernet connectivity-fault-management interfaces
<ethernet-interface-name>
<level md-level>
<brief | detail | extensive>
```

**Release Information**

Command introduced in Junos OS Release 8.4.
Support for ITU-T Y.1731 frame delay measurement added in Junos OS Release 9.5.
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.

**Description**

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.

In addition, for Ethernet interfaces on MX Series routers, also display any ITU-T Y.1731 frame delay measurement (ETH-DM) frame counts when `detail` or `extensive` mode is specified.

For Ethernet interfaces on MX Series routers, display any ITU-T Y.1731 synthetic frame loss measurement (ETH-SLM) statistics and frame counts.

**Options**

- **brief | detail | extensive** — (Optional) Specified level of output.
- **ethernet-interface-name** — (Optional) CFM information only for CFM entities attached to the specified Ethernet interface.
- **level md-level** — (Optional) CFM information for CFM identities enclosed within a maintenance domain of the specified level.

**Required Privilege**

- **view**

**Related Documentation**

- clear oam ethernet connectivity-fault-management statistics on page 1645
- show oam ethernet connectivity-fault-management delay-statistics on page 2236
- show oam ethernet connectivity-fault-management mep-database on page 2262
- show oam ethernet connectivity-fault-management mep-statistics on page 2274
- Ethernet Alarm Indication Signal (ETH-AIS) Function Overview on page 938

**List of Sample Output**

- show oam ethernet connectivity-fault-management interfaces on page 2249
- show oam ethernet connectivity-fault-management interfaces detail on page 2250
- show oam ethernet connectivity-fault-management interfaces detail (One-Way ETH-DM) on page 2251
Output Fields  

Table 185 on page 2245 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 185: show oam ethernet connectivity-fault-management interfaces Output Fields**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>Interface identifier.</td>
<td>All levels</td>
</tr>
<tr>
<td>Interface status</td>
<td>Local interface status.</td>
<td>All levels</td>
</tr>
<tr>
<td>Link status</td>
<td>Local link status. <em>Up, down, or oam-down.</em></td>
<td>All levels</td>
</tr>
<tr>
<td>Maintenance domain name</td>
<td>Maintenance domain name.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Format (Maintenance domain)</td>
<td>Maintenance domain name format configured.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Level</td>
<td>Maintenance domain level configured.</td>
<td>All levels</td>
</tr>
<tr>
<td>Maintenance association name</td>
<td>Maintenance association name.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Format (Maintenance association)</td>
<td>Maintenance association name format configured.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Continuity-check status</td>
<td>Continuity-check status.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Ethernet-ais status</td>
<td>Status of alarm indication signal (AIS). <em>active</em> or <em>in-active.</em></td>
<td>detail extensive</td>
</tr>
<tr>
<td>Interval</td>
<td>Continuity-check message interval.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Loss-threshold</td>
<td>Lost continuity-check message threshold.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Interface status TLV</td>
<td>Status of the interface status TLV, if configured on the MEP interface: <em>none, up, down, testing, unknown, dormant, notPresent, lowerLayerDown</em></td>
<td>detail extensive</td>
</tr>
<tr>
<td>Port status TLV</td>
<td>Status of the port status TLV, if configured on the MEP interface: <em>none, no, yes</em></td>
<td>detail extensive</td>
</tr>
</tbody>
</table>
Table 185: show oam ethernet connectivity-fault-management interfaces Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection Protection TLV</td>
<td>Status of the connection protection TLV if configured on the MEP interface: no, yes if yes, then the transmitted connection protection TLV is decoded and the following three fields are displayed: Prefer me, Protection in use, FRR Flag</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Prefer me</td>
<td>If set to yes, 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. Its value can be yes or no.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Protection in use</td>
<td>Used for protection decision coordination. Its value is set to yes if the endpoint transmitting the CCM is currently transmitting the user traffic to protection path. Its value can be yes or no.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>FRR Flag</td>
<td>LSR/LER forwarding the CCM Frame into a bypass tunnel is set. Its value can be yes or no.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>MEP identifier</td>
<td>Maintenance association end point (MEP) identifier.</td>
<td>All levels</td>
</tr>
<tr>
<td>Neighbors</td>
<td>Number of MEP neighbors.</td>
<td>All levels</td>
</tr>
<tr>
<td>Direction</td>
<td>MEP direction configured.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>MAC address</td>
<td>MAC address configured for the MEP.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>MEP status</td>
<td>Indicates the status of the connectivity fault management (CFM) protocol running on the MEP: Running, inactive, disabled, or unsupported.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Remote MEP not receiving CCM</td>
<td>Whether the remote MEP is not receiving connectivity check messages (CCMs).</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Erroneous CCM received</td>
<td>Whether erroneous CCMs have been received.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Cross-connect CCM received</td>
<td>Whether cross-connect CCMs have been received.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>RDI sent by some MEP</td>
<td>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.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Some remote MEP’s MAC in error state</td>
<td>Indicates whether the remote MEP’s MAC is in error state.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Alarm Indication Signal</td>
<td>Indicates whether the AIS is triggered or is cleared.</td>
<td>detail extensive</td>
</tr>
</tbody>
</table>
### Table 185: show oam ethernet connectivity-fault-management interfaces Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCMs sent</td>
<td>Number of CCMs transmitted.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>CCMs received out of sequence</td>
<td>Number of CCMs received out of sequence.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>LBMs sent</td>
<td>Number of loopback request messages (LBMs) sent.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Valid in-order LBRs received</td>
<td>Number of loopback response messages (LBRs) received that were valid messages and in sequence.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Valid out-of-order LBRs received</td>
<td>Number of LBRs received that were valid messages and not in sequence.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>LBRs received with corrupted data</td>
<td>Number of LBRs received that were corrupted.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>LBRs sent</td>
<td>Number of LBRs transmitted.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>LTMs sent</td>
<td>Linktrace messages (LTMs) transmitted.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>LTMs received</td>
<td>Linktrace messages received.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>LTRs sent</td>
<td>Linktrace responses (LTRs) transmitted.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>LTRs received</td>
<td>Linktrace responses received.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Sequence number of next LTM request</td>
<td>Sequence number of next LTM request to be transmitted.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>1DMs sent</td>
<td>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.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>For all other cases, this field displays 0.</td>
<td></td>
</tr>
<tr>
<td>Valid 1DMs received</td>
<td>If the interface is attached to a receiver MEP for a one-way ETH-DM session: Number of valid 1DM frames received.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>For all other cases, this field displays 0.</td>
<td></td>
</tr>
<tr>
<td>Invalid 1DMs received</td>
<td>If the interface is attached to a receiver MEP for a one-way ETH-DM session: Number of invalid 1DM frames received.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>For all other cases, this field displays 0.</td>
<td></td>
</tr>
<tr>
<td>Out of sync 1DMs received</td>
<td>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.</td>
<td>detail extensive</td>
</tr>
</tbody>
</table>
### Table 185: show oam ethernet connectivity-fault-management interfaces Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DMMs sent</strong></td>
<td>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. For all other cases, this field displays 0.</td>
<td>detail extensive</td>
</tr>
<tr>
<td><strong>Valid DMMs received</strong></td>
<td>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.</td>
<td>detail extensive</td>
</tr>
<tr>
<td><strong>Invalid DMMs received</strong></td>
<td>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.</td>
<td>detail extensive</td>
</tr>
<tr>
<td><strong>DMRs sent</strong></td>
<td>If the interface is attached to a responder MEP for a two-way ETH-DM session: Number of delay measurement reply (DMR) frames sent. For all other cases, this field displays 0.</td>
<td>detail extensive</td>
</tr>
<tr>
<td><strong>Valid DMRs received</strong></td>
<td>If the interface is attached to an initiator MEP for a two-way ETH-DM session: Number of valid DMRs received. For all other cases, this field displays 0.</td>
<td>detail extensive</td>
</tr>
<tr>
<td><strong>Invalid DMRs received</strong></td>
<td>If the interface is attached to an initiator MEP for a two-way ETH-DM session: Number of invalid DMRs received. For all other cases, this field displays 0.</td>
<td>detail extensive</td>
</tr>
<tr>
<td><strong>LMM sent</strong></td>
<td>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.</td>
<td>detail extensive</td>
</tr>
<tr>
<td><strong>Valid LMM received</strong></td>
<td>If the interface is attached to an initiator MEP for a ETH-LM session: Number of valid loss measurement request packets received.</td>
<td>detail extensive</td>
</tr>
<tr>
<td><strong>Invalid LMM received</strong></td>
<td>If the interface is attached to an initiator MEP for a ETH-LM session: Number of invalid loss measurement request packets received.</td>
<td>detail extensive</td>
</tr>
<tr>
<td><strong>LMR sent</strong></td>
<td>If the interface is attached to a responder MEP for a ETH-LM session: Number of loss measurement reply (LMR) frames sent.</td>
<td>detail extensive</td>
</tr>
<tr>
<td><strong>Valid LMR received</strong></td>
<td>If the interface is attached to an initiator MEP for a ETH-LM session: Number of valid LMR frames received.</td>
<td>detail extensive</td>
</tr>
<tr>
<td><strong>Invalid LMR received</strong></td>
<td>If the interface is attached to an initiator MEP for a ETH-LM session: Number of invalid LMR frames received.</td>
<td>detail extensive</td>
</tr>
<tr>
<td><strong>Valid AIS frames transmitted</strong></td>
<td>Number of valid AIS frames transmitted to the peer MEPs.</td>
<td>detail extensive</td>
</tr>
<tr>
<td><strong>Valid AIS frames received</strong></td>
<td>Number of valid AIS frames received from the peer MEPs.</td>
<td>detail extensive</td>
</tr>
</tbody>
</table>
### Table 185: show oam ethernet connectivity-fault-management interfaces Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLM sent</td>
<td>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.</td>
<td><strong>detail extensive</strong></td>
</tr>
<tr>
<td>Valid SLM received</td>
<td>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.</td>
<td><strong>detail extensive</strong></td>
</tr>
<tr>
<td>Invalid SLM received</td>
<td>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.</td>
<td><strong>detail extensive</strong></td>
</tr>
<tr>
<td>SLR sent</td>
<td>If the interface is attached to a responder MEP for a ETH-SLM session: Number of valid SLR PDU frames sent.</td>
<td><strong>detail extensive</strong></td>
</tr>
<tr>
<td>Valid SLR received</td>
<td>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.</td>
<td><strong>detail extensive</strong></td>
</tr>
<tr>
<td>Invalid SLR received</td>
<td>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.</td>
<td><strong>detail extensive</strong></td>
</tr>
<tr>
<td>Remote MEP count</td>
<td>Number of remote MEPs.</td>
<td>extensive</td>
</tr>
<tr>
<td>Identifier (remote MEP)</td>
<td>MEP identifier of the remote MEP.</td>
<td><strong>extensive</strong></td>
</tr>
<tr>
<td>MAC address (remote MEP)</td>
<td>MAC address of the remote MEP.</td>
<td><strong>extensive</strong></td>
</tr>
<tr>
<td>State (remote MEP)</td>
<td>State of the remote MEP.</td>
<td><strong>extensive</strong></td>
</tr>
<tr>
<td>Interface (remote MEP)</td>
<td>Interface of the remote MEP.</td>
<td>extensive</td>
</tr>
</tbody>
</table>

### Sample Output

```
user@host> show oam ethernet connectivity-fault-management interfaces

<table>
<thead>
<tr>
<th>Interface</th>
<th>Link</th>
<th>Status</th>
<th>Level</th>
<th>MEP Identifier</th>
<th>Neighbors</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-1/1/0.0</td>
<td>Up</td>
<td>Active</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>ge-1/1/0.1</td>
<td>Up</td>
<td>Active</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>ge-1/1/0.10</td>
<td>Up</td>
<td>Active</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>ge-1/1/0.100</td>
<td>Up</td>
<td>Active</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>ge-1/1/0.101</td>
<td>Up</td>
<td>Active</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
```
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
  LBM sent : 0
  Valid in-order LBRs received : 0
  Valid out-of-order LBRs received : 0
  LBRs received with corrupted data : 0
  LBRs sent : 0
  LTM sent : 0
  LTM received : 0
  LTRs sent : 0
  LTRs received : 0
  Sequence number of next LTM request : 132033363
  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

<table>
<thead>
<tr>
<th>Identifier</th>
<th>MAC address</th>
<th>State</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>00:90:69:0b:7f:71</td>
<td>ok</td>
<td>ge-5/2/9.0</td>
</tr>
<tr>
<td>4001</td>
<td>00:90:69:0b:09:c5</td>
<td>ok</td>
<td>ge-5/2/9.0</td>
</tr>
</tbody>
</table>

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
- Valid DMRs received : 0
- Invalid DMRs received : 0
- Remote MEP count: 1

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

Remote MEP count: 1

<table>
<thead>
<tr>
<th>Identifier</th>
<th>MAC address</th>
<th>State</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>00:90:69:7f:e4:30</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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  
LTM sent : 0  
LTM 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  

show oam ethernet connectivity-fault-managementinterfaces level  

user@host> show oam ethernet connectivity-fault-managementinterfaces level 7  

<table>
<thead>
<tr>
<th>Interface</th>
<th>Link</th>
<th>Status</th>
<th>Level</th>
<th>MEP Identifier</th>
<th>Neighbors</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-3/0/0.0</td>
<td>Up</td>
<td>Active</td>
<td>7</td>
<td>201</td>
<td>0</td>
</tr>
<tr>
<td>xe-0/0/0.0</td>
<td>Up</td>
<td>Active</td>
<td>7</td>
<td>203</td>
<td>1</td>
</tr>
</tbody>
</table>

show oam ethernet connectivity-fault-managementinterfaces (trunk ports)  

user@host> show oam ethernet connectivity-fault-managementinterfaces  

<table>
<thead>
<tr>
<th>Interface</th>
<th>Link</th>
<th>Status</th>
<th>Level</th>
<th>MEP Identifier</th>
<th>Neighbors</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-4/0/1.0, vlan 100</td>
<td>Up</td>
<td>Active</td>
<td>5</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Interface</td>
<td>Link</td>
<td>Status</td>
<td>Level</td>
<td>MEP Identifier</td>
<td>Neighbors</td>
</tr>
<tr>
<td>------------------------</td>
<td>------</td>
<td>---------</td>
<td>-------</td>
<td>----------------</td>
<td>-----------</td>
</tr>
<tr>
<td>ge-4/0/0.0</td>
<td>Up</td>
<td>Active</td>
<td>6</td>
<td>200</td>
<td>0</td>
</tr>
<tr>
<td>ge-10/3/10.4091, vlan 4091</td>
<td>Down</td>
<td>Inactive</td>
<td>4</td>
<td>400</td>
<td>0</td>
</tr>
</tbody>
</table>

```
user@host> show oam ethernet connectivity-fault-management interfaces ge-4/0/0.0
```

<table>
<thead>
<tr>
<th>Interface</th>
<th>Link</th>
<th>Status</th>
<th>Level</th>
<th>MEP Identifier</th>
<th>Neighbors</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-4/0/0.0</td>
<td>Up</td>
<td>Active</td>
<td>6</td>
<td>200</td>
<td>0</td>
</tr>
</tbody>
</table>

```
user@host> show oam ethernet connectivity-fault-management interfaces ge-4/0/1.0 vlan 100
```

<table>
<thead>
<tr>
<th>Interface</th>
<th>Link</th>
<th>Status</th>
<th>Level</th>
<th>MEP Identifier</th>
<th>Neighbors</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-4/0/1.0, vlan 100</td>
<td>Up</td>
<td>Active</td>
<td>5</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

```
user@host> show oam ethernet connectivity-fault-management interfaces ge-10/3/10.4091 vlan 4091
```

<table>
<thead>
<tr>
<th>Interface</th>
<th>Link</th>
<th>Status</th>
<th>Level</th>
<th>MEP Identifier</th>
<th>Neighbors</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-10/3/10.4091, vlan 4091</td>
<td>Down</td>
<td>Inactive</td>
<td>4</td>
<td>400</td>
<td>0</td>
</tr>
</tbody>
</table>

---

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**show oam ethernet connectivity-fault-management linktrace path-database**

**Syntax**
```
show oam ethernet connectivity-fault-management linktrace path-database mac-address
maintenance-association ma-name maintenance-domain md-name
```

**Release Information**
Command introduced in Junos OS Release 9.0.

**Description**
On M320, MX Series, T320, and T640 routers, display IEEE 802.1ag Operation, Administration, and Management (OAM) connectivity fault management maintenance linktrace database information.

**Options**
- `mac-address`—Display connectivity fault management path database information for the specified MAC address of the remote host.
- `maintenance-association ma-name`—Display connectivity fault management path database information for the specified maintenance association.
- `maintenance-domain md-name`—Display connectivity fault management path database information for the specified maintenance domain.

**Required Privilege Level**
view

**List of Sample Output**
show oam ethernet connectivity-fault-management linktrace path-database on page 2256
show oam ethernet connectivity-fault-management linktrace path-database (Two traceroute Commands) on page 2256

**Output Fields**
Table 186 on page 2255 lists the output fields for the `show oam ethernet connectivity-fault-management linktrace path-database` command. Output fields are listed in the approximate order in which they appear.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linktrace to</td>
<td>MAC address of the 802.1ag node to which the linktrace message is targeted.</td>
</tr>
<tr>
<td>Interface</td>
<td>Interface used by the local MEP to send the linktrace message (LTM).</td>
</tr>
<tr>
<td>Maintenance Domain</td>
<td>Maintenance domain identifier specified in the traceroute command.</td>
</tr>
<tr>
<td>Maintenance Association</td>
<td>Maintenance association identifier specified in the traceroute command.</td>
</tr>
<tr>
<td>Level</td>
<td>Maintenance domain level configured for the maintenance domain.</td>
</tr>
<tr>
<td>Local Mep</td>
<td>MEP identifier of the local MEP originating the linktrace.</td>
</tr>
</tbody>
</table>
Table 186: show oam ethernet connectivity-fault-management linktrace path-database Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hop</td>
<td>Sequential hop count of the linktrace path.</td>
</tr>
<tr>
<td>TTL</td>
<td>Number of hops remaining in the linktrace message (LTM). The time to live (TTL) is decremented at each hop.</td>
</tr>
<tr>
<td>Source MAC address</td>
<td>MAC address of the 802.1ag node responding to the LTM or the source MAC address of the LTR.</td>
</tr>
<tr>
<td>Next hop MAC address</td>
<td>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.</td>
</tr>
<tr>
<td>Transaction Identifier</td>
<td>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 linktraceresponses (LTR), with a previously sent LTM.</td>
</tr>
</tbody>
</table>

Sample Output

```text
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

<table>
<thead>
<tr>
<th>Hop</th>
<th>TTL</th>
<th>Source MAC address</th>
<th>Next hop MAC address</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>63</td>
<td>00:00:aa:aa:aa:aa</td>
<td>00:00:ab:ab:ab:ab</td>
</tr>
<tr>
<td>2</td>
<td>62</td>
<td>00:00:bb:bb:bb:bb</td>
<td>00:00:bc:bc:bc:bc</td>
</tr>
<tr>
<td>3</td>
<td>61</td>
<td>00:00:cc:cc:cc:cc</td>
<td>00:00:cd:cd:cd:cd</td>
</tr>
<tr>
<td>4</td>
<td>60</td>
<td>00:01:02:03:04:05</td>
<td>00:00:00:00:00:00</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Hop</th>
<th>TTL</th>
<th>Source MAC address</th>
<th>Next hop MAC address</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>63</td>
<td>00:00:aa:aa:aa:aa</td>
<td>00:00:ab:ab:ab:ab</td>
</tr>
<tr>
<td>2</td>
<td>62</td>
<td>00:00:bb:bb:bb:bb</td>
<td>00:00:bc:bc:bc:bc</td>
</tr>
<tr>
<td>3</td>
<td>61</td>
<td>00:00:cc:cc:cc:cc</td>
<td>00:00:cd:cd:cd:cd</td>
</tr>
</tbody>
</table>
```
| Transaction Identifier: 100003 |
|-----------------------------|-----------------|-----------------|
| 00:00:00:00:00:00           | 00:00:00:00:00:00 |
| 00:00:aa:aa:aa:aa           | 00:00:ab:ab:ab:ab |
| 00:00:bb:bb:bb:bb           | 00:00:bc:bc:bc:bc |
| 00:00:cc:cc:cc:cc           | 00:00:cd:cd:cd:cd |
| 00:01:02:03:04:05           | 00:00:00:00:00:00 |

Chapter 41: Operational Commands
**show oam ethernet connectivity-fault-management loss-statistics**

**Syntax**
```
show oam ethernet connectivity-fault-management loss-statistics
maintenance-domain md-name
maintenance-association ma-name
<count entry-count>
<local-mep local-mep-id>
<remote-mep remote-mep-id>
```

**Release Information**
Command introduced in Junos OS Release 11.1.

**Description**
On MX Series and ACX series routers with Ethernet interfaces, display ETH-LM statistics for on-demand mode only.

**Options**
- `maintenance-domain md-name`—Name of an existing CFM maintenance domain.
- `maintenance-association ma-name`—Name of an existing CFM maintenance association.
- `count entry-count`—(Optional) Number of entries to display from the statistics table. The range of values is from 1 through 100. The default value is 100.
- `local-mep local-mep-id`—(Optional) Numeric identifier of the local MEP. The range of values is from 1 through 8191.
- `remote-mep remote-mep-id`—(Optional) Numeric identifier of the remote MEP. The range of values is from 1 through 8191.

**Required Privilege Level**
view

**Related Documentation**
- show oam ethernet connectivity-fault-management mep-statistics on page 2274

**Output Fields**
Table 187 on page 2258 lists the output fields for the `show oam ethernet connectivity-fault-management loss-statistics` command. Output fields are listed in the approximate order in which they appear.

**Table 187: show oam ethernet connectivity-fault-management loss-statistics Output Fields**

<table>
<thead>
<tr>
<th>Output Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEP identifier</td>
<td>Maintenance association end point (MEP) numeric identifier.</td>
</tr>
<tr>
<td>MAC address</td>
<td>Unicast MAC address configured for the MEP.</td>
</tr>
<tr>
<td>Remote MEP count</td>
<td>Number of remote MEPs (unless you specify the <code>remote-mep</code> option).</td>
</tr>
<tr>
<td>Remote MEP identifier</td>
<td>Numeric identifier of the remote MEP.</td>
</tr>
</tbody>
</table>
Table 187: `show oam ethernet connectivity-fault-management loss-statistics` Output Fields (continued)

<table>
<thead>
<tr>
<th>Output Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote MAC address</td>
<td>Unicast MAC address of the remote MEP.</td>
</tr>
<tr>
<td>Index</td>
<td>Index number that corresponds to the ETH-LM entry in the CFM database.</td>
</tr>
<tr>
<td>Near-end frame loss</td>
<td>Count of frame loss associated with ingress data frames.</td>
</tr>
<tr>
<td>Far-end frame loss</td>
<td>Count of frame loss associated with egress data frames.</td>
</tr>
<tr>
<td>Near-end loss ratio</td>
<td>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.</td>
</tr>
<tr>
<td>Far-end loss ratio</td>
<td>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.</td>
</tr>
<tr>
<td>Average near-end frame loss</td>
<td>Average frame loss measured in this session associated with ingress data frames.</td>
</tr>
<tr>
<td>Average near-end loss ratio</td>
<td>Average frame loss ratio measured in this session associated with ingress data frames.</td>
</tr>
<tr>
<td>Average far-end frame loss</td>
<td>Average frame loss measured in this session associated with egress data frames.</td>
</tr>
<tr>
<td>Average far-end loss ratio</td>
<td>Average frame loss ratio measured in this session associated with egress data frames.</td>
</tr>
<tr>
<td>Near-end best case loss</td>
<td>Lowest frame loss measured in this session associated with ingress data frames.</td>
</tr>
<tr>
<td>Near-end best case loss ratio</td>
<td>Lowest frame loss ratio measured in this session associated with ingress data frames.</td>
</tr>
<tr>
<td>Near-end worst case loss</td>
<td>Highest frame loss measured in this session associated with ingress data frames.</td>
</tr>
<tr>
<td>Near-end worst case loss ratio</td>
<td>Highest frame loss ratio measured in this session associated with ingress data frames.</td>
</tr>
<tr>
<td>Far-end best case frame loss</td>
<td>Lowest frame loss measured in this session associated with egress data frames.</td>
</tr>
<tr>
<td>Far-end best case loss ratio</td>
<td>Lowest frame loss ratio measured in this session associated with egress data frames.</td>
</tr>
<tr>
<td>Far-end worst case loss</td>
<td>Highest frame loss measured in this session associated with egress data frames.</td>
</tr>
<tr>
<td>Far-end worst case loss ratio</td>
<td>Highest frame loss ratio measured in this session associated with egress data frames.</td>
</tr>
</tbody>
</table>
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


 LM client session-id:4843

 CIR Loss measurement statistics:

<table>
<thead>
<tr>
<th>Index</th>
<th>Near-end</th>
<th>Far-end</th>
<th>Near-end</th>
<th>Far-end</th>
<th>Near-end</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frame loss</td>
<td>Total tx</td>
<td>Total rx</td>
<td>Frame loss</td>
<td>Total tx</td>
</tr>
<tr>
<td></td>
<td>(CIR)</td>
<td>(CIR)</td>
<td>(CIR)</td>
<td>(CIR)</td>
<td>(CIR)</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>245</td>
<td>245</td>
<td>0</td>
<td>244</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>488</td>
<td>488</td>
<td>0</td>
<td>489</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>732</td>
<td>732</td>
<td>0</td>
<td>733</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>977</td>
<td>977</td>
<td>0</td>
<td>976</td>
</tr>
</tbody>
</table>

 EIR Loss measurement statistics:

<table>
<thead>
<tr>
<th>Index</th>
<th>Near-end</th>
<th>Far-end</th>
<th>Near-end</th>
<th>Far-end</th>
<th>Near-end</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frame loss</td>
<td>Total tx</td>
<td>Total rx</td>
<td>Frame loss</td>
<td>Total tx</td>
</tr>
<tr>
<td></td>
<td>(EIR)</td>
<td>(EIR)</td>
<td>(EIR)</td>
<td>(EIR)</td>
<td>(EIR)</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>272</td>
<td>272</td>
<td>0</td>
<td>273</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>546</td>
<td>546</td>
<td>0</td>
<td>545</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>820</td>
<td>820</td>
<td>0</td>
<td>819</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>1092</td>
<td>1092</td>
<td>0</td>
<td>1093</td>
</tr>
</tbody>
</table>

 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 (EIR) : 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

### Syntax
```
show oam ethernet connectivity-fault-management mep-database
maintenance-domain domain-name
maintenance-association ma-name
<local-mep local-mep-id>
<remote-mep remote-mep-id>
extensive
```

### Release Information
- Command introduced in Junos OS Release 8.4.
- Support for ITU-T Y.1731 frame delay measurement added in Junos OS Release 9.5.
- Support for ITU-T Y.1731 synthetic frame loss measurement added in Junos OS Release 13.2 for MX Series routers.
- Support for ITU-T Y.1731 ethernet expected defect function (ETH-ED) added in Junos OS Release 19.1 for MX Series routers.

**NOTE:** Ethernet expected defect function (ETH-ED) will be supported on all MX series routers only when enhanced-ip mode is enabled. ETH-ED will not be supported if CFM is running in centralized mode.

### Description
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.

In addition, on M120, M320, and MX series routers, also display port status TLV, interface status TLV, and action profile information.

In addition, for Ethernet interfaces on MX Series routers, also display any ITU-T Y.1731 frame delay measurement (ETH-DM) frame counts.

For Ethernet interfaces on MX Series routers, display any ITU-T Y.1731 synthetic frame loss measurement (ETH-SLM) statistics and frame counts.

### Options
- `maintenance-association ma-name`—Name of the maintenance association.
- `maintenance-domain domain-name`—Name of the maintenance domain.
- `local-mep-id`—(Optional) Numeric identifier of local MEP.
- `remote-mep-id`—(Optional) Numeric identifier of the remote MEP.

### Required Privilege Level
- `view`
Related Documentation

- clear oam ethernet connectivity-fault-management statistics on page 1645
- show oam ethernet connectivity-fault-management delay-statistics on page 2236
- show oam ethernet connectivity-fault-management interfaces on page 2244
- show oam ethernet connectivity-fault-management mep-statistics on page 2274

List of Sample Output

- show oam ethernet connectivity-fault-management mep-database on page 2267
- show oam ethernet connectivity-fault-management mep-database (One-Way ETH-DM) on page 2268
- show oam ethernet connectivity-fault-management mep-database local-mep remote-mep on page 2269
- show oam ethernet connectivity-fault-management mep-database remote-mep (Action Profile Event) on page 2269
- show oam ethernet connectivity-fault-management mep-database (Connection Protection TLV Configured) on page 2270
- show oam ethernet connectivity-fault-management mep-database on page 2271
- show oam ethernet connectivity-fault-management mep-database (enhanced continuity measurement) on page 2272
- show oam ethernet connectivity-fault-management mep-database local-mep remote-mep on page 2272

Output Fields

Table 188 on page 2263 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>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance domain name</td>
<td>Maintenance domain name.</td>
</tr>
<tr>
<td>Format (Maintenance domain)</td>
<td>Maintenance domain name format configured.</td>
</tr>
<tr>
<td>Level</td>
<td>Maintenance domain level configured.</td>
</tr>
<tr>
<td>Maintenance association name</td>
<td>Maintenance association name.</td>
</tr>
<tr>
<td>Format (Maintenance association)</td>
<td>Maintenance association name format configured.</td>
</tr>
<tr>
<td>Continuity-check status</td>
<td>Continuity-check status.</td>
</tr>
<tr>
<td>Interval</td>
<td>Continuity-check message interval.</td>
</tr>
<tr>
<td>Loss-threshold</td>
<td>Lost continuity-check message threshold.</td>
</tr>
</tbody>
</table>
Table 188: show oam ethernet connectivity-fault-management mep-database Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
</table>
| Connection Protection TLV                   | Status of the connection protection TLV, if configured on the MEP interface: no, yes  
If yes, then the transmitted connection protection TLV is decoded and the following three fields are displayed: Prefer me, Protection in use, FRR Flag                                                                                                                                                                                                 |
| Prefer me                                   | If set to yes, 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.  
Its value can be yes or no.                                                                                                                                                                                                                                                                              |
| Protection in use                           | Used for protection decision coordination. Its value is set to yes if the endpoint transmitting the CCM is currently transmitting the user traffic to protection path.  
Its value can be yes or no.                                                                                                                                                                                                                                                                              |
| FRR Flag                                    | LSR/LER forwarding the CCM Frame into a bypass tunnel is set.  
Its value can be yes or no.                                                                                                                                                                                                                                                                                                                                 |
<p>| MEP identifier                              | Maintenance association end point (MEP) identifier.                                                                                                                                                                                                                                                                                                      |
| Direction                                   | MEP direction configured.                                                                                                                                                                                                                                                                                                                                 |
| MAC address                                 | MAC address configured for the MEP.                                                                                                                                                                                                                                                                                                                    |
| Auto-discovery                              | Whether automatic discovery is enabled or disabled.                                                                                                                                                                                                                                                                                                  |
| Priority                                    | Priority used for CCMs and linktrace messages transmitted by the MEP.                                                                                                                                                                                                                                                                                 |
| Interface name                              | Interface identifier.                                                                                                                                                                                                                                                                                                                                 |
| Interface status                            | Local interface status.                                                                                                                                                                                                                                                                                                                                 |
| Link status                                 | Local link status.                                                                                                                                                                                                                                                                                                                                    |
| Remote MEP not receiving CCM                | Whether the remote MEP is not receiving CCMs.                                                                                                                                                                                                                                                                                                        |
| Erroneous CCM received                      | Whether erroneous CCMs have been received.                                                                                                                                                                                                                                                                                                             |
| Cross-connect CCM received                  | Whether cross-connect CCMs have been received.                                                                                                                                                                                                                                                                                                       |
| RDI sent by some MEP                        | 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.                                                                                                                                                                           |
| CCMs sent                                   | Number of CCMs transmitted.                                                                                                                                                                                                                                                                                                                          |</p>
<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCMs received out of sequence</td>
<td>Number of CCMs received out of sequence.</td>
</tr>
<tr>
<td>LBMssent</td>
<td>Number of loopback messages (LBMs) sent.</td>
</tr>
<tr>
<td>Valid in-order LBRs received</td>
<td>Number of loopback response messages (LBRs) received that were valid messages and in sequence.</td>
</tr>
<tr>
<td>1DMssent</td>
<td>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. For all other cases, this field displays 0.</td>
</tr>
<tr>
<td>Valid 1DMs received</td>
<td>If the MEP is a receiver for a one-way ETH-DM session: Number of valid 1DM frames received.</td>
</tr>
<tr>
<td>For all other cases, this field displays 0.</td>
<td></td>
</tr>
<tr>
<td>Invalid 1DMs received</td>
<td>If the MEP is a receiver for a one-way ETH-DM session: Number of invalid 1DM frames received.</td>
</tr>
<tr>
<td>For all other cases, this field displays 0.</td>
<td></td>
</tr>
<tr>
<td>Out of sync 1DMs received</td>
<td>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.</td>
</tr>
<tr>
<td>DMMssent</td>
<td>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. For all other cases, this field displays 0.</td>
</tr>
<tr>
<td>Valid DMMs received</td>
<td>If the MEP is an initiator for a two-way ETH-DM session: Number of valid two-way delay measurement packets received.</td>
</tr>
<tr>
<td>Invalid DMMs received</td>
<td>If the MEP is an initiator for a two-way ETH-DM session: Number of invalid two-way delay measurement packets received.</td>
</tr>
<tr>
<td>DMRssent</td>
<td>If the MEP is a responder for a ETH-DM session: Number of Delay Measurement Reply (DMR) frames sent.</td>
</tr>
<tr>
<td>For all other cases, this field displays 0.</td>
<td></td>
</tr>
<tr>
<td>Valid DMRs received</td>
<td>If the MEP is an initiator for a two-way ETH-DM session: Number of valid DMRs received.</td>
</tr>
<tr>
<td>For all other cases, this field displays 0.</td>
<td></td>
</tr>
<tr>
<td>Invalid DMRs received</td>
<td>If the MEP is an initiator for a two-way ETH-DM session: Number of invalid DMRs received.</td>
</tr>
<tr>
<td>Valid out-of-order LBRs received</td>
<td>Number of LBRs received that were valid messages and not in sequence.</td>
</tr>
<tr>
<td>Field Name</td>
<td>Field Description</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>LBRs received with corrupted data</td>
<td>Number of LBRs received that were corrupted.</td>
</tr>
<tr>
<td>LBRs sent</td>
<td>Number of LBRs transmitted.</td>
</tr>
<tr>
<td>LTMs sent</td>
<td>Linktrace messages (LTMs) transmitted.</td>
</tr>
<tr>
<td>LTMs received</td>
<td>Linktrace messages received.</td>
</tr>
<tr>
<td>LTRs sent</td>
<td>Linktrace responses (LTRs) transmitted.</td>
</tr>
<tr>
<td>LTRs received</td>
<td>Linktrace responses received.</td>
</tr>
<tr>
<td>Sequence number of next LTM request</td>
<td>Sequence number of the next linktrace message request to be transmitted.</td>
</tr>
<tr>
<td>LMM sent</td>
<td>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.</td>
</tr>
<tr>
<td>Valid LMM received</td>
<td>If the interface is attached to an initiator MEP for a ETH-LM session: Number of valid loss measurement request packets received.</td>
</tr>
<tr>
<td>Invalid LMM received</td>
<td>If the interface is attached to an initiator MEP for a ETH-LM session: Number of invalid loss measurement request packets received.</td>
</tr>
<tr>
<td>LMR sent</td>
<td>If the interface is attached to a responder MEP for a ETH-LM session: Number of loss measurement reply (LMR) frames sent.</td>
</tr>
<tr>
<td>Valid LMR received</td>
<td>If the interface is attached to an initiator MEP for a ETH-LM session: Number of valid LMR frames received.</td>
</tr>
<tr>
<td>Invalid LMR received</td>
<td>If the interface is attached to an initiator MEP for a ETH-LM session: Number of invalid LMR frames received.</td>
</tr>
<tr>
<td>SLM sent</td>
<td>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.</td>
</tr>
<tr>
<td>Valid SLM received</td>
<td>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.</td>
</tr>
<tr>
<td>Invalid SLM received</td>
<td>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.</td>
</tr>
<tr>
<td>SLR sent</td>
<td>If the interface is attached to a responder MEP for a ETH-SLM session: Number detail extensive of synthetic loss reply (SLR) frames sent.</td>
</tr>
<tr>
<td>Valid SLR received</td>
<td>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.</td>
</tr>
</tbody>
</table>
### Table 188: show oam ethernet connectivity-fault-management mep-database Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invalid SLR received</td>
<td>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.</td>
</tr>
<tr>
<td>Remote MEP identifier</td>
<td>MEP identifier of the remote MEP.</td>
</tr>
<tr>
<td>State (remote MEP)</td>
<td>State of the remote MEP: <strong>idle</strong>, <strong>start</strong>, <strong>ok</strong>, or <strong>failed</strong>.</td>
</tr>
<tr>
<td>MAC address</td>
<td>MAC address of the remote MEP.</td>
</tr>
<tr>
<td>Type</td>
<td>Whether the remote MEP MAC address was learned using automatic discovery or configured.</td>
</tr>
<tr>
<td>Interface</td>
<td>Interface of the remote MEP. A seven-digit number is appended if CFM is configured to run on a routing instance of type VPLS.</td>
</tr>
<tr>
<td>Last flapped</td>
<td>Date, time, and how long ago the remote MEP interface went from down to up. The format is <strong>Last flapped: year-month-day hours:minutes:seconds timezone (hours:minutes:seconds ago)</strong>. For example, <strong>Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago)</strong>.</td>
</tr>
<tr>
<td>Remote defect indication</td>
<td>Whether the remote defect indication (RDI) bit is set in messages that have been received or transmitted.</td>
</tr>
<tr>
<td>Port status TLV</td>
<td>• In the Maintenance domain section, displays the last transmitted port status TLV value.</td>
</tr>
<tr>
<td></td>
<td>• In the Remote MEP section, displays the last value of port status TLV received from the remote MEP.</td>
</tr>
<tr>
<td></td>
<td>In the Action profile section, displays the last occurred event <strong>port-status-tlv blocked</strong> event. This event occurred due to the reception of <strong>blocked</strong> value in the port status TLV from remote MEP.</td>
</tr>
<tr>
<td>Interface status TLV</td>
<td>• In the Maintenance domain section, displays the last transmitted interface status TLV value.</td>
</tr>
<tr>
<td></td>
<td>• In the Remote MEP section, displays the last value of interface status TLV received from the remote MEP.</td>
</tr>
<tr>
<td></td>
<td>In the Action profile section, if displays, the last occurred event interface-status-tlv event (either <strong>lower-layer-down</strong> or <strong>down</strong>). This event occurred due to the reception of either lower or <strong>down</strong> value in the interface status TLV from remote MEP.</td>
</tr>
<tr>
<td>Action profile</td>
<td>Name of the action profile occurrence associated with a remote MEP.</td>
</tr>
<tr>
<td>Last event</td>
<td>When an action profile occurs, displays the last event that triggered it.</td>
</tr>
<tr>
<td>Last event cleared</td>
<td>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.</td>
</tr>
<tr>
<td>Action</td>
<td>Action taken and the corresponding time of the action occurrence.</td>
</tr>
</tbody>
</table>

### Sample Output

```bash
show oam ethernet connectivity-fault-
```
management mep-database

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
 IDM sent : 0
 Valid IDM received : 0
 Invalid IDM received : 0
 DMMs sent : 0
 DMRs sent : 0
 Valid DMR received : 0
 Invalid DMR 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-association 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
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
!BRs received with corrupted data : 0
LBRs sent : 0
LTM received : 0
LTRs sent : 0
LTRs received : 0
Sequence number of next LTM request : 0
IDMs sent : 0
Valid IDMs received : 0
Invalid IDMs received : 0
Out of sync IDMs 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: ma5, 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
IDMs sent : 10
Valid IDMs received : 10
Invalid IDMs 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
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-database local-mep remote-mep

When the timer is not running:

user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md6 maintenance-association ma6 local-mep 201 remote-mep 101 extensive

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: 201, Direction: up, MAC address: 00:24:dc:48:46:cd
Auto-discovery: enabled, Priority: 0
Interface status TLV: none, Port status TLV: none
Connection Protection TLV: no
Chassis ID: 00:24:dc:48:47:f2
Management Address: 10.216.34.30
Sendid TLV: no
Interface name: ge-5/1/9.0, Interface status: Active, Link status: Up

Remote MEP identifier: 101, State: ok
MAC address: 00:22:83:db:4c:5b, Type: Configured
Interface: ge-5/3/0.0
Last flapped: 2019-02-05 00:45:57 PST (00:54:51 ago)
Continuity: 99%, Admin-enable duration: 3367sec, Oper-down duration: 43sec
Effective loss threshold: 3 frames
Remote defect indication: false
Port status TLV: none
Interface status TLV: none
Remote Management Address: 0.0.0.0
Sendid TLV: no
Sender ID Remote Chassis Subtype: 0
EDM time remaining: N/A

When the timer is running:

```
user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md6 maintenance-association ma6 local-mep 201 remote-mep 101 extensive

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: 201, Direction: up, MAC address: 00:24:dc:48:46:cd
Auto-discovery: enabled, Priority: 0
Interface status TLV: none, Port status TLV: none
Connection Protection TLV: no
Chassis ID: 00:24:dc:48:47:f2
Management Address: 10.216.34.30
Sendid TLV: no
Interface name: ge-5/1/9.0, Interface status: Active, Link status: Up

Remote MEP identifier: 101, State: ok
MAC address: 00:22:83:db:4c:5b, Type: Configured
Interface: ge-5/3/0.0
Last flapped: 2019-02-05 00:45:57 PST (00:56:16 ago)
Continuity: 99%, Admin-enable duration: 3451sec, Oper-down duration: 43sec
Effective loss threshold: 3 frames
Remote defect indication: false
Port status TLV: none
Interface status TLV: none
Remote Management Address: 0.0.0.0
Sendid TLV: no
Sender ID Remote Chassis Subtype: 0
EDM time remaining: 894 secs
```
**show oam ethernet connectivity-fault-management mep-statistics**

**Syntax**
```
show oam ethernet connectivity-fault-management mep-statistics
 maintenance-domain md-name
 maintenance-association ma-name
 <mep mep-id>
 <remote-mep remote-mep-id>
 <count entry-count>
```

**Release Information**
- Command introduced in Junos OS Release 9.5.
- Command introduced in Junos OS Release 11.4 for EX Series switches.
- Support for ITU-T Y.1731 Ethernet synthetic frame loss measurement (ETH-SLM) added in Junos OS Release 13.2 for MX Series routers.

**Description**
On MX Series and ACX Series routers and EX Series switches with Ethernet interfaces, display ETH-DM statistics and ETH-DM frame counts.

For Ethernet interfaces on MX Series routers, display any ITU-T Y.1731 synthetic frame loss measurement (ETH-SLM) statistics and frame counts.

**Options**
- **maintenance-domain md-name**—Name of an existing CFM maintenance domain.
- **maintenance-association ma-name**—Name of an existing CFM maintenance association.
- **mep mep-id**—(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.
- **remote-mep remote-mep-id**—(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.
- **count entry-count**—(Optional) Number of entries to display from the statistics table. The range of values is 1 through 100. The default value is 100 entries.

**Required Privilege**
- **Level** view

**Related Documentation**
- clear oam ethernet connectivity-fault-management statistics on page 1645
- show oam ethernet connectivity-fault-management delay-statistics on page 2236
- show oam ethernet connectivity-fault-management interfaces on page 2244
- show oam ethernet connectivity-fault-management mep-database on page 2262

**List of Sample Output**
- show oam ethernet connectivity-fault-management mep-statistics (CIR counters only) on page 2277
- show oam ethernet connectivity-fault-management mep-statistics (CIR and EIR counters enabled) on page 2278
Output Fields  Table 189 on page 2275 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 189: show oam ethernet connectivity-fault-management delay-statistics and mep-statistics Output Fields

<table>
<thead>
<tr>
<th>Output Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEP identifier</td>
<td>Maintenance association end point (MEP) numeric identifier.</td>
</tr>
<tr>
<td>MAC address</td>
<td>Unicast MAC address configured for the MEP.</td>
</tr>
<tr>
<td>Remote MEP count</td>
<td>Number of remote MEPs (unless you specify the <code>remote-mep</code> option).</td>
</tr>
<tr>
<td>CCMs sent</td>
<td>Number of continuity check messages (CCMs) sent.</td>
</tr>
<tr>
<td>CCMs received</td>
<td>Number of continuity check messages (CCMs) received for a specific remote MEP and maintenance association.</td>
</tr>
<tr>
<td>CCMs received out of sequence</td>
<td>Number of continuity check messages (CCMs) received that were not in sequence.</td>
</tr>
<tr>
<td>Remote MEP identifier</td>
<td>Numeric identifier of the remote MEP.</td>
</tr>
<tr>
<td>Remote MAC address</td>
<td>Unicast MAC address of the remote MEP.</td>
</tr>
<tr>
<td>Index</td>
<td>Index number that corresponds to the ETH-DM entry in the CFM database.</td>
</tr>
<tr>
<td>One-way delay (usec)</td>
<td>For a one-way ETH-DM session, the frame delay time, in microseconds, measured at the receiver MEP.</td>
</tr>
<tr>
<td></td>
<td>For a detailed description of one-way Ethernet frame delay measurement, see the ITU-T Y.1731 Ethernet Service OAM topics in the Junos OS Network Interfaces Library for Routing Devices.</td>
</tr>
<tr>
<td>Two-way delay (usec)</td>
<td>For a two-way ETH-DM session, the frame delay time, in microseconds, measured at the initiator MEP.</td>
</tr>
<tr>
<td></td>
<td>For a detailed description of two-way Ethernet frame delay measurement, see the ITU-T Y.1731 Ethernet Service OAM topics in the Junos OS Network Interfaces Library for Routing Devices.</td>
</tr>
<tr>
<td>Average one-way delay</td>
<td>Average one-way frame delay for the statistics displayed.</td>
</tr>
</tbody>
</table>
Table 189: show oam ethernet connectivity-fault-management delay-statistics and mep-statistics Output Fields (continued)

<table>
<thead>
<tr>
<th>Output Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average one-way delay variation</td>
<td>Average one-way “frame jitter” for the statistics displayed.</td>
</tr>
<tr>
<td>Best-case one-way delay</td>
<td>Lowest one-way frame delay for the statistics displayed.</td>
</tr>
<tr>
<td>Worst-case one-way delay</td>
<td>Highest one-way frame delay for the statistics displayed.</td>
</tr>
<tr>
<td>Average two-way delay</td>
<td>Average two-way frame delay for the statistics displayed.</td>
</tr>
<tr>
<td>Average two-way delay variation</td>
<td>Average two-way “frame jitter” for the statistics displayed.</td>
</tr>
<tr>
<td>Best-case two-way delay</td>
<td>Lowest two-way frame delay for the statistics displayed.</td>
</tr>
<tr>
<td>Worst-case two-way delay</td>
<td>Highest two-way frame delay calculated in this session.</td>
</tr>
<tr>
<td>SLM packets sent</td>
<td>Total number of synthetic loss message (SLM) PDU frames sent from the source MEP to the remote MEP during this ETH-SLM session.</td>
</tr>
<tr>
<td>SLM packets received</td>
<td>Total number of synthetic loss message (SLM) PDU frames that the remote MEP received from the source MEP during this ETH-SLM session.</td>
</tr>
<tr>
<td>SLR packets sent</td>
<td>Total number of synthetic loss reply (SLR) PDU frames that the remote MEP sent to the source MEP during this measurement session.</td>
</tr>
<tr>
<td>SLR packets received</td>
<td>Total number of synthetic loss reply (SLR) PDU frames that the source MEP received from the remote MEP during this measurement session.</td>
</tr>
<tr>
<td>Local TXFC1 value</td>
<td>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.</td>
</tr>
<tr>
<td>Local RXFC1 value</td>
<td>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.</td>
</tr>
<tr>
<td>Last Received SLR frame TXFCf(tc)</td>
<td>Value of the local counter TxFC1 at the time of SLM frame transmission.</td>
</tr>
<tr>
<td>Last Received SLR frame TXFCb(t)</td>
<td>Value of the local counter RxFC1 at the time of SLR frame transmission.</td>
</tr>
<tr>
<td>Frame loss (near-end)</td>
<td>Count of frame loss associated with ingress data frames.</td>
</tr>
<tr>
<td>Frame loss (far-end)</td>
<td>Count of frame loss associated with egress data frames.</td>
</tr>
</tbody>
</table>
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
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: 0
Invalid LMR received: 0
Remote MEP identifier: 101
Remote MAC address: 00:05:85:73:39:4a

Delay measurement statistics:

<table>
<thead>
<tr>
<th>Index</th>
<th>One-way delay (usec)</th>
<th>Two-way delay (usec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>259</td>
<td>519</td>
</tr>
<tr>
<td>2</td>
<td>273</td>
<td>550</td>
</tr>
<tr>
<td>3</td>
<td>287</td>
<td>571</td>
</tr>
<tr>
<td>4</td>
<td>299</td>
<td>610</td>
</tr>
<tr>
<td>5</td>
<td>313</td>
<td>650</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Index</th>
<th>Near-end Frame loss (CIR)</th>
<th>Far-end Frame loss (CIR)</th>
<th>Near-end Frame loss (EIR)</th>
<th>Far-end Frame loss (EIR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>
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%

user@host> show oam ethernet connectivity-fault-management mep-statistics (CIR and EIR counters enabled)

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
LTM sent : 0
LTM received : 0
LTR sent : 0
LTR received : 0
Sequence number of next LTM request : 0
IDMs sent : 5
Valid 1DMs received : 0
Invalid 1DMs received : 0
DMRs sent : 0
DMRs received : 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 : 0
Invalid LMR received : 0
Remote MEP identifier : 101
Remote MAC address : 00:05:85:73:39:4a

Delay measurement statistics:

<table>
<thead>
<tr>
<th>Index</th>
<th>One-way delay (usec)</th>
<th>Two-way delay (usec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>259</td>
<td>519</td>
</tr>
<tr>
<td>2</td>
<td>273</td>
<td>550</td>
</tr>
<tr>
<td>3</td>
<td>287</td>
<td>571</td>
</tr>
</tbody>
</table>
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:

<table>
<thead>
<tr>
<th>Index</th>
<th>Near-end</th>
<th>Near-end</th>
<th>Far-end</th>
<th>Far-end</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(CIR)</td>
<td>(EIR)</td>
<td>(CIR)</td>
<td>(EIR)</td>
</tr>
<tr>
<td>1</td>
<td>9</td>
<td>2</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>0</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>8</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>6</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

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)
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:
<table>
<thead>
<tr>
<th>Index</th>
<th>One-way delay (usec)</th>
<th>Two-way delay (usec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>259</td>
<td>519</td>
</tr>
<tr>
<td>2</td>
<td>273</td>
<td>550</td>
</tr>
<tr>
<td>3</td>
<td>287</td>
<td>571</td>
</tr>
<tr>
<td>4</td>
<td>299</td>
<td>610</td>
</tr>
<tr>
<td>5</td>
<td>313</td>
<td>650</td>
</tr>
</tbody>
</table>

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:
<table>
<thead>
<tr>
<th>Index</th>
<th>Near-end Frame loss (CIR)</th>
<th>Near-end Frame loss (EIR)</th>
<th>Far-end Frame loss (CIR)</th>
<th>Far-end Frame loss (EIR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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
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:
<table>
<thead>
<tr>
<th>Index</th>
<th>One-way delay (usec)</th>
<th>Two-way delay (usec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>259</td>
<td>519</td>
</tr>
<tr>
<td>2</td>
<td>273</td>
<td>550</td>
</tr>
<tr>
<td>3</td>
<td>287</td>
<td>571</td>
</tr>
<tr>
<td>4</td>
<td>299</td>
<td>610</td>
</tr>
<tr>
<td>5</td>
<td>313</td>
<td>650</td>
</tr>
</tbody>
</table>

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:
<table>
<thead>
<tr>
<th>Index</th>
<th>Near-end Frame loss (CIR)</th>
<th>Near-end Frame loss (EIR)</th>
<th>Far-end Frame loss (CIR)</th>
<th>Far-end Frame loss (EIR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>5</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>6</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>0</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>8</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>6</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

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
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

SLM packets sent : 100
SLM packets received : 0
SLR packets sent : 100
SLR packets received : 0
Accumulated SLM statistics:
Local TXFCl value : 100
Local RXFCl 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 %)
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:

<table>
<thead>
<tr>
<th>Index</th>
<th>One-way delay (usec)</th>
<th>Two-way delay (usec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>259</td>
<td>519</td>
</tr>
<tr>
<td>2</td>
<td>273</td>
<td>550</td>
</tr>
<tr>
<td>3</td>
<td>287</td>
<td>571</td>
</tr>
<tr>
<td>4</td>
<td>299</td>
<td>610</td>
</tr>
<tr>
<td>5</td>
<td>313</td>
<td>650</td>
</tr>
</tbody>
</table>

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 TXFCTC : 100
Last Received SLR frame TXFBCtC : 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 local-mep remote-mep

user@host> show oam ethernet connectivity-fault-management mep-statistics maintenance-domain md1 maintenance-association ma1 local-mep 121 remote-mep 101

MEP identifier: 1, MAC address: 3c:61:04:25:fa:95
Remote MEP count: 1
CCMs sent : 875
CCMs Received : 300
<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCMs received out of sequence</td>
<td>0</td>
</tr>
<tr>
<td>LBMs sent</td>
<td>0</td>
</tr>
<tr>
<td>Valid in-order LBRs received</td>
<td>0</td>
</tr>
<tr>
<td>Valid out-of-order LBRs received</td>
<td>0</td>
</tr>
<tr>
<td>LBRs received with corrupted data</td>
<td>0</td>
</tr>
<tr>
<td>LBRs sent</td>
<td>0</td>
</tr>
<tr>
<td>LTMs sent</td>
<td>0</td>
</tr>
<tr>
<td>LTMs received</td>
<td>0</td>
</tr>
<tr>
<td>LTRs sent</td>
<td>0</td>
</tr>
<tr>
<td>LTRs received</td>
<td>0</td>
</tr>
<tr>
<td>Sequence number of next LTM request</td>
<td>12</td>
</tr>
<tr>
<td>1DMs sent</td>
<td>0</td>
</tr>
<tr>
<td>Valid 1DMs received</td>
<td>0</td>
</tr>
<tr>
<td>Invalid 1DMs received</td>
<td>0</td>
</tr>
<tr>
<td>Out of sync 1DMs received</td>
<td>0</td>
</tr>
<tr>
<td>DMMs sent</td>
<td>0</td>
</tr>
<tr>
<td>Valid DMMs received</td>
<td>0</td>
</tr>
<tr>
<td>Invalid DMMs received</td>
<td>0</td>
</tr>
<tr>
<td>DMRs sent</td>
<td>0</td>
</tr>
<tr>
<td>Valid DMRs received</td>
<td>0</td>
</tr>
<tr>
<td>Invalid DMRs received</td>
<td>0</td>
</tr>
<tr>
<td>LMMs sent</td>
<td>0</td>
</tr>
<tr>
<td>Valid LMMs received</td>
<td>0</td>
</tr>
<tr>
<td>Invalid LMMs received</td>
<td>0</td>
</tr>
<tr>
<td>LMRs sent</td>
<td>0</td>
</tr>
<tr>
<td>Valid LMRs received</td>
<td>0</td>
</tr>
<tr>
<td>Invalid LMRs received</td>
<td>0</td>
</tr>
<tr>
<td>SLMs sent</td>
<td>0</td>
</tr>
<tr>
<td>Valid SLMs received</td>
<td>0</td>
</tr>
<tr>
<td>Invalid SLMs received</td>
<td>0</td>
</tr>
<tr>
<td>SLRs sent</td>
<td>0</td>
</tr>
<tr>
<td>Valid SLRs received</td>
<td>0</td>
</tr>
<tr>
<td>Invalid SLRs received</td>
<td>0</td>
</tr>
<tr>
<td>Valid AISs generated</td>
<td>0</td>
</tr>
<tr>
<td>Valid AISs received</td>
<td>0</td>
</tr>
</tbody>
</table>
**show oam ethernet connectivity-fault-management path-database**

**Syntax**
```
show oam ethernet connectivity-fault-management path-database
<host-mac-address>
<maintenance-association ma-name>
<maintenance-domain domain-name>
```

**Release Information**
Command introduced in Junos OS Release 8.4.

**Description**
On M7i and M10i with Enhanced CFEB (CFEB-E), M320, MX Series, ACX Series, T320, and T640 routers, display IEEE 802.1ag Operation, Administration, and Management (OAM) connectivity fault management path database information for a host configured with an MEP.

**Options**
- `host-mac-address`—(Optional) Display connectivity fault management path database information for a specified Ethernet host.
- `maintenance-association ma-name`—(Optional) Display connectivity fault management path database information for the specified maintenance association.
- `maintenance-domain domain-name`—(Optional) Display connectivity fault management path database information for the specified maintenance domain.

**Required Privilege Level**
view

**List of Sample Output**
`show oam ethernet connectivity-fault-management path-database on page 2287`

**Output Fields**
`Table 190 on page 2286 lists the output fields for the show oam ethernet connectivity-fault-management path-database command. Output fields are listed in the approximate order in which they appear.`

*Table 190: show oam ethernet connectivity-fault-management path-database Output Fields*

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAC address of the remote MEPs in the path.</td>
<td>Linktrace to</td>
</tr>
<tr>
<td>Interface identifier.</td>
<td>Interface</td>
</tr>
<tr>
<td>Maintenance domain name</td>
<td>Maintenance domain name</td>
</tr>
<tr>
<td>Maintenance domain name format configured.</td>
<td>Format (Maintenance domain)</td>
</tr>
<tr>
<td>Maintenance domain level configured.</td>
<td>Level</td>
</tr>
</tbody>
</table>
### Table 190: `show oam ethernet connectivity-fault-management path-database` Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance association name</td>
<td>Maintenance association name.</td>
</tr>
<tr>
<td>Local MEP</td>
<td>Local MEP identifier.</td>
</tr>
</tbody>
</table>

### Sample Output

```
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**

**Syntax**

```
show oam ethernet connectivity-fault-management policer <maintenance-domain md-name> <maintenance-association ma-name>
```

**Release Information**

Command introduced in Junos OS Release 10.0.

**Description**


**Options**

This command has the following options:

- `maintenance-domain md-name`—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.

- `maintenance-association ma-name`—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.

**Required Privilege Level**

view

**Related Documentation**

- clear oam ethernet connectivity-fault-management policer on page 1644

**List of Sample Output**

- show oam ethernet connectivity-fault-management policer on page 2289
- show oam ethernet connectivity-fault-management policer maintenance-domain md-name on page 2289
- show oam ethernet connectivity-fault-management policer maintenance-domain md-name maintenance-association ma-name on page 2290

**Output Fields**

Table 191 on page 2288 lists the output fields for the `show oam ethernet connectivity-fault-management policer` command. Output fields are listed in the approximate order in which they appear.

**Table 191: show oam ethernet connectivity-fault-management policer Output Fields**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Legend for Policer</strong></td>
<td>Describes the symbols used under the Scope and Type headings:</td>
</tr>
<tr>
<td></td>
<td>- G - Global scope</td>
</tr>
<tr>
<td></td>
<td>- S - Service scope</td>
</tr>
<tr>
<td></td>
<td>- cc - Continuity check (Type)</td>
</tr>
<tr>
<td><strong>Maintenance Domain</strong></td>
<td>Displays the maintenance domain name.</td>
</tr>
</tbody>
</table>
### Table 191: `show oam ethernet connectivity-fault-management policer` Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>Displays the maintenance domain level configured.</td>
</tr>
<tr>
<td>Maintenance association</td>
<td>Displays the maintenance association name.</td>
</tr>
<tr>
<td>Policer</td>
<td>Displays the policer name.</td>
</tr>
<tr>
<td>Type</td>
<td>Policer type. Value <code>cc</code> means this policer is used only to police continuity check CFM messages. Value <code>other</code> means this policer is used only to police non-continuity check CFM messages. Value <code>all</code> means this policer is used to police all CFM messages.</td>
</tr>
<tr>
<td>Scope</td>
<td>Policer scope. Displays whether the global (G) policer configuration is applicable or the session (S) specific policer config is applicable.</td>
</tr>
<tr>
<td>Drop count</td>
<td>Displays the number of packets dropped by the indicated policer.</td>
</tr>
</tbody>
</table>

### Sample Output

```
show oam ethernet connectivity-fault-management policer

Legend for Policer
G - Global scope
S - Service scope
cc - Continuity check

Maintenance Domain: md1 Level: 1
<table>
<thead>
<tr>
<th>Maintenance association</th>
<th>Policer</th>
<th>Type</th>
<th>Scope</th>
<th>Drop count</th>
</tr>
</thead>
<tbody>
<tr>
<td>ma1</td>
<td>cfm-policer1</td>
<td>all</td>
<td>G</td>
<td>300</td>
</tr>
<tr>
<td>ma1-2</td>
<td>cfm-policer1 cc</td>
<td>S</td>
<td>259</td>
<td></td>
</tr>
<tr>
<td>ma1-2</td>
<td>cfm-policer1 other</td>
<td>G</td>
<td>300</td>
<td></td>
</tr>
</tbody>
</table>

Maintenance Domain: md2 Level: 2
<table>
<thead>
<tr>
<th>Maintenance association</th>
<th>Policer</th>
<th>Type</th>
<th>Scope</th>
<th>Drop count</th>
</tr>
</thead>
<tbody>
<tr>
<td>ma2</td>
<td>cfm-policer1 cc</td>
<td>G</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>ma2</td>
<td>cfm-policer2 other</td>
<td>S</td>
<td>223</td>
<td></td>
</tr>
</tbody>
</table>
```

Display the policer information for all maintenance associations and their maintenance domains.

```
show oam ethernet connectivity-fault-management policer
```
**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

<table>
<thead>
<tr>
<th>Maintenance Domain: md1 Level: 1</th>
<th>Maintenance association</th>
<th>Policer</th>
<th>Type</th>
<th>Scope</th>
<th>Drop count</th>
</tr>
</thead>
<tbody>
<tr>
<td>ma1</td>
<td>cfm-policer1</td>
<td>all</td>
<td>G</td>
<td></td>
<td>300</td>
</tr>
<tr>
<td>ma1-2</td>
<td>cfm-policer1 cc</td>
<td>S</td>
<td>259</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ma1-2</td>
<td>cfm-policer1 other</td>
<td>G</td>
<td>300</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

```
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

<table>
<thead>
<tr>
<th>Maintenance Domain: md5 Level: 5</th>
<th>Maintenance association</th>
<th>Policer</th>
<th>Type</th>
<th>Scope</th>
<th>Drop count</th>
</tr>
</thead>
<tbody>
<tr>
<td>ma5</td>
<td>cfm-policer cc</td>
<td>S</td>
<td>187</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ma5</td>
<td>cfm-policer-2 other</td>
<td>S</td>
<td>234</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
show oam ethernet connectivity-fault-management sla-iterator-statistics

Syntax

```
show oam ethernet connectivity-fault-management sla-iterator-statistics
maintenance-domain md-name
maintenance-association ma-name
sla-iterator sla-iterator
<local-mep local-mep-id>
<remote-mep remote-mep-id>
```

Release Information

Command introduced in Junos OS Release 11.4 for EX Series switches.
Command introduced in Junos OS Release 12.2 for ACX Series routers.
Command introduced in Junos OS Release 13.2 for MX Series routers (not on MPC3E Hyperion cards).

Description

Display the Ethernet Operation, Administration, and Maintenance (OAM) service-level agreement (SLA) iterator statistics.

Options

- `maintenance-domain md-name`—Name of an existing connectivity fault management (CFM) maintenance domain.
- `maintenance-association ma-name`—Name of an existing CFM maintenance association.
- `sla-iterator sla-iterator`—Name of the iterator profile.
- `local-mep local-mep-id`—(Optional) Numeric identifier of the local MEP. The range of values is 1 through 8191.
- `remote-mep remote-mep-id`—(Optional) Numeric identifier of the remote MEP. The range of values is 1 through 8192.

Required Privilege

view

Related Documentation

- Configuring an Iterator Profile on a Switch (CLI Procedure)
- `clear oam ethernet connectivity-fault-management sla-iterator-statistics`

List of Sample Output

- `show oam ethernet connectivity-fault-management sla-iterator-statistics` on page 2294
- `show oam ethernet connectivity-fault-management sla-iterator-statistics` (MX Series routers) on page 2295
- `show oam ethernet connectivity-fault-management sla-iterator-statistics` (MX Series routers) - Delay Measurement (DM) in Metro Ethernet Forum (MEF) mode on page 2296
- `show oam ethernet connectivity-fault-management sla-iterator-statistics` (MX Series routers) - Synthetic loss measurement (SLM) in Metro Ethernet Forum (MEF) mode on page 2297
Output Fields  Table 192 on page 2292 lists the output fields for the `show oam ethernet connectivity-fault-management sla-iterator-statistics` command. Output fields are listed in the approximate order in which they appear.

Table 192: show oam ethernet connectivity-fault-management sla-iterator-statistics Output Fields

<table>
<thead>
<tr>
<th>Output Field Name</th>
<th>Output Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance domain</td>
<td>Name of the maintenance domain.</td>
</tr>
<tr>
<td>Level</td>
<td>Level of the maintenance domain level configured.</td>
</tr>
<tr>
<td>Maintenance association</td>
<td>Name of the maintenance association.</td>
</tr>
<tr>
<td>Local MEP id</td>
<td>Numeric identifier of the local MEP.</td>
</tr>
<tr>
<td>Remote MEP id</td>
<td>Numeric identifier of the remote MEP.</td>
</tr>
<tr>
<td>Remote MAC address</td>
<td>Unicast MAC address of the remote MEP.</td>
</tr>
<tr>
<td>Iterator name</td>
<td>Name of iterator.</td>
</tr>
<tr>
<td>Iterator Id</td>
<td>Numeric identifier of the iterator.</td>
</tr>
<tr>
<td>Iterator cycle time</td>
<td>Number of cycles (in milliseconds) taken between back-to-back transmission of SLA frames for this connection</td>
</tr>
<tr>
<td>Iteration period</td>
<td>Maximum number of cycles per iteration</td>
</tr>
<tr>
<td>Iterator status</td>
<td>Current status of iterator whether running or stopped.</td>
</tr>
<tr>
<td>Infinite iterations</td>
<td>Status of iteration as infinite or finite.</td>
</tr>
<tr>
<td>Counter reset time</td>
<td>Date and time when the counter was reset.</td>
</tr>
<tr>
<td>Reset reason</td>
<td>Reason to reset counter.</td>
</tr>
<tr>
<td>Delay weight</td>
<td>Calculation weight of delay.</td>
</tr>
</tbody>
</table>
### Table 192: show oam ethernet connectivity-fault-management sla-iterator-statistics Output Fields (continued)

<table>
<thead>
<tr>
<th>Output Field Name</th>
<th>Output Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delay variation weight</td>
<td>Calculation weight of delay variation.</td>
</tr>
<tr>
<td>DMM sent</td>
<td>Delay measurement message (DMM) PDU frames sent to the peer MEP in this session.</td>
</tr>
<tr>
<td>DMM skipped for threshold hit</td>
<td>Number of DMM frames sent to the peer MEP in this session skipped during threshold hit.</td>
</tr>
<tr>
<td>DMM skipped for threshold hit window</td>
<td>Number of DMM frames sent to the peer MEP in this session skipped during the last threshold hit window.</td>
</tr>
<tr>
<td>DMR received</td>
<td>Number of delay measurement reply (DMR) frames received.</td>
</tr>
<tr>
<td>DMR out of sequence</td>
<td>Total number of DMR out of sequence packets received.</td>
</tr>
<tr>
<td>DMR received with invalid time stamps</td>
<td>Total number of DMR frames received with invalid timestamps.</td>
</tr>
<tr>
<td>Average two-way delay</td>
<td>Average two-way frame delay for the statistics displayed.</td>
</tr>
<tr>
<td>Average two-way delay variation</td>
<td>Average two-way “frame jitter” for the statistics displayed.</td>
</tr>
<tr>
<td>Average one-way forward delay variation</td>
<td>Average one-way forward delay variation for the statistics displayed in microseconds.</td>
</tr>
<tr>
<td>Average one-way backward delay variation</td>
<td>Average one-way backward delay variation for the statistics displayed in microseconds.</td>
</tr>
<tr>
<td>Weighted average two-way delay</td>
<td>Weighted average two-way delay for the statistics displayed in microseconds.</td>
</tr>
<tr>
<td>Weighted average two-way delay variation</td>
<td>Weighted average two-way delay variation for the statistics displayed in microseconds.</td>
</tr>
<tr>
<td>Weighted average one-way backward delay variation</td>
<td>Weighted average one-way backward delay variation for the statistics displayed in microseconds.</td>
</tr>
<tr>
<td>Weighted average one-way forward delay variation</td>
<td>Weighted average one-way forward delay variation for the statistics displayed in microseconds.</td>
</tr>
<tr>
<td>SLM packets sent</td>
<td>Total number of synthetic loss message (SLM) PDU frames sent from the source MEP to the remote MEP during this ETH-SLM session.</td>
</tr>
<tr>
<td>SLM packets received</td>
<td>Total number of synthetic loss message (SLM) PDU frames that the remote MEP received from the source MEP during this ETH-SLM session.</td>
</tr>
<tr>
<td>SLR packets sent</td>
<td>Total number of synthetic loss reply (SLR) PDU frames that the remote MEP sent to the source MEP during this measurement session.</td>
</tr>
</tbody>
</table>
Table 192: show oam ethernet connectivity-fault-management sla-iterator-statistics Output Fields (continued)

<table>
<thead>
<tr>
<th>Output Field Name</th>
<th>Output Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLR packets received</td>
<td>Total number of synthetic loss reply (SLR) PDU frames that the source MEP received from the remote MEP during this measurement session.</td>
</tr>
<tr>
<td>Local TXFC1 value</td>
<td>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.</td>
</tr>
<tr>
<td>Local RXFC1 value</td>
<td>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.</td>
</tr>
<tr>
<td>Last Received SLR frame</td>
<td>Value of the local counter TxFCI at the time of SLM frame transmission.</td>
</tr>
<tr>
<td>TXFCI(tc)</td>
<td></td>
</tr>
<tr>
<td>Last Received SLR frame</td>
<td>Value of the local counter RxFCI at the time of SLR frame transmission.</td>
</tr>
<tr>
<td>TXFCb(t)</td>
<td></td>
</tr>
<tr>
<td>Frame loss (near-end)</td>
<td>Count of frame loss associated with ingress data frames.</td>
</tr>
<tr>
<td>Frame loss (far-end)</td>
<td>Count of frame loss associated with egress data frames.</td>
</tr>
</tbody>
</table>

Sample Output

```
show oam ethernet connectivity-fault-management sla-iterator-statistics
user@switch> show oam ethernet connectivity-fault-management sla-iterator-statistics
sla-iterator i1 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: 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
```

Copyright © 2019, Juniper Networks, Inc.
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@router> show oam ethernet connectivity-fault-management sla-iterator-statistics  
maintenance-domain mdu maintenance-association m au 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 (CIR) : 0  
  Near-end loss-ratio (EIR) : 0 (0.00000%)  
  Far-end loss (CIR) : 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) : 0
Sample Output

show oam ethernet connectivity-fault-management sla-iterator-statistics (MX Series routers) - Delay Measurement (DM) in Metro Ethernet Forum (MEF) mode

user@router> show oam ethernet connectivity-fault-management sla-iterator-statistics
maintenance-domain md6-1 maintenance-association ma1 local-mep1 remote-mep2 sla-iterator DM

Iterator statistics:
  Maintenance domain: md6-1, Level: 6
  Maintenance association: ma1, Local MEP id: 1
  Remote MEP id: 2, Remote MAC address: 00:23:9c:db:0d:7a
  Iterator name: Test_DM, Iterator Id: 1
  Iterator cycle time: 1000ms, Iteration period: 2000 cycles
  Iterator status: running, Infinite iterations: true
  Counter reset time: 2018-12-05 19:48:23 PST (00:00:54 ago)
  Reset reason: Adjacency flap

Current delay measurement statistics:
  Measurement Interval Index : 2 (Suspect status : 1)
  Frame Delay two way (min, max, avg) : 251 , 295 , 262 (usec)
  Frame Delay forward (min, max, avg) : 125 , 147 , 131 (usec)
  Frame Delay backward (min, max, avg) : 125 , 147 , 131 (usec)
  Inter Frame Delay two way (min, max, avg) : 0 , 42 , 7 (usec)
  Inter Frame Delay forward (min, max, avg) : 0 , 21 , 3 (usec)
  Inter Frame Delay backward (min, max, avg) : 0 , 21 , 3 (usec)
  Frame Delay Range two way (max, avg) : 0 , 0 (usec)
  Frame Delay Range forward (max, avg) : 0 , 0 (usec)
  Frame Delay Range backward (max, avg) : 0 , 0 (usec)
  SOAM TXed : 52
  SOAM RXed : 52

Delay measurement bin statistics:
  Measurement Interval Index : 2
  Two Way Frame Delay
    [0 - 4999 ] (usec) : 52
    [5000 - 9999 ] (usec) : 0
    [10000 - Infinity ] (usec) : 0
  Forward Frame Delay
    [0 - 4999 ] (usec) : 52
    [5000 - 9999 ] (usec) : 0
    [10000 - Infinity ] (usec) : 0
  Backward Frame Delay
    [0 - 4999 ] (usec) : 52
    [5000 - 9999 ] (usec) : 0
    [10000 - Infinity ] (usec) : 0
  Two Way Inter Frame Delay Variation
    [0 - 4999 ] (usec) : 51
    [5000 - 9999 ] (usec) : 0
    [10000 - Infinity ] (usec) : 0
  Forward Inter Frame Delay Variation
    [0 - 4999 ] (usec) : 51
    [5000 - 9999 ] (usec) : 0
    [10000 - Infinity ] (usec) : 0
  Backward Inter Frame Delay Variation
    [0 - 4999 ] (usec) : 51
    [5000 - 9999 ] (usec) : 0
    [10000 - Infinity ] (usec) : 0
show oam ethernet connectivity-fault-management sla-iterator-statistics (MX Series routers) - Synthetic loss measurement (SLM) in Metro Ethernet Forum (MEF) mode

user@router> show oam ethernet connectivity-fault-management sla-iterator-statistics
maintenance-domain md6-1 maintenance-association ma1 local-mep 1 remote-mep 2 sla-iterator

SLM Iterator statistics:
  Maintenance domain: md6-1, Level: 6
  Maintenance association: ma1, Local MEP id: 1
  Remote MEP id: 2, Remote MAC address: 00:23:9c:db:0d:7a
  Iterator name: Test_SLM, Iterator Id: 2
  Iterator cycle time: 1000ms, Iteration period: 2000 cycles
  Iterator status: running, Infinite iterations: true
  Reset reason: Adjacency flap
  Iterator synthetic loss measurement statistics:
    SLM skipped for threshold hit : 0
    SLM skipped for threshold hit window : 0
    SLR out of sequence : 0
    SLM Sample Size : 180 SLMs
    Local packet Stats (TxFCl, RxFCl) : 11, 11
    Last SLR packet stats (TxFCl, TxFCb) : 11, 11
    Last measured FLR (fwd, bkwd) : 0.000%, 0.000% (Sample #NA)

Current Measurement Interval loss statistics:
  Measurement Interval Index : 2 (Suspect Status: 1)
  SOAM Frames (Tx, Rx) : 10, 10
  Forward Frame Stats (Tx, Rx) : 10, 10
  Backward Frame Stats (Tx, Rx) : 10, 10
  Frame Loss (fwd, bkwd) : 0, 0
  Forward FLR minimum : 0.000%
  Forward FLR maximum : 0.000%
  Forward FLR average : 0.000%
  Backward FLR minimum : 0.000%
  Backward FLR maximum : 0.000%
  Backward FLR average : 0.000%

Current Measurement Interval availability statistics:
  Measurement Interval Index : 2 (Suspect Status: 1)
  High loss (fwd, bkwd) : 0, 0
Consecutive high loss (fwd, bkwd) : 0, 0
Available (fwd, bkwd) : 0, 0
Unavailable (fwd, bkwd) : 0, 0
Forward FLR minimum : 0.000%
Forward FLR maximum : 0.000%
Forward FLR average : 0.000%
Backward FLR minimum : 0.000%
Backward FLR maximum : 0.000%
Backward FLR average : 0.000%

Last known available status (fwd, bkwd) : unknown, unknown
Last known forward availability transition : NA
Last known backward availability transition : NA

show oam ethernet connectivity-fault-management sla-iterator-statistics (MX Series routers) - Delay measurement (DM) statistics in non-Metro Ethernet Forum (MEF) mode

user@router> show oam ethernet connectivity-fault-management sla-iterator-statistics
maintenance-domain md6-1 maintenance-association ma1 local-mep1 remote-mep2 sla-iterator DM

Iterator statistics:
  Maintenance domain: md6-1, Level: 6
  Maintenance association: ma1, Local MEP id: 1
  Remote MEP id: 2, Remote MAC address: 00:23:9c:db:0d:7a
  Iterator name: Test_DM, Iterator id: 1
  Iterator cycle time: 1000ms, Iteration period: 2000 cycles
  Iterator status: running, Infinite iterations: true
  Reset reason: Adjacency flap

Iterator delay measurement statistics:
  Calculation weight: Delay: 1, Delay variation: 1
  DMM sent : 164
  DMM skipped for threshold hit : 0
  DMM skipped for threshold hit window : 0
  DMR received : 164
  DMR out of sequence : 0
  DMR forwarding-class mismatch : 0
  DMR received with invalid time stamps : 0
  Average two-way delay : 234 usec
  Average two-way delay variation : 9 usec
  Average one-way forward delay variation : 346 usec
  Average one-way backward delay variation : 346 usec
  Weighted average two-way delay : 221 usec
  Weighted average two-way delay variation : 2 usec
  Weighted average one-way forward delay variation : 357 usec
  Weighted average one-way backward delay variation : 355 usec
  Bestcase two-way delay : 210 usec
  Worstcase two-way delay : 283 usec
  Weighted Bestcase two-way delay : 210 usec
  Weighted Worstcase two-way delay : 283 usec

show oam ethernet connectivity-fault-management sla-iterator-statistics (MX Series routers) - Synthetic loss measurement (SLM) statistics in non-Metro Ethernet Forum (MEF) mode

user@router> show oam ethernet connectivity-fault-management sla-iterator-statistics
maintenance-domain md6-1 maintenance-association ma1 local-mep1 remote-mep2 sla-iterator SLM
show oam ethernet connectivity-fault-management sla-iterator-statistics (MX Series routers) - Delay Measurement (DM) with “legacy-pm-display” option in enhanced-cfm mode

user@router> show oam ethernet connectivity-fault-management sla-iterator-statistics maintenance-domain md6-1 maintenance-association ma1 local-mep 1 remote-mep 2 sla-iterator Legacy

Iterator statistics:
  Maintenance domain: md6-1, Level: 6
  Maintenance association: ma1, Local MEP id: 1
  Remote MEP id: 2, Remote MAC address: 00:23:9c:db:0d:7a
  Iterator name: Test_DM_Legacy, Iterator Id: 3
  Iterator cycle time: 1000ms, Iteration period: 2000 cycles
  Iterator status: running, Infinite iterations: true
  Counter reset time: 2018-12-05 19:51:33 PST (00:00:15 ago)
  Reset reason: Adjacency flap
  Iterator delay measurement statistics:
    Calculation weight: Delay: 1, Delay variation: 1
    DMM sent                     : 14
    DMM skipped for threshold hit: 0
    DMM skipped for threshold hit window: 0
    DMR received                 : 14
    DMR out of sequence          : 0
    DMR forwarding-class mismatch: 0
    DMR received with invalid time stamps: 0
    Average two-way delay        : 324 usec
    Average two-way delay variation: 7 usec
    Average one-way forward delay variation: 240 usec
    Average one-way backward delay variation: 240 usec
    Weighted average two-way delay: 324 usec
    Weighted average two-way delay variation: 6 usec
    Weighted average one-way forward delay variation: 222 usec
    Weighted average one-way backward delay variation: 222 usec
    Bestcase two-way delay       : 312 usec
show oam ethernet connectivity-fault-management state - To verify the Connectivity Fault Management (CFM) state

The following command is to verify whether the CFM state is in enhanced-cfmm mode or not.

```
user@router> show oam ethernet connectivity-fault-management state
```

Connectivity fault management state:
- CFM Mode Of Operation: Enhanced
- Enhanced IP Mode: Enabled
- CFM Config State: Ok
- CFM Cleanup State: Ok
- CFM Restart Timer State: Cleanup Timer State stopped Rebooting in 0 sec
- CFM CFMMAN Job State: Not Pending
- Number of sessions: 1
- Number of sessions created: 1
- Number of sessions deleted: 0
- Number of sessions freed: 0
- Number of sessions enqueued: 1
- Number of sessions dequeued: 1
- VPLS feature: enabled
- Token based forwarding feature: enabled
- Forwarding table filtering simulation feature: disabled
- Hardware assisted flooding feature: enabled
- Flood resynchronization for GRES feature: enabled
- Shared interface filter feature: disabled
- Hardware timestamping feature: disabled
- Marking of connection protection TLV feature: disabled
- CFMD config memory resource limit (in bytes): 3221225472
- CFMD max resident set (peak) size (in bytes): 24158208

Packet processing state:
- State of the connection to packet processing daemon: down
- State of the flow to packet processing daemon: ready
- State of the packet processing job: ready
- Number of times the connection to packet processing daemon was blocked: 0
- State of the connection to cfmm: slots: 2 3 4 5

Filter state:
- State of the connection to firewall daemon: Connected
- Number of reconnects made to firewall daemon: 0
- Number of requests sent to firewall daemon: 13
- Number of requests accepted by firewall daemon: 13
- Number of requests rejected by firewall daemon: 0
- Number of requests lost due to disconnection: 0
show oam ethernet connectivity-fault-management synthetic-loss-statistics

Syntax

```
show oam ethernet connectivity-fault-management synthetic-loss-statistics
<local-mep local-mep-id>
maintenance-association ma-name
<count entry-count>
maintenance-domain md-name
<remote-mep remote-mep-id>
```

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
- **count entry-count**—(Optional) Number of entries to display from the statistics table. The range of values is from 1 through 100. The default value is 100.
- **local-mep local-mep-id**—(Optional) Numeric identifier of the local MEP. The range of values is from 1 through 8192.
- **maintenance-association ma-name**—Name of an existing CFM maintenance association.
- **maintenance-domain md-name**—Name of an existing connectivity fault management (CFM) maintenance domain.
- **remote-mep remote-mep-id**—(Optional) Numeric identifier of the remote MEP. The range of values is from 1 through 8192.

Required Privilege
view

Related Documentation
- clear oam ethernet connectivity-fault-management statistics on page 1645
- clear oam ethernet connectivity-fault-management synthetic-loss-measurement on page 1647
- show oam ethernet connectivity-fault-management interfaces on page 2244
- show oam ethernet connectivity-fault-management mep-database on page 2262
- show oam ethernet connectivity-fault-management mep-statistics on page 2274
- show oam ethernet connectivity-fault-management synthetic-loss-statistics on page 2302

List of Sample Output
Table 193 on page 2302 lists the output fields for the show oam ethernet connectivity-fault-management synthetic-loss-statistics command. Output fields are listed in the approximate order in which they appear.
### Table 193: show oam ethernet connectivity-fault-management synthetic-loss-statistics Output Fields

<table>
<thead>
<tr>
<th>Output Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEP identifier</td>
<td>Maintenance association end point (MEP) numeric identifier.</td>
</tr>
<tr>
<td>MAC address</td>
<td>Unicast MAC address configured for the MEP.</td>
</tr>
<tr>
<td>Remote MEP count</td>
<td>Number of remote MEPs (unless you specify the remote-mep option).</td>
</tr>
<tr>
<td>Remote MEP identifier</td>
<td>Numeric identifier of the remote MEP.</td>
</tr>
<tr>
<td>Remote MAC address</td>
<td>Unicast MAC address of the remote MEP.</td>
</tr>
<tr>
<td>SLM packets sent</td>
<td>Total number of synthetic loss message (SLM) PDU frames sent from the source MEP to the remote MEP during this ETH-SLM session.</td>
</tr>
<tr>
<td>SLM packets received</td>
<td>Total number of synthetic loss message (SLM) PDU frames that the remote MEP received from the source MEP during this ETH-SLM session.</td>
</tr>
<tr>
<td>SLR packets sent</td>
<td>Total number of synthetic loss reply (SLR) PDU frames that the remote MEP sent to the source MEP during this measurement session.</td>
</tr>
<tr>
<td>SLR packets received</td>
<td>Total number of synthetic loss reply (SLR) PDU frames that the source MEP received from the remote MEP during this measurement session.</td>
</tr>
<tr>
<td>Local TXFC1 value</td>
<td>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.</td>
</tr>
<tr>
<td>Local RXFC1 value</td>
<td>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.</td>
</tr>
<tr>
<td>Last Received SLR frame TXFC1(tc)</td>
<td>Value of the local counter TxFC1 at the time of SLM frame transmission.</td>
</tr>
<tr>
<td>Last Received SLR frame RXFC1(t)</td>
<td>Value of the local counter RxFC1 at the time of SLR frame transmission.</td>
</tr>
<tr>
<td>Frame loss (near-end)</td>
<td>Count of frame loss associated with ingress data frames.</td>
</tr>
<tr>
<td>Frame loss (far-end)</td>
<td>Count of frame loss associated with egress data frames.</td>
</tr>
</tbody>
</table>

### 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
```
<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEP identifier</td>
<td>100</td>
</tr>
<tr>
<td>MAC address</td>
<td>00:05:85:73:7b:39</td>
</tr>
<tr>
<td>Remote MEP count</td>
<td>2</td>
</tr>
<tr>
<td>Remote MEP identifier</td>
<td>101</td>
</tr>
<tr>
<td>Remote MAC address</td>
<td>00:05:85:73:39:4a</td>
</tr>
<tr>
<td>Synthetic Loss measurement statistics:</td>
<td></td>
</tr>
<tr>
<td>SLM packets sent</td>
<td>100</td>
</tr>
<tr>
<td>SLM packets received</td>
<td>0</td>
</tr>
<tr>
<td>SLR packets sent</td>
<td>100</td>
</tr>
<tr>
<td>SLR packets received</td>
<td>0</td>
</tr>
<tr>
<td>Accumulated SLM statistics:</td>
<td></td>
</tr>
<tr>
<td>Local TXFC1 value</td>
<td>100</td>
</tr>
<tr>
<td>Local RXFC1 value</td>
<td>100</td>
</tr>
<tr>
<td>Last Received SLR frame TXFCftc</td>
<td>100</td>
</tr>
<tr>
<td>Last Received SLR frame TXFBCtc</td>
<td>100</td>
</tr>
<tr>
<td>SLM Frame Loss:</td>
<td></td>
</tr>
<tr>
<td>Frame Loss (far-end)</td>
<td>0 (0.00 %)</td>
</tr>
<tr>
<td>Frame Loss (near-end)</td>
<td>0 (0.00 %)</td>
</tr>
</tbody>
</table>
**show oam ethernet evc**

**Syntax**

```
show oam ethernet evc <evc-id>
```

**Release Information**
Command introduced in Junos OS Release 9.5.

**Description**
On MX Series routers with OAM Ethernet Virtual Connection (EVC) configurations, displays the EVC configuration and status information.

**Options**
This command has no options.

**Required Privilege Level**
View

**Output Fields**
Table 194 on page 2304 lists the output fields for the `show oam ethernet evc` command. Output fields are listed in the approximate order in which they appear.

**Table 194: show oam ethernet evc Output Fields**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVC identifier</td>
<td>Header for the EVC information showing the EVC name, configuration, and active/inactive status.</td>
</tr>
<tr>
<td>UNI count</td>
<td>Number of configured and active UNIs.</td>
</tr>
<tr>
<td>Protocol</td>
<td>Protocol configured between the UNIs.</td>
</tr>
<tr>
<td>Local UNIs</td>
<td>Heading for the list of local UNIs</td>
</tr>
<tr>
<td>UNI identifier</td>
<td>Name of the UNI.</td>
</tr>
<tr>
<td>Interface</td>
<td>Interface type-dpc(pic/port).unit-number.</td>
</tr>
<tr>
<td>Status</td>
<td>Status operational or not operational.</td>
</tr>
</tbody>
</table>

**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:
<table>
<thead>
<tr>
<th>UNI identifier</th>
<th>Interface</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>uni1</td>
<td>ge-1/1/1</td>
<td>Operational</td>
</tr>
<tr>
<td>uni2</td>
<td>ge-1/1/1</td>
<td>Not Operational</td>
</tr>
</tbody>
</table>
```
**show oam ethernet fnp interface**

**Syntax**

```
show oam ethernet fnp interface
<ethernet-interface-name>
<routing-instance routing-instance-name>
```

**Release Information**

Command introduced in Junos OS Release 11.4.

**Description**

On MX Series routers with Gigabit Ethernet, Fast Ethernet, or aggregated Ethernet PICs, displays OAM Ethernet Failure Notification Protocol (FNP) information for Ethernet interfaces.

**Options**

- `interface-name`—(Optional) Display Ethernet FNP information for the specified Ethernet interface only.
- `routing-instance-name`—(Optional) Display FNP for the specified routing instance.

**Required Privilege Level**

view

**List of Sample Output**

`show oam ethernet fnp interface on page 2306`

**Output Fields**

Table 195 on page 2306 lists the output fields for the `show oam ethernet fnp interface` command. Output fields are listed in the approximate order in which they appear.

*Table 195: show oam ethernet fnp interface Output Fields*

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>Name of the interface for the displayed information.</td>
</tr>
<tr>
<td>VLAN</td>
<td>Name of the VLAN.</td>
</tr>
<tr>
<td>State</td>
<td>Displays state of the interface.</td>
</tr>
<tr>
<td>FNP Message Interface</td>
<td>Displays the message interface type.</td>
</tr>
<tr>
<td>FNP Message Source MAC</td>
<td>Displays the source MAC address.</td>
</tr>
</tbody>
</table>

**Sample Output**

`show oam ethernet fnp interface`

```
user@host> show oam ethernet fnp interface

The FNP controlled interfaces are:

<table>
<thead>
<tr>
<th>Interface</th>
<th>VLAN</th>
<th>State</th>
<th>FNP message Interface</th>
<th>FNP message Source MAC</th>
</tr>
</thead>
</table>
```

Copyright © 2019, Juniper Networks, Inc.
<table>
<thead>
<tr>
<th>Interface</th>
<th>Index</th>
<th>Status</th>
<th>MAC Address</th>
<th>Ethernet Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-0/0/0.30</td>
<td>30</td>
<td>down</td>
<td>1:si.1054976</td>
<td>a:0:aa:aa:aa:aa</td>
</tr>
<tr>
<td>ge-0/0/0.20</td>
<td>20</td>
<td>down</td>
<td>1:si.1054976</td>
<td>a:0:aa:aa:aa:aa</td>
</tr>
</tbody>
</table>
show oam ethernet fnp messages

**Syntax**

```
show oam ethernet fnp messages
<interface interface-name>
<routing instance routing-instance-name>
```

**Release Information**

Command introduced in Junos OS Release 11.4

**Description**

On MX Series routers with Gigabit Ethernet, Fast Ethernet, or aggregated Ethernet PICs, displays OAM Ethernet Failure Notification Protocol (FNP) messages.

**Options**

- `interface-name`—(Optional) Display Ethernet FNP messages for the specified Ethernet interface only.
- `routing-instance-name`—(Optional) Display FNP messages for the specified routing instance.

**Required Privilege Level**

view

**List of Sample Output**

`show oam ethernet fnp messages on page 2309`

**Output Fields**

Table 196 on page 2308 lists the output fields for the `show oam ethernet fnp messages` command. Output fields are listed in the approximate order in which they appear.

**Table 196: show oam ethernet fnp messages Output Fields**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Message from source MAC address</td>
<td>The source MAC address of the message.</td>
</tr>
<tr>
<td>Originating port number</td>
<td>Port number of the original message.</td>
</tr>
<tr>
<td>Time since last message</td>
<td>Elapsed time in hours, minutes, and seconds since the last message was received.</td>
</tr>
<tr>
<td>Time since last message update</td>
<td>Elapsed time in hours, minutes, and seconds since the last message was updated.</td>
</tr>
<tr>
<td>Total messages received</td>
<td>Number of messages received.</td>
</tr>
<tr>
<td>Domain ID</td>
<td>Domain ID of the message.</td>
</tr>
<tr>
<td>STP Root ID</td>
<td>The spanning tree Root ID of the message.</td>
</tr>
<tr>
<td>Trigger Reason</td>
<td>The reason why the message was triggered.</td>
</tr>
</tbody>
</table>
Table 196: show oam ethernet fnp messages Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effected VLANs</td>
<td>Number of VLANs that are affected</td>
</tr>
<tr>
<td>Disabled interfaces</td>
<td>Name of the interfaces that are disabled</td>
</tr>
</tbody>
</table>

Sample Output

show oam ethernet fnp messages

user@host> show oam ethernet fnp messages
Active FNP messages on interface lsi.1054465
   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
   Effected VLANs: 10
   Disabled interfaces:
      Interface VLAN
      ge-0/0/0.10 10
**show oam ethernet fnp status**

**Syntax**

```
show oam ethernet fnp status
<interface interface-name>
<routing-instance routing-instance-name>
```

**Release Information**

Command introduced in Junos OS Release 11.4

**Description**

On MX Series routers with Gigabit Ethernet, Fast Ethernet, or aggregated Ethernet PICs, displays OAM Ethernet Failure Notification Protocol (FNP) status.

**Options**

- `interface-name`—(Optional) Display Ethernet FNP information for the specified Ethernet interface only.

- `routing-instance-name`—(Optional) Display FNP for the specified routing instance.

**Required Privilege Level**

view

**List of Sample Output**

show oam ethernet fnp status on page 2310

**Output Fields**

Table 197 on page 2310 lists the output fields for the `show oam ethernet fnp status` command. Output fields are listed in the approximate order in which they appear.

*Table 197: show oam ethernet fnp status Output Fields*

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FNP interval</td>
<td>The time interval between messages.</td>
</tr>
<tr>
<td>Loss threshold</td>
<td>The number of messages that can be lost before FNP is marked as down.</td>
</tr>
<tr>
<td>FNP enabled interfaces</td>
<td>Displays interfaces that are enabled.</td>
</tr>
<tr>
<td>Interface</td>
<td>The name of the interface.</td>
</tr>
<tr>
<td>Domain ID</td>
<td>Domain ID of the message.</td>
</tr>
<tr>
<td>STP Root ID</td>
<td>The spanning tree Root ID of the message.</td>
</tr>
<tr>
<td>FNP Messages</td>
<td>The total number of messages received.</td>
</tr>
</tbody>
</table>

**Sample Output**

```
show oam ethernet fnp status
user@host> show oam ethernet status
```
<table>
<thead>
<tr>
<th>Interface</th>
<th>Domain ID</th>
<th>STP Root ID</th>
<th>FNP Messages</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-0/0/0.1278</td>
<td>100</td>
<td>0.f0:ff:ff:ff:ff</td>
<td>0</td>
</tr>
</tbody>
</table>
show oam ethernet link-fault-management

Syntax

```
show oam ethernet link-fault-management
  <brief | detail>
  <interface-name>
```

Release Information

Command introduced in Junos OS Release 8.2.

Description

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.

Options

- **brief | detail**—(Optional) Display the specified level of output.
- **interface-name**—(Optional) Display link fault management information for the specified Ethernet interface only.

Required Privilege

```
view
```

List of Sample Output

- `show oam ethernet link-fault-management brief` on page 2317
- `show oam ethernet link-fault-management brief (Loopback tracking)` on page 2317
- `show oam ethernet link-fault-management detail` on page 2317
- `show oam ethernet link-fault-management detail (backup Routing Engine)` on page 2318

Output Fields

Table 198 on page 2312 lists the output fields for the `show oam ethernet link-fault-management` command. Output fields are listed in the approximate order in which they appear.

**Table 198: show oam ethernet link-fault-management Output Fields**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status</td>
<td>Indicates the status of the OAM discovery state mechanism.</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>• <strong>Down</strong>—Discovery mechanism is not running.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Running</strong>—Discovery mechanism is running.</td>
<td></td>
</tr>
<tr>
<td>Discovery state</td>
<td>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:</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>• <strong>Passive Wait</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Active Send Local</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Send Any</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Send Local Remote</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Send Local Remote Ok</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Fault</strong></td>
<td></td>
</tr>
</tbody>
</table>
### Table 198: show oam ethernet link-fault-management Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ISSU</strong></td>
<td>Specifies that the local end is undergoing a unified in-service software upgrade (ISSU).</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Peer address</strong></td>
<td>Address of the OAM peer.</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Flags</strong></td>
<td>Information about the interface. Possible values are described in the “Link Flags” section under Common Output Fields Description.</td>
<td>All levels</td>
</tr>
<tr>
<td>• Remote-Stable</td>
<td>Indicates remote OAM client acknowledgment of and satisfaction with local OAM state information. <em>False</em> indicates that remote DTE either has not seen or is unsatisfied with local state information. <em>True</em> indicates that remote DTE has seen and is satisfied with local state information.</td>
<td></td>
</tr>
<tr>
<td>• Local-Stable</td>
<td>Indicates local OAM client acknowledgment of and satisfaction with remote OAM state information. <em>False</em> indicates that local DTE either has not seen or is unsatisfied with remote state information. <em>True</em> indicates that local DTE has seen and is satisfied with remote state information.</td>
<td></td>
</tr>
<tr>
<td>• Remote-State-Valid</td>
<td>Indicates the OAM client has received remote state information found within Local Information TLVs of received Information OAMPDUs. <em>False</em> indicates that OAM client has not seen remote state information. <em>True</em> indicates that the OAM client has seen remote state information.</td>
<td></td>
</tr>
<tr>
<td><strong>Remote loopback status</strong></td>
<td>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).</td>
<td>All levels</td>
</tr>
<tr>
<td><strong>Remote entity information</strong></td>
<td>Remote entity information.</td>
<td>All levels</td>
</tr>
<tr>
<td>• Remote MUX action</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>• Remote parser action</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>• Discovery mode</td>
<td>Indicates whether discovery mode is active or inactive.</td>
<td></td>
</tr>
<tr>
<td>• Unidirectional mode</td>
<td>Indicates the ability to operate a link in a unidirectional mode for diagnostic purposes.</td>
<td></td>
</tr>
<tr>
<td>• Remote loopback mode</td>
<td>Indicates whether remote loopback is supported or unsupported.</td>
<td></td>
</tr>
<tr>
<td>• Link events</td>
<td>Indicates whether interpreting link events is supported or unsupported on the remote peer.</td>
<td></td>
</tr>
<tr>
<td>• Variable requests</td>
<td>Indicates whether variable requests are supported. The Variable Request OAM PDU is used to request one or more MIB variables from the remote peer.</td>
<td></td>
</tr>
<tr>
<td>• Remote in ISSU</td>
<td>Indicates that the remote end is undergoing a unified in-service software upgrade (ISSU).</td>
<td></td>
</tr>
<tr>
<td><strong>Loopback Tracking</strong></td>
<td>Indicates that loopback detection is enabled or disabled.</td>
<td>All levels</td>
</tr>
</tbody>
</table>
### Table 198: show oam ethernet link-fault-management Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loop Status</td>
<td>Indicates that a loopback issue is either found, not found, or unknown when loopback tracking is enabled.</td>
<td>All levels</td>
</tr>
<tr>
<td>Detect LOC</td>
<td>Indicates that loss-of-continuity (LOC) detection is enabled or disabled.</td>
<td>All levels</td>
</tr>
<tr>
<td>LOC status</td>
<td>Indicates that a LOC issue is either found, not found, or unknown when Detect LOC is enabled. Status is unknown when LOC detection is disabled.</td>
<td>All levels</td>
</tr>
</tbody>
</table>

**OAM Receive Statistics**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information</td>
<td>The total number of information PDUs received.</td>
<td>detail</td>
</tr>
<tr>
<td>Event</td>
<td>The total number of loopback control PDUs received.</td>
<td>detail</td>
</tr>
<tr>
<td>Variable request</td>
<td>The total number of variable request PDUs received.</td>
<td>detail</td>
</tr>
<tr>
<td>Variable response</td>
<td>The total number of variable response PDUs received.</td>
<td>detail</td>
</tr>
<tr>
<td>Loopback control</td>
<td>The total number of loopback control PDUs received.</td>
<td>detail</td>
</tr>
<tr>
<td>Organization specific</td>
<td>The total number of vendor organization specific PDUs received.</td>
<td>detail</td>
</tr>
</tbody>
</table>

**OAM Transmit Statistics**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information</td>
<td>The total number of information PDUs transmitted.</td>
<td>detail</td>
</tr>
<tr>
<td>Event</td>
<td>The total number of event notification PDUs transmitted.</td>
<td>detail</td>
</tr>
<tr>
<td>Variable request</td>
<td>The total number of variable request PDUs transmitted.</td>
<td>detail</td>
</tr>
<tr>
<td>Variable response</td>
<td>The total number of variable response PDUs transmitted.</td>
<td>detail</td>
</tr>
<tr>
<td>Loopback control</td>
<td>The total number of loopback control PDUs transmitted.</td>
<td>detail</td>
</tr>
<tr>
<td>Organization specific</td>
<td>The total number of vendor organization specific PDUs transmitted.</td>
<td>detail</td>
</tr>
</tbody>
</table>

**OAM Received Symbol Error Event information**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Events</td>
<td>The number of symbol error event TLVs that have been received since the OAM sublayer was reset.</td>
<td>detail</td>
</tr>
<tr>
<td>Window</td>
<td>The symbol error event window in the received PDU.</td>
<td>detail</td>
</tr>
<tr>
<td></td>
<td>The protocol default value is the number of symbols that can be received in one second on the underlying physical layer.</td>
<td></td>
</tr>
<tr>
<td>Threshold</td>
<td>The number of errored symbols in the period required for the event to be generated.</td>
<td>detail</td>
</tr>
</tbody>
</table>
### Table 198: show oam ethernet link-fault-management Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Errors in period</td>
<td>The number of symbol errors in the period reported in the received event PDU.</td>
<td>detail</td>
</tr>
<tr>
<td>Total errors</td>
<td>The number of errored symbols that have been reported in received event TLVs since the OAM sublayer was reset.</td>
<td>detail</td>
</tr>
<tr>
<td></td>
<td>Symbol errors are coding symbol errors.</td>
<td></td>
</tr>
<tr>
<td>OAM Received Frame Error Event Information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Events</td>
<td>The number of errored frame event TLVs that have been received since the OAM sublayer was reset.</td>
<td>detail</td>
</tr>
<tr>
<td>Window</td>
<td>The duration of the window in terms of the number of 100 ms period intervals.</td>
<td>detail</td>
</tr>
<tr>
<td>Threshold</td>
<td>The number of detected errored frames required for the event to be generated.</td>
<td>detail</td>
</tr>
<tr>
<td>Errors in period</td>
<td>The number of detected errored frames in the period.</td>
<td>detail</td>
</tr>
<tr>
<td>Total errors</td>
<td>The number of errored frames that have been reported in received event TLVs since the OAM sublayer was reset.</td>
<td>detail</td>
</tr>
<tr>
<td></td>
<td>A frame error is any frame error on the underlying physical layer.</td>
<td></td>
</tr>
<tr>
<td>OAM Received Frame Period Error Event Information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Events</td>
<td>The number of frame seconds errors event TLVs that have been received since the OAM sublayer was reset.</td>
<td>detail</td>
</tr>
<tr>
<td>Window</td>
<td>The duration of the frame seconds window.</td>
<td>detail</td>
</tr>
<tr>
<td>Threshold</td>
<td>The number of frame seconds errors in the period.</td>
<td>detail</td>
</tr>
<tr>
<td>Errors in period</td>
<td>The number of frame seconds errors in the period.</td>
<td>detail</td>
</tr>
<tr>
<td>Total errors</td>
<td>The number of frame seconds errors that have been reported in received event TLVs since the OAM sublayer was reset.</td>
<td>detail</td>
</tr>
<tr>
<td>OAM Transmitted Symbol Error Event Information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Events</td>
<td>The number of symbol error event TLVs that have been transmitted since the OAM sublayer was reset.</td>
<td>detail</td>
</tr>
<tr>
<td>Window</td>
<td>The symbol error event window in the transmitted PDU.</td>
<td>detail</td>
</tr>
<tr>
<td>Threshold</td>
<td>The number of errored symbols in the period required for the event to be generated.</td>
<td>detail</td>
</tr>
<tr>
<td>Errors in period</td>
<td>The number of symbol errors in the period reported in the transmitted event PDU.</td>
<td>detail</td>
</tr>
</tbody>
</table>
Table 198: show oam ethernet link-fault-management Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total errors</td>
<td>The number of errored symbols reported in event TLVs that have been transmitted since the OAM sublayer was reset.</td>
<td>detail</td>
</tr>
<tr>
<td><strong>OAM Current Symbol Error Event Information</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Events</td>
<td>The number of symbol error TLVs that have been generated regardless of whether the threshold for sending event TLVs has been crossed.</td>
<td>detail</td>
</tr>
<tr>
<td>Window</td>
<td>The symbol error event window in the transmitted PDU.</td>
<td>detail</td>
</tr>
<tr>
<td>Threshold</td>
<td>The number of errored symbols in the period required for the event to be generated.</td>
<td>detail</td>
</tr>
<tr>
<td>Errors in period</td>
<td>The total number of symbol errors in the period reported.</td>
<td>detail</td>
</tr>
<tr>
<td>Total errors</td>
<td>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.</td>
<td>detail</td>
</tr>
<tr>
<td><strong>OAM Transmitted Frame Error Event Information</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Events</td>
<td>The number of errored frame event TLVs that have been transmitted since the OAM sublayer was reset.</td>
<td>detail</td>
</tr>
<tr>
<td>Window</td>
<td>The duration of the window in terms of the number of 100 ms period intervals.</td>
<td>detail</td>
</tr>
<tr>
<td>Threshold</td>
<td>The number of detected errored frames required for the event to be generated.</td>
<td>detail</td>
</tr>
<tr>
<td>Errors in period</td>
<td>The number of detected errored frames in the period.</td>
<td>detail</td>
</tr>
<tr>
<td>Total errors</td>
<td>The number of errored frames that have been detected since the OAM sublayer was reset.</td>
<td>detail</td>
</tr>
<tr>
<td><strong>OAM Current Frame Error Event Information</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Events</td>
<td>The number of errored frame event TLVs that have been generated regardless of whether the threshold for sending event TLVs has been crossed.</td>
<td>detail</td>
</tr>
<tr>
<td>Window</td>
<td>The duration of the window in terms of the number of 100 ms period intervals.</td>
<td>detail</td>
</tr>
<tr>
<td>Threshold</td>
<td>The number of detected errored frames required for the event to be generated.</td>
<td>detail</td>
</tr>
<tr>
<td>Errors in period</td>
<td>The number of errored frames in the period.</td>
<td>detail</td>
</tr>
<tr>
<td>Total errors</td>
<td>The number of errored frames detected regardless of whether the threshold for transmitting event TLVs has been crossed.</td>
<td>detail</td>
</tr>
</tbody>
</table>
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 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
```

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show oam ethernet link-fault-management detail (backup Routing Engine)

```
user@host> show oam ethernet link-fault-management ge-0/2/0 detail

Interface: ge-0/2/0
Status: Running, Discovery state: Send Any
    Transmit interval: 100ms, PDU threshold: 3 frames, Hold time: 300ms
    Peer address: ac:4b:c8:81:90:a4
    Flags: Remote-Stable Remote-State-Valid Local-Stable 0x50

OAM receive statistics:
    Information: 0, Event: 0, Variable request: 0, Variable response: 0
    Loopback control: 0, Organization specific: 0

OAM receive statistics:
    Information: 0, Event: 0, Variable request: 0, Variable response: 0
    Loopback control: 0, Organization specific: 0

OAM transmit statistics:
    Information: 0, Event: 0, Variable request: 0, Variable response: 0
    Loopback control: 0, Organization specific: 0

OAM transmit statistics:
    Information: 0, Event: 0, Variable request: 0, Variable response: 0
    Loopback control: 0, Organization specific: 0

OAM receive frame error event information:
    Events: 0, Window: 0, Threshold: 1
    Errors in period: 0, Total errors: 0

OAM receive frame period error event information:
    Events: 0, Window: 0, Threshold: 1
    Errors in period: 0, Total errors: 0

OAM receive frame seconds error event information:
    Events: 0, Window: 0, Threshold: 1
    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

Application profile statistics:
<table>
<thead>
<tr>
<th>Profile Name</th>
<th>Invoked</th>
<th>Executed</th>
</tr>
</thead>
<tbody>
<tr>
<td>LK_ADJ_LOSS100_1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
```
Chapter 41: Operational Commands

<table>
<thead>
<tr>
<th>Command</th>
<th>Value1</th>
<th>Value2</th>
</tr>
</thead>
<tbody>
<tr>
<td>LK_ADJ_LOSS100_2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS100_3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS101_1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>LK_ADJ_LOSS101_2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS101_3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS106_1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS106_2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS106_3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS107_1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS107_2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LK_ADJ_LOSS107_3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
**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 199 on page 2320 lists the output fields for the show oam ethernet lmi command. Output fields are listed in the approximate order in which they appear.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Interface</td>
<td>Header for the EVC information showing the Ethernet virtual circuit (EVC) name, configuration, and active/inactive status.</td>
</tr>
<tr>
<td>UNI Identifier</td>
<td>Name of the UNI.</td>
</tr>
<tr>
<td>EVC map type</td>
<td>EVC configuration.</td>
</tr>
<tr>
<td>Polling verification timer</td>
<td>Polling verification timer status.</td>
</tr>
<tr>
<td>E-LMI state</td>
<td>Operational status of the E-LMI configuration in the interfaces or specified interface.</td>
</tr>
<tr>
<td>Priority/Untagged VLAN ID</td>
<td>To be provided.</td>
</tr>
<tr>
<td>Default EVC</td>
<td>The EVC set as the default EVC.</td>
</tr>
</tbody>
</table>
Table 199: show oam ethernet lmi Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Associated EVCs</td>
<td>Heading for the list of configured EVCs.</td>
</tr>
<tr>
<td>EVC Identifier</td>
<td>EVC name.</td>
</tr>
<tr>
<td>Reference ID</td>
<td>To be provided.</td>
</tr>
<tr>
<td>Status</td>
<td>Status active or not active.</td>
</tr>
<tr>
<td>CE VLAN IDs</td>
<td>Customer edge VLAN ID numbers.</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>EVC Identifier</th>
<th>Reference ID</th>
<th>Status</th>
<th>CE VLAN IDs</th>
</tr>
</thead>
<tbody>
<tr>
<td>evc1</td>
<td>1</td>
<td>Active (New)</td>
<td>1-2048</td>
</tr>
<tr>
<td>evc2</td>
<td>2</td>
<td>Not Active</td>
<td>2049-4096</td>
</tr>
</tbody>
</table>
```
show oam ethernet lmi statistics

Syntax

show oam ethernet lmi statistics <interface interface-name>

Release Information

Command introduced in Junos OS Release 9.5.

Description

On MX Series routers with Gigabit Ethernet, Fast Ethernet, or aggregated Ethernet PICs, displays OAM Ethernet Local Management Interface (LMI) statistics.

Options

interface—(Optional) Display LMI statistics for a specified interface.

interface-name—(Optional) Display Ethernet LMI information for the specified Ethernet interface only.

Required Privilege

view

List of Sample Output

show oam ethernet lmi statistics on page 2323

Output Fields

Table 200 on page 2322 lists the output fields for the show oam ethernet lmi statistics command. Output fields are listed in the approximate order in which they appear.

Table 200: show oam ethernet lmi statistics Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical interface</td>
<td>Name of the interface for the displayed statistics.</td>
</tr>
<tr>
<td>Reliability errors</td>
<td>Number of E-LMI reliability errors logged.</td>
</tr>
<tr>
<td>Protocol errors</td>
<td>Number of E-LMI protocol errors.</td>
</tr>
<tr>
<td>Status check received</td>
<td>Number of E-LMI status check receive errors.</td>
</tr>
<tr>
<td>Status check sent</td>
<td>Number of E-LMI status check sent errors.</td>
</tr>
<tr>
<td>Full status received</td>
<td>Number of E-LMI full status receive errors.</td>
</tr>
<tr>
<td>Full status sent</td>
<td>Number of E-LMI full status sent errors.</td>
</tr>
<tr>
<td>Full status continued received</td>
<td>Number of E-LMI status continued received errors.</td>
</tr>
<tr>
<td>Full status continued sent</td>
<td>Number of E-LMI full status continued sent errors.</td>
</tr>
<tr>
<td>Asynchronous status sent</td>
<td>Number of E-LMI asynchronous status sent errors.</td>
</tr>
</tbody>
</table>
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
  Status check received                   0  Status check sent
  Full status received                  694  Full status sent
  Full status continued received          0  Full status continued sent
  Asynchronous status sent                0
```
**show pppoe interfaces**

**Syntax**

```
show pppoe interfaces
  <brief | detail
  <pp0.logical>
```

**Release Information**

Command introduced before Junos OS Release 7.4.

**Description**

Display session-specific information about PPPoE interfaces.

**Options**

- `none`—Display interface information for all PPPoE interfaces.
- `brief | detail`—(Optional) Display the specified level of output.
- `pp0.logical`—(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.

**Required Privilege**

view

**Related Documentation**

- Verifying and Managing Agent Circuit Identifier-Based Dynamic VLAN Configuration

**List of Sample Output**

- `show pppoe interfaces on page 2326`
- `show pppoe interfaces (Status for the Specified Interface) on page 2326`
- `show pppoe interfaces brief on page 2326`
- `show pppoe interfaces detail on page 2327`
- `show pppoe interfaces (PPPoE Subscriber Interface with ACI Interface Set) on page 2327`

**Output Fields**

Table 201 on page 2324 lists the output fields for the `show pppoe interfaces` 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.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logical Interface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logical interface</td>
<td>Name of the logical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Index</td>
<td>Index number of the logical interface, which reflects its initialization sequence.</td>
<td>detail extensive, none</td>
</tr>
<tr>
<td>State</td>
<td>State of the logical interface: <strong>up</strong> or <strong>down</strong>.</td>
<td>All levels</td>
</tr>
<tr>
<td>Session ID</td>
<td>Session ID.</td>
<td>All levels</td>
</tr>
</tbody>
</table>

---

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### Table 201: show pppoe interfaces Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Origin of the logical interface: <strong>Static</strong> or <strong>Dynamic</strong>. Indicates whether the interface was statically or dynamically created.</td>
<td><strong>detail extensive</strong> none</td>
</tr>
<tr>
<td><strong>Service name</strong></td>
<td>Type of service required (can be used to indicate an ISP name or a class or quality of service).</td>
<td><strong>detail extensive</strong> none</td>
</tr>
<tr>
<td><strong>Configured AC name</strong></td>
<td>Configured access concentrator name.</td>
<td><strong>detail extensive</strong> none</td>
</tr>
<tr>
<td><strong>Session AC name</strong></td>
<td>Name of the access concentrator.</td>
<td><strong>detail extensive</strong> none</td>
</tr>
<tr>
<td><strong>Remote MAC address or Remote MAC</strong></td>
<td>MAC address of the remote side of the connection, either the access concentrator or the PPPoE client.</td>
<td><strong>All levels</strong></td>
</tr>
<tr>
<td><strong>Session uptime</strong></td>
<td>Length of time the session has been up, in <strong>hh:mm:ss</strong>.</td>
<td><strong>detail extensive</strong> none</td>
</tr>
<tr>
<td><strong>Dynamic Profile</strong></td>
<td>Name of the dynamic profile that was used to create this interface. If the interface was statically created, this field is not displayed.</td>
<td><strong>detail extensive</strong> none</td>
</tr>
<tr>
<td><strong>Underlying interface</strong></td>
<td>Interface on which PPPoE is running.</td>
<td><strong>All levels</strong></td>
</tr>
<tr>
<td><strong>Agent Circuit ID</strong></td>
<td>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.</td>
<td><strong>detail extensive</strong> none</td>
</tr>
<tr>
<td><strong>Agent Remote ID</strong></td>
<td>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.</td>
<td><strong>detail extensive</strong> none</td>
</tr>
<tr>
<td><strong>ACI Interface Set</strong></td>
<td>Internally-generated name of the dynamic ACI interface set, if configured, and the set index number of the ACI entry in the session database.</td>
<td><strong>detail extensive</strong> none</td>
</tr>
</tbody>
</table>
Table 201: `show pppoe interfaces` Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Packet Type</strong></td>
<td>Number of packets sent and received during the PPPoE session, categorized by packet type and packet errors:</td>
<td><strong>extensive</strong></td>
</tr>
<tr>
<td></td>
<td>• PADI—PPPoE Active Discovery Initiation packets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• PADO—PPPoE Active Discovery Offer packets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• PADR—PPPoE Active Discovery Request packets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• PADS—PPPoE Active Discovery Session-Confirmation packets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• PADT—PPPoE Active Discovery Termination packets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Service name error—Packets for which the Service-Name request could not be honored.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• AC system error—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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Generic error—Packets that indicate an unrecoverable error occurred.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Malformed packets—Malformed or short packets that caused the packet handler to discard the frame as unreadable.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Unknown packets—Unrecognized packets.</td>
<td></td>
</tr>
</tbody>
</table>

**Sample Output**

```bash
table
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: 00:00:5e:00:53:00,
  Auto-reconnect timeout: 100 seconds, Idle timeout: Never,
  Underlying interface: at-5/0/0.0 Index 71

table
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: 00:00:5e:00:53: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: pppoeProfile
  Agent Remote ID: westford

table
show pppoe interfaces brief

user@host> show pppoe interfaces brief

<table>
<thead>
<tr>
<th>Interface</th>
<th>Underlying interface</th>
<th>State</th>
<th>Session ID</th>
<th>Remote MAC</th>
</tr>
</thead>
</table>
```
show pppoe interfaces detail

user@host> show pppoe interfaces detail

<table>
<thead>
<tr>
<th>Interface</th>
<th>Address</th>
<th>Session ID</th>
<th>Type</th>
<th>Service name</th>
<th>Configured AC name</th>
<th>Session AC name</th>
<th>Remote MAC address</th>
<th>Auto-reconnect timeout</th>
<th>Idle timeout</th>
<th>Underlying interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>pp0.0</td>
<td>ge-2/0/3.2</td>
<td>None</td>
<td>Static</td>
<td>None</td>
<td>sapphire</td>
<td>None</td>
<td>00:00:5e:00:53:00</td>
<td>100 seconds</td>
<td>Never</td>
<td>at-5/0/0.0 Index 71</td>
</tr>
<tr>
<td>pp0.1</td>
<td>ge-2/0/3.2</td>
<td>None</td>
<td>Static</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>00:00:5e:00:53:00</td>
<td>100 seconds</td>
<td>Never</td>
<td>ge-2/0/3.2</td>
</tr>
<tr>
<td>pp0.1073741824</td>
<td>ge-2/0/3.1</td>
<td>None</td>
<td>Static</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>00:00:5e:00:53:00</td>
<td>100 seconds</td>
<td>Never</td>
<td>ge-2/0/3.1</td>
</tr>
<tr>
<td>pp0.1073741825</td>
<td>ge-2/0/3.1</td>
<td>None</td>
<td>Static</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>00:00:5e:00:53:00</td>
<td>100 seconds</td>
<td>Never</td>
<td>ge-2/0/3.1</td>
</tr>
<tr>
<td>pp0.1073741826</td>
<td>ge-2/0/3.1</td>
<td>None</td>
<td>Static</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>00:00:5e:00:53:00</td>
<td>100 seconds</td>
<td>Never</td>
<td>ge-2/0/3.1</td>
</tr>
</tbody>
</table>

show pppoe interfaces (PPPoE Subscriber Interface with ACI Interface Set)

user@host> show pppoe interfaces pp0.1073741827

<table>
<thead>
<tr>
<th>Interface</th>
<th>Address</th>
<th>Session ID</th>
<th>Type</th>
<th>Service name</th>
<th>Remote MAC address</th>
<th>Session AC name</th>
<th>Dynamic Profile</th>
<th>Underlying interface</th>
<th>Agent Circuit ID</th>
<th>ACI Interface Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>pp0.1073741827</td>
<td>Index 346</td>
<td>4</td>
<td>Dynamic</td>
<td>AGILENT</td>
<td>00:00:5e:00:53:62</td>
<td>nbc</td>
<td>aci-vlan-pppoe-profile</td>
<td>demux0.1073741826</td>
<td>aci-ppp-dhcp-dvlan-50</td>
<td>aci-1002-demux0.1073741826 Index 2</td>
</tr>
</tbody>
</table>
**show pppoe service-name-tables**

**Syntax**

```plaintext
show pppoe service-name-tables
<table-name>
```

**Release Information**

Command introduced in Junos OS Release 10.0.

**Description**

Display configuration information about PPPoE service name tables.

**Options**

- `none`—Display the names of configured PPPoE service name tables.
- `table-name`—(Optional) Name of a configured PPPoE service name table.

**Required Privilege**

- **Level:** `view`

**Related Documentation**

- Verifying a PPPoE Configuration on page 378
- Verifying and Managing Dynamic PPPoE Configuration

**List of Sample Output**

- show pppoe service-name-tables on page 2329
- show pppoe service-name-tables (For the Specified Table Name) on page 2329

**Output Fields**

Table 202 on page 2328 lists the output fields for the `show pppoe service-name-tables` command. Output fields are listed in the approximate order in which they appear.

**Table 202: show pppoe service-name-tables Output Fields**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Name Table</td>
<td>Name of the PPPoE service name table.</td>
<td>none</td>
</tr>
<tr>
<td>Service Name</td>
<td>Name of a configured service in the PPPoE service name table:</td>
<td>none</td>
</tr>
<tr>
<td></td>
<td>- <code>&lt;empty&gt;</code>—Service of zero length that represents an unspecified service</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <code>&lt;any&gt;</code>—Default service for non-empty service entries that do not match the</td>
<td></td>
</tr>
<tr>
<td></td>
<td>configured empty or named service entries</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <code>service-name</code>—Named service entry</td>
<td></td>
</tr>
<tr>
<td>Action</td>
<td>Action taken when the PPPoE underlying interface interface receives a PPPoE</td>
<td>none</td>
</tr>
<tr>
<td></td>
<td>Active Discovery Initiation (PADI) packet with the specified named service,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>empty service, any service, or AC/vari pair:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <code>Delay seconds</code>—Number of seconds that the interface delays before</td>
<td></td>
</tr>
<tr>
<td></td>
<td>responding with a PPPoE Active Discovery Offer (PADO) packet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <code>Drop</code>—Interface drops (ignores) the packet.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- <code>Terminate</code>—Interface responds immediately with a PADO packet</td>
<td></td>
</tr>
</tbody>
</table>
**Table 202: show pppoe service-name-tables Output Fields (continued)**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dynamic Profile</strong></td>
<td>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, empty service, any service, or ACI/ARI pair.</td>
<td>none</td>
</tr>
<tr>
<td><strong>Routing Instance</strong></td>
<td>Name of the routing instance in which to instantiate the dynamic PPPoE subscriber interface. A routing instance can be assigned to a named service, empty service, any service, or ACI/ARI pair.</td>
<td>none</td>
</tr>
<tr>
<td><strong>Max Sessions</strong></td>
<td>Maximum number of active PPPoE sessions that the router can establish with the specified named service, empty service, or any service.</td>
<td>none</td>
</tr>
<tr>
<td><strong>Active Sessions</strong></td>
<td>Current count of active PPPoE sessions created using the specified named service, empty service, or any service. The Active Sessions value cannot exceed the Max Sessions value.</td>
<td>none</td>
</tr>
<tr>
<td><strong>ACI</strong></td>
<td>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, empty service, or any service.</td>
<td>none</td>
</tr>
<tr>
<td><strong>ARI</strong></td>
<td>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, empty service, or any service.</td>
<td>none</td>
</tr>
<tr>
<td><strong>Static Interface</strong></td>
<td>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.</td>
<td>none</td>
</tr>
</tbody>
</table>

**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>
```
<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drop</td>
<td>ACI: velorum-ge-2/0/3</td>
</tr>
<tr>
<td></td>
<td>ARI: westford</td>
</tr>
<tr>
<td></td>
<td>Action: Terminate</td>
</tr>
<tr>
<td></td>
<td>Static Interface: pp0.100</td>
</tr>
<tr>
<td></td>
<td>ACI: volantis-ge-5/0/5</td>
</tr>
<tr>
<td></td>
<td>ARI: sunnyvale</td>
</tr>
<tr>
<td></td>
<td>Action: Terminate</td>
</tr>
<tr>
<td></td>
<td>Static Interface: pp0.101</td>
</tr>
<tr>
<td>Service Name</td>
<td>Wholesale</td>
</tr>
<tr>
<td>Action</td>
<td>Terminate</td>
</tr>
<tr>
<td>Dynamic Profile</td>
<td>WholesalePppoeProfile</td>
</tr>
<tr>
<td>Routing Instance</td>
<td>WholesaleRI</td>
</tr>
<tr>
<td>Max Sessions</td>
<td>16000</td>
</tr>
<tr>
<td>Active Sessions</td>
<td>4</td>
</tr>
</tbody>
</table>
show pppoe sessions

Syntax

```
show pppoe sessions
<aci circuit-id-string>
<ari remote-id-string>
<service service-name>
```

Release Information

Command introduced in Junos OS Release 10.2.

Description

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).

Options

```
one—Display information for all active PPPoE sessions on the router.

aci circuit-id-string—(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.

ari remote-id-string—(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.

service service-name—(Optional) Display information only for active PPPoE sessions established with the specified service, where service-name can be empty, any, or a named service.
```

Required Privilege

view

Related Documentation

- Verifying a PPPoE Configuration on page 378
- Verifying and Managing Dynamic PPPoE Configuration

List of Sample Output

- show pppoe sessions (For All Active Sessions) on page 2332
- show pppoe sessions (For All Active Sessions Matching the Agent Circuit Identifier) on page 2332

Output Fields

Table 203 on page 2331 lists the output fields for the `show pppoe sessions` command. Output fields are listed in the approximate order in which they appear.

Table 203: show pppoe sessions Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>Name of the statically-created or dynamically-created PPPoE interface for the active PPPoE session.</td>
<td>none</td>
</tr>
</tbody>
</table>
Table 203: show pppoe sessions Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underlying</td>
<td>Interface on which PPPoE is running.</td>
<td>none</td>
</tr>
<tr>
<td>State</td>
<td>State of the PPPoE session; displays Session Up for active PPPoE sessions.</td>
<td>none</td>
</tr>
<tr>
<td>Session ID</td>
<td>PPPoE session identifier.</td>
<td>none</td>
</tr>
<tr>
<td>Remote MAC</td>
<td>MAC address of the remote side of the connection, either the access concentrator</td>
<td>none</td>
</tr>
<tr>
<td></td>
<td>or the PPPoE client.</td>
<td></td>
</tr>
</tbody>
</table>

Sample Output

**show pppoe sessions (For All Active Sessions)**

```
user@host> show pppoe sessions
      Interface     Underlying interface State    Session    Remote MAC
   pp0.0          ge-2/0/3.2            Session Up  27                      00:00:5e:00:53:c1
   pp0.1          ge-2/0/3.2            Session Up  28                      00:00:5e:00:53:c1
   pp0.1073741824 ge-2/0/3.1            Session Up  29                      00:00:5e:00:53:c1
   pp0.1073741825 ge-2/0/3.1            Session Up  30                      00:00:5e:00:53:c1
   pp0.1073741826 ge-2/0/3.1            Session Up  31                      00:00:5e:00:53: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 interface State    Session    Remote MAC
   pp0.0          ge-2/0/3.2            Session Up  27                      00:00:5e:00:53:c1
   pp0.1          ge-2/0/3.2            Session Up  28                      00:00:5e:00:53:c1
```
show pppoe statistics

Syntax

show pppoe statistics
<logical-interface-name>

Release Information

Command introduced before Junos OS Release 7.4.
logical-interface-name option introduced in Junos OS Release 10.1.

Description

Display statistics information about PPPoE interfaces.

Options

none—Display PPPoE statistics for all interfaces.
logical-interface-name—(Optional) Name of a PPPoE underlying logical interface.

Required Privilege

view

Related Documentation

• show ppp address-pool
• show pppoe underlying-interfaces on page 2335

List of Sample Output

show pppoe statistics on page 2334
show pppoe statistics (For the Specified Underlying Interface Only) on page 2334

Output Fields

Table 204 on page 2333 lists the output fields for the show pppoe statistics command. Output fields are listed in the approximate order in which they appear.

Table 204: show pppoe statistics Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active PPPoE sessions</td>
<td>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:</td>
</tr>
<tr>
<td></td>
<td>• PADI—PPPoE Active Discovery Initiation packets.</td>
</tr>
<tr>
<td></td>
<td>• PADO—PPPoE Active Discovery Offer packets.</td>
</tr>
<tr>
<td></td>
<td>• PADR—PPPoE Active Discovery Request packets.</td>
</tr>
<tr>
<td></td>
<td>• PADS—PPPoE Active Discovery Session-Confirmation packets.</td>
</tr>
<tr>
<td></td>
<td>• PADT—PPPoE Active Discovery Termination packets.</td>
</tr>
<tr>
<td></td>
<td>• Service name error—Packets for which the Service-Name request could not be honored.</td>
</tr>
<tr>
<td></td>
<td>• AC system error—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.</td>
</tr>
<tr>
<td></td>
<td>• Generic error—Packets that indicate an unrecoverable error occurred.</td>
</tr>
<tr>
<td></td>
<td>• Malformed packets—Malformed or short packets that caused the packet handler to discard the frame as unreadable.</td>
</tr>
<tr>
<td></td>
<td>• Unknown packets—Unrecognized packets.</td>
</tr>
</tbody>
</table>

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Table 204: show pppoe statistics Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Timeouts</strong></td>
<td>Information about timeouts that occurred during the PPPoE session (not displayed for M120, M320, and MX Series routers):</td>
</tr>
<tr>
<td>PADI</td>
<td>No PADR packet has been received within the timeout period. (This value is always zero and is not supported.)</td>
</tr>
<tr>
<td>PADO</td>
<td>No PPPoE Active Discovery Offer packet has been received within the timeout period.</td>
</tr>
<tr>
<td>PADR</td>
<td>No PADS packet has been received within the timeout period.</td>
</tr>
</tbody>
</table>

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              0          0
PADI                  0          0
PADO                  0          0
PADR                  0          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

Syntax

```
show pppoe underlying-interfaces
  <brief | detail | extensive>
  <lockout>
  <logical-interface-name>
```

Release Information

Command introduced in Junos OS Release 10.0.
`lockout` option added in Junos OS Release 11.4.

Description

Display information about PPPoE underlying interfaces.

Options

```
brief | detail | extensive — (Optional) Display the specified level of output.
lockout — (Optional) Display summary information about the lockout condition and the
lockout grace period for PPPoE clients on the PPPoE underlying interface.
logical-interface-name — (Optional) Name of a PPPoE underlying logical interface.
```

Required Privilege

```
view
```

Related Documentation

- Verifying and Managing Dynamic PPPoE Configuration
- Configuring an Underlying Interface for Dynamic PPPoE Subscriber Interfaces
- Configuring the PPPoE Family for an Underlying Interface
- Verifying and Managing Agent Circuit Identifier-Based Dynamic VLAN Configuration
- Verifying and Managing Configurations for Dynamic VLANs Based on Access-Line Identifiers

List of Sample Output

- show pppoe underlying-interfaces brief on page 2338
- show pppoe underlying-interfaces detail on page 2338
- show pppoe underlying-interfaces extensive on page 2339
- show pppoe underlying-interfaces extensive (PPPoE client in lockout condition) on page 2339
- show pppoe underlying-interfaces lockout on page 2340
- show pppoe underlying-interfaces detail (Autosensing Configured for ACI-based Dynamic VLANs) on page 2340
- show pppoe underlying-interfaces detail (Autosensing Configured for ALI-based Dynamic VLANs) on page 2340

Output Fields

Table 205 on page 2336 lists the output fields for the `show pppoe underlying-interfaces` command. Output fields are listed in the approximate order in which they appear.
<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underlying Interface</td>
<td>Name of the PPPoE underlying logical interface.</td>
<td>All levels</td>
</tr>
<tr>
<td>Service Name Table</td>
<td>Name of the service name table.</td>
<td>All levels</td>
</tr>
<tr>
<td>Dynamic Profile</td>
<td>Name of the dynamic profile that was used to create this interface. If the interface was statically created, then the value is none.</td>
<td>All levels</td>
</tr>
<tr>
<td>Index</td>
<td>Index number of the logical interface, which reflects its initialization sequence.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>State</td>
<td>Origin of the logical interface: Static or Dynamic. Indicates whether the interface was statically or dynamically created.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Operational States</td>
<td>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.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Max Sessions</td>
<td>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.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Max Sessions VSA Ignore</td>
<td>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 max-sessions statement: Off (default) or On.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Active Sessions</td>
<td>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.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Agent Circuit Identifier</td>
<td>Whether the underlying interface is configured with the agent-circuit-identifier statement to enable creation of autosensed dynamic VLAN subscriber interfaces based on agent circuit identifier (ACI) information.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>Autosensing 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.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>NOTE: The Agent Circuit Identifier field is replaced with the Line Identity field when an ALI interface set is configured with the line-identity autoconfiguration stanza.</td>
<td></td>
</tr>
</tbody>
</table>
Table 205: show pppoe underlying-interfaces Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Line Identity</strong></td>
<td>Whether the underlying interface is configured with the <code>line-identity</code> statement to enable creation of autosensed dynamic VLAN subscriber interfaces based on the specified trusted option: ACI, ARI, both, or neither. Autosensing indicates that creation of ALI-based dynamic VLAN interfaces is enabled on the underlying interface. If creation of ALI dynamic VLANs based on trusted options is not configured on the underlying interface, this field does not appear. <strong>NOTE:</strong> The Line Identity field is replaced with the ACI VLAN field when an ACI interface set is configured with the <code>agent-circuit-id</code> autoconfiguration stanza.</td>
<td></td>
</tr>
<tr>
<td><strong>Duplicate Protection</strong></td>
<td>State of PPPoE duplicate protection: <strong>On</strong> or <strong>Off</strong>. 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.</td>
<td>detail extensive</td>
</tr>
<tr>
<td><strong>Short Cycle Protection</strong></td>
<td>State of PPPoE short cycle protection: <strong>mac-address</strong>, <strong>circuit-id</strong>, or <strong>Off</strong>. 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 or agent circuit identifier (ACI) value.</td>
<td>detail extensive</td>
</tr>
<tr>
<td><strong>Direct Connect</strong></td>
<td>State of the configuration to ignore DSL Forum VSAs: <strong>On</strong> or <strong>Off</strong>. When configured, the router ignores any of these VSAs received from a directly connected CPE device on the interface.</td>
<td>detail extensive none</td>
</tr>
<tr>
<td><strong>AC Name</strong></td>
<td>Name of the access concentrator.</td>
<td>detail extensive</td>
</tr>
</tbody>
</table>
| **PacketType**       | Number of packets sent and received during the PPPoE session, categorized by packet type and packet errors:  
  - **PADI**—PPPoE Active Discovery Initiation packets.  
  - **PADO**—PPPoE Active Discovery Offer packets.  
  - **PADR**—PPPoE Active Discovery Request packets.  
  - **PADS**—PPPoE Active Discovery Session-Confirmation packets.  
  - **PADT**—PPPoE Active Discovery Termination packets.  
  - **Service name error**—Packets for which the Service-Name request could not be honored.  
  - **AC system error**—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.  
  - **Generic error**—Packets that indicate an unrecoverable error occurred.  
  - **Malformed packets**—Malformed or short packets that caused the packet handler to discard the frame as unreadable.  
  - **Unknown packets**—Unrecognized packets. | detail extensive |
Table 205: show pppoe underlying-interfaces Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lockout Time (sec)</td>
<td>The PPPoE lockout range, the number of PPPoE clients in lockout condition, and the number of PPPoE clients in a lockout grace period if Short Cycle Protection is enabled (On):</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Min—Minimum lockout time, in seconds, configured on the PPPoE underlying interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Max—Maximum lockout time, in seconds, configured on the PPPoE underlying interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Total clients in lockout—Number of PPPoE clients currently undergoing lockout.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Total clients in lockout grace period—Number of PPPoE clients currently in a lockout grace period. A lockout grace period occurs when the time between lockout events is greater than either 15 minutes or the maximum lockout time.</td>
<td></td>
</tr>
<tr>
<td>MAC source address of the PPPoE client.</td>
<td>extensive</td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>Current lockout time, in seconds; displays 0 (zero) if the PPPoE client is not undergoing lockout.</td>
<td></td>
</tr>
<tr>
<td>Time elapsed into the lockout period, in seconds; displays 0 if the PPPoE client is not undergoing lockout</td>
<td>extensive</td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td>extensive</td>
<td></td>
</tr>
</tbody>
</table>

Sample Output

**show pppoe underlying-interfaces brief**

```
user@host> show pppoe underlying-interfaces brief
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

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

<table>
<thead>
<tr>
<th>PacketType</th>
<th>Sent</th>
<th>Received</th>
</tr>
</thead>
<tbody>
<tr>
<td>PADI</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PADO</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PADR</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PADS</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PADT</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Service name error</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>AC system error</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Generic error</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Malformed packets</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Unknown packets</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>PacketType</th>
<th>Sent</th>
<th>Received</th>
</tr>
</thead>
<tbody>
<tr>
<td>PADI</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>PADO</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>PADR</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>PADS</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>PADT</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Service name error</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>AC system error</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Generic error</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Malformed packets</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Unknown packets</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

show pppoe underlying-interfaces extensive (PPPoE client in lockout condition)

user@host> show pppoe underlying-interfaces extensive 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
00:00:5e:00:53:11             4           3       8

show pppoe underlying-interfaces lockout

user@host> show pppoe underlying-interfaces ge-1/0/0.0 lockout

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,
AC Name: nbc,
Short Cycle Protection: circuit-id,
Max Sessions: 32000, Max Sessions VSA Ignore: Off,
Active Sessions: 1,
**Line Identity: Autosensing**,  
Service Name Table: None,
Duplicate Protection: On, Short Cycle Protection: Off,
Direct Connect: Off,
AC Name: nbc,
Short Cycle Protection: circuit-id,
show pppoe version

Syntax

```
show pppoe version
```

Release Information

Command introduced before Junos OS Release 7.4.

Description

(M120 routers and M320 routers only) Display version information about PPPoE.

Options

This command has no options.

Required Privilege Level

view

List of Sample Output

```
show pppoe version
```

Sample Output

```
show pppoe version

user@host> show pppoe version
```

Output Fields

Table 206 on page 2342 lists the output fields for the `show pppoe version` command. Output fields are listed in the approximate order in which they appear.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>version n</td>
<td>PPPoE version number and RFC. For example, <code>version 1, rfc 2516</code>.</td>
</tr>
<tr>
<td>PPPoE protocol</td>
<td>State of the PPPoE protocol: enabled or disabled.</td>
</tr>
<tr>
<td>Maximum Sessions</td>
<td>Maximum active sessions supported per router. The default is 256 sessions.</td>
</tr>
<tr>
<td>PADI resend timeout</td>
<td>Initial time, in seconds, that the router waits to receive a PPPoE Active Discovery Offer (PADO) packet for the PPPoE Active Discovery Initiation (PADI) packet sent. This timeout doubles for each successive PADI packet sent. Not displayed for M120 and M320 routers.</td>
</tr>
<tr>
<td>PADR resend timeout</td>
<td>Initial time, in seconds, that the router waits to receive a PPPoE Active Discovery Session Confirmation (PADS) packet for the PPPoE Active Discovery Request (PADR) packet sent. This timeout doubles for each successive PADR packet sent. Not displayed for M120 and M320 routers.</td>
</tr>
<tr>
<td>Max resend timeout</td>
<td>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.</td>
</tr>
<tr>
<td>Max Configured AC timeout</td>
<td>Time, in seconds, during which the configured access concentrator must respond. Not displayed for M120 and M320 routers.</td>
</tr>
<tr>
<td>Parameter</td>
<td>Value</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>PPPoE protocol</td>
<td>Enabled</td>
</tr>
<tr>
<td>Maximum Sessions</td>
<td>256</td>
</tr>
<tr>
<td>PADI resend timeout</td>
<td>2 seconds</td>
</tr>
<tr>
<td>PADR resend timeout</td>
<td>16 seconds</td>
</tr>
<tr>
<td>Max resend timeout</td>
<td>64 seconds</td>
</tr>
<tr>
<td>Max Configured AC timeout</td>
<td>4 seconds</td>
</tr>
</tbody>
</table>
**show protection-group ethernet-ring aps**

<table>
<thead>
<tr>
<th>Syntax</th>
<th>show protection-group ethernet-ring aps</th>
</tr>
</thead>
</table>

**Release Information**

Command introduced in Junos OS Release 9.4.
Command introduced in Junos OS Release 12.1 for EX Series switches.
Command introduced in Junos OS Release 18.1 for EX2300 and EX3400 switches.

**Description**

Display the status of the Automatic Protection Switching (APS) and Ring APS (RAPS) messages on an Ethernet ring.

**Options**

This command has no options.

**Required Privilege Level**

view

**Related Documentation**

- show protection-group ethernet-ring data-channel on page 2355
- show protection-group ethernet-ring interface on page 2360
- show protection-group ethernet-ring node-state on page 2364
- show protection-group ethernet-ring statistics on page 2369
- show protection-group ethernet-ring vlan on page 2375

**List of Sample Output**

- show protection-group ethernet-ring aps (EX Switches) on page 2345
- show protection-group ethernet-ring aps (Owner Node, Normal Operation on ACX and MX Routers) on page 2345
- show protection-group ethernet-ring aps detail (Owner Node, Normal Operation on ACX and MX Routers) on page 2346
- show protection-group ethernet-ring aps (MX RPL Owner Ring Node, Failure condition on non-RPL link of the ring) on page 2346
- show protection-group ethernet-ring aps (MX Interconnection Ring Node, Failure condition in major ring on non-RPL link of the ring) on page 2346
- show protection-group ethernet-ring aps (MX Series router) on page 2346
- show protection-group ethernet-ring aps detail (MX Series router) on page 2346
- show protection-group ethernet-ring aps (MX Interconnection Ring Node as RPL owner of major ring, rings in IDLE state) on page 2347
- show protection-group ethernet-ring aps detail (EX2300 and EX3400 Switches) on page 2347

**Output Fields**

Table 207 on page 2345 lists the output fields for the show protection-group ethernet-ring aps command. Output fields are listed in the approximate order in which they appear.
Table 207: show protection-group ethernet-ring aps Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethernet Ring</td>
<td>Name configured for the Ethernet ring.</td>
</tr>
<tr>
<td>Request/State</td>
<td>Status of the Ethernet ring RAPS messages.</td>
</tr>
<tr>
<td></td>
<td>• NR—Indicates that there is no request for APS on the ring.</td>
</tr>
<tr>
<td></td>
<td>• SF—Indicates that there is a signal failure on the ring.</td>
</tr>
<tr>
<td></td>
<td>• FS—Indicates that there are active forced-switch requests in the ring.</td>
</tr>
<tr>
<td></td>
<td>• MS—Indicates that there are active manual-switch requests in the ring.</td>
</tr>
<tr>
<td></td>
<td>NOTE: Both FS and MS values are valid only when G.8032v2 is supported.</td>
</tr>
<tr>
<td>Ring Protection Link Blocked</td>
<td>Blocking on the ring protection link: Yes or No.</td>
</tr>
<tr>
<td>No Flush</td>
<td>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.</td>
</tr>
<tr>
<td>Blocked Port Reference</td>
<td>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.</td>
</tr>
<tr>
<td>Blocked Port Reference</td>
<td>Reference of the ring port on which traffic is blocked.</td>
</tr>
<tr>
<td>Originator</td>
<td>Indicates whether the node is the originator of the RAPS messages.</td>
</tr>
<tr>
<td>Remote Node ID</td>
<td>Identifier (in MAC address format) of the remote node.</td>
</tr>
</tbody>
</table>

Sample Output

show protection-group ethernet-ring aps (EX Switches)

user@switch> show protection-group ethernet-ring aps

<table>
<thead>
<tr>
<th>Ring Name</th>
<th>Request/state</th>
<th>No Flush</th>
<th>RPL Blocked</th>
<th>Originator</th>
<th>Remote Node ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>erpl</td>
<td>NR</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>00:1F:12:30:B8:81</td>
</tr>
</tbody>
</table>

Sample Output

show protection-group ethernet-ring aps (Owner Node, Normal Operation on ACX and MX Routers)

user@host> show protection-group ethernet-ring aps

<table>
<thead>
<tr>
<th>Ethernet Ring</th>
<th>Request/state</th>
<th>RPL Blocked</th>
<th>No Flush</th>
<th>BPR</th>
<th>Originator</th>
<th>Remote Node ID</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Sample Output

show protection-group ethernet-ring aps detail (Owner Node, Normal Operation on ACX and MX Routers)

```bash
user@host> show protection-group ethernet-ring aps detail
Ethernet-Ring name : Erp_1
Request/State      : NR
Ring Protection Link blocked : Yes
No Flush Flag      : No
Blocked Port Reference : 1
Originator         : No
Remote Node ID     : 00:00:00:02:00:01
```

show protection-group ethernet-ring aps (MX RPL Owner Ring Node, Failure condition on non-RPL link of the ring)

```bash
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)

```bash
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)

```bash
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)

```bash
user@host> show protection-group ethernet-ring aps detail
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 : 00:00:03:00:03:00:02

show protection-group ethernet-ring aps detail (EX2300 and EX3400 Switches)

user@switch>show protection-group ethernet-ring aps detail

Ethernet-Ring name : pg1001
Request/State : NR
Ring Protection Link blocked : Yes
No Flush Flag : Yes
Blocked Port Reference : 0
Originator : Yes
Remote Node ID : NA
show protection-group ethernet-ring configuration

Syntax

```
show protection-group ethernet-ring configuration
```

Release Information

Command introduced in Junos OS Release 12.1 for EX Series switches.
Command introduced in Junos OS Release 14.1 for MX Series routers.
Command introduced in Junos OS Release 18.1 for EX2300 and EX3400 switches.

Description

Display the configuration of Ethernet ring protection group on EX Switches and MX Series routers.

Required Privilege Level

view

Related Documentation

- show protection-group ethernet-ring aps on page 2344
- show protection-group ethernet-ring data-channel on page 2355
- show protection-group ethernet-ring interface on page 2360
- show protection-group ethernet-ring node-state on page 2364
- show protection-group ethernet-ring statistics on page 2369
- show protection-group ethernet-ring vlan on page 2375

List of Sample Output

show protection-group ethernet-ring configuration (EX Switch) on page 2350
show protection-group ethernet-ring configuration detail (MX Series Router) on page 2351
show protection-group ethernet-ring configuration (MX Series Router) on page 2351
show protection-group ethernet-ring configuration detail (MX Series Router) on page 2351
show protection-group ethernet-ring configuration detail (MX Series Router) on page 2352
show protection-group ethernet-ring configuration (MX Series Router) on page 2352
show protection-group ethernet-ring configuration detail (MX Series Router) on page 2353

Output Fields

Table 208 on page 2348 lists the output fields for the `show protection-group ethernet-ring configuration` command. Output fields are listed in the approximate order in which they appear.

Table 208: show protection-group ethernet-ring configuration Output Fields

<table>
<thead>
<tr>
<th>Output Fields</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>G8032 Compatibility Version</td>
<td>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.</td>
</tr>
<tr>
<td>East Interface</td>
<td>One of the two switch interfaces that participates in a ring link. When Junos supports G8032v2, this interface is treated as interface 0.</td>
</tr>
<tr>
<td>West Interface</td>
<td>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.</td>
</tr>
</tbody>
</table>
### Table 208: show protection-group ethernet-ring configuration Output Fields (continued)

<table>
<thead>
<tr>
<th>Output Fields</th>
<th>Field Description</th>
</tr>
</thead>
</table>
| **Restore Interval** | 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.  
**NOTE:** Wait to Restore (WTR) configuration values on EX2300 and EX3400 switches must be 5-12 minutes.                                                                                           |
| **Wait to Block Interval** | 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.  
**NOTE:** The Wait To Block Timer (WTB) is always disabled on EX2300 and EX3400 switches because it is not supported in ERPSv1. Any configuration you make to the WTB setting has no effect. The output from the CLI command `show protection-group ethernet-ring node-state detail` lists a WTB setting but that setting has no effect. |
| **Guard Interval**   | 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. |
| **Hold off interval** | 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.                                                                                           |
| **Node ID**          | 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.                                                                                     |
| **Ring ID**          | 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.                                                                 |
| **Node Role**        | 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.                                                                 |

---

**Copyright © 2019, Juniper Networks, Inc.**
### Table 208: show protection-group ethernet-ring configuration Output Fields (continued)

<table>
<thead>
<tr>
<th>Output Fields</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Revertive Mode of Operation</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>RAPS Tx Dot1p priority</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Node type</strong></td>
<td>Indicates whether ring node is a normal ring node having two ring-links or an 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.</td>
</tr>
<tr>
<td><strong>Major ring name</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Interconnection mode</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>PropagateTopologyChange event</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Control Vlan</strong></td>
<td>The VLAN that transfers ERP PDUs from one node to another.</td>
</tr>
<tr>
<td><strong>Physical Ring</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Data Channel VLAN(s)</strong></td>
<td>Data VLANs for which forwarding behavior is controlled by the ring instance.</td>
</tr>
</tbody>
</table>

### Sample Output

#### show protection-group ethernet-ring configuration (EX Switch)

```bash
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
```
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guard interval</td>
<td>500 ms</td>
</tr>
<tr>
<td>Hold off interval</td>
<td>0 ms</td>
</tr>
<tr>
<td>Node ID</td>
<td>64:87:88:65:37:D0</td>
</tr>
<tr>
<td>Ring ID (1 ... 239)</td>
<td>1</td>
</tr>
<tr>
<td>Node role (normal/rpl-owner/rpl-neighbour)</td>
<td>rpl-owner</td>
</tr>
<tr>
<td>Node RPL end</td>
<td>east-port</td>
</tr>
<tr>
<td>Revertive mode of operation</td>
<td>1</td>
</tr>
<tr>
<td>RAPS Tx Dot1p priority (0 .. 7)</td>
<td>0</td>
</tr>
<tr>
<td>Node type (normal/open/interconnection)</td>
<td>Normal</td>
</tr>
<tr>
<td>Control Vlan</td>
<td>100</td>
</tr>
<tr>
<td>Physical Ring</td>
<td>No</td>
</tr>
<tr>
<td>Data Channel Vlan(s)</td>
<td>200,300</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>G8032 Compatibility Version</td>
<td>2</td>
</tr>
<tr>
<td>East interface (interface 0)</td>
<td>xe-2/3/0.1</td>
</tr>
<tr>
<td>West interface (interface 1)</td>
<td>(no erp)</td>
</tr>
<tr>
<td>Restore interval</td>
<td>5 minutes</td>
</tr>
<tr>
<td>Wait to Block interval</td>
<td>5 seconds</td>
</tr>
<tr>
<td>Guard interval</td>
<td>500 ms</td>
</tr>
<tr>
<td>Hold off interval</td>
<td>0 ms</td>
</tr>
<tr>
<td>Node ID</td>
<td>64:87:88:65:37:D0</td>
</tr>
<tr>
<td>Ring ID (1 ... 239)</td>
<td>1</td>
</tr>
<tr>
<td>Node role (normal/rpl-owner/rpl-neighbour)</td>
<td>rpl-owner</td>
</tr>
<tr>
<td>Node RPL end</td>
<td>east-port</td>
</tr>
<tr>
<td>Revertive mode of operation</td>
<td>1</td>
</tr>
<tr>
<td>RAPS Tx Dot1p priority (0 .. 7)</td>
<td>0</td>
</tr>
<tr>
<td>Node type (normal/open/interconnection)</td>
<td>Open</td>
</tr>
<tr>
<td>Control Vlan</td>
<td>100</td>
</tr>
<tr>
<td>Physical Ring</td>
<td>No</td>
</tr>
<tr>
<td>Data Channel Vlan(s)</td>
<td>200,300</td>
</tr>
</tbody>
</table>
```

**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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>G8032 Compatibility Version</td>
<td>2</td>
</tr>
<tr>
<td>East interface (interface 0)</td>
<td>xe-2/3/0.1</td>
</tr>
<tr>
<td>West interface (interface 1)</td>
<td>xe-2/2/1.1</td>
</tr>
<tr>
<td>Restore interval</td>
<td>5 minutes</td>
</tr>
<tr>
<td>Wait to Block interval</td>
<td>5 seconds</td>
</tr>
<tr>
<td>Guard interval</td>
<td>500 ms</td>
</tr>
<tr>
<td>Hold off interval</td>
<td>0 ms</td>
</tr>
<tr>
<td>Node ID</td>
<td>64:87:88:65:37:D0</td>
</tr>
<tr>
<td>Ring ID (1 ... 239)</td>
<td>1</td>
</tr>
<tr>
<td>Node role (normal/rpl-owner/rpl-neighbour)</td>
<td>rpl-owner</td>
</tr>
<tr>
<td>Node RPL end</td>
<td>east-port</td>
</tr>
<tr>
<td>Revertive mode of operation</td>
<td>1</td>
</tr>
<tr>
<td>RAPS Tx Dot1p priority (0 .. 7)</td>
<td>0</td>
</tr>
<tr>
<td>Node type (normal/open/interconnection)</td>
<td>Normal</td>
</tr>
<tr>
<td>Control Vlan</td>
<td>100</td>
</tr>
<tr>
<td>Physical Ring</td>
<td>No</td>
</tr>
<tr>
<td>Data Channel Vlan(s)</td>
<td>200,300</td>
</tr>
</tbody>
</table>
### show protection-group ethernet-ring configuration detail (MX Series Router)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethernet Ring configuration information for protection group pg_subring</td>
<td></td>
</tr>
<tr>
<td>G8032 Compatibility Version</td>
<td>2</td>
</tr>
<tr>
<td>East interface (interface 0)</td>
<td>ge-2/0/0.1</td>
</tr>
<tr>
<td>West interface (interface 1)</td>
<td>(no erp)</td>
</tr>
<tr>
<td>Restore interval</td>
<td>5 minutes</td>
</tr>
<tr>
<td>Wait to Block interval</td>
<td>5 seconds</td>
</tr>
<tr>
<td>Guard interval</td>
<td>500 ms</td>
</tr>
<tr>
<td>Hold off interval</td>
<td>0 ms</td>
</tr>
<tr>
<td>Node ID</td>
<td>64:87:88:65:37:D0</td>
</tr>
<tr>
<td>Ring ID (1 ... 239)</td>
<td>2</td>
</tr>
<tr>
<td>Node role (normal/rpl-owner/rpl-neighbour)</td>
<td>normal</td>
</tr>
<tr>
<td>Revertive mode of operation</td>
<td>1</td>
</tr>
<tr>
<td>RAPS Tx Dot1p priority (0 .. 7)</td>
<td>0</td>
</tr>
<tr>
<td>Node type (normal/open/interconnection)</td>
<td>Non-VC-Interconnection</td>
</tr>
<tr>
<td>Major ring name</td>
<td>pg_major</td>
</tr>
<tr>
<td>Interconnection mode (VC/Non-VC)</td>
<td>Non-VC mode</td>
</tr>
<tr>
<td>Propagate Topology Change event</td>
<td>0</td>
</tr>
<tr>
<td>Control Vlan</td>
<td>101</td>
</tr>
<tr>
<td>Physical Ring</td>
<td>No</td>
</tr>
<tr>
<td>Data Channel Vlan(s)</td>
<td>200,300</td>
</tr>
</tbody>
</table>

<p>| 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 |</p>
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interconnection mode (VC/Non-VC)</td>
<td>Non-VC mode</td>
</tr>
<tr>
<td>Propagate Topology Change event</td>
<td>0</td>
</tr>
<tr>
<td>Control Vlan</td>
<td>101</td>
</tr>
<tr>
<td>Physical Ring</td>
<td>No</td>
</tr>
<tr>
<td>Data Channel Vlan(s)</td>
<td>200,300</td>
</tr>
</tbody>
</table>
show protection-group ethernet-ring data-channel

**Syntax**

```
show protection-group ethernet-ring data-channel
    <brief | detail>
    <group-name group-name>
```

**Release Information**

Command introduced in Junos OS Release 10.2. Command introduced in Junos OS Release 18.1 for EX2300 and EX3400 switches.

**Description**

Display the configuration of Ethernet ring protection group on EX Switches and MX Series routers.

**Options**

brief | detail—(Optional) Display the specified level of output.

`group-name`—(Optional) Protection group for which to display statistics. If you omit this optional field, all protection group statistics for configured groups will be displayed.

**Required Privilege Level**

view

**Related Documentation**

- show protection-group ethernet-ring aps on page 2344
- show protection-group ethernet-ring interface on page 2360
- show protection-group ethernet-ring node-state on page 2364
- show protection-group ethernet-ring statistics on page 2369
- show protection-group ethernet-ring vlan on page 2375

**List of Sample Output**

- show protection-group ethernet-ring data-channel on page 2356
- show protection-group ethernet-ring data-channel detail on page 2356
- show protection-group ethernet-ring data-channel detail (EX2300 and EX3400 Switches) on page 2357

**Output Fields**

Table 209 on page 2355 lists the output fields for the `show protection-group ethernet-ring data-channel` command. Output fields are listed in the approximate order in which they appear.

Table 209: `show protection-group ethernet-ring data-channel` Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>Name of the interface configured for the Ethernet ring.</td>
</tr>
</tbody>
</table>
Table 209: show protection-group ethernet-ring data-channel Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STP index</td>
<td>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.</td>
</tr>
</tbody>
</table>

**Forward State**

- **forwarding**—Indicates packets are being forwarded.
- **discarding**—Indicates packets are being discarded.

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
```
show protection-group ethernet-ring data-channel detail (EX2300 and EX3400 Switches)

user@switch> show protection-group ethernet-ring data-channel detail

Ethernet ring data channel parameters for protection group pg1001

<table>
<thead>
<tr>
<th>Interface name</th>
<th>STP index</th>
<th>Forward State</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-0/0/42</td>
<td>52</td>
<td>discarding</td>
</tr>
<tr>
<td>ge-0/0/38</td>
<td>53</td>
<td>forwarding</td>
</tr>
</tbody>
</table>
**show protection-group ethernet-ring flush-info**

**Syntax**

```
show protection-group ethernet-ring flush-info
```

**Release Information**

Command introduced in Junos OS Release 14.2.

**Description**

Display information about flush ports in an Ethernet ring.

**Options**

This command has no options.

**Required Privilege Level**

view

**Related Documentation**

- show protection-group ethernet-ring data-channel on page 2355
- show protection-group ethernet-ring aps on page 2344
- show protection-group ethernet-ring node-state on page 2364
- show protection-group ethernet-ring statistics on page 2369
- show protection-group ethernet-ring vlan on page 2375

**List of Sample Output**

show protection-group ethernet-ring flush-info (ACX and MX Series Routers) on page 2359

show protection-group ethernet-ring flush-info detail (ACX and MX Series Routers) on page 2359

**Output Fields**

Table 210 on page 2358 lists the output fields for the `show protection-group ethernet-ring flush-info` command. Output fields are listed in the approximate order in which they appear.

**Table 210: show protection-group ethernet-ring flush-info Output Fields**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>Physical interface configured for the Ethernet ring. This can be an aggregated Ethernet link also.</td>
</tr>
<tr>
<td>Originating Node</td>
<td>Node from which RAPS protocol data units originates on the Ethernet Ring.</td>
</tr>
<tr>
<td>Blocked Port Reference</td>
<td>Reference of the ring port on which traffic is blocked.</td>
</tr>
</tbody>
</table>
Sample Output

show protection-group ethernet-ring flush-info (ACX and MX Series Routers)

user@host> show protection-group ethernet-ring flush-info

Ethernet ring flush port information for protection group pg100

<table>
<thead>
<tr>
<th>Interface</th>
<th>Originating Node</th>
<th>Blocked Port Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>xe-5/0/2.4001</td>
<td>00:00:00:00:00:00</td>
<td>0</td>
</tr>
<tr>
<td>xe-2/2/0.4001</td>
<td>00:00:00:00:00:00</td>
<td>0</td>
</tr>
</tbody>
</table>

show protection-group ethernet-ring flush-info detail (ACX and MX Series Routers)

user@host> show protection-group ethernet-ring flush-info detail

Ethernet ring flush port information for protection group pg100

<table>
<thead>
<tr>
<th>Interface name</th>
<th>Originating Node</th>
<th>Blocked Port Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>xe-5/0/2.4001</td>
<td>00:00:00:00:00:00</td>
<td>0</td>
</tr>
<tr>
<td>xe-2/2/0.4001</td>
<td>00:00:00:00:00:00</td>
<td>0</td>
</tr>
</tbody>
</table>
**show protection-group ethernet-ring interface**

**Syntax**

```
show protection-group ethernet-ring interface
```

**Release Information**

Command introduced in Junos OS Release 9.4.
Command introduced in Junos OS Release 12.3X54 for ACX Series routers.
Command introduced in Junos OS Release 18.1 for EX2300 and EX3400 switches.

**Description**

Displays the status of the Automatic Protection Switching (APS) interfaces on an Ethernet ring.

**Options**

This command has no options.

**Required Privilege**

view

**Related Documentation**

- show protection-group ethernet-ring data-channel on page 2355
- show protection-group ethernet-ring aps on page 2344
- show protection-group ethernet-ring node-state on page 2364
- show protection-group ethernet-ring statistics on page 2369
- show protection-group ethernet-ring vlan on page 2375

**List of Sample Output**

show protection-group ethernet-ring interface (EX Series Switch Owner Node) on page 2361
show protection-group ethernet-ring interface (Owner Node MX Series Router) on page 2361
show protection-group ethernet-ring interface detail (Owner Node MX Series Router) on page 2361
show protection-group ethernet-ring interface (EX Series Switch Ring Node) on page 2362
show protection-group ethernet-ring interface detail (ACX Series and MX Series) on page 2362
show protection-group ethernet-ring interface detail (EX2300 and EX3400 Switches) on page 2362
show protection-group ethernet-ring interface detail (EX2300 and EX3400 Switches) on page 2363

**Output Fields**

Table 211 on page 2361 lists the output fields for both the EX Series switch, and the ACX Series and MX Series router `show protection-group ethernet-ring interface` commands. Output fields are listed in the approximate order in which they appear.
## Table 211: MX Series Routers show protection-group ethernet-ring interface Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethernet ring port parameters for protection group <strong>group-name</strong></td>
<td>Output is organized by configured protection group.</td>
</tr>
<tr>
<td>Interface</td>
<td>Physical interfaces configured for the Ethernet ring. This can be an aggregated Ethernet link also.</td>
</tr>
<tr>
<td>Control Channel</td>
<td>(MX Series router only) Logical unit configured on the physical interface.</td>
</tr>
<tr>
<td>Direction</td>
<td>Direction of the traffic.</td>
</tr>
<tr>
<td>Forward State</td>
<td>State of the ring forwarding on the interface: <strong>discarding</strong> or <strong>forwarding</strong>.</td>
</tr>
<tr>
<td>Ring Protection Link End</td>
<td>Whether this interface is the end of the ring: <strong>Yes</strong> or <strong>No</strong>.</td>
</tr>
<tr>
<td>Signal Failure</td>
<td>Whether there a signal failure exists on the link: <strong>Clear</strong> or <strong>Set</strong>.</td>
</tr>
<tr>
<td>Admin State</td>
<td>State of the interface: For EX switches, <strong>ready</strong>, <strong>if ready</strong>, or <strong>waiting</strong>. For MX routers, <strong>IFF ready</strong> or <strong>IFF disabled</strong>.</td>
</tr>
</tbody>
</table>

### 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

<table>
<thead>
<tr>
<th>Interface</th>
<th>Forward State</th>
<th>RPL End</th>
<th>Signal Failure</th>
<th>Admin State</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-0/0/3.0</td>
<td>discarding</td>
<td>Yes</td>
<td>Clear</td>
<td>ready</td>
</tr>
<tr>
<td>ge-0/0/9.0</td>
<td>forwarding</td>
<td>No</td>
<td>Clear</td>
<td>ready</td>
</tr>
</tbody>
</table>
```

**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

<table>
<thead>
<tr>
<th>Interface</th>
<th>Control Channel</th>
<th>Direction</th>
<th>Forward State</th>
<th>RPL End</th>
<th>SF</th>
<th>Admin State</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-1/2/0</td>
<td>ge-1/2/0.100</td>
<td>east</td>
<td>forwarding</td>
<td>No</td>
<td>Clear</td>
<td>IFF ready</td>
</tr>
<tr>
<td>ge-1/2/2</td>
<td>ge-1/2/2.100</td>
<td>west</td>
<td>forwarding</td>
<td>No</td>
<td>Clear</td>
<td>IFF ready</td>
</tr>
</tbody>
</table>
```

**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
```
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

<table>
<thead>
<tr>
<th>Interface</th>
<th>Forward State</th>
<th>RPL End</th>
<th>Signal Failure</th>
<th>Admin State</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-0/0/3.0</td>
<td>discarding</td>
<td>Yes</td>
<td>Clear</td>
<td>ready</td>
</tr>
<tr>
<td>ge-0/0/9.0</td>
<td>forwarding</td>
<td>No</td>
<td>Clear</td>
<td>ready</td>
</tr>
</tbody>
</table>

show protection-group ethernet-ring interface detail (ACX Series and MX Series)

user@host> show protection-group ethernet-ring interface detail

Ethernet ring port parameters for protection group Erp_1

<table>
<thead>
<tr>
<th>Interface</th>
<th>Forward State</th>
<th>RPL End</th>
<th>Signal Failure</th>
<th>Admin State</th>
</tr>
</thead>
<tbody>
<tr>
<td>xe-0/0/0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>et-0/0/48</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

show protection-group ethernet-ring interface detail (EX2300 and EX3400 Switches)

user@switch> show protection-group ethernet-ring interface detail

Ethernet ring port parameters for protection group pg1001

<table>
<thead>
<tr>
<th>Interface name</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-0/0/14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Control channel name           : ge-0/0/14.0
Interface direction            : east
Ring Protection Link End       : No
Signal Failure                 : Clear
Forward State                  : forwarding
Interface Admin State          : IFF ready

Interface name                 : ge-0/0/18
Control channel name           : ge-0/0/18.0
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 detail (EX2300 and EX3400 Switches)

user@switch>show protection-group ethernet-ring interface detail

Ethernet ring port parameters for protection group pg1001

Interface name                 : ge-0/0/42
Control channel name           : ge-0/0/42.0
Interface direction            : east
Ring Protection Link End       : Yes
Signal Failure                 : Clear
Forward State                  : discarding
Interface Admin State          : IFF ready

Interface name                 : ge-0/0/38
Control channel name           : ge-0/0/38.0
Interface direction            : west
Ring Protection Link End       : No
Signal Failure                 : Clear
Forward State                  : forwarding
Interface Admin State          : IFF ready
### show protection-group ethernet-ring node-state

<table>
<thead>
<tr>
<th>Syntax</th>
<th><code>show protection-group ethernet-ring node-state</code></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Display the status of the Automatic Protection Switching (APS) nodes on an Ethernet ring.</td>
</tr>
<tr>
<td><strong>Options</strong></td>
<td>This command has no options.</td>
</tr>
<tr>
<td><strong>Required Privilege Level</strong></td>
<td>view</td>
</tr>
</tbody>
</table>

**Related Documentation**
- `show protection-group ethernet-ring data-channel on page 2355`
- `show protection-group ethernet-ring aps on page 2344`
- `show protection-group ethernet-ring interface on page 2360`
- `show protection-group ethernet-ring statistics on page 2369`
- `show protection-group ethernet-ring vlan on page 2375`

**List of Sample Output**
- `show protection-group ethernet-ring node-state (MX Series Router - RPL Owner Node, Normal Operation) on page 2366`
- `show protection-group ethernet-ring node-state (MX Series Router - Normal Ring Node, Normal Operation) on page 2366`
- `show protection-group ethernet-ring node-state (MX Series Router - RPL Owner Node, Remote Failure Condition) on page 2366`
- `show protection-group ethernet-ring node-state detail (ACX Series and MX Series Router) on page 2366`
- `show protection-group ethernet-ring node-state detail (MX Series Router - RPL Owner Node, Normal Operation) on page 2367`
- `show protection-group ethernet-ring node-state detail (MX Series Router with WTR Timer) on page 2367`
- `show protection-group ethernet-ring node-state detail (MX Series Router with WTB Timer) on page 2367`
- `show protection-group ethernet-ring node-state detail (EX2300 and EX3400 Switches) on page 2368`

**Output Fields**
Table 212 on page 2365 lists the output fields for the `show protection-group ethernet-ring node-state` command. Output fields are listed in the approximate order in which they appear.
Table 212: show protection-group ethernet-ring node-state Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ring Name/Ethernet Ring</td>
<td>Name configured for the Ethernet ring.</td>
</tr>
<tr>
<td>APS State</td>
<td>State of the Ethernet ring APS.</td>
</tr>
<tr>
<td></td>
<td>• idle—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.</td>
</tr>
<tr>
<td></td>
<td>• protected—Indicates that there is a protection switch on the ring because of a signal failure condition on the ring link.</td>
</tr>
<tr>
<td></td>
<td>• MS—Indicates that the manual switch command is active in the ring.</td>
</tr>
<tr>
<td></td>
<td>• FS—Indicates that the forced switch command is active in the ring.</td>
</tr>
<tr>
<td></td>
<td>• pending—Indicates that the ring is in pending state.</td>
</tr>
<tr>
<td>Event</td>
<td>Events on the ring.</td>
</tr>
<tr>
<td></td>
<td>• NR-RB—Indicates that there is no APS request and the ring link is blocked on the ring owner node.</td>
</tr>
<tr>
<td></td>
<td>• NR—Indicates that there is no APS request pending in the ring.</td>
</tr>
<tr>
<td></td>
<td>• local SF—Indicates that there is signal failure on one or both of the ring links of the node.</td>
</tr>
<tr>
<td></td>
<td>• remote SF—Indicates that there is signal failure on one or more ring links of any other node of the ring.</td>
</tr>
<tr>
<td></td>
<td>• local FS—Indicates that there is a forced switched command active on one or both of the ring links of the node.</td>
</tr>
<tr>
<td></td>
<td>• remote FS—Indicates that there is a forced switch command active on one or more ring links of any other node of the ring.</td>
</tr>
<tr>
<td></td>
<td>• local MS—Indicates that there is a manual switch command active on one of the ring links of the node.</td>
</tr>
<tr>
<td></td>
<td>• remote MS—Indicates that there is a manual switch command active on one or more ring links of any other node of the ring.</td>
</tr>
<tr>
<td></td>
<td>• WTR running—Indicates that the wait to restore timer is running on the RPL owner.</td>
</tr>
<tr>
<td></td>
<td>• WTB running—Indicates that the wait to block timer is running on the RPL owner.</td>
</tr>
<tr>
<td>RPL Owner / Ring Protection Link Owner</td>
<td>Whether this node is the ring owner: Yes or No.</td>
</tr>
<tr>
<td>WTR Timer / Restore Timer</td>
<td>Restoration timer: running or disabled.</td>
</tr>
<tr>
<td>WTB Timer / Wait to block timer</td>
<td>Wait to block timer: running or disabled.</td>
</tr>
</tbody>
</table>

**NOTE:** The Wait To Block Timer (WTB) is always disabled on EX2300 and EX3400 switches because it is not supported in ERPSv1. Any configuration you make to the WTB setting has no effect. The output from the CLI command 'show protection-group ethernet-ring node-state detail' lists a WTB setting but that setting has no effect.
Table 212: show protection-group ethernet-ring node-state Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wait to block timer (WTB Timer)</td>
<td>Wait to block interval.</td>
</tr>
<tr>
<td></td>
<td>NOTE: The Wait To Block Timer (WTB) is always disabled on EX2300 and EX3400 switches because it is not supported in ERPSv1. Any configuration you make to the WTB setting has no effect. The output from the CLI command ‘show protection-group ethernet-ring node-state detail’ lists a WTB setting but that setting has no effect.</td>
</tr>
<tr>
<td>Guard Timer</td>
<td>Guard timer: running or disabled.</td>
</tr>
<tr>
<td>Op State / Operational State</td>
<td>State of the node: Operational or any internal wait state.</td>
</tr>
</tbody>
</table>

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 detail (ACX Series and MX Series Router)

```
user@host> show protection-group ethernet-ring node-state detail
Ethernet-Ring name : Erp_1
APS State         : idle
Event             : NR-RB
```
<table>
<thead>
<tr>
<th>Ring Protection Link Owner</th>
<th>Wait to Restore Timer</th>
<th>Wait to Block Timer</th>
<th>Guard Timer</th>
<th>Operation state</th>
</tr>
</thead>
<tbody>
<tr>
<td>: No</td>
<td>disabled</td>
<td>disabled</td>
<td>disabled</td>
<td>operational</td>
</tr>
<tr>
<td>: disabled</td>
<td>disabled</td>
<td>disabled</td>
<td>disabled</td>
<td>operational</td>
</tr>
<tr>
<td>: disabled</td>
<td>disabled</td>
<td>disabled</td>
<td>disabled</td>
<td>operational</td>
</tr>
<tr>
<td>: operational</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**show protection-group ethernet-ring node-state detail (MX Series Router - RPL Owner Node, Normal Operation)**

```bash
user@host> show protection-group ethernet-ring node-state detail
```

<table>
<thead>
<tr>
<th>Ethernet-Ring name</th>
<th>APS State</th>
<th>Event</th>
<th>Ring Protection Link Owner</th>
<th>Wait to Restore Timer</th>
<th>Wait to Block Timer</th>
<th>Guard Timer</th>
<th>Operation state</th>
</tr>
</thead>
<tbody>
<tr>
<td>pg101</td>
<td>idle</td>
<td>NR-RB</td>
<td>Yes</td>
<td>disabled</td>
<td>disabled</td>
<td>disabled</td>
<td>operational</td>
</tr>
<tr>
<td>pg102</td>
<td>idle</td>
<td>NR-RB</td>
<td>No</td>
<td>disabled</td>
<td>disabled</td>
<td>disabled</td>
<td>operational</td>
</tr>
</tbody>
</table>

**show protection-group ethernet-ring node-state detail (MX Series Router with WTR Timer)**

```bash
user@host> show protection-group ethernet-ring node-state detail
```

<table>
<thead>
<tr>
<th>Ethernet-Ring name</th>
<th>APS State</th>
<th>Event</th>
<th>Ring Protection Link Owner</th>
<th>Wait to Restore Timer</th>
<th>Wait to Block Timer</th>
<th>Guard Timer</th>
<th>Operation state</th>
</tr>
</thead>
<tbody>
<tr>
<td>pg_major</td>
<td>pending</td>
<td>WTR running</td>
<td>Yes</td>
<td>running (time to expire: 269 sec)</td>
<td>disabled</td>
<td>disabled</td>
<td>operational</td>
</tr>
<tr>
<td>pg_subring</td>
<td>pending</td>
<td>NR</td>
<td>No</td>
<td>disabled</td>
<td>disabled</td>
<td>disabled</td>
<td>operational</td>
</tr>
</tbody>
</table>

**show protection-group ethernet-ring node-state detail (MX Series Router with WTB Timer)**

```bash
user@host> show protection-group ethernet-ring node-state detail
```

<table>
<thead>
<tr>
<th>Ethernet-Ring name</th>
<th>APS State</th>
<th>Event</th>
<th>Ring Protection Link Owner</th>
<th>Wait to Restore Timer</th>
<th>Wait to Block Timer</th>
<th>Guard Timer</th>
<th>Operation state</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pg-2</td>
<td>pending</td>
<td>WTB running</td>
<td>Yes</td>
<td>Yes</td>
<td>disabled</td>
<td>disabled</td>
<td>operational</td>
</tr>
</tbody>
</table>

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2367
<table>
<thead>
<tr>
<th>Timer</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wait to Block Timer</td>
<td>running (time to expire: 2 sec)</td>
</tr>
<tr>
<td>Guard Timer</td>
<td>disabled</td>
</tr>
<tr>
<td>Operation state</td>
<td>operational</td>
</tr>
</tbody>
</table>

**show protection-group ethernet-ring node-state detail (EX2300 and EX3400 Switches)**

```
user@switch>show protection-group ethernet-ring node-state detail
```

<table>
<thead>
<tr>
<th>Ethernet-Ring name</th>
<th>pg1001</th>
</tr>
</thead>
<tbody>
<tr>
<td>APS State</td>
<td>idle</td>
</tr>
<tr>
<td>Event</td>
<td>NR-RB</td>
</tr>
<tr>
<td>Ring Protection Link Owner</td>
<td>Yes</td>
</tr>
<tr>
<td>Wait to Restore Timer</td>
<td>disabled</td>
</tr>
<tr>
<td>Wait to Block Timer</td>
<td>disabled</td>
</tr>
<tr>
<td></td>
<td>&lt;-field not supported. Always disabled.</td>
</tr>
<tr>
<td>Guard Timer</td>
<td>disabled</td>
</tr>
<tr>
<td>Operation state</td>
<td>operational</td>
</tr>
</tbody>
</table>
show protection-group ethernet-ring statistics

Syntax

```
show protection-group ethernet-ring statistics group-name group-name
<brief | detail>
```

Release Information

Command introduced in Junos OS Release 9.4.
Command introduced in Junos OS Release 12.1 for EX Series switches.
Command introduced in Junos OS Release 12.3X54 for ACX Series routers.

Description

Display statistics regarding Automatic Protection Switching (APS) protection groups on an Ethernet ring.

Options

- `group-name`—Display statistics for the protection group. If you omit this option, protection group statistics for all configured groups are displayed.
- `brief`—Display brief statistics for the protection group.
- `detail`—Display detailed statistics for the protection group.

Required Privilege

view

Related Documentation

- show protection-group ethernet-ring data-channel on page 2355
- show protection-group ethernet-ring aps on page 2344
- show protection-group ethernet-ring node-state on page 2364
- show protection-group ethernet-ring interface on page 2360
- show protection-group ethernet-ring vlan on page 2375

List of Sample Output

- show protection-group ethernet-ring statistics (EX Series Switch) on page 2371
- show protection-group ethernet-ring statistics (MX Series Router) on page 2371
- show protection-group ethernet-ring statistics detail (Specific Group) (MX Series Router) on page 2372
- show protection-group ethernet-ring statistics (Owner Node, Failure Condition on ACX and MX Router) on page 2372
- show protection-group ethernet-ring statistics (Ring Node, Failure Condition on ACX and MX Router) on page 2373
- show protection-group ethernet-ring statistics detail (EX2300 and EX3400 Switches) on page 2373
- show protection-group ethernet-ring statistics detail (EX2300 and EX3400 Switches) on page 2373

Output Fields

Table 213 on page 2370 lists the output fields for the `show protection-group ethernet-ring statistics` command.
### Table 213: `show protection-group ethernet-ring statistics` Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethernet Ring Statistics for PG</td>
<td>Name of the protection group for which statistics are displayed.</td>
</tr>
<tr>
<td>RAPS event sent</td>
<td>Number of times Ring Automatic Protection Switching (RAPS) message transmission event occurred locally. This field is applicable only to MX Series routers.</td>
</tr>
<tr>
<td>RAPS event received</td>
<td>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.</td>
</tr>
<tr>
<td>Local SF</td>
<td>Number of times a signal failure has occurred locally.</td>
</tr>
<tr>
<td>Remote SF</td>
<td>Number of times a signal failure has occurred anywhere else on the ring.</td>
</tr>
<tr>
<td>NR event</td>
<td>Number of times a No Request event has occurred on the ring. This field is applicable only to EX Series switches.</td>
</tr>
<tr>
<td>NR event sent</td>
<td>Number of times a No Request event has occurred locally. This field is applicable only to MX Series routers.</td>
</tr>
<tr>
<td>NR event received</td>
<td>Number of times a No Request event has occurred anywhere else on the ring. This field is applicable only to MX Series routers.</td>
</tr>
<tr>
<td>NR-RB event</td>
<td>Number of times a No Request, Ring Blocked event has occurred on the ring. This field is applicable only to EX Series switches.</td>
</tr>
<tr>
<td>NR-RB event sent</td>
<td>Number of times a No Request, Ring Blocked event has occurred locally. This field is applicable only to MX Series routers.</td>
</tr>
<tr>
<td>NR-RB event received</td>
<td>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.</td>
</tr>
<tr>
<td>Flush event sent</td>
<td>Number of times flush-event RAPS message transmission event occurred locally. This field is applicable only to MX Series routers.</td>
</tr>
<tr>
<td>Flush event received</td>
<td>Number of flush-event RAPS messages received and processed by the ring instance control process. This field is applicable only to MX Series routers.</td>
</tr>
<tr>
<td>Local FS event sent</td>
<td>Number of times a forced switch event has occurred locally. This field is applicable only to MX Series routers.</td>
</tr>
<tr>
<td>Remote FS event received</td>
<td>Number of times a forced switch event has occurred anywhere else on the ring. This field is applicable only to MX Series routers.</td>
</tr>
<tr>
<td>Local MS event sent</td>
<td>Number of times a manual switch event has occurred locally. This field is applicable only to MX Series routers.</td>
</tr>
</tbody>
</table>
Table 213: show protection-group ethernet-ring statistics Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote MS event received</td>
<td>Number of times a manual switch event has occurred anywhere else on the ring. This field is applicable only to MX Series routers.</td>
</tr>
</tbody>
</table>

Table 214 on page 2371 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 214: show protection-group ethernet-ring statistics detail Output Fields (for MX Series Routers)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of FDB flush</td>
<td>Number of times forwarding database (FDB) flush has happened for the ring instance.</td>
</tr>
<tr>
<td>Flush-logic triggered flush</td>
<td>Number of times FDB flush has happened because of flush-logic based on node ID and Blocked Port Reference (BPR).</td>
</tr>
<tr>
<td>Remote RAPS PDU received</td>
<td>Number of valid RAPS PDU messages received. This counter counts only RAPS messages generated by other devices on the ring.</td>
</tr>
<tr>
<td>Remote RAPS dropped due to guard-timer</td>
<td>Number of RAPS messages dropped by the device because the guard timer is running.</td>
</tr>
<tr>
<td>Invalid remote RAPS PDU dropped</td>
<td>Number of RAPS messages dropped by the device because the messages are invalid.</td>
</tr>
<tr>
<td>RAPS dropped due to miscellaneous errors</td>
<td>Number of RAPS messages dropped because of any other reason. For example, messages dropped because of unsupported functionality.</td>
</tr>
<tr>
<td>Local received RAPS PDU dropped</td>
<td>Number of self-generated RAPS messages received and dropped.</td>
</tr>
</tbody>
</table>

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
```
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 sent                     : 0
Local MS event sent                      : 0
Remote MS event received                 : 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 statistics (Owner Node, Failure Condition on ACX and MX Router)

user@host> 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
NR event sent                            : 0
NR-RB event sent                         : 1
NR-RB event received                     : 0
Flush event sent                         : 0
Flush event received                     : 0
Local FS event sent                      : 0
Remote FS event sent                     : 0
Remote FS event received                 : 0
show protection-group ethernet-ring statistics (Ring Node, Failure Condition on ACX and MX Router)

```
user@host> show protection-group ethernet-ring statistics group-name pg102
Ethernet Ring statistics for PG pg102
RAPS sent                        : 1
RAPS received                    : 0
Local SF happened:               : 0
Remote SF happened:              : 0
NR event happened:               : 0
NR-RB event happened:            : 1
NR event sent:                   : 0
NR event received:               : 0
NR-RB event sent:                : 1
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
```

show protection-group ethernet-ring statistics detail (EX2300 and EX3400 Switches)

```
user@switch> show protection-group ethernet-ring statistics detail
Ethernet Ring statistics for PG pg1001
RAPS event sent                          : 1
RAPS event received                      : 1
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                     : 1
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                 : 145
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
```
<table>
<thead>
<tr>
<th>Event Description</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local SF happened</td>
<td>0</td>
</tr>
<tr>
<td>Remote SF happened</td>
<td>0</td>
</tr>
<tr>
<td>NR event sent</td>
<td>1</td>
</tr>
<tr>
<td>NR event received</td>
<td>0</td>
</tr>
<tr>
<td>NR-RB event sent</td>
<td>1</td>
</tr>
<tr>
<td>NR-RB event received</td>
<td>0</td>
</tr>
<tr>
<td>Flush event sent</td>
<td>0</td>
</tr>
<tr>
<td>Flush event received</td>
<td>0</td>
</tr>
<tr>
<td>Total number of FDB flush</td>
<td>0</td>
</tr>
<tr>
<td>Remote raps PDU received</td>
<td>211</td>
</tr>
<tr>
<td>Remote raps dropped due to guard-timer</td>
<td>0</td>
</tr>
<tr>
<td>Invalid remote raps PDU dropped</td>
<td>0</td>
</tr>
<tr>
<td>Raps dropped due to miscellaneous errors</td>
<td>0</td>
</tr>
<tr>
<td>Local received raps PDU dropped</td>
<td>91</td>
</tr>
</tbody>
</table>
show protection-group ethernet-ring vlan

Syntax

show protection-group ethernet-ring vlan
<brief | detail>
<group-name group-name>

Release Information

Command introduced in Junos OS Release 10.2.
Command introduced in Junos OS Release 18.1 for EX2300 and EX3400 switches.

Description

On MX Series routers, display all data channel logical interfaces and the VLAN IDs controlled by a ring instance data channel.

Options

brief | detail—(Optional) Display the specified level of output.

group-name—(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.

Required Privilege Level

view

Related Documentation

- show protection-group ethernet-ring aps on page 2344
- show protection-group ethernet-ring data-channel on page 2355
- show protection-group ethernet-ring interface on page 2360
- show protection-group ethernet-ring node-state on page 2364
- show protection-group ethernet-ring statistics on page 2369

List of Sample Output

show protection-group ethernet-ring vlan on page 2376
show protection-group ethernet-ring vlan brief on page 2377
show protection-group ethernet-ring vlan detail on page 2377
show protection-group ethernet-ring vlan group-name vkm01 on page 2378
show protection-group ethernet-ring vlan detail (EX2300 and EX3400 Switches) on page 2378

Output Fields

Table 215 on page 2375 lists the output fields for the show protection-group ethernet-ring vlan command. Output fields are listed in the approximate order in which they appear.

Table 215: show protection-group ethernet-ring vlan Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>Name of the interface configured for the Ethernet protection ring.</td>
</tr>
</tbody>
</table>
Table 215: show protection-group ethernet-ring vlan Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vlan</td>
<td>Name of the VLAN associated with the interface configured for the Ethernet protection ring.</td>
</tr>
<tr>
<td>STP index</td>
<td>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.</td>
</tr>
<tr>
<td>Bridge Domain</td>
<td>Name of the bridge domain that is associated with the VLAN configured for the Ethernet protection ring.</td>
</tr>
</tbody>
</table>

Sample Output

```bash
user@host> show protection-group ethernet-ring vlan
Ethernet ring IFBD parameters for protection group vkm01

<table>
<thead>
<tr>
<th>Interface</th>
<th>Vlan</th>
<th>STP Index</th>
<th>Bridge Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>xe-5/0/2</td>
<td>1</td>
<td>78</td>
<td>default-switch/bd1</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>2</td>
<td>79</td>
<td>default-switch/bd1</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>2</td>
<td>78</td>
<td>default-switch/bd2</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>2</td>
<td>79</td>
<td>default-switch/bd2</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>3</td>
<td>78</td>
<td>default-switch/bd3</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>3</td>
<td>79</td>
<td>default-switch/bd3</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>4</td>
<td>78</td>
<td>default-switch/bd4</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>4</td>
<td>79</td>
<td>default-switch/bd4</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>5</td>
<td>78</td>
<td>default-switch/bd5</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>5</td>
<td>79</td>
<td>default-switch/bd5</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>6</td>
<td>78</td>
<td>default-switch/bd6</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>6</td>
<td>79</td>
<td>default-switch/bd6</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>7</td>
<td>78</td>
<td>default-switch/bd7</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>7</td>
<td>79</td>
<td>default-switch/bd7</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>8</td>
<td>78</td>
<td>default-switch/bd8</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>8</td>
<td>79</td>
<td>default-switch/bd8</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>9</td>
<td>78</td>
<td>default-switch/bd9</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>9</td>
<td>79</td>
<td>default-switch/bd9</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>10</td>
<td>78</td>
<td>default-switch/bd10</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>10</td>
<td>79</td>
<td>default-switch/bd10</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>11</td>
<td>78</td>
<td>default-switch/bd11</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>11</td>
<td>79</td>
<td>default-switch/bd11</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>12</td>
<td>78</td>
<td>default-switch/bd12</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>12</td>
<td>79</td>
<td>default-switch/bd12</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>13</td>
<td>78</td>
<td>default-switch/bd13</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>13</td>
<td>79</td>
<td>default-switch/bd13</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>14</td>
<td>78</td>
<td>default-switch/bd14</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>14</td>
<td>79</td>
<td>default-switch/bd14</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>15</td>
<td>78</td>
<td>default-switch/bd15</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>15</td>
<td>79</td>
<td>default-switch/bd15</td>
</tr>
</tbody>
</table>
```
show protection-group ethernet-ring vlan brief

user@host> show protection-group ethernet-ring vlan brief

Ethernet ring IFBD parameters for protection group vkm01

<table>
<thead>
<tr>
<th>Interface</th>
<th>Vlan</th>
<th>STP Index</th>
<th>Bridge Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>xe-5/0/2</td>
<td>1</td>
<td>78</td>
<td>default-switch/bd1</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>1</td>
<td>79</td>
<td>default-switch/bd1</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>2</td>
<td>78</td>
<td>default-switch/bd2</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>2</td>
<td>79</td>
<td>default-switch/bd2</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>3</td>
<td>78</td>
<td>default-switch/bd3</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>3</td>
<td>79</td>
<td>default-switch/bd3</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>4</td>
<td>78</td>
<td>default-switch/bd4</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>4</td>
<td>79</td>
<td>default-switch/bd4</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>5</td>
<td>78</td>
<td>default-switch/bd5</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>5</td>
<td>79</td>
<td>default-switch/bd5</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>6</td>
<td>78</td>
<td>default-switch/bd6</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>6</td>
<td>79</td>
<td>default-switch/bd6</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>7</td>
<td>78</td>
<td>default-switch/bd7</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>7</td>
<td>79</td>
<td>default-switch/bd7</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>8</td>
<td>78</td>
<td>default-switch/bd8</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>8</td>
<td>79</td>
<td>default-switch/bd8</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>9</td>
<td>78</td>
<td>default-switch/bd9</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>9</td>
<td>79</td>
<td>default-switch/bd9</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>10</td>
<td>78</td>
<td>default-switch/bd10</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>10</td>
<td>79</td>
<td>default-switch/bd10</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>11</td>
<td>78</td>
<td>default-switch/bd11</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>11</td>
<td>79</td>
<td>default-switch/bd11</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>12</td>
<td>78</td>
<td>default-switch/bd12</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>12</td>
<td>79</td>
<td>default-switch/bd12</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>13</td>
<td>78</td>
<td>default-switch/bd13</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>13</td>
<td>79</td>
<td>default-switch/bd13</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>14</td>
<td>78</td>
<td>default-switch/bd14</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>14</td>
<td>79</td>
<td>default-switch/bd14</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>15</td>
<td>78</td>
<td>default-switch/bd15</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>15</td>
<td>79</td>
<td>default-switch/bd15</td>
</tr>
</tbody>
</table>

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
show protection-group ethernet-ring vlan group-name vkm01

user@host> show protection-group ethernet-ring vlan vkm01

<table>
<thead>
<tr>
<th>Interface</th>
<th>Vlan</th>
<th>STP Index</th>
<th>Bridge Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>xe-5/0/2</td>
<td>16</td>
<td>80</td>
<td>default-switch/bd16</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>16</td>
<td>81</td>
<td>default-switch/bd16</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>17</td>
<td>80</td>
<td>default-switch/bd17</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>17</td>
<td>81</td>
<td>default-switch/bd17</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>18</td>
<td>80</td>
<td>default-switch/bd18</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>18</td>
<td>81</td>
<td>default-switch/bd18</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>19</td>
<td>80</td>
<td>default-switch/bd19</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>19</td>
<td>81</td>
<td>default-switch/bd19</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>20</td>
<td>80</td>
<td>default-switch/bd20</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>20</td>
<td>81</td>
<td>default-switch/bd20</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>21</td>
<td>80</td>
<td>default-switch/bd21</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>21</td>
<td>81</td>
<td>default-switch/bd21</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>22</td>
<td>80</td>
<td>default-switch/bd22</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>22</td>
<td>81</td>
<td>default-switch/bd22</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>23</td>
<td>80</td>
<td>default-switch/bd23</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>23</td>
<td>81</td>
<td>default-switch/bd23</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>24</td>
<td>80</td>
<td>default-switch/bd24</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>24</td>
<td>81</td>
<td>default-switch/bd24</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>25</td>
<td>80</td>
<td>default-switch/bd25</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>25</td>
<td>81</td>
<td>default-switch/bd25</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>26</td>
<td>80</td>
<td>default-switch/bd26</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>26</td>
<td>81</td>
<td>default-switch/bd26</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>27</td>
<td>80</td>
<td>default-switch/bd27</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>27</td>
<td>81</td>
<td>default-switch/bd27</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>28</td>
<td>80</td>
<td>default-switch/bd28</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>28</td>
<td>81</td>
<td>default-switch/bd28</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>29</td>
<td>80</td>
<td>default-switch/bd29</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>29</td>
<td>81</td>
<td>default-switch/bd29</td>
</tr>
<tr>
<td>xe-5/0/2</td>
<td>30</td>
<td>80</td>
<td>default-switch/bd30</td>
</tr>
<tr>
<td>xe-2/2/0</td>
<td>30</td>
<td>81</td>
<td>default-switch/bd30</td>
</tr>
</tbody>
</table>

show protection-group ethernet-ring vlan detail (EX2300 and EX3400 Switches)

user@switch> show protection-group ethernet-ring vlan detail

<table>
<thead>
<tr>
<th>Interface name</th>
<th>Vlan</th>
<th>STP Index</th>
<th>Bridge Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-0/0/42</td>
<td>2001</td>
<td>52</td>
<td>default-switch/vlan2001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interface name</td>
<td>ge-0/0/38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vlan</td>
<td>2001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STP index</td>
<td>53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridge Domain</td>
<td>default-switch/vlan2001</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
show security macsec connections (MX Series)

Syntax

```
show security macsec connections
<interface interface-name>
```

Release Information

Command introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers. Support for MPC7E-10G introduced in Junos OS Release 16.1R1 for MX240, MX480, and MX960 routers.

Description

Display the status of the active MACsec connections on the router.

Options

- `none`—Display MACsec connection information for all interfaces on the switch.
- `interface interface-name`—(Optional) Display MACsec connection information for the specified interface only.

Required Privilege Level

`view`

List of Sample Output

- show security macsec connections on page 2381
- show security macsec connections (MX480 routers with MPC7E-10G) on page 2381
- show security macsec connections (MX960 routers with MPC7E-10G) on page 2382

Output Fields

Table 216 on page 2380 lists the output fields for the `show security macsec connections` command. Output fields are listed in the approximate order in which they appear.

Table: show security macsec connections Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface name</td>
<td>Name of the interface.</td>
</tr>
<tr>
<td>CA name</td>
<td>Name of the connectivity association.</td>
</tr>
<tr>
<td>Cipher suite</td>
<td>Name of the cipher suite used for encryption.</td>
</tr>
<tr>
<td>Encryption</td>
<td>Encryption setting. Encryption is enabled when this output is <code>on</code> and disabled when this output is <code>off</code>. The encryption setting is set using the <code>no-encryption</code> statement in the connectivity association when using static connectivity association key (CAK) security mode and is set using the <code>encryption</code> statement in the secure channel when using static secure association key (SAK) or dynamic security mode.</td>
</tr>
</tbody>
</table>
Table 216: show security macsec connections Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key server offset</td>
<td>The offset value in a packet from which encryption can be performed. The offset is set using the <code>offset</code> 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.</td>
</tr>
<tr>
<td>Include SCI</td>
<td>SCI tagging. The SCI tag is included on packets in a secure channel when this output is <code>yes</code>, and not included on packets in a secure channel when this output is <code>no</code>. SCI tagging is automatically enabled on MX Series routers. By default, include SCI tag is disabled. You can enable SCI tagging using the <code>include-sci</code> statement in the connectivity association configuration.</td>
</tr>
<tr>
<td>Replay protect</td>
<td>By default, replay protection is disabled. Replay protection ensures that a snooped packet is not replayed or a packet number is reused. Replay protection is enabled when this output is <code>on</code> and disabled when this output is <code>off</code>. You can enable replay protection using the <code>replay-protect</code> statement in the connectivity association configuration.</td>
</tr>
<tr>
<td>Replay window</td>
<td>Number of packets that can be replayed. Must be configured with replay protection. This output is set to 0 when replay protection is disabled, and is the size of the replay window, in number of packets, when replay protection is enabled. The size of the replay window is configured using the <code>replay-window-size</code> statement in the connectivity association configuration.</td>
</tr>
</tbody>
</table>

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 connections (MX480 routers with MPC7E-10G)**

```
user@host> show security macsec connections
Interface name: xe-4/0/18
   CA name: cal
   Cipher suite: GCM-AES-128   Encryption: on
   Key server offset: 30  Include SCI: no
   Replay protect: off  Replay window: 0
   Outbound secure channels
   SC Id: 54:1E:56:B4:0D:3A/1
   Outgoing packet number: 11
   Secure associations
   AN: 1 Status: inuse Create time: 1d 17:31:10
```
show security macsec connections (MX480 routers with MPC7E-10G)

user@host> show security macsec connections interface xe-1/0/7

CA name: caae1
  Cipher suite: AES_GCM_128   Encryption: off
  Key server offset: 0       Include SCI: no
  Replay protect: off        Replay window: 0

Outbound secure channels
  SC Id: 54:1E:56:B3:CA:9C/1
  Outgoing packet number: 1

Secure associations
  AN: 0 Status: inuse Create time: 4d 05:56:06

Inbound secure channels
  SC Id: 54:1E:56:B3:CA:A7/1

Secure associations
  AN: 1 Status: inuse Create time: 1d 17:31:10
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. Support for MPC7E-10G introduced in Junos OS Release 16.1R1 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

**view**

List of Sample Output

- show security macsec statistics interface detail on page 2385
- show security macsec statistics (MX480 router with MPC7E-10G) on page 2386
- show security macsec statistics (MX480 router with MPC7E-10G) on page 2386
- show security macsec statistics detail (MX480 router with MPC7E-10G) on page 2387

Output Fields

Table 217 on page 2383 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’s 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 217: show security macsec statistics Output Fields

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface name</td>
<td>Name of the interface.</td>
<td>All levels</td>
</tr>
</tbody>
</table>
### Table 217: show security macsec statistics Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fields for Secure Channel transmitted</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encrypted packets</td>
<td>Total number of packets transmitted out of the interface in the secure channel that were secured and encrypted using MACsec.</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>Data packets are sent in the secure channel when MACsec is enabled, and are secured using a secure association key (SAK).</td>
<td></td>
</tr>
<tr>
<td>Encrypted bytes</td>
<td>Total number of bytes transmitted out of the interface in the secure channel that were secured and encrypted using MACsec.</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>Data packets are sent in the secure channel when MACsec is enabled, and are secured using a secure association key (SAK).</td>
<td></td>
</tr>
<tr>
<td>Protected packets</td>
<td>Total number of packets transmitted out of the interface in the secure channel that were secured but not encrypted using MACsec.</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>Data packets are sent in the secure channel when MACsec is enabled, and are secured using a secure association key (SAK).</td>
<td></td>
</tr>
<tr>
<td>Protected bytes</td>
<td>Total number of bytes transmitted out of the interface in the secure channel that were secured but not encrypted using MACsec.</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>Data packets are sent in the secure channel when MACsec is enabled, and are secured using a secure association key (SAK).</td>
<td></td>
</tr>
<tr>
<td><strong>Fields for Secure Association transmitted</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encrypted packets</td>
<td>Total number of packets transmitted out of the interface in the connectivity association that were secured and encrypted using MACsec.</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>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).</td>
<td></td>
</tr>
<tr>
<td>Protected packets</td>
<td>Total number of packets transmitted out of the interface in the connectivity association that were secured but not encrypted using MACsec.</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>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).</td>
<td></td>
</tr>
<tr>
<td><strong>Fields for Secure Channel received</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accepted packets</td>
<td>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.</td>
<td>All levels</td>
</tr>
<tr>
<td></td>
<td>A packet is considered accepted for this counter when it has been received by this interface and it has passed the MACsec integrity check.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>This counter increments for traffic that is and is not encrypted using MACsec.</td>
<td></td>
</tr>
</tbody>
</table>
Table 217: show security macsec statistics Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Validated bytes</td>
<td>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. This counter does not increment when MACsec encryption is disabled.</td>
<td>All levels</td>
</tr>
<tr>
<td>Decrypted bytes</td>
<td>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. 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.</td>
<td>All levels</td>
</tr>
</tbody>
</table>

Fields for Secure Association received

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accepted packets</td>
<td>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. A packet is considered accepted for this counter when it has been received by this interface and it has passed the MACsec integrity check.</td>
<td>All levels</td>
</tr>
<tr>
<td>Validated bytes</td>
<td>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. This counter does not increment when MACsec encryption is disabled.</td>
<td>All levels</td>
</tr>
<tr>
<td>Decrypted bytes</td>
<td>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. 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.</td>
<td>All levels</td>
</tr>
</tbody>
</table>

Sample Output

show security macsec statistics interface 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
```
show security macsec statistics (MX480 router with MPC7E-10G)  
user@host> show security macsec statistics  
Interface name: xe-4/0/18  
Secure Channel transmitted  
    Encrypted packets: 10  
    Encrypted bytes: 840  
    Protected packets: 0  
    Protected bytes: 0  
Secure Association transmitted  
    Encrypted packets: 10  
    Protected packets: 0  
Secure Channel received  
    Accepted packets: 0  
    Validated bytes: 0  
    Decrypted bytes: 0  
Secure Association received  
    Accepted packets: 0  
    Validated bytes: 0  
    Decrypted bytes: 0  
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 macsec statistics (MX480 router with MPC7E-10G)  
user@host> show security macsec statistics interface xe-1/0/7  
Secure Channel transmitted  
    Encrypted packets: 0  
    Encrypted bytes: 0  
    Protected packets: 0  
    Protected bytes: 0  
Secure Association transmitted  

show security macsec statistics detail (MX480 router with MPC7E-10G)

user@host> show security macsec statistics xe-4/0/18 detail

Interface name: xe-4/0/18

Secure Channel transmitted
  Encrypted packets: 10
  Encrypted bytes: 840
  Protected packets: 0
  Protected bytes: 0

Secure Association transmitted
  Encrypted packets: 10

Secure Channel received
  Accepted packets: 0
  Validated bytes: 0
  Decrypted bytes: 0

Secure Association received
  Accepted packets: 0
  Validated bytes: 0
  Decrypted bytes: 0

Error and debug
Secure Channel transmitted packets
  Untagged: 0, Too long: 0

Secure Channel received packets
  Control: 0, Tagged miss: 0
  Untagged hit: 0, Untagged: 0
  No tag: 8590007894, Bad tag: 0
  Unknown SCI: 0, No SCI: 0
  Control pass: 0, Control drop: 0
  Uncontrol pass: 0, 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)

**Syntax**

```
show security mka sessions
<interface interface-name>
```

**Release Information**

Command introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers. Support for MPC7E-10G introduced in Junos OS Release 16.1R1 for MX240, MX480, and MX960 routers.

**Description**

Display MACsec Key Agreement (MKA) session information for all interfaces. The MKA protocol is responsible for maintaining MACsec on the link, and decides which router on the point-to-point link becomes the key server.

**Options**

- `interface interface-name`—(Optional) Display the MKA session information for the specified interface only.
- `none`—Display the MKA session information for all interfaces.

**Required Privilege Level**

`view`

**List of Sample Output**

- show security mka sessions on page 2389
- show security mka sessions (MX480 with MPC7E-10G) on page 2389
- show security mka sessions (MX480 with MPC7E-10G) on page 2390

**Output Fields**

Table 218 on page 2388 lists the output fields for the `show security mka sessions` command. Output fields are listed in the approximate order in which they appear.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface name</td>
<td>Name of the interface.</td>
</tr>
<tr>
<td>Member identifier</td>
<td>Name of the member identifier.</td>
</tr>
<tr>
<td>CAK name</td>
<td>Name of the connectivity association key (CAK). The CAK is configured using the <code>cak</code> keyword when configuring the pre-shared key.</td>
</tr>
<tr>
<td>Transmit interval</td>
<td>The transmit interval. Both ends of the point-to-point link should be configured to the same value. Default value is 2000 seconds. Possible values: 2000 through 10000 milliseconds.</td>
</tr>
<tr>
<td>Outbound SCI</td>
<td>Name of the outbound secure channel identifier.</td>
</tr>
<tr>
<td>Message number</td>
<td>Number of the last data message.</td>
</tr>
<tr>
<td>Key number</td>
<td>Key number.</td>
</tr>
</tbody>
</table>
Table 218: show security mka sessions Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key server</td>
<td>Key server status. The router is the key server when this output is yes. The router is not the key server when this output is no.</td>
</tr>
<tr>
<td>Key server priority</td>
<td>Displays the priority of the key server. Lower value indicates higher priority. Use the key-server-priority statement to set the priority. Possible values: 0 through 255.</td>
</tr>
<tr>
<td>Latest SAK AN</td>
<td>Name of the latest secure association key (SAK) association number.</td>
</tr>
<tr>
<td>Latest SAK KI</td>
<td>Name of the latest secure association key (SAK) key identifier.</td>
</tr>
<tr>
<td>Member identifier</td>
<td>Name of the member identifier.</td>
</tr>
<tr>
<td>Hold time</td>
<td>Hold time, in seconds.</td>
</tr>
<tr>
<td>Message number</td>
<td>Number of the last data message</td>
</tr>
<tr>
<td>SCI</td>
<td>Name of the secure channel identifier.</td>
</tr>
<tr>
<td>Lowest acceptable PN</td>
<td>Number of the lowest acceptable packet number (PN).</td>
</tr>
</tbody>
</table>

Sample Output

show security mka sessions

```
user@host> show security mka sessions

  Interface name: xe-0/1/0
    Member identifier: 0CCBEE42F8778300F8D0C1DC
    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: 00000000000000000000000000000000/0
    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 sessions (MX480 with MPC7E-10G)
```

```
user@host> show security mka sessions

  Interface name: xe-4/0/18
    Member identifier: FA606FD4A4C2172F0C9D9C1F
```
show security mka sessions (MX480 with MPC7E-10G)

user@host> show security mka sessions interface xe-1/0/7

<table>
<thead>
<tr>
<th>Member identifier</th>
<th>CAK name</th>
<th>Transmit interval:</th>
<th>Outbound SCI:</th>
<th>Message number:</th>
<th>Key number:</th>
<th>Key server priority:</th>
</tr>
</thead>
<tbody>
<tr>
<td>653D8911B42DAE946993B40F</td>
<td>1111</td>
<td>2000(ms)</td>
<td>54:1E:56:B3:CA:9C/1</td>
<td>179139</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peer list</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Member identifier: 64EF352178BD1833600338F9 (live)</td>
<td>179175 Hold time: 4500 (ms)</td>
<td>54:1E:56:B4:0D:2F/1</td>
<td>Lowest acceptable PN: 0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
show security mka statistics (MX Series)

**Syntax**

```
show security mka statistics
<interface interface-name>
```

**Release Information**

Command introduced in Junos OS Release 15.1 for MX240, MX480, and MX960 routers. Support for MPC7E-10G introduced in Junos OS Release 16.1R1 for MX240, MX480, and MX960 routers.

**Description**

Display MACsec Key Agreement (MKA) protocol statistics.

The output for this command does not include statistics for MACsec data traffic. For MACsec data traffic statistics, see `show security macsec statistics`.

**Options**

- `interface interface-name`—(Optional) Display the MKA information for the specified interface only.
- `none`—Display the MKA information for all interfaces.

**Required Privilege Level**

`view`

**List of Sample Output**

- `show security mka statistics on page 2392`
- `show security mka statistics (MX480 routers with MPC7E-10G) on page 2392`
- `show security mka statistics (MX480 routers with MPC7E-10G) on page 2393`

**Output Fields**

Table 219 on page 2391 lists the output fields for the `show security mka statistics` command. Output fields are listed in the approximate order in which they appear.

**Table 219: show security mka statistics Output Fields**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Received packets</td>
<td>Number of received MKA control packets. This counter increments for received MKA control packets only. This counter does not increment when data packets are received.</td>
</tr>
<tr>
<td>Transmitted packets</td>
<td>Number of transmitted MKA packets. This counter increments for transmitted MKA control packets only. This counter does not increment when data packets are transmitted.</td>
</tr>
<tr>
<td>Version mismatch packets</td>
<td>Number of version mismatch packets.</td>
</tr>
<tr>
<td>CAK mismatch packets</td>
<td>Number of Connectivity Association Key (CAK) mismatch packets. 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.</td>
</tr>
</tbody>
</table>
### Table 219: show security mka statistics Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICV mismatch packets</td>
<td>Number of ICV mismatched packets.</td>
</tr>
<tr>
<td></td>
<td>This counter increments when the connectivity association key (CAK) value does not</td>
</tr>
<tr>
<td></td>
<td>match on both ends of a MACsec-secured Ethernet link.</td>
</tr>
<tr>
<td>Duplicate message identifier packets</td>
<td>Number of duplicate message identifier packets.</td>
</tr>
<tr>
<td>Duplicate message number packets</td>
<td>Number of duplicate message number packets.</td>
</tr>
<tr>
<td>Duplicate address packets</td>
<td>Number of duplicate source MAC address packets.</td>
</tr>
<tr>
<td>Invalid destination address packets</td>
<td>Number of invalid destination MAC address packets.</td>
</tr>
<tr>
<td>Formatting error packets</td>
<td>Number of formatting error packets.</td>
</tr>
<tr>
<td>Old Replayed message number packets</td>
<td>Number of old replayed message number packets.</td>
</tr>
</tbody>
</table>

### Sample Output

**show security mka statistics**

```
user@host> show security mka statistics

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Received packets:</td>
<td>1525844</td>
</tr>
<tr>
<td>Transmitted packets:</td>
<td>1525841</td>
</tr>
<tr>
<td>Version mismatch packets:</td>
<td>0</td>
</tr>
<tr>
<td>CAK mismatch packets:</td>
<td>0</td>
</tr>
<tr>
<td>ICV mismatch packets:</td>
<td>0</td>
</tr>
<tr>
<td>Duplicate message identifier packets:</td>
<td>0</td>
</tr>
<tr>
<td>Duplicate message number packets:</td>
<td>0</td>
</tr>
<tr>
<td>Duplicate address packets:</td>
<td>0</td>
</tr>
<tr>
<td>Invalid destination address packets:</td>
<td>0</td>
</tr>
<tr>
<td>Formatting error packets:</td>
<td>0</td>
</tr>
<tr>
<td>Old Replayed message number packets:</td>
<td>0</td>
</tr>
</tbody>
</table>
```

**show security mka statistics (MX480 routers with MPC7E-10G)**

```
user@host> show security mka statistics

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface name: xe-4/0/18</td>
<td></td>
</tr>
<tr>
<td>Received packets:</td>
<td>73009</td>
</tr>
<tr>
<td>Transmitted packets:</td>
<td>73011</td>
</tr>
<tr>
<td>Version mismatch packets:</td>
<td>0</td>
</tr>
<tr>
<td>CAK mismatch packets:</td>
<td>1</td>
</tr>
<tr>
<td>ICV mismatch packets:</td>
<td>0</td>
</tr>
<tr>
<td>Duplicate message identifier packets:</td>
<td>0</td>
</tr>
<tr>
<td>Duplicate message number packets:</td>
<td>0</td>
</tr>
<tr>
<td>Duplicate address packets:</td>
<td>0</td>
</tr>
<tr>
<td>Invalid destination address packets:</td>
<td>0</td>
</tr>
</tbody>
</table>
```
Formatting error packets: 0
Old Replayed message number packets: 0

---

**show security mka statistics (MX480 routers with MPC7E-10G)**

```
user@host> show security mka statistics interface xe-1/0/7

Received packets: 179211
Transmitted packets: 179186
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

**Syntax**

```
show vrrp
   <brief | detail | extensive | summary>
   <interface interface-name <group number>>
   <logical-system logical-system-name >
   <nsr>
```

**Release Information**

Command introduced before Junos OS Release 7.4.

nsr option added in Junos OS Release 13.2.

**Description**

Display status information about Virtual Router Redundancy Protocol (VRRP) groups.

**Options**

- **none**—(Same as brief) Display brief status information about all VRRP interfaces.
- **brief | detail | extensive | summary**—(Optional) Display the specified level of output.
- **interface interface-name <group number>**—(Optional) Display information and status about the specified VRRP interface and, optionally, the group number.
- **logical-system logical-system-name**—(Optional) Perform this operation on a particular logical system.
- **nsr**—(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.

**Required Privilege**

view

**Related Documentation**

- show vrrp track
- clear vrrp

**List of Sample Output**

show vrrp on page 2400
show vrrp brief on page 2400
show vrrp detail (IPv6) on page 2400
show vrrp detail (Route Track) on page 2401
show vrrp detail (Route Track) on page 2401
show vrrp extensive on page 2402
show vrrp interface on page 2402
show vrrp nsr on page 2403
show vrrp summary on page 2404

**Output Fields**

Table 220 on page 2395 lists the output fields for the show vrrp command. Output fields are listed in the approximate order in which they appear.
<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>Name of the logical interface.</td>
<td>brief extensive none summary</td>
</tr>
<tr>
<td>Interface index</td>
<td>Physical interface index number, which reflects its initialization sequence.</td>
<td>extensive</td>
</tr>
<tr>
<td>Groups</td>
<td>Total number of VRRP groups configured on the interface.</td>
<td>extensive</td>
</tr>
<tr>
<td>Active</td>
<td>Total number of VRRP groups that are active (that is, whose interface state is either up or down).</td>
<td>extensive</td>
</tr>
<tr>
<td>Interface VRRP PDU statistics</td>
<td>Non-errored statistics for the logical interface:</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>• Advertisement sent—Number of VRRP advertisement protocol data units (PDUs) that the interface has transmitted.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Advertisement received—Number of VRRP advertisement PDUs received by the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Packets received—Number of VRRP packets received for VRRP groups on the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• No group match received—Number of VRRP packets received for VRRP groups that do not exist on the interface.</td>
<td></td>
</tr>
<tr>
<td>Interface VRRP PDU error statistics</td>
<td>Errored statistics for the logical interface:</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>• Invalid IPAH next type received—Number of packets received that use the IP Authentication Header protocol (IPAH) and that do not encapsulate VRRP packets.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Invalid VRRP ttl value received—Number of packets received whose IP time-to-live (TTL) value is not 255.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Invalid VRRP version received—Number of packets received whose VRRP version is not 2.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Invalid VRRP pdu type received—Number of packets received whose VRRP PDU type is not 1.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Invalid VRRP authentication type received—Number of packets received whose VRRP authentication is not none, simple, or md5.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Invalid VRRP IP count received—Number of packets received whose VRRP IP count exceeds 8.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Invalid VRRP checksum received—Number of packets received whose VRRP checksum does not match the calculated one.</td>
<td></td>
</tr>
<tr>
<td>Physical interface</td>
<td>Name of the physical interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Unit</td>
<td>Logical unit number.</td>
<td>All levels</td>
</tr>
<tr>
<td>Address</td>
<td>Address of the physical interface.</td>
<td>brief detail extensive none</td>
</tr>
<tr>
<td>Index</td>
<td>Physical interface index number, which reflects its initialization sequence.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>SNMP ifindex</td>
<td>SNMP index number for the physical interface.</td>
<td>detail extensive</td>
</tr>
</tbody>
</table>
### Table 220: show vrrp Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>VRRP-Trap</td>
<td>Status of VRRP traps: <strong>Enabled</strong> or <strong>Disabled</strong>.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>VRRP-Version</td>
<td>VRRP version: 2 or 3.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Type and Address</td>
<td>Identifier for the address and the address itself:</td>
<td>brief none summary</td>
</tr>
<tr>
<td></td>
<td>• lcl—Configured local interface address.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• mas—Address of the master virtual router. This address is displayed only when the local interface is acting as a backup router.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• vip—Configured virtual IP addresses.</td>
<td></td>
</tr>
<tr>
<td>Interface state/Int state/State</td>
<td>State of the physical interface:</td>
<td>brief extensive none summary</td>
</tr>
<tr>
<td></td>
<td>• down—The device is present and the link is unavailable.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• not present—The interface is configured, but no physical device is present.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• unknown—The VRRP process has not had time to query the kernel about the state of the interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• up—The device is present and the link is established.</td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>VRRP group number.</td>
<td>brief extensive none summary</td>
</tr>
<tr>
<td>State</td>
<td>The state of the interface on which VRRP is running:</td>
<td>extensive</td>
</tr>
<tr>
<td></td>
<td>• backup—The interface is acting as the backup router interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• bringup—VRRP is just starting and the physical device is not yet present.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• idle—VRRP is configured on the interface and is disabled. This can occur when VRRP is first enabled on an interface whose link is established.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• init—VRRP is initializing.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• master—The interface is acting as the master router interface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• master(ISU)—The master router interface is going through a unified in-service software upgrade.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• transition—The interface is changing between being the backup and being the master router.</td>
<td></td>
</tr>
<tr>
<td>VRRP Mode</td>
<td>If the interface inherits its state and configuration from the active VRRP group, or if it is part of the active VRRP group.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>• Active—Part of the active VRRP group</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Inherit—Inherits state and configuration from the active VRRP group.</td>
<td></td>
</tr>
<tr>
<td>Priority</td>
<td>Configured VRRP priority for the interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Advertisement interval</td>
<td>Configured VRRP advertisement interval.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Authentication type</td>
<td>Configured VRRP authentication type: none, simple, or md5.</td>
<td>detail extensive</td>
</tr>
</tbody>
</table>
Table 220: show vrrp Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advertisement Threshold</td>
<td>A value from 1 through 15, used for setting the time when a peer should be considered down.</td>
<td>detail extensive</td>
</tr>
<tr>
<td></td>
<td>• The time a peer is considered down is equal to the advertisement-threshold multiplied by the advertisement-interval.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• (advertisement-threshold * advertisement-interval) = Peer down.</td>
<td></td>
</tr>
<tr>
<td>Computed Send Rate</td>
<td>How many protocol data units (PDUs) are generated per second. Based on the number of instances and the advertisement interval.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Preempt</td>
<td>Whether preemption is allowed on the interface: yes or no.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Accept-data mode</td>
<td>Whether the interface is configured to accept packets destined for the virtual IP address: yes or no.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>VIP count</td>
<td>Number of virtual IP addresses that have been configured on the interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>VIP</td>
<td>List of virtual IP addresses configured on the interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Advertisement timer</td>
<td>How long, in seconds, until the advertisement timer expires.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Master router</td>
<td>IP address of the interface that is acting as the master. If the VRRP interface is down, the output is N/A.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Virtual router uptime</td>
<td>How long, in seconds, that the virtual router has been up.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Master router uptime</td>
<td>How long, in seconds, that the master route has been up.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Virtual MAC</td>
<td>MAC address associated with the virtual IP address.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Tracking</td>
<td>Whether tracking is enabled or disabled.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Current priority</td>
<td>Current operational priority for being the VRRP master.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Configured priority</td>
<td>Configured base priority for being the VRRP master.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Priority hold-time</td>
<td>Minimum time interval, in seconds, between successive changes to the current priority. Disabled indicates no minimum interval.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Remaining-time</td>
<td>(track option only) Displays the time remaining in the priority hold-time interval.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Interface tracking</td>
<td>Whether interface tracking is enabled or disabled. When enabled, the output also displays the number of tracked interfaces.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Interface/Tracked</td>
<td>Name of the tracked interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>interface/Track Int</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 220: show vrrp Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int state/Interface state/State</td>
<td>Current operational state of the tracked interface: up or down.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Int speed/Speed</td>
<td>Current operational speed, in bits per second, of the tracked interface.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Incurred priority cost</td>
<td>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.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Threshold</td>
<td>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. An entry of down means that the corresponding priority cost is incurred when the interface is down.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Route tracking</td>
<td>Whether route tracking is enabled or disabled. When enabled, the output also displays the number of tracked routes.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Route count</td>
<td>The number of routes being tracked.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Route</td>
<td>The IP address of the route being tracked.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>VRF name</td>
<td>The VPN routing and forwarding (VRF) routing instance that the tracked route is in.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Route state</td>
<td>The state of the route being tracked: up, down, or unknown.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Priority cost</td>
<td>Configured priority cost. This value is incurred when the interface speed drops below the corresponding threshold or when the tracked route goes down.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Active</td>
<td>Whether the threshold is active (*). If the threshold is active, the corresponding priority cost is incurred.</td>
<td>detail extensive</td>
</tr>
<tr>
<td>Group VRRP PDU statistics</td>
<td>Number of VRRP advertisements sent and received by the group.</td>
<td>extensive</td>
</tr>
</tbody>
</table>
### Table 220: show vrrp Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group VRRP PDU error statistics</strong></td>
<td>Errored statistics for the VRRP group:</td>
<td>extensive</td>
</tr>
<tr>
<td>• Bad authentication type received</td>
<td>Number of VRRP PDUs received with an invalid authentication type. The received authentication can be <strong>none</strong>, <strong>simple</strong>, or <strong>md5</strong> and must be the same for all routers in the VRRP group.</td>
<td></td>
</tr>
<tr>
<td>• Bad password received</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>• Bad MD5 digest received</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>• Bad advertisement timer received</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>• Bad VIP count received</td>
<td>Number of VRRP PDUs whose virtual IP address counts differ from the count that has been configured on the VRRP instance.</td>
<td></td>
</tr>
<tr>
<td>• Bad VIPADDR received</td>
<td>Number of VRRP PDUs whose virtual IP addresses differ from the list of virtual IP addresses configured on the VRRP instance.</td>
<td></td>
</tr>
<tr>
<td><strong>Group state transition statistics</strong></td>
<td>State transition statistics for the VRRP group:</td>
<td>extensive</td>
</tr>
<tr>
<td>• Idle to master transitions</td>
<td>Number of times that the VRRP instance transitioned from the idle state to the master state.</td>
<td></td>
</tr>
<tr>
<td>• Idle to backup transitions</td>
<td>Number of times that the VRRP instance transitioned from the idle state to the backup state.</td>
<td></td>
</tr>
<tr>
<td>• Backup to master transitions</td>
<td>Number of times that the VRRP instance transitioned from the backup state to the master state.</td>
<td></td>
</tr>
<tr>
<td>• Master to backup transitions</td>
<td>Number of times that the VRRP instance transitioned from the master state to the backup state.</td>
<td></td>
</tr>
<tr>
<td><strong>VR state</strong></td>
<td>The state of the VRRP:</td>
<td>brief none summary</td>
</tr>
<tr>
<td>• backup</td>
<td>The interface is acting as the backup router interface.</td>
<td></td>
</tr>
<tr>
<td>• bringup</td>
<td>VRRP is just starting, and the physical device is not yet present.</td>
<td></td>
</tr>
<tr>
<td>• idle</td>
<td>VRRP is configured on the interface and is disabled. This can occur when VRRP is first enabled on an interface whose link is established.</td>
<td></td>
</tr>
<tr>
<td>• init</td>
<td>VRRP is initializing.</td>
<td></td>
</tr>
<tr>
<td>• master</td>
<td>The interface is acting as the master router interface.</td>
<td></td>
</tr>
<tr>
<td>• transition</td>
<td>The interface is changing between being the backup and being the master router.</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** 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.
### Table 220: show vrrp Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
<th>Level of Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSR</td>
<td>VRRP nonstop active routing is enabled for the configured VRRP group: <em>yes</em> or <em>no</em>.</td>
<td>brief none</td>
</tr>
</tbody>
</table>

**NOTE:** A *yes* value means that the new master Routing Engine will immediately start with the VRRP State value from the original master Routing Engine.

A *no* value means that the VRRP session will:

- Start afresh.
- Go through an silent startup period.
- Move to a backup state.
- Wait for the D Timer to run out before becoming the master (only if the master has not been configured already).

<table>
<thead>
<tr>
<th>RPD-NSR</th>
<th>The routing options have been set to nonstop active routing: <em>yes</em> or <em>no</em>.</th>
<th>brief none</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timer</td>
<td>VRRP timer information:</td>
<td>brief none</td>
</tr>
</tbody>
</table>

- A—How long, in seconds, until the advertisement timer expires.
- D—How long, in seconds, until the Master is Down timer expires.

---

### 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 lcl   fec0::12:1:1:1
                      vip     fe80::12:1:1:99
fe-0/0/2.131        up        1      master   A 0.364 lcl   fec0::13:1:1:1
                      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 2400.

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
```
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: 101.1.1.100
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:01:01
Tracking: enabled

Current priority: 150, Configured priority: 150
Priority hold-time: disabled
Interface tracking: disabled
Route tracking: enabled, Route count: 1
<table>
<thead>
<tr>
<th>Route</th>
<th>VRF name</th>
<th>Route state</th>
<th>Priority cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>192.168.40.0/22</td>
<td>default</td>
<td>up</td>
<td>30</td>
</tr>
</tbody>
</table>

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:01:64
Tracking: enabled

Current priority: 150, Configured priority: 150
Priority hold-time: disabled
Interface tracking: disabled
Route tracking: enabled, Route count: 1
<table>
<thead>
<tr>
<th>Route</th>
<th>VRF name</th>
<th>Route state</th>
<th>Priority cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>192.168.40.0/22</td>
<td>default</td>
<td>up</td>
<td>30</td>
</tr>
</tbody>
</table>
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 MDS 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
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.

```
show vrrp nsr

<table>
<thead>
<tr>
<th>Interface</th>
<th>State</th>
<th>Group</th>
<th>VR state</th>
<th>VR Mode</th>
<th>Type</th>
<th>NSR</th>
<th>RPD-NSR</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-1/0/1.0</td>
<td>up</td>
<td>1</td>
<td>master</td>
<td>Active</td>
<td>lcl</td>
<td>yes</td>
<td>yes</td>
<td>10.0.0.1</td>
</tr>
</tbody>
</table>
```
## show vrrp summary

<table>
<thead>
<tr>
<th>Interface</th>
<th>State</th>
<th>Group</th>
<th>VR state</th>
<th>Type</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-4/2/0.0</td>
<td>up</td>
<td>1</td>
<td>backup</td>
<td>lcl</td>
<td>10.57.0.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>vip</td>
<td>10.57.0.100</td>
</tr>
</tbody>
</table>

## show vrrp summary

<table>
<thead>
<tr>
<th>Interface</th>
<th>State</th>
<th>Group</th>
<th>VR state</th>
<th>Type</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-1/0/1.0</td>
<td>up</td>
<td>2</td>
<td>master</td>
<td>Active</td>
<td>10.0.0.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>lcl</td>
<td>yes</td>
<td>20.0.0.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>yes</td>
<td>yes</td>
<td>20.0.0.3</td>
</tr>
<tr>
<td>ge-1/0/1.0</td>
<td>up</td>
<td>3</td>
<td>master</td>
<td>Active</td>
<td>20.0.0.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>lcl</td>
<td>yes</td>
<td>30.0.0.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>yes</td>
<td>yes</td>
<td>30.0.0.3</td>
</tr>
<tr>
<td>ge-1/0/1.0</td>
<td>up</td>
<td>4</td>
<td>master</td>
<td>Active</td>
<td>40.0.0.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>lcl</td>
<td>yes</td>
<td>40.0.0.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>yes</td>
<td>yes</td>
<td>40.0.0.3</td>
</tr>
<tr>
<td>ge-1/0/1.0</td>
<td>up</td>
<td>5</td>
<td>master</td>
<td>Active</td>
<td>50.0.0.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>lcl</td>
<td>yes</td>
<td>50.0.0.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>yes</td>
<td>yes</td>
<td>50.0.0.3</td>
</tr>
<tr>
<td>ge-1/0/1.0</td>
<td>up</td>
<td>1</td>
<td>master</td>
<td>Active</td>
<td>1000::1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>lcl</td>
<td>yes</td>
<td>1000::1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>yes</td>
<td>yes</td>
<td>1000::3</td>
</tr>
<tr>
<td>fe80::200:5eff:fe00:1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1000::3</td>
</tr>
<tr>
<td>ge-1/0/1.0</td>
<td>up</td>
<td>2</td>
<td>master</td>
<td>Active</td>
<td>2000::1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>lcl</td>
<td>yes</td>
<td>2000::1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>yes</td>
<td>yes</td>
<td>2000::3</td>
</tr>
<tr>
<td>fe80::200:5eff:fe00:2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2000::3</td>
</tr>
<tr>
<td>ge-1/0/1.0</td>
<td>up</td>
<td>3</td>
<td>master</td>
<td>Active</td>
<td>3000::1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>lcl</td>
<td>yes</td>
<td>3000::1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>yes</td>
<td>yes</td>
<td>3000::3</td>
</tr>
<tr>
<td>fe80::200:5eff:fe00:3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3000::3</td>
</tr>
<tr>
<td>ge-1/0/1.0</td>
<td>up</td>
<td>4</td>
<td>master</td>
<td>Active</td>
<td>4000::1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>lcl</td>
<td>yes</td>
<td>4000::1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>yes</td>
<td>yes</td>
<td>4000::3</td>
</tr>
<tr>
<td>fe80::200:5eff:fe00:4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4000::3</td>
</tr>
<tr>
<td>ge-1/0/1.0</td>
<td>up</td>
<td>5</td>
<td>master</td>
<td>Active</td>
<td>5000::1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>lcl</td>
<td>yes</td>
<td>5000::1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>yes</td>
<td>yes</td>
<td>5000::3</td>
</tr>
<tr>
<td>fe80::200:5eff:fe00:5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5000::3</td>
</tr>
</tbody>
</table>
traceroute ethernet

Syntax

```
traceroute ethernet
local-mep mep-id
maintenance-association ma-name
maintenance-domain md-name
<ttl value>
<wait seconds>
mac-address | mep-id
<detail>
```

Release Information

Command introduced in Junos OS Release 9.0.

- `mep-id` option introduced in Junos OS Release 9.1.
- `local-mep` option introduced in Junos OS Release 15.1

Description

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 `show oam ethernet connectivity-fault-management path-database` command.

Before using the traceroute command, you can verify the remote MEP's MAC address using the `show oam ethernet connectivity-fault-management path-database` command.

Options

- `local-mep mep-id`—(Required when multiple MEPs are configured) Identifier for the local maintenance endpoint.
- `detail`—(Optional) Provide detailed information of the responder hostname, ingress port name, egress port name, TTL, and relay action.
- `mac-address`—Destination unicast MAC address of the remote maintenance point.
- `mep-id`—MEP Identifier of the remote maintenance point. The range of values is 1 through 8191.
- `maintenance-association ma-name`—Specifies an existing maintenance association from the set of configured maintenance associations.
- `maintenance-domain md-name`—Specifies an existing maintenance domain from the set of configured maintenance domains.
- `ttl value`—Number of hops to use in the linktrace request. The range is 1 to 255 hops. The default is 4.
- `wait seconds`—(Optional) Maximum time to wait for a response to the traceroute request. The range is 1 to 255 seconds. The default is 5.

Required Privilege

- `network`
**List of Sample Output**  
traceroute ethernet on page 2407  
traceroute ethernet detail on page 2407

**Output Fields**  
Table 221 on page 2406 lists the output fields for the traceroute ethernet command. Output fields are listed in the approximate order in which they appear.

*Table 221: traceroute ethernet Output Fields*

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linktrace to</td>
<td>MAC address of the destination maintenance point.</td>
</tr>
<tr>
<td>Interface</td>
<td>Local interface used to send the linktrace message (LTM).</td>
</tr>
<tr>
<td>Maintenance Domain</td>
<td>Maintenance domain specified in the traceroute command.</td>
</tr>
<tr>
<td>Level</td>
<td>Maintenance domain level configured.</td>
</tr>
<tr>
<td>Maintenance Association</td>
<td>Maintenance association specified in the traceroute command.</td>
</tr>
<tr>
<td>Local Mep</td>
<td>The local maintenance end point identifier.</td>
</tr>
<tr>
<td>Transaction Identifier</td>
<td>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.</td>
</tr>
<tr>
<td>Hop</td>
<td>Sequential hop count of the linktrace path.</td>
</tr>
<tr>
<td>TTL</td>
<td>Number of hops remaining in the linktrace message. The time to live (TTL) is decremented at each hop.</td>
</tr>
<tr>
<td>Source MAC address</td>
<td>MAC address of the 802.1ag node responding to the LTM or the source MAC address of the LTR.</td>
</tr>
<tr>
<td>Next-hop MAC address</td>
<td>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.</td>
</tr>
<tr>
<td>Responder Hostname</td>
<td>The hostname of the responding router. A valid hostname is received only when the responding system is a Juniper Networks router.</td>
</tr>
<tr>
<td>Ingress port name</td>
<td>The port name for ingress connections.</td>
</tr>
<tr>
<td>Egress port name</td>
<td>The port name for egress connections.</td>
</tr>
</tbody>
</table>
### Table 221: traceroute ethernet Output Fields (continued)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flags</strong></td>
<td>The configurable flags can include:</td>
</tr>
<tr>
<td></td>
<td>• H—Hardware only, incoming LT frame has hardware bit set.</td>
</tr>
<tr>
<td></td>
<td>• T—Terminal MEP, responder is a terminating MEP.</td>
</tr>
<tr>
<td></td>
<td>• F—FWD yes, LTM frame is relayed further.</td>
</tr>
<tr>
<td><strong>Relay Action</strong></td>
<td>The associated relay action. Relay action can be one of the following:</td>
</tr>
<tr>
<td></td>
<td>• RlyHit—Relay hit; target MAC address matches the MP mac address.</td>
</tr>
<tr>
<td></td>
<td>• RlyFDB—Relay FDB; output port decided by consulting forwarding database.</td>
</tr>
<tr>
<td></td>
<td>• RlyMPDB—Relay MIP; output port decided by consulting MIP database.</td>
</tr>
</tbody>
</table>

---

**Sample Output**

**traceroute ethernet**

```bash
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**

```bash
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
```
<table>
<thead>
<tr>
<th>TTL</th>
<th>Responder Hostname</th>
<th>Ingress port name</th>
<th>Egress port name</th>
<th>Flags</th>
</tr>
</thead>
<tbody>
<tr>
<td>62</td>
<td>host1</td>
<td>ge-1/0/0.1</td>
<td>ge-2/3/0.1</td>
<td>RlyFDB</td>
</tr>
<tr>
<td>br1</td>
<td></td>
<td>00:00:5E:00:53:00</td>
<td>00:00:5E:00:53:A0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ge-2/3/0.1</td>
<td>ge-1/0/0.1</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>host2</td>
<td>ge-1/0/0.1</td>
<td>ge-1/0/0.1</td>
<td>RlyFDB</td>
</tr>
<tr>
<td>br1</td>
<td></td>
<td>00:00:5E:00:53:A0</td>
<td>00:00:5E:00:53:A2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
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