Junos® OS

Circuit Emulation Interfaces Feature Guide for Routing Devices

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Using the Examples in This Manual

If you want to use the examples in this manual, you can use the **load merge** or the **load merge relative** command. These commands cause the software to merge the incoming configuration into the current candidate configuration. The example does not become active until you commit the candidate configuration.

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

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

Merging a Full Example

To merge a full example, follow these steps:

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

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

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

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

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

Merging a Snippet

To merge a snippet, follow these steps:

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

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

   ```
   commit {
     file ex-script-snippet.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 on page xv defines notice icons used in this guide.

Table 1: Notice Icons

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

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

Table 2: Text and Syntax Conventions

Convention	Description	Examples
Bold text like this	Represents text that you type.	To enter configuration mode, type the **configure** command: user@host> **configure**

Table 2: Text and Syntax Conventions (continued)

Convention	Description	Examples
`Fixed-width text like this`	Represents output that appears on the terminal screen.	`user@host>` **show chassis alarms** `No alarms currently active`
Italic text like this	• Introduces or emphasizes important new terms. • Identifies guide names. • Identifies RFC and Internet draft titles.	• A policy *term* is a named structure that defines match conditions and actions. • *Junos OS CLI User Guide* • RFC 1997, *BGP Communities Attribute*
Italic text like this	Represents variables (options for which you substitute a value) in commands or configuration statements.	Configure the machine's domain name: [edit] root@# **set system domain-name** *domain-name*
Text like this	Represents names of configuration statements, commands, files, and directories; configuration hierarchy levels; or labels on routing platform components.	• To configure a stub area, include the **stub** statement at the **[edit protocols ospf area area-id]** hierarchy level. • The console port is labeled **CONSOLE**.
< > (angle brackets)	Encloses optional keywords or variables.	**stub <default-metric** ***metric*****>;**
| (pipe symbol)	Indicates a choice between the mutually exclusive keywords or variables on either side of the symbol. The set of choices is often enclosed in parentheses for clarity.	**broadcast | multicast** **(*string1* | *string2* | *string3*)**
# (pound sign)	Indicates a comment specified on the same line as the configuration statement to which it applies.	**rsvp { # Required for dynamic MPLS only**
[ ] (square brackets)	Encloses a variable for which you can substitute one or more values.	**community name members [** ***community-ids*** **]**

Indention and braces ({ })	Identifies a level in the configuration hierarchy.	[edit]
		routing-options {
		  static {
		  route default {
		  nexthop *address*;
		  retain;
		  }
		  }
		}

; (semicolon)	Identifies a leaf statement at a configuration hierarchy level.	
GUI Conventions		
Bold text like this	Represents graphical user interface (GUI) items you click or select.	• In the Logical Interfaces box, select **All Interfaces**. • To cancel the configuration, click **Cancel**.

Table 2: Text and Syntax Conventions (continued)

Convention	Description	Examples
> (bold right angle bracket)	Separates levels in a hierarchy of menu selections.	In the configuration editor hierarchy, select **Protocols>Ospf**.

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- Find product documentation: https://www.juniper.net/documentation/
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- 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/
- Open a case online in the CSC Case Management tool: https://www.juniper.net/cm/

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

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

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

PART 1

Overview

CHAPTER 1

Understanding Circuit Emulation Interfaces

Understanding Circuit Emulation Services and the Supported PIC Types

Circuit emulation service is a method through which data can be transmitted over ATM, Ethernet, or MPLS networks. This information is error-free and has a constant delay, thereby enabling you to use it for services that use time-division multiplexing (TDM). This technology can be implemented through Structure-Agnostic TDM over Packet (SAToP) and Circuit Emulation Service over Packet-Switched Network (CESoPSN) protocols.

SAToP enables you to encapsulate TDM bit-streams such as T1, E1, T3, and E3 as pseudowires over packet-switched networks (PSNs).

CESoPSN enables you to encapsulate structured (*N*xDS0) TDM signals as pseudowires over packet-switching networks.

A pseudowire is a Layer 2 circuit or service, that emulates the essential attributes of a telecommunications service— such as a T1 line, over an MPLS PSN. The pseudowire is intended to provide only the minimum necessary functionality to emulate the wire with the required degree of faithfulness for the given service definition.

The following Circuit Emulation PICs are specifically designed for mobile backhaul applications.

4-Port Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP

The 4-port Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP —MIC-3D-4COC3-1COC12-CE—is a channelized Circuit Emulation MIC with rate-selectability. You can specify its port speed as **COC3-CSTM1** or **COC12-CSTM4**. The default port speed is **COC3-CSTM1**. To configure the 4-port Channelized OC3/STM1 Circuit Emulation MIC, see "Configuring SAToP on 4-Port Channelized OC3/STM1 Circuit Emulation MICs" on page 19.

All ATM interfaces are either T1 or E1 channels within the COC3/CSTM1 hierarchy. Each COC3 interface can be partitioned as 3 COC1 slices, each of which in turn can be partitioned further into 28 ATM interfaces and the size of each interface created is that of a T1 interface. Each CS1 interface can be portioned as 1 CAU4 interface, which can be further partitioned as E1-sized ATM interfaces.

The following features are supported on the MIC-3D-4COC3-1COC12-CE MIC:

- Per-MIC SONET/SDH framing
- Internal and loop clocking
- T1/E1 and SONET clocking
- Mixed SAToP and ATM interfaces on any port
- SONET mode—Each OC3 port can be channelized down to 3 COC1 channels, and then each COC1 can channel down to 28 T1 channels.
- SDH mode—Each STM1 port can be channelized down to 4 CAU4 channels, and then each CAU4 can channel down to 63 E1 channels.
- SAToP
- CESoPSN
- Pseudowire Emulation Edge to Edge (PWE3) control word for use over an MPLS PSN

The MIC-3D-4COC3-1COC12-CE MIC supports T1 and E1 options with the following exceptions:

- **bert-algorithm**, **bert-error-rate**, and **bert-period** options are supported for CT1 or CE1 configurations only.
- **framing** is supported for CT1 or CE1 configurations only. It is not applicable in SAToP configurations.
- **buildout** is supported in CT1 configurations only.
- **line-encoding** is supported in CT1 configurations only.
- **loopback local** and **loopback remote** are supported in CE1 and CT1 configurations only. By default, no loopback is configured.
- **loopback payload** is not supported. It is not applicable in SAToP configurations.
- **idle-cycle-flag** is not supported. It is not applicable in SAToP configurations.

- **start-end-flag** is not supported. It is not applicable in SAToP configurations.
- **invert-data** is not supported. It is not applicable in SAToP configurations.
- **fcs16** is not supported in E1 and T1 configurations only.
- **fcs32** is not supported in E1 and T1 configurations only. It is not applicable in SAToP configurations.
- **timeslots** is not supported. It is not applicable in SAToP or ATM configurations.
- **byte-encoding** is not supported in T1 configurations only. It is not applicable in SAToP configurations. **nx56** byte encoding is not supported.
- **crc-major-alarm-threshold** and **crc-minor-alarm-threshold** are T1 options supported in SAToP configurations only.
- **remote-loopback-respond** is not supported. It is not applicable in SAToP configurations.
- If you attempt to configure the local loopback capability on an *at-* interface—ATM1 or ATM2 intelligent queuing (IQ) interface or a virtual ATM interface on a Circuit Emulation (ce-) interface—by including the **loopback local** statement at the **[edit interfaces at-*fpc/pic/port* e1-options]**, **[edit interfaces at-*fpc/pic/port* e3-options]**, **[edit interfaces at-*fpc/pic/port* t1-options]**, or the **[edit interfaces at-*fpc/pic/port* t3-options]** hierarchy level (to define the E1, E3, T1, or T3 physical interface properties) and commit the configuration, the commit is successful. However, local loopback on AT interfaces does not take effect and a system log message is generated stating that local loopback is not supported. You must not configure local loopback because it is not supported on at- interfaces.
- Mixing T1 and E1 channels is not supported on individual ports.

For more information about MIC-3D-4COC3-1COC12-CE, see *Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP*.

12-Port Channelized T1/E1 Circuit Emulation PIC

The 12-port Channelized T1/E1 Circuit Emulation PIC supports TDM interfaces by using the SAToP protocol [RFC 4553] encapsulation, and supports T1/E1 and SONET clocking features. The 12-port Channelized T1/E1 Circuit Emulation PIC can be configured to work as either 12 T1 interfaces or 12 E1 interfaces. Mixing T1 interfaces and E1 interfaces is not supported. To configure the 12-Port Channelized T1/E1 Circuit Emulation PIC, see "Configuring the 12-Port Channelized T1/E1 Circuit Emulation PIC" on page 76.

The 12-port Channelized T1/E1 Circuit Emulation PICs support T1 and E1 options, with the following exceptions:

- **bert-algorithm**, **bert-error-rate**, and **bert-period** options are supported for CT1 or CE1 configurations only.
- **framing** is supported for CT1 or CE1 configurations only. It is not applicable in SAToP configurations.
- **buildout** is supported in CT1 configurations only.
- **line-encoding** is supported in CT1 configurations only.

- **loopback local** and **loopback remote** are supported in CE1 and CT1 configurations only.
- **loopback payload** is not supported. It is not applicable in SAToP configurations.
- **idle-cycle-flag** is not supported. It is not applicable in SAToP or ATM configurations.
- **start-end-flag** is not supported. It is not applicable in SAToP or ATM configurations.
- **invert-data** is not supported. It is not applicable in SAToP configurations.
- **fcs32** is not supported. **fcs** is not applicable in SAToP or ATM configurations.
- **timeslots** is not supported. It is not applicable in SAToP configurations.
- **byte-encoding nx56** is not supported. It is not applicable in SAToP or ATM configurations.
- **crc-major-alarm-threshold** and **crc-minor-alarm-threshold** are not supported.
- **remote-loopback-respond** is not supported. It is not applicable in SAToP configurations.

8-Port OC3/STM1 or 12-port OC12/STM4 ATM MIC

The 8-port OC3/STM1 or 2-port OC12/STM4 Circuit Emulation ATM MIC supports both SONET and SDH framing mode. The mode can be set at the MIC level or at the port level. ATM MICs are rate-selectable at the following rates: 2-port OC12 or 8-port OC3. The ATM MIC supports ATM pseudowire encapsulation and swapping of VPI and VCI values in both directions.

NOTE: **Cell-relay VPI/VCI swapping and cell-relay VPI swapping on both egress and ingress are not compatible with the ATM policing feature.**

16-Port Channelized E1/T1 Circuit Emulation MIC

The 16-port Channelized E1/T1 Circuit Emulation MIC (MIC-3D-16CHE1-T1-CE) is a channelized MIC with 16 E1 or T1 ports.

The following features are supported on the MIC-3D-16CHE1-T1-CE MIC:

- Each MIC can be separately configured in either T1 or E1 framing mode.
- Each T1 port supports superframe (D4) and extended superframe (ESF) framing modes.
- Each E1 port supports G704 with CRC4, G704 without CRC4, and unframed framing modes.
- Clear channel and *N*xDS0 channelization. For T1 the value of *N* ranges from 1 through 24 and for E1 the value of *N* ranges from 1 through 31.
- Diagnostic features:
  - T1/E1
  - T1 facilities data link (FDL)
  - Channel service unit (CSU)

    - Bit error rate test (BERT)
    - Juniper Integrity Test (JIT)
- T1/E1 alarm and performance monitoring (a Layer 1 OAM function)
- External (loop) timing and internal (system) timing
- TDM circuit emulation services CESoPSN and SAToP
- CoS parity with IQE PICs. The CoS features supported on MPCs are supported on this MIC.
- Encapsulations:
    - ATM CCC cell relay
    - ATM CCC VC multiplex
    - ATM VC multiplex
    - Multilink Point-to-Point Protocol (MLPPP)
    - Multilink Frame Relay (MLFR) FRF.15
    - Multilink Frame Relay (MLFR) FRF.16
    - Point-to-Point Protocol (PPP)
    - Cisco High-Level Data Link Control
- ATM class-of-service (CoS) features—traffic shaping, scheduling, and policing
- ATM Operation, Administration, and Maintenance
- Graceful Routing Engine switchover (GRES)

NOTE:

- When GRES is enabled you must execute the **clear interface statistics** (*interface-name* | **all**) operational mode command to reset the cumulative values for local statistics. For more information, see *Resetting Local Statistics*.
- Unified ISSU is not supported on the 16-port Channelized E1/T1 Circuit Emulation MIC (MIC-3D-16CHE1-T1-CE).

For more information about MIC-3D-16CHE1-T1-CE, see *Channelized E1/T1 Circuit Emulation MIC*.

Layer 2 Circuit Standards

Junos OS substantially supports the following Layer 2 circuit standards:

- RFC 4447, *Pseudowire Setup and Maintenance Using the Label Distribution Protocol (LDP)* (except section 5.3)
- RFC 4448, *Encapsulation Methods for Transport of Ethernet over MPLS Networks*

- Internet draft draft-martini-l2circuit-encap-mpls-11.txt, *Encapsulation Methods for Transport of Layer 2 Frames Over IP and MPLS Networks* (expires August 2006)

Junos OS has the following exceptions:

- A packet with a sequence number of 0 is treated as out of sequence.
  - Any packet that does not have the next incremental sequence number is considered out of sequence.
  - When out-of-sequence packets arrive, the expected sequence number for the neighbor is set to the sequence number in the Layer 2 circuit control word.
- Internet draft draft-martini-l2circuit-trans-mpls-19.txt, *Transport of Layer 2 Frames Over MPLS* (expires September 2006).

These drafts are available on the IETF website at http://www.ietf.org/.

Related Documentation

- Displaying Information About Circuit Emulation PICs on page 113

Understanding Circuit Emulation PIC Clocking Features

All Circuit Emulation PICs support the following clocking features:

- External clocking—Also known as *loop timing.* Clock is distributed via TDM interfaces.
- Internal clocking with external synchronization—Also known as *external timing* or *external synchronization.*
- Internal clocking with PIC-level line synchronization—The PIC's internal clock is synchronized with a clock recovered from a TDM interface local to the PIC.

This feature set is useful for aggregation in mobile backhaul applications.

NOTE: **The primary reference source (PRS) of the clock recovered from one interface may not be the same as that of another TDM interface. There is a limitation on the number of timing domains that can be supported in practice.**

Related Documentation

- Understanding Mobile Backhaul on page 13

Understanding ATM QoS or Shaping

M7i, M10i, M40e, M120, and M320 routers with 4-port Channelized OC3/STM1 Circuit Emulation PICs and 12-port T1/E1 Circuit Emulation PICs and MX Series routers with Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP and 16-port Channelized E1/T1 Circuit Emulation MIC support ATM pseudowire service with QoS features for ingress and egress direction traffic shaping. Policing is performed by monitoring the configured parameters on the incoming traffic and is also referred to as ingress shaping. Egress shaping uses queuing and scheduling to shape the outgoing traffic. Classification is provided per virtual circuit (VC). To configure ATM QoS or shaping, see "Configuring ATM QoS or Shaping" on page 108.

The following QoS features are supported:

- CBR, rtVBR, nrtVBR, and UBR
- Policing on a per VC basis
- Independent PCR and SCR policing
- Counting policing actions

Circuit Emulation PICs provide pseudowire service towards the core. This section describes the ATM service QoS features.

Circuit Emulation PICs support two types of ATM pseudowires:

- cell—**atm-ccc-cell-relay** encapsulation
- aal5—**atm-ccc-vc-mux**

NOTE: **Only ATM pseudowires are supported; no other encapsulation types are supported.**

Since cells within a VC cannot be re-ordered, and since only the VC is mapped to a pseudowire, classification is not meaningful in the context of a pseudowire. However, different VCs can be mapped to different classes of traffic and can be classified in the core network.

Such a service would connect two ATM networks with an IP/MPLS core. Figure 1 on page 10 shows that the routers marked PE are equipped with Circuit Emulation PICs.

Figure 1: Two ATM Networks with QoS Shaping and Pseudowire Connection

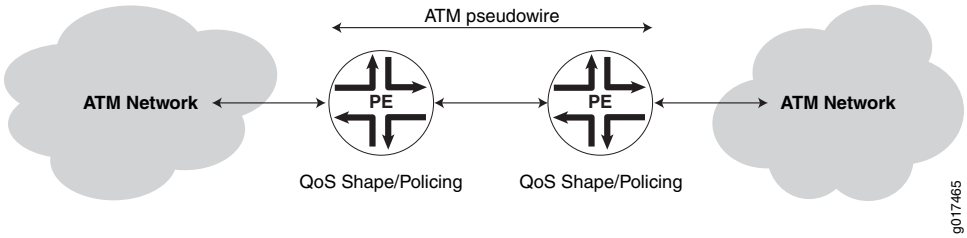


Figure 1 on page 10 shows that traffic is shaped in the egress direction towards the ATM networks. In the ingress direction towards the core, the traffic is policed and the appropriate action is taken. Depending on a very elaborate state machine in the PIC, the traffic is either discarded or sent towards the core with a particular QoS class.

Each port has four transmit queues and one receive queue. Packets arrive from the ingress network on this single queue. Remember that this is per port and multiple VCs arrive on this queue, each with its own QoS class. To simplify unidirectional connections, only a Circuit Emulation PIC (PE 1 router) to Circuit Emulation PIC (PE 2 router) configuration is shown in Figure 2 on page 10.

Figure 2: VC Mapping with Circuit Emulation PICs

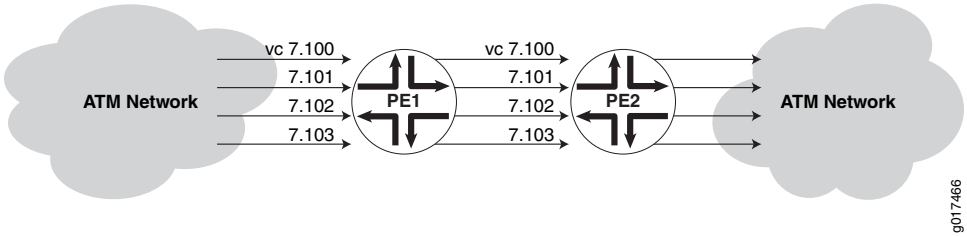


Figure 2 on page 10 shows the four VCs with different classes mapped to different pseudowires in the core. Each VC has a different QoS class and is assigned a unique queue number. This queue number is copied to the EXP bits in the MPLS header as follows:

Qn concatenated with CLP -> EXP

Qn is 2 bits and can have four combinations; 00, 01, 10, and 11. Since CLP cannot be extracted from the PIC and put into each packet prefix, it is 0. The valid combinations are shown in Table 3 on page 10.

Table 3: Valid EXP Bit Combinations

Qn	CLP
00	0
01	0
10	0
11	0

For example, VC 7.100 has CBR, VC 7.101 has rt-VBR, 7.102 has nrt-VBR, 7.103 has UBR, and each VC is assigned a queue number as follows:

- VC 7.100 -> 00
- VC 7.101 -> 01
- VC 7.102 -> 10
- VC 7.103 -> 11

NOTE: **Lower queue numbers have higher priorities.**

Each VC will have the following EXP bits:

- VC 7.100 -> 000
- VC 7.101 -> 010
- VC 7.102 -> 100
- VC 7.103 -> 110

A packet arriving on VC 7.100 at the ingress router has the queue number 00 before being forwarded to the Packet Forwarding Engine. The Packet Forwarding Engine then translates this to 000 EXP bits in the core. At the egress router, the Packet Forwarding Engine retranslates this to queue 00 and stamps the packet with this queue number. The PIC receiving this queue number sends the packet out on the transmit queue that is mapped to queue 0, which could be the highest priority transmit queue on the egress side.

To briefly summarize, shaping and policing are possible. Classification is possible at the VC level by mapping a specific VC to a particular class.

Related Documentation

- ATM Support on Circuit Emulation PICs Overview on page 71
- Configuring ATM QoS or Shaping on page 108
- *shaping*

CHAPTER 2

Understanding How Circuit Emulation Interfaces Support Converged Networks That Accommodate Both IP And Legacy Services

Understanding Mobile Backhaul

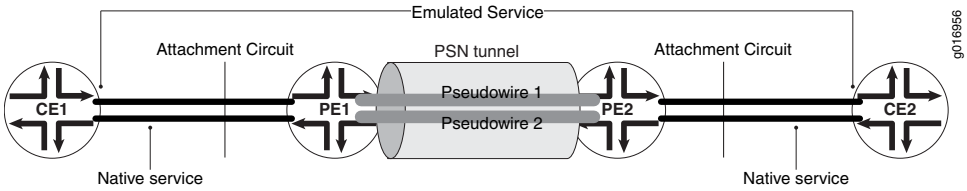
In a network of core routers, edge routers, access networks, and other components, the network paths that exist between the core network and edge subnetworks are known as backhaul. This backhaul can be designed as a wired backhaul setup or a wireless backhaul setup or as a combination of both on the basis of your requirement. In a mobile network, the network path between the cell tower and service provider is considered to be backhaul and is called mobile backhaul.

The following sections explain mobile backhaul application solution and IP/MPLS-based mobile backhaul solution.

Mobile Backhaul Application Overview

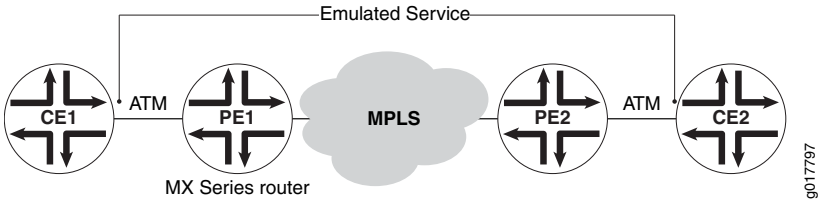
This topic provides an application example (see Figure 3 on page 14) based on the mobile backhaul reference model where customer edge 1 (CE1) is a base station controller (BSC), provider edge 1 (PE1) is a cell site router, PE2 is an M Series (aggregation) router, and CE2 is a BSC and Radio Network Controller (RNC). The Internet Engineering Task Force (RFC 3895) describes pseudowire as “a mechanism that emulates the essential attributes of a telecommunications service (such as a T1 leased line or Frame Relay) over a PSN” (Packet Switching Network).

Figure 3: Mobile Backhaul Application



For MX Series routers with ATM MICs with SFP, the mobile backhaul reference model is modified (see Figure 4 on page 14), where the provider edge 1 (PE1) router is an MX Series router with an ATM MIC with SFP. The PE2 router can be any router, such as an M Series (aggregation router) that might or might not support swapping (rewriting) of virtual path identifier (VPI) or virtual circuit identifier (VCI) values. An ATM pseudowire carries ATM cells over an MPLS network. The pseudowire encapsulation can be either cell relay or AAL5. Both modes enable sending of ATM cells between the ATM MIC and the Layer 2 network. You can configure the ATM MIC to swap the VPI value, VCI value, or both. You can also disable swapping of the values.

Figure 4: Mobile Backhaul Application on MX Series Routers with ATM MICs with SFP



IP/MPLS-based Mobile Backhaul

Juniper Networks IP/MPLS-based mobile backhaul solutions provide the following benefits:

- Flexibility to support converged networks that accommodate both IP and legacy services (leveraging proven circuit emulation techniques).
- Scalability to support emerging data-intensive technologies.
- Cost-effectiveness to compensate for rising levels of backhaul traffic.

M7i, M10i, M40e, M120, and M320 routers with 12-port T1/E1 interfaces, 4-port Channelized OC3/STM1 interfaces, and MX Series routers with ATM MICs with SFP, with 2-port OC3/STM1 or 8-port OC12/STM4 circuit emulation interfaces, offer IP/MPLS-based mobile backhaul solutions that enable operators to combine diverse transport technologies onto a single transport architecture, to reduce operating costs while enhancing user features and increasing profits. This architecture accommodates the backhaul of legacy services, emerging IP-based services, location-based services, mobile gaming and mobile TV, and new emerging technologies such as LTE and WiMAX.

Related Documentation

- ATM Cell Relay Pseudowire VPI/VCI Swapping Overview on page 100
- no-vpivci-swapping on page 129
- psn-vci on page 130

- psn-vpi on page 131

PART 2

Configuring Circuit Emulation Interfaces

CHAPTER 3

Configuring SAToP Support on Circuit Emulation PICs

Configuring SAToP on 4-Port Channelized OC3/STM1 Circuit Emulation MICs

To configure Structure-Agnostic TDM over Packet (SAToP) on a 4-port Channelized OC3/STM1 Circuit Emulation MIC (MIC-3D-4COC3-1COC12-CE), you must configure the framing mode at the MIC level or port level and then configure each port as E1 interface or T1 interface.

Configuring SONET/SDH Rate-Selectability

You can configure rate-selectability on the Channelized OC3/STM1 (Multi-Rate) MICs with SFP by specifying its port speed as **COC3-CSTM1** or **COC12-CSTM4**.

To configure rate-selectability:

1. In configuration mode, go to the **[edit chassis fpc *slot* pic *slot* port *slot*]** hierarchy level.

   ```
   [edit]
   user@host# edit chassis fpc slot pic slot port slot
   ```

   For example:

   ```
   [edit]
   user@host# edit chassis fpc 1 pic 0 port 0
   ```

2. Set the speed as **coc3-cstm1** or **coc12-cstm4**.

```
[edit chassis fpc slot pic slot port slot]
user@host# set speed (coc3-cstm1 | coc12-cstm4)
```

For example:

```
[edit chassis fpc 1 pic 0 port 0]
user@host# set speed coc3-cstm1
```

NOTE: When the speed is set as **coc12-cstm4**, instead of configuring COC3 ports down to T1 channels and CSTM1 ports down to E1 channels, you must configure COC12 ports down to T1 channels and CSTM4 channels down to E1 channels.

Configuring SONET/SDH Framing Mode at the MIC Level

To configure framing mode at the MIC level:

1. Go to the **[edit chassis fpc *fpc-slot* pic *pic-slot*]** hierarchy level.

   ```
   [edit]
   [edit chassis fpc fpc-slot pic pic-slot]
   ```

2. Configure the framing mode as SONET for COC3 or SDH for CSTM1.

   ```
   [edit chassis fpc fpc-slot pic pic-slot]
   user@host# set framing (sonet | sdh)
   ```

After a MIC is brought online, interfaces are created for the MIC's available ports on the basis of the MIC type and the configured framing mode of each port:

- When the **framing sonet** statement (for a COC3 Circuit Emulation MIC) is enabled, four COC3 interfaces are created.
- When the **framing sdh** statement (for a CSTM1 Circuit Emulation MIC) is enabled, four CSTM1 interfaces are created.
- Note that when you do not specify framing mode at the MIC level, then the default framing mode is SONET for all the four ports.

NOTE: If you set the framing option incorrectly for the MIC type, the commit operation fails.

Bit error rate test (BERT) patterns with all ones received by T1/E1 interfaces on Circuit Emulation MICs configured for SAToP do not result in an alarm indication signal (AIS) defect. As a result, the T1/E1 interfaces remain up.

Configuring SONET/SDH Framing Mode at the Port Level

Each port's framing mode can be configured individually, as either COC3 (SONET) or STM1 (SDH). Ports not configured for framing retain the MIC framing configuration, which

is SONET by default if you have not specified framing at the MIC level. To set the framing mode for individual ports, include the **framing** statement at the **[edit chassis fpc *fpc-slot* pic *pic-slot* port *port-number*]** hierarchy level:

To configure the framing mode as SONET for COC3 or SDH for CSTM1 at port level:

1. Go to the **[edit chassis fpc *fpc-slot* pic *pic-slot* port *port-number*]** hierarchy level.

   [edit]
   [edit chassis fpc *fpc-slot* pic *pic-slot* port *port-number*]

2. Configure the framing mode as SONET for COC3 or SDH for CSTM1.

   [edit chassis fpc *fpc-slot* pic *pic-slot* port *port-number*]
   user@host# set framing (sonet | sdh)

NOTE: Configuring the framing mode at the port level overwrites the previous MIC-level framing mode configuration for the specified port. Subsequently, configuring the MIC-level framing mode overwrites the port-level framing configuration. For example, if you want three STM1 ports and one COC3 port, then it is practical to first configure the MIC for SDH framing and then configure one port for SONET framing.

Configuring SAToP Options on T1 interfaces

To configure the SAToP on an T1 interface, you must perform the following tasks:

1. Configuring COC3 Ports Down to T1 Channels on page 21
2. Configuring SAToP Options on a T1 interface on page 22

Configuring COC3 Ports Down to T1 Channels

On any port (numbered 0 through 3) configured for SONET framing, you can configure three COC1 channels (numbered 1 through 3). On each COC1 channel, you can configure 28 T1 channels (numbered 1 through 28).

To configure COC3 channelization down to COC1 and then down to T1 channels:

1. In configuration mode, go to the **[edit interfaces coc3-*fpc-slot/pic-slot/port*]**

   [edit]
   user@host# edit interfaces coc3-*fpc-slot/pic-slot/port*

   For example:

   [edit]
   user@host# edit interfaces coc3-1/0/0

2. Configure the sublevel interface partition index, range of SONET/SDH slices, and sublevel interface type.

   [edit interfaces coc3-*fpc-slot/pic-slot/port*]

```
user@host# set partition partition-number oc-slice oc-slice interface-type coc1
```

For example:

```
[edit interfaces coc3-1/0/0]
user@host# set partition 1 oc-slice 1 interface-type coc1
```

3. Enter **up** command to go to **[edit interfaces]** hierarchy level.

```
[edit interfaces coc3-fpc-slot/pic-slot/port]
user@host# up
```

4. Configure the channelized OC1 interface, sublevel interface partition index, and the interface type.

```
[edit interfaces]
user@host# set coc1-fpc-slot/pic-slot/port:channel-number partition partition-number
  interface-type t1
```

For example:

```
[edit interfaces]
user@host# set coc1-1/0/0:1 partition 1 interface-type t1
```

5. Enter **up** to go to **[edit interfaces]** hierarchy level.

6. Configure the FPC slot, MIC slot and the port for T1 interface. Configure the encapsulation as SAToP and the logical interface for T1 interface.

```
[edit interfaces]
user@host# set t1-fpc-slot/pic-slot/port:channel encapsulation encapsulation-type
  unit interface-unit-number;
```

For example:

```
[edit interfaces]
user@host# set t1-1/0/:1 encapsulation satop unit 0;
```

NOTE: Similarly, you can configure the COC12 ports down to T1 channels. When configuring COC12 ports down to T1 channels, on a port configured for SONET framing, you can configure twelve COC1 channels (numbered 1 through 12). On each COC1 channel, you can configure 28 T1 channels (numbered 1 through 28).

After you partition the T1 channels, configure the SAToP options.

Configuring SAToP Options on a T1 interface

To configure SAToP options on a T1 interface:

1. In configuration mode, go to the **[edit interfaces t1-*fpc-slot/pic-slot/port*]** hierarchy level.

```
[edit]
user@host# edit interfaces t1-fpc-slot/pic-slot/port
```

2. Use the **edit** command to go to the **satop-options** hierarchy level.

```
[edit interfaces t1-fpc-slot/pic-slot/port]
user@host# edit satop-options
```

3. Configure the following SAToP options:

- **excessive-packet-loss-rate**—Set packet loss options. The options are **sample-period** and **threshold**.

```
[edit interfaces t1-fpc-slot/pic-slot/port satop-options]
user@host# set excessive-packet-loss-rate sample-period sample-period threshold
  percentile
```

- **idle-pattern**—An 8-bit hexadecimal pattern to replace TDM data in a lost packet (from 0 through 255).

```
[edit interfaces t1-fpc-slot/pic-slot/port satop-options]
user@host# set idle-pattern pattern
```

- **jitter-buffer-auto-adjust**—Automatically adjust the jitter buffer.

```
[edit interfaces t1-fpc-slot/pic-slot/port satop-options]
user@host# set jitter-buffer-auto-adjust
```

NOTE: The **jitter-buffer-auto-adjust** option is not applicable on MX Series routers.

- **jitter-buffer-latency**—Time delay in the jitter buffer (from 1 through 1000 milliseconds).

```
[edit interfaces t1-fpc-slot/pic-slot/port satop-options]
user@host# set jitter-buffer-latency milliseconds
```

- **jitter-buffer-packets**—Number of packets in the jitter buffer (from 1 through 64 packets).

```
[edit interfaces t1-fpc-slot/pic-slot/port satop-options]
user@host# set jitter-buffer-packets packets
```

- **payload-size**—Configure the payload size, in bytes (from 32 through 1024 bytes).

```
[edit interfaces t1-fpc-slot/pic-slot/port satop-options]
user@host# set payload-size bytes
```

Configuring SAToP Options on E1 Interfaces

To configure the SAToP on an E1 interface.

1. Configuring CSTM1 Ports Down to E1 Channels on page 24
2. Configuring SAToP Options on E1 Interfaces on page 25

Configuring CSTM1 Ports Down to E1 Channels

On any port (numbered 0 through 3) configured for SDH framing, you can configure one CAU4 channel. On each CAU4 channel, you can configure 63 E1 channels (numbered 1 through 63).

To configure CSTM1 channelization down to CAU4 and then down to E1 channels.

1. In configuration mode, go to the **[edit interfaces cstm1-*fpc-slot/pic-slot/port*]**

   ```
   [edit]
   [edit interfaces cstm1-fpc-slot/pic-slot/port]
   ```

   For example:

   ```
   [edit]
   [edit interfaces cstm1-1/0/1]
   ```

2. Configure the channelize interface as clear channel and the set the interface-type as cau4

   ```
   [edit interfaces cstm1-fpc-slot/pic-slot/port]
   user@host# set no-partition interface-type cau4;
   ```

3. Enter **up** to go to **[edit interfaces]** hierarchy level.

4. Configure the FPC slot, MIC slot and the port for CAU4 interface. Configure the sublevel interface partition index and the interface type as E1.

   ```
   [edit interfaces]
   user@host# set cau4-fpc-slot/pic-slot/port partition partition-number interface-type
     e1
   ```

   For example:

   ```
   [edit interfaces]
   user@host# set cau4-1/0/1 partition 1 interface-type e1
   ```

5. Enter **up** to go to **[edit interfaces]** hierarchy level.

6. Configure the FPC slot, MIC slot and the port for E1 interface. Configure the encapsulation as SAToP and the logical interface for E1 interface.

   ```
   [edit interfaces]
   user@host# set e1-fpc-slot/pic-slot/port:channel encapsulation encapsulation-type
     unit interface-unit-number;
   ```

   For example:

   ```
   [edit interfaces]
   user@host# set e1-1/0/:1 encapsulation satop unit 0;
   ```

NOTE: Similarly, you can configure the CSTM4 channels down to E1 channels.

After you configure the E1 channels, configure the SAToP options.

Configuring SAToP Options on E1 Interfaces

To configure SAToP options on E1 interfaces:

1. In configuration mode, go to the **[edit interfaces e1-*fpc-slot/pic-slot/port*]** hierarchy level.

   ```
   [edit]
   user@host# edit interfaces e1-fpc-slot/pic-slot/port
   ```

2. Use the **edit** command to go to the **satop-options** hierarchy level.

   ```
   [edit interfaces e1-fpc-slot/pic-slot/port]
   user@host# edit satop-options
   ```

3. Configure the following SAToP options:

   - **excessive-packet-loss-rate**—Set packet loss options. The options are **sample-period** and **threshold**.

     ```
     [edit interfaces e1-fpc-slot/pic-slot/port satop-options]
     user@host# set excessive-packet-loss-rate sample-period sample-period threshold
       percentile
     ```

   - **idle-pattern**—An 8-bit hexadecimal pattern to replace TDM data in a lost packet (from 0 through 255).

     ```
     [edit interfaces e1-fpc-slot/pic-slot/port satop-options]
     user@host# set idle-pattern pattern
     ```

   - **jitter-buffer-auto-adjust**—Automatically adjust the jitter buffer.

     ```
     [edit interfaces e1-fpc-slot/pic-slot/port satop-options]
     user@host# set jitter-buffer-auto-adjust
     ```

     NOTE: The **jitter-buffer-auto-adjust** option is not applicable on MX Series routers.

   - **jitter-buffer-latency**—Time delay in the jitter buffer (from 1 through 1000 milliseconds).

     ```
     [edit interfaces e1-fpc-slot/pic-slot/port satop-options]
     user@host# set jitter-buffer-latency milliseconds
     ```

   - **jitter-buffer-packets**—Number of packets in the jitter buffer (from 1 through 64 packets).

     ```
     [edit interfaces e1-fpc-slot/pic-slot/port satop-options]
     user@host# set jitter-buffer-packets packets
     ```

- **payload-size**—Configure the payload size, in bytes (from 32 through 1024 bytes).

  [edit interfaces e1-*fpc-slot/pic-slot/port* satop-options]
  user@host# **set payload-size** ***bytes***

Related Documentation

- Understanding Circuit Emulation Services and the Supported PIC Types on page 3

Configuring SAToP Emulation on T1/E1 Interfaces on 12-Port Channelized T1/E1 Circuit Emulation PICs

The following sections describes configuring SAToP on the 12-port Channelized T1/E1 Circuit Emulation PICs:

- Setting the Emulation Mode on page 26
- Configuring SAToP Emulation on T1/E1 Interfaces on page 26

Setting the Emulation Mode

To set the framing emulation mode, include the **framing** statement at the **[edit chassis fpc *fpc-slot* pic *pic-slot*]** hierarchy level:

```
[edit chassis fpc fpc-slot pic pic-slot]
user@host# set framing (t1 | e1);
```

After a PIC is brought online, interfaces are created for the PIC's available ports according to the PIC type and the framing option used:

- If you include the **framing t1** statement (for a T1 Circuit Emulation PIC), 12 CT1 interfaces are created.
- If you include the **framing e1** statement (for an E1 Circuit Emulation PIC), 12 CE1 interfaces are created.

NOTE: If you set the framing option incorrectly for the PIC type, the commit operation fails.

Circuit Emulation PICs with SONET and SDH ports require prior channelization down to T1 or E1 before you can configure them. Only T1/E1 channels support SAToP encapsulation or SAToP options.

Bit error rate test (BERT) patterns with all ones received by T1/E1 interfaces on Circuit Emulation PICs configured for SAToP do not result in an alarm indication signal (AIS) defect. As a result, the T1/E1 interfaces remain up.

Configuring SAToP Emulation on T1/E1 Interfaces

- Setting the Encapsulation Mode on page 27
- Configuring Loopback for a T1 Interface or an E1 Interface on page 27

Setting the Encapsulation Mode

E1 channels on Circuit Emulation PICs can be configured with SAToP encapsulation at the provider edge (PE) router, as follows:

NOTE: The below mentioned procedure can be used to configure T1 channels on circuit emulation PICs with SAToP encapsulation at the PE router.

1. In the configuration mode, go to **[edit interfaces e1-*fpc-slot/pic-slot/port*]** hierarchy level.

   ```
   [edit]
   user@host# [edit interfaces e1 fpc-slot/pic-slot/port]
   ```

   For example:

   ```
   [edit]
   [edit interfaces e1-1/0/0]
   ```

2. Configure SAToP encapsulation and the logical interface for E1 interface

   ```
   [edit interfaces e1-1/0/0]
   user@host# set encapsulation encapsulation-typeunit interface-unit-number;
   ```

   For example:

   ```
   [edit interfaces e1-1/0/0]
   user@host# set encapsulation satop unit 0;
   ```

You do not need to configure any cross-connect circuit family because it is automatically created for the above encapsulation.

Configuring Loopback for a T1 Interface or an E1 Interface

To configure loopback capability between the local T1 interface and the remote channel service unit (CSU), see *Configuring T1 Loopback Capability*. To configure loopback capability between the local E1 interface and the remote channel service unit (CSU), see *Configuring E1 Loopback Capability*.

NOTE: By default, no loopback is configured.

Setting the SAToP Options

To configure SAToP options on T1/E1 interfaces:

1. In configuration mode, go to the **[edit interfaces e1-*fpc-slot/pic-slot/port*]** hierarchy level.

   ```
   [edit]
   ```

```
user@host# edit interfaces e1-fpc-slot/pic-slot/port
```

For example:

```
[edit]
user@host# edit interfaces e1-1/0/0
```

2. Use the **edit** command to go to the **satop-options** hierarchy level.

```
[edit]
user@host# edit satop-options
```

3. In this hierarchy level, using the **set** command you can configure the following SAToP options:

- **excessive-packet-loss-rate**—Set packet loss options. The options are **groups**, **sample-period**, and **threshold**.
  - **groups**—Specify groups.
  - **sample-period**—Time required to calculate excessive packet loss rate (from 1000 through 65,535 milliseconds).
  - **threshold**—Percentile designating the threshold of excessive packet loss rate (1–100 percent).
- **idle-pattern**—An 8-bit hexadecimal pattern to replace TDM data in a lost packet (from 0 through 255).
- **jitter-buffer-auto-adjust**—Automatically adjust the jitter buffer.

NOTE: **The jitter-buffer-auto-adjust option is not applicable on MX Series routers.**

- **jitter-buffer-latency**—Time delay in the jitter buffer (from 1 through 1000 milliseconds).
- **jitter-buffer-packets**—Number of packets in the jitter buffer (from 1 through 64 packets).
- **payload-size**—Configure the payload size, in bytes (from 32 through 1024 bytes).

NOTE: **In this section, we are configuring only one SAToP option. You can follow the same method to configure all the other SAToP options.**

```
[edit interfaces e1-1/0/0 satop-options]
user@host# set excessive-packet-loss-rate sample-period sample-period
```

For example:

```
[edit interfaces e1-1/0/0 satop-options]
user@host# set excessive-packet-loss-rate sample-period 4000
```

To verify this configuration, use the **show** command at the **[edit interfaces e1-1/0/0]** hierarchy level:

```
[edit interfaces e1-1/0/0]
user@host# show
satop-options {
   excessive-packet-loss-rate {
      sample-period 4000;
   }
}
```

See Also

- satop-options on page 132

Configuring the Pseudowire Interface

To configure the TDM pseudowire at the provider edge (PE) router, use the existing Layer 2 circuit infrastructure, as shown in the following procedure:

1. In the configuration mode, go to **[edit protocols l2circuit]** hierarchy level.

   ```
   [edit]
   user@host# edit protocol l2circuit
   ```

2. Configure the IP address of the neighboring router or switch, interface forming the layer 2 circuit and the identifier for the layer 2 circuit.

   ```
   [edit protocol l2circuit]
   user@host# set neighbor ip-address interface
     interface-name-fpc-slot/pic-slot/port.interface-unit-number virtual-circuit-id
     virtual-circuit-id;
   ```

   NOTE: To configure T1 interface as the layer 2 circuit, replace e1 with t1 in the below statement.

   For example:

   ```
   [edit protocol l2circuit]
   user@host# set neighbor 10.255.0.6 interface e1-1/0/0.0 virtual-circuit-id 1
   ```

3. To verify the configuration use the **show** command at the **[edit protocols l2circuit]** hierarchy level.

   ```
   [edit protocols l2circuit]
   user@host# show
   neighbor 10.255.0.6 {
     interface e1-1/0/0.0 {
       virtual-circuit-id 1;
     }
   }
   ```

After the customer edge (CE)-bound interfaces (for both PE routers) are configured with proper encapsulation, payload size, and other parameters, the two PE routers try to

establish a pseudowire with Pseudowire Emulation Edge-to-Edge (PWE3) signaling extensions. The following pseudowire interface configurations are disabled or ignored for TDM pseudowires:

- **ignore-encapsulation**
- **mtu**

The supported pseudowire types are:

- 0x0011 Structure-Agnostic E1 over Packet
- 0x0012 Structure-Agnostic T1 (DS1) over Packet

When the local interface parameters match the received parameters, and the pseudowire type and control word bit are equal, the pseudowire is established.

For detailed information about configuring TDM pseudowire, see the *Junos OS VPNs Library for Routing Devices*.

For detailed information about PICs, see the *PIC Guide* for your router.

NOTE: When T1 is used for SAToP, the T1 facility data-link (FDL) loop is *not* supported on the CT1 interface device. The is because SAToP does not analyze T1 framing bits.

Related Documentation

- Understanding Mobile Backhaul on page 13
- Understanding Circuit Emulation Services and the Supported PIC Types on page 3
- Configuring SAToP on 4-Port Channelized OC3/STM1 Circuit Emulation MICs on page 19

Setting the SAToP Options

To configure SAToP options on T1/E1 interfaces:

1. In configuration mode, go to the **[edit interfaces e1-*fpc-slot/pic-slot/port*]** hierarchy level.

   ```
   [edit]
   user@host# edit interfaces e1-fpc-slot/pic-slot/port
   ```

   For example:

   ```
   [edit]
   user@host# edit interfaces e1-1/0/0
   ```

2. Use the **edit** command to go to the **satop-options** hierarchy level.

   ```
   [edit]
   user@host# edit satop-options
   ```

3. In this hierarchy level, using the **set** command you can configure the following SAToP options:

   - **excessive-packet-loss-rate**—Set packet loss options. The options are **groups**, **sample-period**, and **threshold**.
     - **groups**—Specify groups.
     - **sample-period**—Time required to calculate excessive packet loss rate (from 1000 through 65,535 milliseconds).
     - **threshold**—Percentile designating the threshold of excessive packet loss rate (1–100 percent).
   - **idle-pattern**—An 8-bit hexadecimal pattern to replace TDM data in a lost packet (from 0 through 255).
   - **jitter-buffer-auto-adjust**—Automatically adjust the jitter buffer.

     NOTE: **The jitter-buffer-auto-adjust option is not applicable on MX Series routers.**
   - **jitter-buffer-latency**—Time delay in the jitter buffer (from 1 through 1000 milliseconds).
   - **jitter-buffer-packets**—Number of packets in the jitter buffer (from 1 through 64 packets).
   - **payload-size**—Configure the payload size, in bytes (from 32 through 1024 bytes).

     NOTE: **In this section, we are configuring only one SAToP option. You can follow the same method to configure all the other SAToP options.**

   ```
   [edit interfaces e1-1/0/0 satop-options]
   user@host# set excessive-packet-loss-rate sample-period sample-period
   ```

   For example:

   ```
   [edit interfaces e1-1/0/0 satop-options]
   user@host# set excessive-packet-loss-rate sample-period 4000
   ```

To verify this configuration, use the **show** command at the **[edit interfaces e1-1/0/0]** hierarchy level:

```
[edit interfaces e1-1/0/0]
user@host# show
satop-options {
  excessive-packet-loss-rate {
    sample-period 4000;
  }
}
```

Related Documentation

- satop-options on page 132

CHAPTER 4

Configuring SAToP Support on Circuit Emulation MICs

Configuring SAToP on 16-Port Channelized E1/T1 Circuit Emulation MIC

The following sections describes configuring SAToP on the 16-Port Channelized E1/T1 Circuit Emulation MIC (MIC-3D-16CHE1-T1-CE).

Configuring T1/E1 Framing Mode at the MIC Level

To configure the framing emulation mode at the MIC level.

1. Go to the **[edit chassis fpc *fpc-slot* pic *pic-slot*]** hierarchy level.

   ```
   [edit]
   [edit chassis fpc fpc-slot pic pic-slot]
   ```

2. Configure the framing emulation mode as E1 or T1.

   ```
   [edit chassis fpc fpc-slot pic pic-slot]
   user@host# set framing (t1 | e1)
   ```

After a MIC is brought online, interfaces are created for the MIC's available ports on the basis of the MIC type and the framing option used:

- If you include the **framing t1** statement, 16 channelized T1 (CT1) interfaces are created.
- If you include the **framing e1** statement, 16 channelized E1 (CE1) interfaces are created.

NOTE: If you set the framing option incorrectly for the MIC type, the commit operation fails.

By default, t1 framing mode is selected.

Circuit Emulation PICs with SONET and SDH ports require prior channelization down to T1 or E1 before you can configure them. Only T1/E1 channels support SAToP encapsulation or SAToP options.

Bit error rate test (BERT) patterns with all binary 1s (ones) received by CT1/CE1 interfaces on Circuit Emulation MICs configured for SAToP do not result in an alarm indication signal (AIS) defect. As a result, the CT1/CE1 interfaces remain up.

Configuring CT1 Ports Down to T1 Channels

To configure a CT1 port down to a T1 channel, use the following procedure:

NOTE: To configure a CE1 port down to the E1 channel, replace ct1 with ce1 and t1 with e1 in the procedure.

1. In configuration mode, go to the **[edit interfaces ct1-*mpc-slot/mic-slot/port-number*]** hierarchy level.

   ```
   [edit]
   user@host# edit interfaces ct1-mpc-slot/mic-slot/port-number
   ```

   For example:

   ```
   [edit]
   user@host# edit interfaces ct1-1/0/0
   ```

2. On the CT1 interface, set the **no-partition** option and then set the interface type as T1.

   ```
   [edit interfaces ct1-mpc-slot/mic-slot/port-number]
   user@host# set no-partition interface-type t1
   ```

   In the following example, the ct1-1/0/1 interface is configured to be of type T1 and to have no partitions.

   ```
   [edit interfaces ct1-1/0/1]
   user@host# set no-partition interface-type t1
   ```

Configuring CT1 Ports Down to DS Channels

To configure a channelized T1 (CT1) port down to a DS channel, include the **partition** statement at the **[edit interfaces ct1-*mpc-slot/mic-slot/port-number*]** hierarchy level:

NOTE: To configure a CE1 port down to a DS channel, replace ct1 with ce1 in the following procedure.

1. In configuration mode, go to the **[edit interfaces ct1-*mpc-slot/mic-slot/port-number*]** hierarchy level.

   ```
   [edit]
   user@host# edit interfaces ct1-mpc-slot/mic-slot/port-number
   ```

   For example:

   ```
   [edit]
   user@host# edit interfaces ct1-1/0/0
   ```

2. Configure the partition, the time slot, and the interface type.

   ```
   [edit interfaces ct1-mpc-slot/mic-slot/port-number]
   user@host# set partition partition-number timeslots timeslots interface-type ds
   ```

   In the following example, the ct1-1/0/0 interface is configured as a DS interface with one partition and three time slots:

   ```
   [edit interfaces ct1-1/0/0]
   user@host# set partition 1 timeslots 1-4,9,22-24 interface-type ds
   ```

To verify the configuration of the ct1-1/0/0 interface, use the **show** command at the **[edit interfaces ct1-1/0/0]** hierarchy level.

```
[edit interfaces ct1-1/0/0]
user@host# show
partition 1 timeslots 1-4,9,22-24 interface-type ds;
```

An *N*xDS0 interface can be configured from channelized T1 interface. Here *N* represents the time slots on the CT1 interface. The value of *N* is:

- 1 through 24 when a DS0 interface is configured from a CT1 interface.
- 1 through 31 when a DS0 interface is configured from a CE1 interface.

After you partition the DS interface, configure the SAToP options on it. See "Setting the SAToP Options" on page 27.

Related Documentation

- Understanding Circuit Emulation Services and the Supported PIC Types on page 3
- Setting the SAToP Options on page 27

Configuring SAToP Encapsulation on T1/E1 Interfaces

This configuration applies to the mobile backhaul application shown in Figure 3 on page 14.

This topic includes the following tasks:

Setting the Encapsulation Mode

E1 channels on Circuit Emulation MICs can be configured with SAToP encapsulation at the provider edge (PE) router, as follows:

NOTE: **The following procedure can be used to configure T1 channels on Circuit Emulation MICs with SAToP encapsulation at the PE router.**

1. In configuration mode, go to the **[edit interfaces e1-*fpc-slot/pic-slot/port*]** hierarchy level.

   ```
   [edit]
   user@host# edit interfaces e1-fpc-slot/pic-slot/port
   ```

   For example:

   ```
   [edit]
   user@host# edit interfaces e1-1/0/0
   ```

2. Configure the SAToP encapsulation and the logical interface for E1 interface.

   ```
   [edit interfaces e1-1/0/0]
   user@host# set encapsulation satop unit interface-unit-number
   ```

   For example:

   ```
   [edit interfaces e1-1/0/0]
   user@host# set encapsulation satop unit 0
   ```

You do not need to configure any cross-connect circuit family because it is automatically created for the SAToP encapsulation.

T1/E1 Loopback Support

Use the CLI to configure remote and local loopback as T1 (CT1) or E1 (CE1). By default, no loopback is configured. See *Configuring T1 Loopback Capability* and *Configuring E1 Loopback Capability*.

T1 FDL Support

If T1 is used for SAToP, the T1 facility data-link (FDL) loop is *not* supported on the CT1 interface device because SAToP does not analyze T1 framing bits.

Setting the SAToP Options

To configure SAToP options on T1/E1 interfaces:

1. In configuration mode, go to the **[edit interfaces e1-*fpc-slot/pic-slot/port*]** hierarchy level.

   ```
   [edit]
   user@host# edit interfaces e1-fpc-slot/pic-slot/port
   ```

   For example:

   ```
   [edit]
   user@host# edit interfaces e1-1/0/0
   ```

2. Use the **edit** command to go to the **satop-options** hierarchy level.

   ```
   [edit]
   user@host# edit satop-options
   ```

3. In this hierarchy level, using the **set** command you can configure the following SAToP options:

   - **excessive-packet-loss-rate**—Set packet loss options. The options are **groups**, **sample-period**, and **threshold**.
     - **groups**—Specify groups.
     - **sample-period**—Time required to calculate excessive packet loss rate (from 1000 through 65,535 milliseconds).
     - **threshold**—Percentile designating the threshold of excessive packet loss rate (1–100 percent).
   - **idle-pattern**—An 8-bit hexadecimal pattern to replace TDM data in a lost packet (from 0 through 255).
   - **jitter-buffer-auto-adjust**—Automatically adjust the jitter buffer.

     NOTE: **The jitter-buffer-auto-adjust option is not applicable on MX Series routers.**

   - **jitter-buffer-latency**—Time delay in the jitter buffer (from 1 through 1000 milliseconds).
   - **jitter-buffer-packets**—Number of packets in the jitter buffer (from 1 through 64 packets).
   - **payload-size**—Configure the payload size, in bytes (from 32 through 1024 bytes).

NOTE: In this section, we are configuring only one SAToP option. You can follow the same method to configure all the other SAToP options.

```
[edit interfaces e1-1/0/0 satop-options]
user@host# set excessive-packet-loss-rate sample-period sample-period
```

For example:

```
[edit interfaces e1-1/0/0 satop-options]
user@host# set excessive-packet-loss-rate sample-period 4000
```

To verify this configuration, use the **show** command at the **[edit interfaces e1-1/0/0]** hierarchy level:

```
[edit interfaces e1-1/0/0]
user@host# show
satop-options {
  excessive-packet-loss-rate {
    sample-period 4000;
  }
}
```

See Also

- satop-options on page 132

Configuring the Pseudowire Interface

To configure the TDM pseudowire at the provider edge (PE) router, use the existing Layer 2 circuit infrastructure, as shown in the following procedure:

1. In configuration mode, go to the **[edit protocols l2circuit]** hierarchy level.

   ```
   [edit]
   user@host# edit protocol l2circuit
   ```

2. Configure the IP address of the neighboring router or switch, the interface forming the Layer 2 circuit, and the identifier for the Layer 2 circuit.

   ```
   [edit protocol l2circuit]
   user@host# set neighbor ip-address interface
     interface-name-fpc-slot/pic-slot/port.interface-unit-number virtual-circuit-id
     virtual-circuit-id
   ```

   NOTE: To configure the T1 interface as the Layer 2 circuit, replace e1 with t1 in the configuration statement.

   For example:

   ```
   [edit protocol l2circuit]
   user@host# set neighbor 10.255.0.6 interface e1-1/0/0.0 virtual-circuit-id 1
   ```

3. To verify this configuration, use the **show** command at the **[edit protocols l2circuit]** hierarchy level.

```
[edit protocols l2circuit]
user@host# show
neighbor 10.255.0.6 {
   interface e1-1/0/0.0 {
      virtual-circuit-id 1;
   }
}
```

After the customer edge (CE)-bound interfaces (for both PE routers) are configured with proper encapsulation, payload size, and other parameters, the two PE routers try to establish a pseudowire with Pseudowire Emulation Edge-to-Edge (PWE3) signaling extensions. The following pseudowire interface configurations are disabled or ignored for TDM pseudowires:

- **ignore-encapsulation**
- **mtu**

The supported pseudowire types are:

- 0x0011 Structure-Agnostic E1 over Packet
- 0x0012 Structure-Agnostic T1 (DS1) over Packet

When the local interface parameters match the received parameters, and the pseudowire type and control word bit are equal, the pseudowire is established.

For detailed information about configuring TDM pseudowire, see the *Junos OS VPNs Library for Routing Devices*.

For detailed information about MICs, see the *PIC Guide* for your router.

Related Documentation

- Understanding Mobile Backhaul on page 13

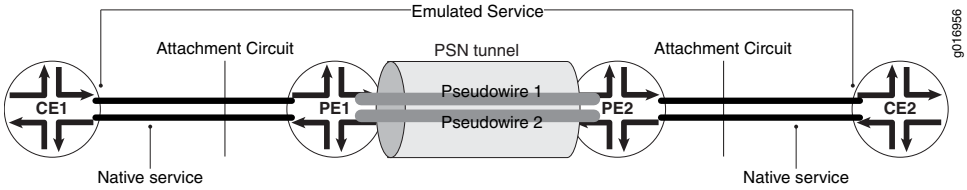
SAToP Emulation on T1 and E1 Interfaces Overview

Structure-Agnostic time-division multiplexing (TDM) over Packet (SAToP), as defined in RFC 4553, *Structure-Agnostic TDM over Packet (SAToP)* is supported on the ACX Series Universal Metro routers with built-in T1 and E1 interfaces. SAToP is used for pseudowire encapsulation for TDM bits (T1, E1). The encapsulation disregards any structure imposed on the T1 and E1 streams, in particular the structure imposed by standard TDM framing. SAToP is used over packet-switched networks, where the provider edge (PE) routers do not need to interpret TDM data or participate in the TDM signaling.

NOTE: ACX5048 and ACX5096 routers do not support SAToP.

Figure 5 on page 40 shows a packet-switched network (PSN) in which two PE routers (PE1 and PE2) provide one or more pseudowires to customer edge (CE) routers (CE1 and CE2), establishing a PSN tunnel to provide a data path for the pseudowire.

Figure 5: Pseudowire Encapsulation with SAToP



Pseudowire traffic is invisible to the core network, and the core network is transparent to the CEs. Native data units (bits, cells, or packets) arrive via the attachment circuit, are encapsulated in a pseudowire protocol data unit (PDU), and carried across the underlying network via the PSN tunnel. The PEs perform the necessary encapsulation and the decapsulation of the pseudowire PDUs and handle any other function required by the pseudowire service, such as sequencing or timing.

Related Documentation

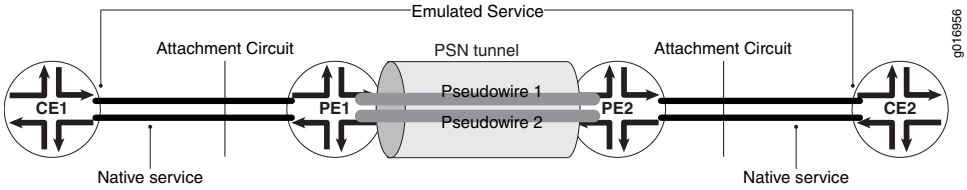
- Configuring SAToP Emulation on Channelized T1 and E1 Interfaces on page 40

Configuring SAToP Emulation on Channelized T1 and E1 Interfaces

This configuration is the base configuration of SAToP on an ACX Series router as described in RFC 4553, *Structure-Agnostic Time Division Multiplexing (TDM) over Packet (SAToP)*. When you configure SAToP on built-in channelized T1 and E1 interfaces, the configuration results in a pseudowire that acts as a transport mechanism for the T1 and E1 circuit signals across a packet-switched network.

The network between the customer edge (CE) routers appears transparent to the CE routers, making it seem that the CE routers are directly connected. With the SAToP configuration on the provider edge (PE) router's T1 and E1 interfaces, the interworking function (IWF) forms a payload (frame) that contains the CE router's T1 and E1 Layer 1 data and control word. This data is transported to the remote PE over the pseudowire. The remote PE removes all the Layer 2 and MPLS headers added in the network cloud and forwards the control word and the Layer 1 data to the remote IWF, which in turn forwards the data to the remote CE.

Figure 6: Pseudowire Encapsulation with SAToP



In Figure 6 on page 40 the Provider Edge (PE) router represents the ACX Series router that is being configured in these steps. The result of these steps is the pseudowire from PE1 to PE2. Topics include:

- Setting the T1/E1 Emulation Mode on page 41
- Configuring One Full T1 or E1 Interface on Channelized T1 and E1 Interfaces on page 42
- Setting the SAToP Encapsulation Mode on page 45
- Configure the Layer 2 Circuit on page 45

Setting the T1/E1 Emulation Mode

Emulation is a mechanism that duplicates the essential attributes of a service (such as T1 or E1) over a packet-switched network. You set the emulation mode so that the built-in channelized T1 and E1 interfaces on the ACX Series router can be configured to work in either T1 or E1 mode. This configuration is at the PIC level, so all ports operate as either T1 interfaces or E1 interfaces. A mix of T1 and E1 interfaces is not supported. By default all the ports operate as T1 interfaces.

- Configure the emulation mode:

  [edit chassis fpc *fpc-slot* pic *pic-slot*]
  user@host# **set framing (t1 | e1)**

  For example:

  [edit chassis fpc 0 pic 0]
  user@host# **set framing t1**

  After a PIC is brought online and depending on the framing option used (**t1** or **e1**), on the ACX2000 router, 16 CT1 or 16 CE1 interfaces are created, and on the ACX1000 router, 8 CT1 or 8 CE1 interfaces are created.

  The following output shows this configuration:

```
user@host# show chassis
fpc 0 {
    pic 0 {
        framing t1;
    }
}
```

  The following output from the **show interfaces terse** command shows the 16 CT1 interfaces created with the framing configuration.

```
user@host# run show interfaces terse
Interface               Admin Link Proto    Local                 Remote
ct1-0/0/0               up    down
ct1-0/0/1               up    down
ct1-0/0/2               up    down
ct1-0/0/3               up    down
ct1-0/0/4               up    down
ct1-0/0/5               up    down
ct1-0/0/6               up    down
ct1-0/0/7               up    down
ct1-0/0/8               up    down
ct1-0/0/9               up    down
```

```
ct1-0/0/10              up    down
ct1-0/0/11              up    down
ct1-0/0/12              up    down
ct1-0/0/13              up    down
ct1-0/0/14              up    down
ct1-0/0/15              up    down
```

NOTE: If you set the framing option incorrectly for the PIC type, the commit operation fails.

If you change the mode, the router will reboot the built-in T1 and E1 interfaces.

Bit error rate test (BERT) patterns with all ones received by T1 and E1 interfaces configured for SAToP do not result in an alarm indication signal (AIS) defect. As a result, the T1 and E1 interfaces remain up.

See Also

- SAToP Emulation on T1 and E1 Interfaces Overview on page 39
- *Obsolete: Inverse Multiplexing for ATM (IMA) Overview*

Configuring One Full T1 or E1 Interface on Channelized T1 and E1 Interfaces

You must configure a child T1 or E1 interface on the built-in channelized T1 or E1 interface created because the channelized interface is not a configurable interface and SAToP encapsulation must be configured (in the next step) for the pseudowire to function. The following configuration creates one full T1 interface on the channelized **ct1** interface. You can follow the same process to create one E1 interface on the channelized **ce1** interface.

- Configure one full T1/E1 interface:

  [edit interfaces ct1-*fpc/pic /port*]
  user@host# **set no-partition interface-type (t1 | e1)**

  For example:

  [edit interfaces ct1-0/0/0
  user@host# **set no-partition interface-type t1**

  The following output shows this configuration:

```
[edit]
user@host# show interfaces
ct1-0/0/0 {
    no-partition interface-type t1;
}
```

The preceding command creates the **t1-0/0/0** interface on the channelized **ct1-0/0/0** interface. Check the configuration with the **show interfaces *interface-name* extensive** command. Run the command to display output for the channelized interface and the newly created T1 or E1interface. The following output provides an example of the output

for a CT1 interface and the T1 interface created from the preceding example configuration. Notice that **ct1-0/0/0** is running at T1 speed and that the media is T1.

```
user@host> show interfaces ct1-0/0/0 extensive
Physical interface: ct1-0/0/0, Enabled, Physical link is Up
  Interface index: 152, SNMP ifIndex: 780, Generation: 1294
  Link-level type: Controller, Clocking: Internal, Speed: T1, Loopback: None,
Framing: ESF, Parent: None
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps Internal: 0x0
  Link flags     : None
  Hold-times     : Up 0 ms, Down 0 ms
  CoS queues     : 8 supported, 4 maximum usable queues
  Last flapped   : 2012-04-03 06:27:55 PDT (00:13:32 ago)
  Statistics last cleared: 2012-04-03 06:40:34 PDT (00:00:53 ago)
  DS1   alarms   : None
  DS1   defects  : None
  T1 media:            Seconds        Count  State
    SEF                          0            0  OK
    BEE                          0            0  OK
    AIS                          0            0  OK
    LOF                          0            0  OK
    LOS                          0            0  OK
    YELLOW                       0            0  OK
    CRC Major                    0            0  OK
    CRC Minor                    0            0  OK
    BPV                          0            0
    EXZ                          0            0
    LCV                          0            0
    PCV                          0            0
    CS                           0            0
    CRC                          0            0
    LES                          0
    ES                           0
    SES                          0
    SEFS                         0
    BES                          0
    UAS                          0
    Line encoding: B8ZS
    Buildout       : 0 to 132 feet
  DS1 BERT configuration:
    BERT time period: 10 seconds, Elapsed: 0 seconds
    Induced Error rate: 0, Algorithm: 2^15 - 1, O.151, Pseudorandom (9)
  Packet Forwarding Engine configuration:
    Destination slot: 0 (0x00)
```

In the following output for the T1 interface, the parent interface is shown as **ct1-0/0/0** and the link level type and encapsulation are **TDM-CCC-SATOP**.

```
user@host> show interfaces t1-0/0/0 extensive
Physical interface: t1-0/0/0, Enabled, Physical link is Up
  Interface index: 160, SNMP ifIndex: 788, Generation: 1302
  Link-level type: TDM-CCC-SATOP, MTU: 1504, Speed: T1, Loopback: None, FCS:
16, Parent: ct1-0/0/0 Interface index 152
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps Internal: 0x0
  Link flags     : None
  Hold-times     : Up 0 ms, Down 0 ms
  CoS queues     : 8 supported, 4 maximum usable queues
```

```
  Last flapped   : 2012-04-03 06:28:43 PDT (00:01:16 ago)
  Statistics last cleared: 2012-04-03 06:29:58 PDT (00:00:01 ago)
  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
  DS1   alarms   : None
  DS1   defects  : None
  SAToP configuration:
    Payload size: 192
    Idle pattern: 0xFF
    Octet aligned: Disabled
    Jitter buffer: packets: 8, latency: 7 ms, auto adjust: Disabled
    Excessive packet loss rate: sample period: 10000 ms, threshold: 30%
  Packet Forwarding Engine configuration:
    Destination slot: 0
  CoS information:
    Direction : Output
    CoS transmit queue               Bandwidth               Buffer Priority
Limit
                              %           bps     %           usec
    0 best-effort            95       1459200    95              0      low
none
    3 network-control         5         76800     5              0      low
none

  Logical interface t1-0/0/0.0 (Index 308) (SNMP ifIndex 789) (Generation 11238)

    Flags: Point-To-Point SNMP-Traps Encapsulation: TDM-CCC-SATOP
  CE info               Packets        Bytes  Count
    CE Tx                     0            0
    CE Rx                     0            0
    CE Rx Forwarded                        0
    CE Strayed                0
    CE Lost                   0
    CE Malformed              0
    CE Misinserted            0
    CE AIS dropped            0
    CE Dropped                0            0
    CE Overrun Events                         0
    CE Underrun Events                        0
    Protocol ccc, MTU: 1504, Generation: 13130, Route table: 0
```

Setting the SAToP Encapsulation Mode

The built-in T1 and E1 interfaces must be configured with SAToP encapsulation at the PE router so that the interworking function (IWF) can segment and encapsulate TDM signals into SAToP packets, and in the reverse direction, to decapsulate the SAToP packets and reconstitute them into TDM signals.

1. On the PE router, configure SAToP encapsulation on the physical interface:

   [edit interfaces (t1 | e1)–*fpc/pic /port*]
   user@host# **set encapsulation satop**

   For example:

   [edit interfaces t1-0/0/0
   user@host# **set encapsulation satop**

2. On the PE router, configure the logical interface:

   [edit interfaces]
   user@host# **set (t1 | e1)–*fpc/pic/port* unit *logical-unit-number***

   For example:

   [edit interfaces]
   user@host# **set t1-0/0/0 unit 0**

   It is not necessary to configure the circuit cross-connect (CCC) family because it is automatically created for the preceding encapsulation. The following output shows this configuration.

```
[edit interfaces]
user@host# show t1-0/0/0
encapsulation satop;
unit 0;
```

Configure the Layer 2 Circuit

When you configure the Layer 2 circuit, you designate the neighbor for the provider edge (PE) router. Each Layer 2 circuit is represented by the logical interface connecting the local PE router to the local customer edge (CE) router. All the Layer 2 circuits that use a particular remote PE router, designated for remote CE routers, are listed under the **neighbor** statement. Each neighbor is identified by its IP address and is usually the end-point destination for the label-switched path (LSP) tunnel that transports the Layer 2 circuit. Configure the Layer 2 circuit:

- [edit protocols l2circuit neighbor *address*]
  user@host# **set interface *interface-name* virtual-circuit-id *identifier***

  For example, for a T1 interface:

  [edit protocols l2circuit neighbor 2.2.2.2
  user@host# **set interface t1-0/0/0.0 virtual-circuit-id 1**

The preceding configuration is for a T1 interface. To configure an E1 interface, use the E1 interface parameters. The following output shows this configuration.

```
[edit protocols l2circuit]
user@host# show neighbor 2.2.2.2
interface t1-0/0/0.0 {
    virtual-circuit-id 1;
}
```

See Also

- *Configuring Interfaces for Layer 2 Circuits Overview*
- *Enabling the Layer 2 Circuit When the MTU Does Not Match*

CHAPTER 5

Configuring CESoPSN Support on Circuit Emulation MIC

TDM CESoPSN Overview

Circuit Emulation Service over Packet-Switched Network (CESoPSN) is an encapsulation layer intended to carry *Nx*DS0 services over a packet-switched network (PSN). CESoPSN enables pseudowire emulation of some properties of structure-aware time division multiplexed (TDM) networks.

Particularly, CESoPSN enables the deployment of bandwidth-saving fractional point-to-point E1 or T1 applications as follows:

- A pair of customer edge (CE) devices operate as though they were connected by an emulated E1 or T1 circuit, which reacts to the alarm indication signal (AIS) and remote alarm indication (RAI) states of the devices' local attachment circuits.
- The PSN carries only an *Nx*DS0 service, where *N* is the number of actually used time slots in the circuit connecting the pair of CE devices, thus saving bandwidth.

Related Documentation

- Configuring TDM CESoPSN on ACX Series Routers Overview on page 48
- *Configuring CESoPSN Encapsulation on DS Interfaces*
- Configuring CE1 Channels Down to DS Interfaces on page 66

Configuring TDM CESoPSN on ACX Series Routers Overview

Structure-aware time division multiplexed (TDM) Circuit Emulation Service over Packet-Switched Network (CESoPSN) is a method of encapsulating TDM signals into CESoPSN packets, and in the reverse direction, decapsulating CESoPSN packets back into TDM signals. This method is also termed as *Interworking Function* (IWF). The following CESoPSN features are supported on Juniper Networks ACX Series Universal Metro Routers:

Channelization up to the DS0 Level

The following numbers of *Nx*DS0 pseudowires are supported for 16 T1 and E1 built-in ports and 8 T1 and E1 built-in ports, where *N* represents the time slots on the T1 and E1 built-in ports.

16 T1 and E1 built-in ports support the following number of pseudowires:

- Each T1 port can have up to 24 *Nx*DS0 pseudowires, which add up to a total of up to 384 *Nx*DS0 pseudowires.
- Each E1 port can have up to 31 *Nx*DS0 pseudowires, which add up to a total of up to 496 *Nx*DS0 pseudowires.

8 T1 and E1 built-in ports support the following number of pseudowires:

- Each T1 port can have up to 24 *Nx*DS0 pseudowires, which add up to a total of up to 192 *Nx*DS0 pseudowires.
- Each E1 port can have up to 31 *Nx*DS0 pseudowires, which add up to a total of up to 248 *Nx*DS0 pseudowires.

Protocol Support

All protocols that support Structure-Agnostic TDM over Packet (SAToP) support CESoPSN *Nx*DS0 interfaces.

Packet Latency

The time required to create packets (from 1000 through 8000 microseconds).

CESoPSN Encapsulation

The following statements are supported at the [**edit interfaces** *interface-name*] hierarchy level:

- **ct1-***x/y/z* **partition** *partition-number* **timeslots** *timeslots* **interface-type ds**
- **ds-***x/y/z:n* **encapsulation cesopsn**

CESoPSN Options

The following statements are supported at the [**edit interfaces** *interface-name* **cesopsn-options**] hierarchy level:

- **excessive-packet-loss-rate** (**sample-period** *milliseconds*)
- **idle-pattern** *pattern*
- **jitter-buffer-latency** *milliseconds*
- **jitter-buffer-packets** *packets*
- **packetization-latency** *microseconds*

show Commands

The **show interfaces** *interface-name* **extensive** command is supported for **t1**, **e1**, and **at** interfaces.

CESoPSN Pseudowires

CESoPSN pseudowires are configured on the logical interface, not on the physical interface. So the **unit** *logical-unit-number* statement must be included in the configuration at the [**edit interfaces** *interface-name*] hierarchy level. When you include the **unit** *logical-unit-number* statement, circuit cross-connect (CCC) for the logical interface is created automatically.

Related Documentation

- Setting the CESoPSN Options on page 51

Configuring CESoPSN on Channelized E1/T1 Circuit Emulation MIC

To configure Circuit Emulation Service over Packet-Switched Network (CESoPSN) protocol on a 16-port Channelized E1/T1 Circuit Emulation MIC (MIC-3D-16CHE1-T1-CE), you must configure the framing mode, configure CT1 interface down to DS channels, and configure the CESoPSN encapsulation on DS interfaces.

- Configuring T1/E1 Framing Mode at the MIC Level on page 50
- Configuring CT1 Interface Down to DS Channels on page 50
- Setting the CESoPSN Options on page 51
- Configuring CESoPSN on DS Interfaces on page 52

Configuring T1/E1 Framing Mode at the MIC Level

To set the framing mode at the MIC (MIC-3D-16CHE1-T1-CE) level, for all four ports on the MIC, include the **framing** statement at the **[edit chassis fpc *slot* pic *slot*]** hierarchy level.

```
[edit chassis fpc slot pic slot]
user@host# set framing (t1 | e1);
```

After a MIC is brought online, interfaces are created for the MIC's available ports on the basis of the MIC type and the framing option used.

- If you include the **framing t1** statement, 16 CT1 interfaces are created.
- If you include the **framing e1** statement, 16 CE1 interfaces are created.

NOTE: If you set the framing option incorrectly for the MIC type, the commit operation fails.

Bit error rate test (BERT) patterns with all binary 1s (ones) received by CT1/CE1 interfaces on Circuit Emulation MICs configured for CESoPSN do not result in an alarm indication signal (AIS) defect. As a result, the CT1/CE1 interfaces remain up.

Configuring CT1 Interface Down to DS Channels

To configure a channelized T1 (CT1) interface down to DS channels, include the **partition** statement at the **[edit interfaces ct1-*mpc-slot/mic-slot/port-number*]** hierarchy level:

NOTE: To configure a CE1 interface down to DS channels, replace **ct1** with **ce1** in the following procedure.

1. In configuration mode, go to the **[edit interfaces ct1-*mpc-slot/mic-slot/port-number*]** hierarchy level.

   ```
   [edit]
   user@host# edit interfaces ct1-mpc-slot/mic-slot/port-number
   ```

   For example:

   ```
   [edit]
   user@host# edit interfaces ct1-1/0/0
   ```

2. Configure the sublevel interface partition index and the time slots, and set the interface type as **ds**.

   ```
   [edit interfaces ct1-mpc-slot/mic-slot/port-number]
   user@host# set partition partition-number timeslots timeslots interface-type ds
   ```

For example:

```
[edit interfaces ct1-1/0/0]
user@host# set partition 1 timeslots 1-4 interface-type ds
```

NOTE: You can assign multiple time slots on a CT1 interface. In the **set** command, separate the time slots by commas and do not include spaces between them. For example:

```
[edit interfaces ct1-1/0/0]
user@host# set partition 1 timeslots 1-4,9,22-24 interface-type ds
```

To verify this configuration, use the **show** command at the **[edit interfaces ct1-1/0/0]** hierarchy level.

```
[edit interfaces ct1-1/0/0]
user@host# show
partition 1 timeslots 1-4 interface-type ds;
```

An *N*xDS0 interface can be configured from a CT1 interface. Here *N* represents the number of time slots on the CT1 interface. The value of *N* is:

- 1 through 24 when a DS0 interface is configured from a CT1 interface.
- 1 through 31 when a DS0 interface is configured from a CE1 interface.

After you partition the DS interface, configure CESoPSN options on it.

Setting the CESoPSN Options

To configure CESoPSN options:

1. In configuration mode, go to the **[edit interfaces ds-*fpc-slot/pic-slot/port*:*channel*]** hierarchy level.

   ```
   [edit]
   user@host# edit interfaces ds-fpc-slot/pic-slot/port:channel
   ```

   For example:

   ```
   [edit]
   user@host# edit interfaces ds-1/0/0:1:1:1
   ```

2. Use the **edit** command to go to the **[edit cesopsn-options]** hierarchy level.

   ```
   [edit interfaces ds-fpc-slot/pic-slot/port:channel]
   user@host# edit cesopsn-options
   ```

3. Configure the following CESoPSN options:

NOTE: When you stitch pseudowires by using interworking (iw) interfaces, the device stitching the pseudowire cannot interpret the characteristics of the circuit because the circuits originate and terminate in other nodes. To negotiate between the stitching point and circuit endpoints, you need to configure the following options.

- **excessive-packet-loss-rate**—Set packet loss options. The options are **sample-period** and **threshold**.

  ```
  [edit interfaces ds-fpc-slot/pic-slot/port:channel cesopsn-options]
  user@host# set excessive-packet-loss-rate sample-period sample-period
  ```

- **idle-pattern**—An 8-bit hexadecimal pattern to replace TDM data in a lost packet (from 0 through 255).
- **jitter-buffer-latency**—Time delay in the jitter buffer (from 1 through 1000 milliseconds).
- **jitter-buffer-packets**—Number of packets in the jitter buffer (from 1 through 64 packets).
- **packetization-latency**—Time required to create packets (from 1000 through 8000 microseconds).
- **payload-size**—Payload size for virtual circuits that terminate on Layer 2 interworking (iw) logical interfaces (from 32 through 1024 bytes).

To verify the configuration using the values shown in the examples, use the **show** command at the **[edit interfaces ds-1/0/0:1:1:1]** hierarchy level:

```
[edit interfaces ds-1/0/0:1:1:1]
user@host# show
cesopsn-options {
   excessive-packet-loss-rate {
      sample-period 4000;
   }
}
```

See Also

- Setting the Encapsulation Mode on page 63
- Configuring the Pseudowire Interface on page 65

Configuring CESoPSN on DS Interfaces

To configure CESoPSN encapsulation on a DS interface, include the **encapsulation** statement at the **[edit interfaces ds-*mpc-slot/mic-slot/port-number:channel*]** hierarchy level.

1. In configuration mode, go to the **[edit interfaces ds-*mpc-slot/mic-slot/port-number:channel*]** hierarchy level.

   ```
   [edit]
   user@host# edit interfaces ds-mpc-slot/mic-slot/ port-number:channel
   ```

For example:

```
[edit]
user@host# edit interfaces ds-1/0/0:1
```

2. Configure CESoPSN as the encapsulation type.

```
[edit interfaces ds-mpc-slot/mic-slot/port-number:partition ]
user@host# set encapsulation cesopsn
```

For example:

```
[edit interfaces ds-1/0/0:1 ]
user@host# set encapsulation cesopsn
```

3. Configure the logical interface for the DS interface.

```
[edit interfaces ds-mpc-slot/mic-slot/port-number:partition ]
uset@host# set unit interface-unit-number
```

For example:

```
[edit interfaces ds-1/0/0:1 ]
user@host# set unit 0
```

To verify this configuration, use the **show** command at the **[edit interfaces ds-1/0/0:1]** hierarchy level.

```
[edit interfaces ds-1/0/0:1]
user@host# show
encapsulation cesopsn;
unit 0;
```

Related Documentation

- Understanding Circuit Emulation Services and the Supported PIC Types on page 3

Configuring CESoPSN on Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP

To configure CESoPSN options on a Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP, you must configure the speed and framing mode at MIC level and configure the encapsulation as CESoPSN on DS interfaces.

- Configuring SONET/SDH Rate-Selectability on page 53
- Configuring SONET/SDH Framing Mode at the MIC Level on page 54
- Configuring CESoPSN Encapsulation on DS Interfaces on CT1 Channels on page 55
- Configuring CESoPSN Encapsulation on DS Interfaces on CE1 Channels on page 58

Configuring SONET/SDH Rate-Selectability

You can configure rate-selectability on the Channelized OC3/STM1 (Multi-Rate) MICs with SFP(MIC-3D-4COC3-1COC12-CE) by specifying the port speed. The Channelized

OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP is rate-selectable and its port speed can be specified as COC3-CSTM1 or COC12-CSTM4.

To configure port speed to select a speed option of **coc3-cstm1** or **coc12-cstm4**:

1. In configuration mode, go to the **[edit chassis fpc *slot* pic *slot* port *slot*]** hierarchy level.

   ```
   [edit]
   user@host# edit chassis fpc slot pic slot port slot
   ```

   For example:

   ```
   [edit]
   user@host# edit chassis fpc 1 pic 0 port 0
   ```

2. Set the speed as **coc3-cstm1** or **coc12-cstm4**.

   ```
   [edit chassis fpc slot pic slot port slot]
   user@host# set speed (coc3-cstm1 | coc12-cstm4)
   ```

   For example:

   ```
   [edit chassis fpc 1 pic 0 port 0]
   user@host# set speed coc3-cstm1
   ```

NOTE: When the speed is set as **coc12-cstm4**, instead of configuring COC3 ports down to T1 channels and CSTM1 ports down to E1 channels, you must configure COC12 ports down to T1 channels and CSTM4 channels down to E1 channels.

Configuring SONET/SDH Framing Mode at the MIC Level

To set the framing mode at the MIC (MIC-3D-4COC3-1COC12-CE) level, for all four ports on the MIC, include the **framing** statement at the **[edit chassis fpc *slot* pic *slot*]** hierarchy level.

```
[edit chassis fpc slot pic slot]
user@host# set framing (sonet | sdh) # SONET for COC3/COC12 or SDH for CSTM1/CSTM4
```

After a MIC is brought online, interfaces are created for the MIC's available ports on the basis of the MIC type and the framing option used.

- If you include the **framing sonet** statement, four COC3 interfaces are created when the speed is configured as **coc3-cstm1**.
- If you include the **framing sdh** statement, four CSTM1 interfaces are created when the speed is configured as **coc3-cstm1**.
- If you include the **framing sonet** statement, one COC12 interface is created when the speed is configured as **coc12-cstm4**.

- If you include the **framing sdh** statement, one CSTM4 interface is created when the speed is configured as **coc12-cstm4**.
- If you do not specify framing at the MIC level, then the default framing is SONET for all the ports.

NOTE: If you set the framing option incorrectly for the MIC type, the commit operation fails.

Bit error rate test (BERT) patterns with all binary 1s (ones) received by CT1/CE1 interfaces on Circuit Emulation MICs configured for CESoPSN do not result in an alarm indication signal (AIS) defect. As a result, the CT1/CE1 interfaces remain up.

Configuring CESoPSN Encapsulation on DS Interfaces on CT1 Channels

This topic includes the following tasks:

1. Configuring COC3 Ports Down to CT1 Channels on page 55
2. Configuring CT1 Channels Down to DS Interfaces on page 56
3. Configuring CESoPSN on DS Interfaces on page 57

Configuring COC3 Ports Down to CT1 Channels

When configuring COC3 ports down to CT1 channels, on any MIC configured for SONET framing (numbered 0 through 3), you can configure three COC1 channels (numbered 1 through 3). On each COC1 channel, you can configure a maximum of 28 CT1 channels and a minimum of 1 CT1 channel based on the time slots.

When configuring COC12 ports down to CT1 channels on a MIC configured for SONET framing, you can configure 12 COC1 channels (numbered 1 through 12). On each COC1 channel, you can configure 24 CT1 channels (numbered 1 through 28).

To configure COC3 channelization down to COC1 and then down to CT1 channels, include the **partition** statement at the **[edit interfaces (coc1 | coc3)-*mpc-slot/mic-slot/port-number*]** hierarchy level:

NOTE: To configure COC12 ports down to CT1 channels, replace coc3 with coc12 in the following procedure.

1. In configuration mode, go to the **[edit interfaces coc3-*mpc-slot/mic-slot/port-number*]** hierarchy level.

   ```
   [edit]
   user@host# edit interfaces coc3-mpc-slot/mic-slot/port-number
   ```

   For example:

   ```
   [edit]
   user@host# edit interfaces coc3-1/0/0
   ```

2. Configure the sublevel interface partition index and the range of SONET/SDH slices, and set the sublevel interface type as **coc1**.

   ```
   [edit interfaces coc3-mpc-slot/mic-slot/port-number]
   user@host# set partition partition-number oc-slice oc-slice interface-type coc1
   ```

   For example:

   ```
   [edit interfaces coc3-1/0/0]
   user@host# set partition 1 oc-slice 1 interface-type coc1
   ```

3. Enter the **up** command to go to the **[edit interfaces]** hierarchy level.

   ```
   [edit interfaces coc3-mpc-slot/mic-slot/port-number]
   user@host# up
   ```

   For example:

   ```
   [edit interfaces coc3-1/0/0]
   user@host# up
   ```

4. Configure the channelized OC1 interface and the sublevel interface partition index, and set the interface type as **ct1**.

   ```
   [edit interfaces]
   user@host# set coc1-1/0/0:1 partition partition-number interface-type ct1
   ```

   For example:

   ```
   [edit interfaces]
   user@host# set coc1-1/0/0:1 partition 1 interface-type ct1
   ```

To verify the configuration, use the **show** command at the **[edit interfaces]** hierarchy level.

```
[edit interfaces]
user@host# show
coc3-1/0/0 {
    partition 1 oc-slice 1 interface-type coc1;
}
coc1-1/0/0:1 {
    partition 1 interface-type ct1;
}
```

Configuring CT1 Channels Down to DS Interfaces

To configure CT1 channels down to a DS interface, include the **partition** statement at the **[edit interfaces ct1-*mpc-slot/mic-slot/port-number:channel:channel*]** hierarchy level:

1. In configuration mode, go to the **[edit interfaces ct1-*mpc-slot/mic-slot/port-number:channel:channel*]** hierarchy level.

   ```
   [edit]
   user@host# edit interfaces ct1-mpc-slot/mic-slot/port-number:channel:channel
   ```

   For example:

   ```
   [edit]
   ```

```
user@host# edit interfaces ct1-1/0/0:1:1
```

2. Configure the partition, the time slots, and the interface type.

   ```
   [edit interfaces ct1-mpc-slot/mic-slot/port-number:channel:channel]
   user@host# set partition partition-number timeslots timeslots interface-type ds
   ```

   For example:

   ```
   [edit interfaces ct1-1/0/0:1:1]
   user@host# set partition 1 timeslots 1-4 interface-type ds
   ```

   NOTE: You can assign multiple time slots on a CT1 interface. In the set command, separate the time slots by commas and do not include spaces between them. For example:

   ```
   [edit interfaces ct1-1/0/0:1:1]
   user@host# set partition 1 timeslots 1-4,9,22-24 interface-type ds
   ```

To verify this configuration, use the **show** command at the **[edit interfaces ct1-1/0/0:1:1]** hierarchy level.

```
[edit interfaces ct1-1/0/0:1:1]
user@host# show
partition 1 timeslots 1-4 interface-type ds;
```

An *N*xDS0 interface can be configured from channelized T1 interface (ct1). Here *N* represents the time slots on the CT1 interface.

The value of *N* is 1 through 24 when a DS0 interface is configured from a CT1 interface.

After you partition the DS interface, configure the CESoPSN options on it. See "Setting the CESoPSN Options" on page 51.

Configuring CESoPSN on DS Interfaces

To configure CESoPSN encapsulation on a DS interface, include the **encapsulation** statement at the **[edit interfaces ds-*mpc-slot/mic-slot/port-number:channel:channel:channel*]** hierarchy level.

1. In configuration mode, go to the **[edit interfaces ds-*mpc-slot/mic-slot/port-number:channel:channel:channel*]** hierarchy level.

   ```
   [edit]
   user@host# edit interfaces ds-mpc-slot/mic-slot/ port-number:channel:channel:channel
   ```

   For example:

   ```
   [edit]
   user@host# edit interfaces ds-1/0/0:1:1:1
   ```

2. Configure CESoPSN as the encapsulation type and the logical interface for the DS interface.

```
[edit interfaces ds-mpc-slot/mic-slot/port-number:channel:channel:channel]
user@host# set encapsulation cesopsn unit interface-unit-number
```

For example:

```
[edit interfaces ds-1/0/0:1:1:1 ]
user@host# set encapsulation cesopsn unit 0
```

To verify this configuration, use the **show** command at the **[edit interfaces ds-1/0/0:1:1:1]** hierarchy level.

```
[edit interfaces ds-1/0/0:1:1:1]
user@host# show
encapsulation cesopsn;
unit 0;
```

See Also

- Understanding Mobile Backhaul on page 13
- Configuring CESoPSN Encapsulation on DS Interfaces on page 62

Configuring CESoPSN Encapsulation on DS Interfaces on CE1 Channels

This topic includes the following tasks:

- Configuring CSTM1 Ports Down to CE1 Channels on page 58
- Configuring CSTM4 Ports Down to CE1 Channels on page 59
- Configuring CE1 Channels Down to DS Interfaces on page 61
- Configuring CESoPSN on DS Interfaces on page 62

Configuring CSTM1 Ports Down to CE1 Channels

On any port configured for SDH framing (numbered 0 through 3), you can configure one CAU4 channel. On each CAU4 channel, you can configure 31 CE1 channels (numbered 1 through 31).

To configure CSTM1 channelization down to CAU4 and then down to CE1 channels, include the **partition** statement at the **[edit interfaces (cau4 | cstm1)-*mpc-slot/mic-slot/port-number*]** hierarchy level, as shown in the following example:

1. In configuration mode, go to the **[edit interfaces cstm1-*mpc-slot/mic-slot/port-number*]** hierarchy level.

   ```
   [edit]
   user@host# edit interfaces cstm1-mpc-slot/mic-slot/port-number
   ```

   For example:

   ```
   [edit]
   user@host# edit interfaces cstm1-1/0/1
   ```

2. On the CSTM1 interface, set the **no-partition** option, and then set the interface type as **cau4**.

   ```
   [edit interfaces cstm1-mpc-slot/mic-slot/port-number]
   ```

```
user@host# set no-partition interface-type cau4
```

For example:

```
[edit interfaces cstm1-1/0/1]
user@host# set no-partition interface-type cau4
```

3. Enter the **up** command to go to the **[edit interfaces]** hierarchy level.

```
[edit interfaces cstm1-mpc-slot/mic-slot/port-number]
user@host# up
```

For example:

```
[edit interfaces cstm1-1/0/1]
user@host# up
```

4. Configure the MPC slot, the MIC slot, and the port for the CAU4 interface. Set the sublevel interface partition index and set the interface type as **ce1**.

```
[edit interfaces]
user@host# set cau4-mpc-slot/mic-slot/port-number partition partition-number
  interface-type ce1
```

For example:

```
[edit interfaces]
user@host# set cau4-1/0/1 partition 1 interface-type ce1
```

To verify this configuration, use the **show** command at the **[edit interfaces]** hierarchy level.

```
[edit interfaces]
user@host# show
cstm1-1/0/1 {
  no-partition interface-type cau4;
}
cau4-1/0/1 {
  partition 1 interface-type ce1;
}
```

Configuring CSTM4 Ports Down to CE1 Channels

NOTE: When the port speed is configured as coc12-cstm4 at the **[edit chassis fpc *slot* pic *slot* port *slot*]** hierarchy level, you must configure CSTM4 ports down to CE1 channels.

On a port configured for SDH framing, you can configure one CAU4 channel. On the CAU4 channel, you can configure 31 CE1 channels (numbered 1 through 31).

To configure CSTM4 channelization down to CAU4 and then down to CE1 channels, include the **partition** statement at the **[edit interfaces (cau4|cstm4)-*mpc-slot/mic-slot/port-number*]** hierarchy level.

1. In configuration mode, go to the **[edit interfaces cstm4-*mpc-slot/mic-slot/port-number*]** hierarchy level.

   ```
   [edit]
   user@host# edit interfaces cstm4-mpc-slot/mic-slot/port-number
   ```

   For example:

   ```
   [edit]
   user@host# edit interfaces cstm4-1/0/0
   ```

2. Configure the sublevel interface partition index and the range of SONET/SDH slices, and set the sublevel interface type as **cau4**.

   ```
   [edit interfaces cstm4-1/0/0]
   user@host# set partition partition-number oc-slice oc-slice interface-type cau4
   ```

   For **oc-slice**, select from the following ranges: 1–3, 4–6, 7–9, and 10–12.

   For **partition**, select a value from 1 through 4.

   For example:

   ```
   [edit interfaces cstm4-1/0/0]
   user@host# set partition 1 oc-slice 1-3 interface-type cau4
   ```

3. Enter the **up** command to go to the **[edit interfaces]** hierarchy level.

   ```
   [edit interfaces cstm4-mpc-slot/mic-slot/port-number]
   user@host# up
   ```

   For example:

   ```
   [edit interfaces cstm4-1/0/0]
   user@host# up
   ```

4. Configure the MPC slot, the MIC slot, and the port for the CAU4 interface. Set the sublevel interface partition index and set the interface type as **ce1**.

   ```
   [edit interfaces]
   user@host# set cau4-mpc-slot/mic-slot/port-number:channel partition
     partition-number interface-type ce1
   ```

   For example:

   ```
   [edit interfaces]
   user@host# set cau4-1/0/0:1 partition 1 interface-type ce1
   ```

To verify this configuration, use the **show** command at the **[edit interfaces]** hierarchy level.

```
[edit interfaces]
user@host# show
```

```
cstm4-1/0/0 {
   partition 1 oc-slice 1-3 interface-type cau4;
}
cau4-1/0/0:1 {
   partition 1 interface-type ce1;
}
```

Configuring CE1 Channels Down to DS Interfaces

To configure CE1 channels down to a DS interface, include the **partition** statement at the **[edit interfaces ce1-*mpc-slot/mic-slot/port*:*channel*]** hierarchy level.

1. In configuration mode, go to the **[edit interfaces ce1-*mpc-slot/mic-slot/port*:*channel*]** hierarchy level.

   ```
   [edit]
   user@host# edit interfaces ce1-mpc-slot/mic-slot/port:channel
   ```

   ```
   [edit]
   user@host# edit interfaces ce1-1/0/0:1:1
   ```

2. Configure the partition and the time slots, and set the interface type as **ds**.

   ```
   [edit interfaces ce1-1/0/0:1:1]
   user@host# set partition partition-number timeslots timeslots interface-type ds
   ```

   For example:

   ```
   [edit interfaces ce1-1/0/0:1:1]
   user@host# set partition 1 timeslots 1-4 interface-type ds
   ```

   NOTE: You can assign multiple time slots on a CE1 interface. In the set command, separate the time slots by commas and do not include spaces between them. For example:

   ```
   [edit interfaces ce1-1/0/0:1:1]
   user@host# set partition 1 timeslots 1-4,9,22-31 interface-type ds
   ```

To verify this configuration, use the **show** command at the **[edit interfaces ce1-1/0/0:1:1** hierarchy level.

```
[edit interfaces ce1-1/0/0:1:1 ]
user@host# show
partition 1 timeslots 1-4 interface-type ds;
```

An *N*xDS0 interface can be configured from a channelized E1 interface (CE1). Here *N* represents the number of time slots on the CE1 interface.

The value of *N* is 1 through 31 when a DS0 interface is configured from a CE1 interface.

After you partition the DS interface, configure the CESoPSN options.

See Also

- Understanding Mobile Backhaul on page 13
- Configuring CESoPSN Encapsulation on DS Interfaces on page 62

Configuring CESoPSN on DS Interfaces

To configure CESoPSN encapsulation on a DS interface, include the **encapsulation** statement at the **[edit interfaces ds-*mpc-slot/mic-slot/port-number:channel:channel:channel*]** hierarchy level.

1. In configuration mode, go to the **[edit interfaces ds-*mpc-slot/mic-slot/port-number:channel:channel:channel*]** hierarchy level.

   ```
   [edit]
   user@host# edit interfaces ds-mpc-slot/mic-slot/port-number:channel:channel:channel
   ```

   For example:

   ```
   [edit]
   user@host# edit interfaces ds-1/0/0:1:1:1
   ```

2. Configure CESoPSN as the encapsulation type and then set the logical interface for the ds interface.

   ```
   [edit interfaces ds-1/0/0:1:1:1 ]
   user@host# set encapsulation cesopsn unit interface-unit-number
   ```

   For example:

   ```
   [edit interfaces ds-1/0/0:1:1:1 ]
   user@host# set encapsulation cesopsn unit 0
   ```

To verify this configuration, use the **show** command at the **[edit interfaces ds-1/0/0:1:1:1]** hierarchy level.

```
[edit interfaces ds-1/0/0:1:1:1]
user@host# show
encapsulation cesopsn;
unit 0;
```

Related Documentation

- Understanding Mobile Backhaul on page 13
- Configuring CESoPSN Encapsulation on DS Interfaces on page 62

Related Documentation

- Understanding Mobile Backhaul on page 13
- Configuring CESoPSN Encapsulation on DS Interfaces on page 62

Configuring CESoPSN Encapsulation on DS Interfaces

This configuration applies to the mobile backhaul application shown in Figure 3 on page 14.

1. Setting the Encapsulation Mode on page 63
2. Setting the CESoPSN Options on page 63
3. Configuring the Pseudowire Interface on page 65

Setting the Encapsulation Mode

To configure a DS interface on Circuit Emulation MICs with CESoPSN encapsulation at the provider edge (PE) router:

1. In configuration mode, go to the **[edit interfaces ds-*mpc-slot/mic-slot/port*<:channel>]** hierarchy level.

   ```
   [edit]
   user@host# edit interfaces ds-mpc-slot/mic-slot/port<:channel>
   ```

   For example:

   ```
   [edit]
   user@host# edit interfaces ds-1/0/0:1:1:1
   ```

2. Configure CESoPSN as the encapsulation type and set the logical interface for the DS interface.

   ```
   [edit interfaces ds-mpc-slot/mic-slot/port<:channel>]
   user@host# set encapsulation cesopsn unit logical-unit-number
   ```

   For example:

   ```
   [edit interfaces ds-1/0/0:1:1:1]
   user@host# set encapsulation cesopsn unit 0
   ```

To verify this configuration, use the **show** command at the **[edit interfaces ds-1/0/0:1:1:1]** hierarchy level:

```
[edit interfaces ds-1/0/0:1:1:1]
user@host# show
encapsulation cesopsn;
unit 0;
```

You do not need to configure any circuit cross-connect family because it is automatically created for the CESoPSN encapsulation.

See Also

- Setting the CESoPSN Options on page 51
- Configuring the Pseudowire Interface on page 65

Setting the CESoPSN Options

To configure CESoPSN options:

1. In configuration mode, go to the **[edit interfaces ds-*fpc-slot/pic-slot/port*:*channel*]** hierarchy level.

   ```
   [edit]
   user@host# edit interfaces ds-fpc-slot/pic-slot/port:channel
   ```

   For example:

   ```
   [edit]
   ```

```
user@host# edit interfaces ds-1/0/0:1:1:1
```

2. Use the **edit** command to go to the **[edit cesopsn-options]** hierarchy level.

```
[edit]
user@host# edit cesopsn-options
```

3. At this hierarchy level, using the **set** command you can configure the following CESoPSN options:

NOTE: When you stitch pseudowires by using interworking (iw) interfaces, the device stitching the pseudowire cannot interpret the characteristics of the circuit because the circuits originate and terminate in other nodes. To negotiate between the stitching point and circuit endpoints, you need to configure the following options.

- **excessive-packet-loss-rate**—Set packet loss options. The options are **sample-period** and **threshold**.
  - **sample-period**—Time required to calculate excessive packet loss rate (from 1000 through 65,535 milliseconds).
  - **threshold**—Percentile designating the threshold of excessive packet loss rate (1–100 percent).
- **idle-pattern**—An 8-bit hexadecimal pattern to replace TDM data in a lost packet (from 0 through 255).
- **jitter-buffer-latency**—Time delay in the jitter buffer (from 1 through 1000 milliseconds).
- **jitter-buffer-packets**—Number of packets in the jitter buffer (from 1 through 64 packets).
- **packetization-latency**—Time required to create packets (from 1000 through 8000 microseconds).
- **payload-size**—Payload size for virtual circuits that terminate on Layer 2 interworking (iw) logical interfaces (from 32 through 1024 bytes).

NOTE: This topic shows the configuration of only one CESoPSN option. You can follow the same method to configure all the other CESoPSN options.

```
[edit interfaces ds-fpc-slot/pic-slot/port:channel cesopsn-options]
user@host# set excessive-packet-loss-rate sample-period sample-period
```

For example:

```
[edit interfaces ds-1/0/0:1:1:1 cesopsn-options]
user@host# set excessive-packet-loss-rate sample-period 4000
```

To verify the configuration using the values shown in the examples, use the **show** command at the **[edit interfaces ds-1/0/0:1:1:1]** hierarchy level:

```
[edit interfaces ds-1/0/0:1:1:1]
user@host# show
cesopsn-options {
   excessive-packet-loss-rate {
      sample-period 4000;
   }
}
```

See Also

- Setting the Encapsulation Mode on page 63
- Configuring the Pseudowire Interface on page 65

Configuring the Pseudowire Interface

To configure the TDM pseudowire at the provider edge (PE) router, use the existing Layer 2 circuit infrastructure, as shown in the following procedure:

1. In configuration mode, go to the **[edit protocols l2circuit]** hierarchy level.

   ```
   [edit]
   user@host# edit protocol l2circuit
   ```

2. Configure the IP address of the neighboring router or switch, the interface forming the Layer 2 circuit, and the identifier for the Layer 2 circuit.

   ```
   [edit protocol l2circuit]
   user@host# set neighbor ip-address interface
     interface-name-fpc-slot/pic-slot/port.interface-unit-number virtual-circuit-id
     virtual-circuit-id
   ```

   For example:

   ```
   [edit protocol l2circuit]
   user@host# set neighbor 10.255.0.6 interface ds-1/0/0:1:1:1 virtual-circuit-id 1
   ```

To verify this configuration, use the **show** command at the **[edit protocols l2circuit]** hierarchy level.

```
[edit protocols l2circuit]
user@host# show
neighbor 10.255.0.6 {
   interface ds-1/0/0:1:1:1 {
      virtual-circuit-id 1;
   }
}
```

After the customer edge (CE)-bound interfaces (for both PE routers) are configured with proper encapsulation, packetization latency, and other parameters, the two PE routers try to establish a pseudowire with Pseudowire Emulation Edge-to-Edge (PWE3) signaling extensions. The following pseudowire interface configurations are disabled or ignored for TDM pseudowires:

- **ignore-encapsulation**
- **mtu**

The supported pseudowire type is 0x0015 CESoPSN basic mode.

When the local interface parameters match the received parameters, and the pseudowire type and control word bit are equal, the pseudowire is established.

For detailed information about configuring TDM pseudowire, see the *Junos OS VPNs Library for Routing Devices*.

For detailed information about PICs, see the *PIC Guide* for your router.

See Also
- Setting the Encapsulation Mode on page 63
- Setting the CESoPSN Options on page 51

Related Documentation
- Configuring CESoPSN on Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP on page 53
- Understanding Mobile Backhaul on page 13

Configuring CE1 Channels Down to DS Interfaces

You can configure a DS interface on a channelized E1 interface (CE1) and then apply CESoPSN encapsulation for the pseudowire to function. An *N*x*DS0* interface can be configured from a channelized CE1 interface, where *N* represents the time slots on the CE1 interface. The value of *N* is 1 through 31 when a DS0 interface is configured from a CE1 interface.

To configure CE1 channels down to a DS interface, include the **partition** statement at the **[edit interfaces ce1-*fpc/pic/port*]** hierarchy level, as shown in the following example:

```
[edit interfaces]
user@host# show
ce1-0/0/1 {
    partition 1 timeslots 1-4 interface-type ds;
}
```

After you partition the DS interface, configure the CESoPSN options on it. See "Setting the CESoPSN Options" on page 51.

To configure CE1 channels down to a DS interface:

1. Create the CE1 interface.

   ```
   [edit interfaces]
   user@host# edit interfaces ce1-fpc/pic/port
   ```

   For example:

   ```
   [edit interfaces]
   user@host# edit interface ce1-0/0/1
   ```

2. Configure the partition, the time slot, and the interface type.

   ```
   [edit interfaces ce1-fpc/pic/port]
   user@host# set partition partition-number timeslots timeslots interface-type ds;
   ```

   For example:

   ```
   [edit interfaces ce1-0/0/1]
   user@host# set partition 1 timeslots 1-4 interface-type ds;
   ```

   NOTE: You can assign multiple time slots on a CE1 interface; in the configuration, separate the time slots by comma without spaces. For example:

   ```
   [edit interfaces ce1-0/0/1]
   user@host# set partition 1 timeslots 1-4,9,22–31 interface-type ds;
   ```

3. Configure the CESoPSN encapsulation for the DS interface.

   ```
   [edit interfaces ds-fpc/pic/port:partition]
   user@host# set encapsulation encapsulation-type
   ```

   For example:

   ```
   [edit interfaces ds-0/0/1:1]
   user@host# set encapsulation cesopsn
   ```

4. Configure the logical interface for the DS interface.

   ```
   [edit interfaces ds-fpc/pic/port:partition]
   user@host# set unit logical-unit-number;
   ```

   For example:

   ```
   [edit interfaces ds-0/0/1:1]
   user@host# set unit 0
   ```

When you are finished configuring CE1 channels down to a DS interface, enter the **commit** command from configuration mode.

From configuration mode, confirm your configuration by entering the **show** command. For example:

```
[edit interfaces]
user@host# show
ce1-0/0/1 {
    partition 1 timeslots 1-4 interface-type ds;
}
ds-0/0/1:1 {
    encapsulation cesopsn;
    unit 0;
}
```

Related Documentation

- Understanding Mobile Backhaul on page 13
- Configuring CESoPSN Encapsulation on DS Interfaces on page 62

Configuring CESoPSN on Channelized E1/T1 Circuit Emulation MIC on ACX Series

This configuration applies to the mobile backhaul application shown in Figure 3 on page 14.

- Configuring T1/E1 Framing Mode at the MIC Level on page 68
- Configuring CT1 Interface Down to DS channels on page 68
- Configuring CESoPSN on DS Interfaces on page 69

Configuring T1/E1 Framing Mode at the MIC Level

To set the framing mode at the MIC (ACX-MIC-16CHE1-T1-CE) level, for all four ports on the MIC, include the **framing** statement at the **[edit chassis fpc *slot* pic *slot*]** hierarchy level.

```
[edit chassis fpc slot pic slot]
user@host# set framing (t1 | e1);
```

After a MIC is brought online, interfaces are created for the MIC's available ports on the basis of the MIC type and the framing option used.

- If you include the **framing t1** statement, 16 CT1 interfaces are created.
- If you include the **framing e1** statement, 16 CE1 interfaces are created.

NOTE: If you set the framing option incorrectly for the MIC type, the commit operation fails.

Bit error rate test (BERT) patterns with all binary 1s (ones) received by CT1/CE1 interfaces on Circuit Emulation MICs configured for CESoPSN do not result in an alarm indication signal (AIS) defect. As a result, the CT1/CE1 interfaces remain up.

Configuring CT1 Interface Down to DS channels

To configure a channelized T1 (CT1) interface down to DS channels, include the **partition** statement at the **[edit interfaces ct1-*mpc-slot/mic-slot/port-number*]** hierarchy level:

NOTE: To configure a CE1 interface down to DS channels, replace **ct1** with **ce1** in the following procedure.

1. In configuration mode, go to the **[edit interfaces ct1-*mpc-slot/mic-slot/port-number*]** hierarchy level.

   ```
   [edit]
   user@host# edit interfaces ct1-mpc-slot/mic-slot/port-number
   ```

For example:

```
[edit]
user@host# edit interfaces ct1-1/0/0
```

2. Configure the sublevel interface partition index and the time slots, and set the interface type as **ds**.

   ```
   [edit interfaces ct1-mpc-slot/mic-slot/port-number]
   user@host# set partition partition-number timeslots timeslots interface-type ds
   ```

   For example:

   ```
   [edit interfaces ct1-1/0/0]
   user@host# set partition 1 timeslots 1-4 interface-type ds
   ```

   NOTE: You can assign multiple time slots on a CT1 interface. In the set command, separate the time slots by commas and do not include spaces between them. For example:

   ```
   [edit interfaces ct1-1/0/0]
   user@host# set partition 1 timeslots 1-4,9,22-24 interface-type ds
   ```

To verify this configuration, use the **show** command at the **[edit interfaces ct1-1/0/0]** hierarchy level.

```
[edit interfaces ct1-1/0/0]
user@host# show
partition 1 timeslots 1-4 interface-type ds;
```

An *N*xDS0 interface can be configured from a CT1 interface. Here *N* represents the number of time slots on the CT1 interface. The value of *N* is:

- 1 through 24 when a DS0 interface is configured from a CT1 interface.
- 1 through 31 when a DS0 interface is configured from a CE1 interface.

After you partition the DS interface, configure CESoPSN options on it. See "Setting the CESoPSN Options" on page 51.

Configuring CESoPSN on DS Interfaces

To configure CESoPSN encapsulation on a DS interface, include the **encapsulation** statement at the **[edit interfaces ds-*mpc-slot/mic-slot/port-number:channel*]** hierarchy level.

1. In configuration mode, go to the **[edit interfaces ds-*mpc-slot/mic-slot/port-number:channel*]** hierarchy level.

   ```
   [edit]
   user@host# edit interfaces ds-mpc-slot/mic-slot/ port-number:channel
   ```

   For example:

   ```
   [edit]
   ```

```
user@host# edit interfaces ds-1/0/0:1
```

2. Configure CESoPSN as the encapsulation type.

```
[edit interfaces ds-mpc-slot/mic-slot/port-number:partition ]
user@host# set encapsulation cesopsn
```

For example:

```
[edit interfaces ds-1/0/0:1 ]
user@host# set encapsulation cesopsn
```

3. Configure the logical interface for the DS interface.

```
[edit interfaces ds-mpc-slot/mic-slot/port-number:partition ]
uset@host# set unit interface-unit-number
```

For example:

```
[edit interfaces ds-1/0/0:1 ]
user@host# set unit 0
```

To verify this configuration, use the **show** command at the **[edit interfaces ds-1/0/0:1]** hierarchy level.

```
[edit interfaces ds-1/0/0:1]
user@host# show
encapsulation cesopsn;
unit 0;
```

Related Documentation

- *16-Port Channelized E1/T1 Circuit Emulation MIC Overview*

CHAPTER 6

Configuring ATM Support on Circuit Emulation PICs

ATM Support on Circuit Emulation PICs Overview

The following components support ATM over MPLS (RFC 4717) and packet encapsulations (RFC 2684):

- 4-port COC3/CSTM1 Circuit Emulation PIC on M7i and M10i routers.
- 12-port T1/E1 Circuit Emulation PIC on M7i and M10i routers.
- Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP (MIC-3D-4COC3-1COC12-CE) on MX Series routers.
- 16-Port Channelized E1/T1 Circuit Emulation MIC (MIC-3D-16CHE1-T1-CE) on MX Series routers.

Circuit Emulation PIC ATM configuration and behavior is consistent with existing ATM2 PICs.

NOTE: Circuit Emulation PICs require firmware version rom-ce-9.3.pbin or rom-ce-10.0.pbin for ATM IMA functionality on M7i, M10i, M40e, M120, and M320 routers running JUNOS OS Release 10.0R1 or later.

ATM OAM Support

ATM OAM supports:

- Generation and monitoring of F4 and F5 OAM cells types:
  - F4 AIS (end-to-end)
  - F4 RDI (end-to-end)
  - F4 loopback (end-to-end)
  - F5 loopback
  - F5 AIS
  - F5 RDI
- Generation and monitoring of end-to-end cells of type AIS and RDI
- Monitor and terminate loopback cells
- OAM on each VP and VC simultaneously

VP Pseudowires (CCC Encapsulation)—In the case of ATM virtual path (VP) pseudowires—all virtual circuits (VCs) in a VP are transported over a single *N-to-one* mode pseudowire—all F4 and F5 OAM cells are forwarded through the pseudowire.

Port Pseudowires (CCC Encapsulation)—Like VP pseudowires, with port pseudowires, all F4 and F5 OAM cells are forwarded through the pseudowire.

VC Pseudowires (CCC Encapsulation)—In the case of VC pseudowires, F5 OAM cells are forwarded through the pseudowire, while F4 OAM cells are terminated at the Routing Engine.

Protocol and Encapsulation Support

The following protocols are supported:

- QoS or CoS queues. All virtual circuit (VCs) are unspecified bit rate (UBR).

NOTE: This protocol is not supported on M7i and M10i routers.

- ATM over MPLS (RFC 4717)
- ATM via dynamic labels (LDP, RSVP-TE)

NxDS0 grooming is not supported

The following ATM2 encapsulations are not supported:

- **atm-cisco-nlpid**—Cisco-compatible ATM NLPID encapsulation
- **atm-mlppp-llc**—ATM MLPPP over AAL5/LLC
- **atm-nlpid**—ATM NLPID encapsulation
- **atm-ppp-llc**—ATM PPP over AAL5/LLC
- **atm-ppp-vc-mux**—ATM PPP over raw AAL5
- **atm-snap**—ATM LLC/SNAP encapsulation
- **atm-tcc-snap**—ATM LLC/SNAP for translational cross-connect
- **atm-tcc-vc-mux**—ATM VC for translational cross-connect
- **vlan-vci-ccc**—CCC for VLAN Q-in-Q and ATM VPI/VCI interworking
- **atm-vc-mux**—ATM VC multiplexing
- **ether-over-atm-llc**—Ethernet over ATM (LLC/SNAP) encapsulation
- **ether-vpls-over-atm-llc**—Ethernet VPLS over ATM (bridging) encapsulation

Scaling Support

Table 4 on page 73 lists the maximum number of virtual circuits (VCs) that are supported on various components on the M10i router, on the M7i router, and on MX Series routers.

Table 4: Maximum Number of VCs

Component	Maximum Number of VCs
12-port Channelized T1/E1 Circuit Emulation PIC	1000 VCs
4-port Channelized COC3/STM1 Circuit Emulation PIC	2000 VCs
Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP	2000 VCs
16-Port Channelized E1/T1 Circuit Emulation MIC	1000 VCs

Limitations to ATM Support on Circuit Emulation PICs

The following limitations apply to ATM support on Circuit Emulation PICs:

- Packet MTU—Packet MTU is limited to 2048 bytes.
- Trunk mode ATM pseudowires—Circuit Emulation PICs do not support trunk mode ATM pseudowires.

- OAM-FM segment—Segment F4 flows are not supported. Only end-to-end F4 flows are supported.
- IP and Ethernet encapsulations—IP and Ethernet encapsulations are not supported.
- F5 OAM—OAM termination is not supported.

Related Documentation

- Configuring the 12-Port Channelized T1/E1 Circuit Emulation PIC on page 76
- Configuring the 4-Port Channelized COC3/STM1 Circuit Emulation PIC on page 74
- ATM IMA Configuration Overview on page 84
- Configuring ATM IMA on page 91
- Configuring ATM Pseudowires on page 94
- Configuring EPD Threshold on page 107
- Configuring Layer 2 Circuit and Layer 2 VPN Pseudowires on page 107

Configuring the 4-Port Channelized COC3/STM1 Circuit Emulation PIC

- T1/E1 Mode Selection on page 74
- Configuring a Port for SONET or SDH Mode on a 4-Port Channelized COC3/STM1 Circuit Emulation PIC on page 75
- Configuring an ATM Interface on a Channelized OC1 interface on page 76

T1/E1 Mode Selection

All ATM interfaces are either T1 or E1 channels within the COC3/CSTM1 hierarchy. Each COC3 interface can be partitioned as 3 COC1 slices, each of which in turn can be partitioned further into 28 ATM interfaces and the size of each interface created is that of a T1. Each CS1 can be portioned as 1 CAU4, which can be further partitioned as E1 sized ATM interfaces.

To configure the T1/E1 mode selection, note the following:

1. To create **coc3-*fpc/pic/port*** or **cstm1-*fpc/pic/port*** interfaces, chassisd will look for configuration at the **[edit chassis fpc *fpc-slot* pic *pic-slot* port *port* framing (sonet | sdh)]** hierarchy level. If the **sdh** option is specified, chassisd will create a **cstm1-*fpc/pic/port*** interface. Otherwise, chassisd will create **coc3-*fpc/pic/port*** interfaces.
2. Only interface **coc1** can be created from **coc3**, and **t1** can be created from **coc1**.
3. Only interface **cau4** can be created from **cstm1**, and **e1** can be created from **cau4**.

Figure 7 on page 75 and Figure 8 on page 75 illustrate the possible interfaces that can be created on the 4-port Channelized COC3/STM1 Circuit Emulation PIC.

Figure 7: 4-Port Channelized COC3/STM1 Circuit Emulation PIC Possible Interfaces (T1 Size)

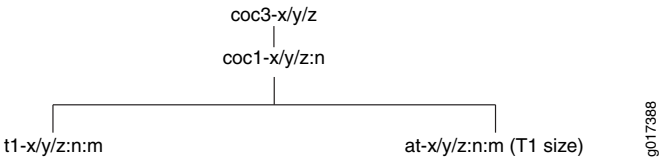
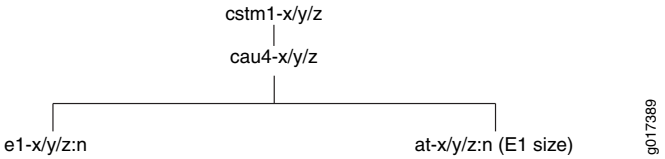


Figure 8: 4-Port Channelized COC3/STM1 Circuit Emulation PIC Possible Interfaces (E1 Size)



Subrate T1 is not supported.

ATM NxDS0 grooming is not supported.

External and internal loopback of T1/E1 (on ct1/ce1 physical interfaces) can be configured using the **sonet-options** statement. By default, no loopback is configured.

Configuring a Port for SONET or SDH Mode on a 4-Port Channelized COC3/STM1 Circuit Emulation PIC

Each port of the 4-port Channelized COC3/STM1 Circuit Emulation PIC can be independently configured for either SONET or SDH mode. To configure a port for either SONET or SDH mode, enter the **framing (sonet | sdh)** statement at the **[chassis fpc** *number* **pic** *number* **port** *number***]** hierarchy level.

The following example shows how to configure FPC 1, PIC 1, and port 0 for SONET mode and port 1 for SDH mode:

```
set chassis fpc 1 pic 1 port 0 framing sonet
set chassis fpc 1 pic 1 port 1 framing sdh
```

Or specify the following:

```
[edit]
fpc 1 {
  pic 1 {
    port 0 {
      framing sonet;
    }
    port 1 {
      framing sdh;
    }
  }
}
```

Configuring an ATM Interface on a Channelized OC1 interface

To create an ATM interface on a channelized OC1 interface (COC1), enter the following command:

To create an ATM interface on CAU4, enter the following command:

set interfaces cau4-*fpc/pic/port* partition interface-type at

Or specify the following:

```
interfaces {
  cau4-fpc/pic/port {
  }
}
```

You can use the **show chassis hardware** command to display a list of the installed PICs.

Related Documentation

- ATM Support on Circuit Emulation PICs Overview on page 71

Configuring the 12-Port Channelized T1/E1 Circuit Emulation PIC

When the 12-port Channelized T1/E1 Circuit Emulation PIC is brought online, 12 channelized T1 (ct1) interfaces or 12 channelized E1 (ce1) interfaces are created, depending on the T1 or E1 mode selection of the PIC.

Figure 9 on page 76 and Figure 10 on page 76 illustrate the possible interfaces that can be created on the 12-port T1/E1 Circuit Emulation PIC.

Figure 9: 12-Port T1/E1 Circuit Emulation PIC Possible Interfaces (T1 Size)

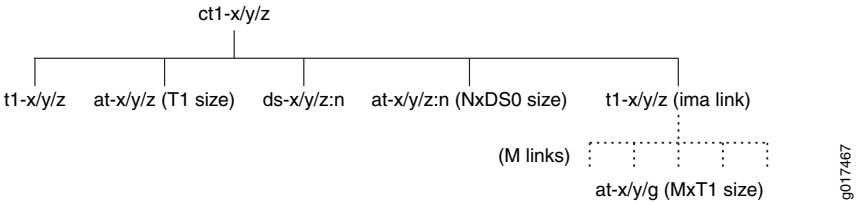
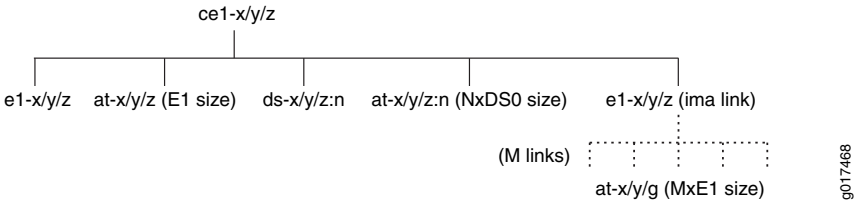


Figure 10: 12-Port T1/E1 Circuit Emulation PIC Possible Interfaces (E1 Size)



The following sections explain:

- Configuring CT1/CE1 Interfaces on page 77
- Configuring Interface-Specific Options on page 78

Configuring CT1/CE1 Interfaces

The following sections explain how to configure the T1/E1 mode at the PIC level to create ct1 interfaces or ce1 interfaces and to create an ATM interface on a CT1 interface or a CE1 interface:

Configuring T1/E1 Mode at the PIC level

To configure T1/E1 mode at the PIC level:

1. Go to the **[edit chassis]** hierarchy level.

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

2. Configure the FPC slot and PIC slot.

   ```
   [edit chassis]
   user@host# edit fpc fpc-slot pic pic-slot
   ```

3. Configure the framing mode as E1 or T1.

   ```
   [edit chassis fpc fpc-slot pic pic-slot]
   user@host# edit framing (e1 | t1)
   ```

After the PIC is brought online, 12 channelized T1 (ct1) interfaces or 12 channelized E1 (ce1) interfaces are created.

NOTE: If the mode is not manually configured, then the PIC defaults to T1.

Creating an ATM Interface on a CT1 or CE1

To create an ATM interface on a CT1 interface:

1. Go to the **[edit interfaces ct1-*fpc/pic/port*]** hierarchy level.

   ```
   [edit]
   user@host# edit interfaces ct1-fpc/pic/port
   ```

2. Configure the **no-partition** statement to use channelized interface as clear channel and to set the interface type as an ATM interface.

   ```
   [edit interfaces ct1-fpc/pic/port]
   user@host# set no-partition interface-type at
   ```

The interface **at-*fpc/pic/port*** is created.

You can use the **show chassis hardware** command to display a list of the installed PICs.

Creating an ATM Interface on a CE1 Interface

To create an ATM interface on a CE1 interface, enter the following command:

1. Go to the **[edit interfaces ce1-*fpc/pic/port*]** hierarchy level.

   ```
   [edit]
   iser@host# [edit interfaces ce1-fpc/pic/port]
   set interfaces no-partition interface-type at
   ```

2. Configure the **no-partition** statement to use channelized interface as clear channel and to set the interface type as an ATM interface.

   ```
   [edit interfaces ce1-fpc/pic/port]
   user@host# set no-partition interface-type at
   ```

The interface **at-*fpc/pic/port*** is created.

You can use the **show chassis hardware** command to display a list of the installed PICs.

Configuring Interface-Specific Options

ATM supports T1 and E1 interfaces on 12-port Channelized T1/E1 Circuit Emulation PICs. The following sections explain how to configure the interface-specific options for ATM, E1, and T1 interfaces.

- Configuring ATM Interface-Specific Options on page 78
- Configuring E1 Interface-Specific Options on page 79
- Configuring T1 Interface-Specific Options on page 79

Configuring ATM Interface-Specific Options

To configure ATM interface-specific options:

1. Go to the **[edit interfaces at-*fpc-slot/pic-slot/port*:*logical-unit*]**.

   ```
   [edit]
   user@host# edit interfaces at-fpc-slot/pic-slot/port:logical-unit
   ```

2. Configure the supported PIC type as a CE PIC—**atm-ce**, a ATM I PIC—**atm1**, or as a ATM II IQ PIC—**atm2** under the **atm-options** statement.

   ```
   [edit interfaces at-fpc-slot/pic-slot/port:logical-unit]
   user@host# edit atm-options (atm-ce | atm1 | atm2)
   ```

NOTE: To configure Circuit Emulation PICs, you must specify the **pic-type** option as **atm-ce** at the **[edit interfaces at-*fpc-slot/pic-slot/port*:*logical-unit* atm-options]** hierarchy level.

On MX Series routers with ATM MICs with SFP, Junos OS automatically sets the PIC type to ATM MIC.

Note that this topic uses the term PIC for ATM MICs where the reference is to a CLI or Junos OS entity.

Configuring E1 Interface-Specific Options

To configure E1 interface-specific options:

1. Go to the **[edit interfaces at-*fpc-slot/pic-slot/port*:*logical-unit* e1-options]**.

   ```
   [edit]
   user@host# edit interfaces at-fpc-slot/pic-slot/port:logical-unit e1-options
   ```

2. Configure the framing format for E1 interfaces as G704 mode with CRC4—**g704**, G704 mode without CRC4—**g704-no-crc4**, or unframed mode—**unframed**.

   ```
   [edit interfaces at-fpc-slot/pic-slot/port:logical-unit e1-options]
   user@host# set framing (g704 | g704-no-crc4 | unframed)
   ```

3. Configure the **bert-algorithm** statement with the pattern to send in the bit stream during a bit error rate test (BERT).

   ```
   [edit interfaces at-fpc-slot/pic-slot/port:logical-unit e1-options]
   user@host# set bert-algorithm algorithm
   ```

4. Configure the duration of a BERT test from 1 through 86,400 seconds.

   ```
   [edit interfaces at-fpc-slot/pic-slot/port:logical-unit e1-options]
   user@host# set bert-period seconds
   ```

5. Configure the loopback mode as local loopback or remote loopback

   ```
   [edit interfaces at-fpc-slot/pic-slot/port:logical-unit e1-options]
   user@host# set loopback (local | remote)
   ```

Configuring T1 Interface-Specific Options

To configure T1 interface-specific options:

1. Go to the **[edit interfaces at-*fpc-slot/pic-slot/port*:*logical-unit* t1-options]**.

   ```
   [edit]
   user@host# edit interfaces at-fpc-slot/pic-slot/port:logical-unit t1-options
   ```

2. Configure the framing format for T1 interfaces as extended super frame—**esf** or super frame—**sf**.

   [edit interfaces at-*fpc-slot/pic-slot/port*:*logical-unit* t1-options]
   user@host# **set framing (esf | sf)**

3. Configure the **bert-algorithm** statement with the pattern to send in the bit stream during a bit error rate test (BERT).

   [edit interfaces at-*fpc-slot/pic-slot/port*:*logical-unit* t1-options]
   user@host# **set bert-algorithm *algorithm***

4. Configure the duration of a BERT test from 1 through 86,400 seconds.

   [edit interfaces at-*fpc-slot/pic-slot/port*:*logical-unit* t1-options]
   user@host# **set bert-period *seconds***

5. Configure the loopback mode as local loopback, payload loopback, or remote loopback.

   [edit interfaces at-*fpc-slot/pic-slot/port*:*logical-unit* t1-options]
   user@host# **set loopback (local | payload| remote)**

6. Configure the CRC minor alarm threshold value.

   [edit interfaces at-*fpc-slot/pic-slot/port*:*logical-unit* t1-options]
   user@host# **set crc-major-alarm-threshold (1e-3 | 1e-4 | 1e-5 | 1e-6 | 5e-4 | 5e-5 | 5e-6)**

7. Configure the CRC major alarm threshold value.

   [edit interfaces at-*fpc-slot/pic-slot/port*:*logical-unit* t1-options]
   user@host# **set crc-major-alarm-threshold (1e-3 | 1e-4 | 1e-5 | 5e-4 | 5e-5)**

8. Configure the **invert-data** statement to invert the transmission of unused data bits on the T1 interface.

   [edit interfaces at-*fpc-slot/pic-slot/port*:*logical-unit* t1-options]
   user@host# **set invert-data**

Related Documentation

- ATM Support on Circuit Emulation PICs Overview on page 71

Understanding Inverse Multiplexing for ATM

Inverse multiplexing for ATM (IMA) is a technique of transporting ATM traffic over a bundle of T1 or E1 interfaces. The following sections explain IMA in detail:

- Understanding Asynchronous Transfer Mode on page 81
- Understanding Inverse Multiplexing for ATM on page 81
- How Inverse Multiplexing for ATM Works on page 81
- Supported Platforms on page 83

Understanding Asynchronous Transfer Mode

Asynchronous Transfer Mode (ATM) is a high-speed networking technology that handles data in fixed-size units called cells. It enables high-speed communication between edge routers and core routers in an ATM network.

ATM is designed to facilitate the simultaneous handling of various types of traffic streams (voice, data, and video) at very high speeds over a dedicated connection. ATM uses asynchronous time-division multiplexing (TDM) and it encodes data into 53-byte cells, thereby simplifying the design of hardware and enabling it to quickly determine the destination address of each cell. ATM operates over either fiber optic cables or twisted-pair cables. Each ATM PIC is assigned an ATM switch ID that displays the switch's IP address and the local interface names of the adjacent Fore ATM switches. For information about ATM PICs, see the platform-specific *Hardware Guide*.

ATM relies on the concepts of virtual paths (VPs) and virtual circuits (VCs). A virtual path, represented by a specific virtual path identifier (VPI), establishes a route between two devices in a network. Each VPI can contain multiple VCs, each represented by a virtual circuit identifier (VCI). VPIs and VCIs are local to the router, which means that only the two devices connected by the VCI or VPI need know the details of the connection. In a typical ATM network, user data might traverse multiple connections, using many different VPI and VCI connections. Each end device, just like each device in the network, needs to know only the VCI and VPI information for the path to the next device.

An ATM interface is indicated by the **at-*fpc/pic/port*** CLI descriptor.

Understanding Inverse Multiplexing for ATM

Inverse multiplexing is a method where a single data stream is divided into multiple smaller data streams that are transmitted over either fiber optic cables or twisted pair cables and are recombined on the other end to form the original data stream. This concept is useful for attaining high-speed data transmission rates. This concept has been extended to ATM and is called inverse multiplexing for ATM or IMA.

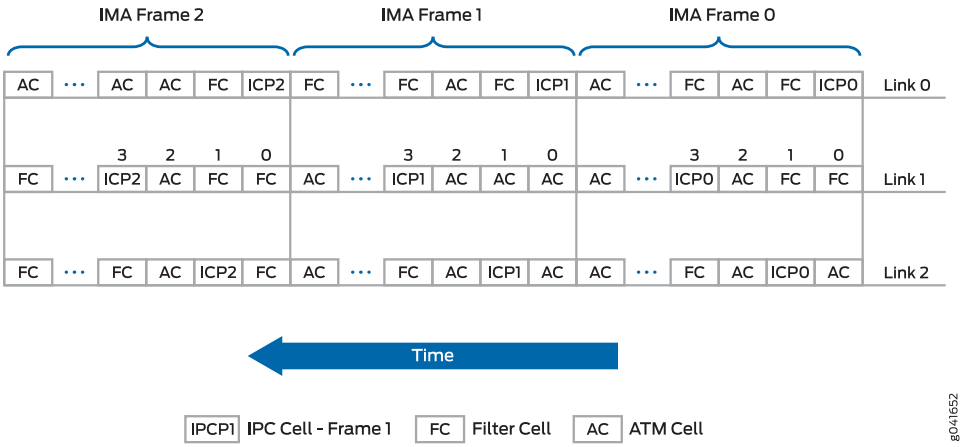
IMA is a technique of transporting ATM traffic over a bundle of T1 or E1 interfaces. IMA divides a single data stream into multiple smaller data streams, that is transmitted at the same time across separate channels (such as T1 or E1 interfaces) and then reconstructed at the other end back into the original data stream.

Two versions of IMA are available–IMA 1.0 (af-phy-0086.000-IMA) and IMA 1.1 (af-phy-0086.001-IMA). You can configure either of these versions, by using the Junos OS CLI. If not specified, IMA 1.1 is selected by default. Note that IMA 1.0 and IMA 1.1 do not interoperate. The IMA v1.1 specification increments the OAM (operations and maintenance) label value used in the IMA OAM cells in order to differentiate v1.1 from v1.0 IMA units.

How Inverse Multiplexing for ATM Works

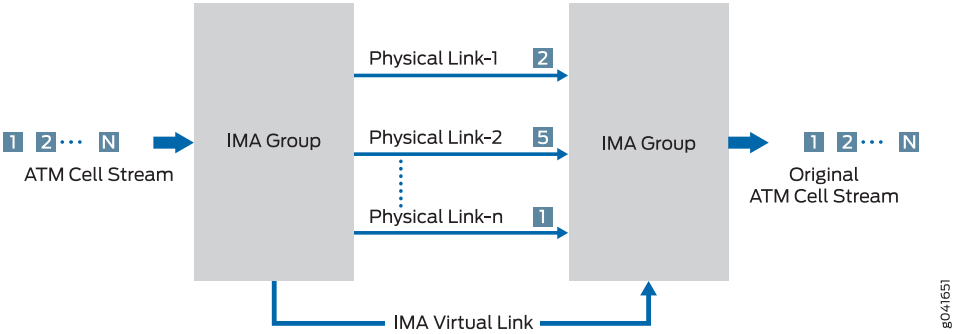
Figure 11 on page 82 displays IMA frames on different links. An IMA frame consists of ATM cells, an ICP cell, and filler cells (if required).

Figure 11: IMA Frames on Links



On the transmission side of the ATM IMA network, the ATM cell stream (received from the ATM layer) is divided across multiple links in an IMA group on a cell by cell basis. On the receiving end of the ATM IMA network, the cells are recombined to form the original ATM cells stream (with the help of ICP cells), and then passed on to the ATM layer. Figure 12 on page 82 displays an IMA frame being transmitted and received through an IMA group.

Figure 12: IMA Frames Transmitted Through IMA Group



IMA Control Protocol (ICP) cells are special cells that are sent over the ATM IMA interface with the ATM cell stream to help align the ATM cells at the receiving end. An ICP cell tracks link differential delay, reduces cell delay variation (CDV), and performs other functions.

When there are no ATM cells to be sent on an IMA frame, the IMA transmitter inserts filler cells to maintain a continuous stream of cells at the physical layer. The filler cells are discarded by the IMA receiver. An OAM cell has codes that define it as an ICP cell or a filler cell.

Supported Platforms

The following are the various Juniper Networks routers and their components that support inverse multiplexing for ATM (IMA):

- 16-port Channelized E1/T1 Circuit Emulation MIC (MIC-3D-16CHE1-T1-CE) on MX Series routers (from Junos OS Release 13.2R1 onward).
- 4-port Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP (MIC-3D-4COC3-1COC12-CE) on MX Series routers (from Junos OS Release 13.2R1 onward).
- 4-port Channelized OC3/STM1 Circuit Emulation PIC with SFP (PB-4CHOC3-CE-SFP) on M7i, M10i, M40e, M120, and M320 routers supports channelized OC3/STM1 (down to T1) ATM IMA.
- 12-port E1/T1 Circuit Emulation PIC (PB-12T1E1-CE-TELCO) on M7i, M10i, M40e, M120, and M320 routers supports discrete T1 ATM IMA.

NOTE: **Circuit Emulation PICs require firmware version rom-ce-9.3.pbin or rom-ce-10.0.pbin for ATM IMA functionality on M7i, M10i, M40e, M120, and M320 routers running Junos OS Release 10.0R1 or later.**

Related Documentation

- ATM IMA Configuration Overview on page 84
- ATM Support on Circuit Emulation PICs Overview on page 71
- Configuring ATM IMA on page 91

ATM IMA Configuration Overview

Inverse multiplexing for ATM (IMA) involves inverse multiplexing and demultiplexing of ATM cells in a round-robin sequence among links grouped to form a higher-bandwidth logical link whose rate is the sum of all the link rates. This group of links is called an IMA group. An IMA group can also be defined as a group of links at the transmitting end that is used to establish an IMA virtual link to the receiving end. The IMA virtual link is a virtual link that is established between two IMA units or routers over a number of physical links (in an IMA group). IMA groups terminate at each end of the IMA virtual link.

You can configure 42 IMA groups. Each group can contain from 1 through 32 links.

You can configure a maximum of 16 IMA groups on the 16-port Channelized E1/T1 Circuit Emulation MIC (MIC-3D-16CHE1-T1-CE) and each group can have from 1 through 8 IMA links. Port numbers starting from 0 through 15 are used for T1/E1 ports; therefore, IMA port numbers start from 16 onward. For information about MIC-3D-16CHE1-T1-CE, see *Channelized E1/T1 Circuit Emulation MIC*.

You can configure a maximum of 42 IMA groups on the 4-port Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP (MIC-3D-4COC3-1COC12-CE). The IMA port numbers start from 16 onward. For information about MIC-3D-4COC3-1COC12-CE, see *Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP*.

To configure an IMA group, execute the **set chassis fpc *fpc-slot* pic *pic-slot* aggregated devices ima device-count *count*** configuration command, where ***count*** results in the creation of interfaces from at-x/y/*g* through at-x/y/*g*+*count*-1. The variable *g* is chosen such that there is no conflict with non-IMA ATM interfaces on the same PIC. For example, if the count variable is set to 4, then the new ATM interfaces are created from at-x/y/16 through at-x/y/19.

You can implement inverse multiplexing for ATM (IMA) on Juniper Networks routers by configuring an IMA group and its options. The following sections explain the various options that can be set for an IMA group:

IMA Version

Either IMA 1.0 (af-phy-0086.000-IMA) or IMA 1.1 (af-phy-0086.001-IMA) can be selected through the CLI. To choose the IMA specification version, execute the **set interfaces** ***interface-name*** **ima-group-options (1.0|1.1)** configuration command. Note that, if you do not specify the version, IMA 1.1 is selected by default.

IMA 1.0 and IMA 1.1 do not interoperate.

The IMA v1.1 specification increments the operations and maintenance (OAM) label value used in the IMA OAM cells in order to differentiate v1.1 from v1.0 IMA units.

IMA Frame Length

An IMA frame consists of ATM cells, an ICP cell, and filler cells (if required). When you configure an IMA group, you can choose a frame length of 32, 64, 128, or 256. The frame length can be selected independently in each direction and in each group. To set the frame length, execute the **set interface** ***interface-name*** **frame-length (32 |64 |128 |256)** configuration command. Note that if the frame length is not specified, the frame length value of 128 is selected by default.

Transmit Clock

When you create an IMA group, you can configure a common transmit clock timing mode or an independent transmit clock timing mode to reflect the primary reference source (PRS) of the clock for each link in a group. By default, the common mode is selected. To select the transmit clock timing mode, execute the **set interface** ***interface-name*** **ima-group-options transmit-clock (common | independent)** configuration command.

IMA Group Symmetry

You can configure an IMA group to allow symmetric or asymmetric cell rate transfer over an IMA virtual link. You can configure the IMA group with one of the following modes:

- Symmetrical configuration and operation—In this mode, on the ATM IMA device, an IMA link must be configured in each direction for all physical links that the ATM IMA device is configured to use. In this mode, the ATM IMA device can transmit and receive ATM layer cells over the physical links on which the IMA links running in both directions are **Active**.
- Symmetrical configuration and asymmetrical operation—In this mode, on the ATM IMA device, an IMA link must be configured in each direction for all physical links that the ATM IMA device is configured to use. In this mode, the ATM IMA device can transmit ATM layer cells over the physical links on which the IMA links in the transmit direction are **Active**, while the IMA links in the receive direction are not **Active** or contrariwise.

Asymmetrical configuration and operation are not supported.

The mode can be configured through the CLI when an IMA group is created. To select the symmetry option, execute the **set interface** ***interface-name*** **ima-group-options symmetry (symmetrical-config-and-operation | symmetrical-config-asymmetrical-operation)** configuration command. By default, symmetrical configuration and operation is selected.

Minimum Active Links

You can set the minimum active links for an IMA group from 1 through 32.

- P_{Tx} is the minimum number of links required to be active in the transmit direction for the IMA group to move into the operational state.
- P_{Rx} is the minimum number of links required to be active in the receive direction for the IMA group to move into the operational state.

You configure P_{Tx} and P_{Rx} through the CLI when an IMA group is created. By default, 1 is selected.

For a symmetrical configuration, P_{Tx} is equal to P_{Rx}.

To set minimum links, execute the **set interface** ***interface-name*** **ima-group-options minimum-links** ***links*** configuration command. By default, symmetrical configuration and operation is selected.

State Transition Variables: Alpha, Beta, and Gamma

Frame synchronization is a process of recovery of the aggregated frames. The frame synchronization states form a basis for the different error and maintenance states. You can configure the IMA frame synchronization link state transition variables as alpha, beta, and gamma. The valid ranges and default values are shown in Table 5 on page 86.

Table 5: IMA Frame Synchronization Link State Transition Variables

Setting	Range	Default	Description
alpha	1–2	2	Consecutive invalid ICP cells
beta	1–5	2	Consecutive errored ICP cells
gamma	1–5	1	Consecutive valid ICP cells

To set the frame synchronization option, execute the **set interface** ***interface-name*** **ima-group-options frame-synchronization alpha** ***number*** **beta** ***number*** **gamma** ***number*** configuration command.

IMA Link Addition and Deletion

When an IMA group is up, you can add links to or delete links from the group without dropping cells.

To create an IMA link, you must:

- Configure the encapsulation as **ima** at the **[edit interfaces *interface-name* encapsulation]** hierarchy level.
- Configure an ATM interface with one T1 link or one E1 link with the **set interfaces *interface-name* ima-link-options group-id *g*** configuration command.

The ***interface-name*** variable refers to the T1 or E1 interface to be set as an IMA interface link and the variable ***g*** refers to the port in the *at-x/y/g* interface.

To delete the configured IMA link, you must execute the following configuration commands:

- **delete interfaces *interface-name* encapsulation ima**
- **delete interfaces *interface-name* ima-link-options group *g***

IMA Test Pattern Procedure

A test pattern procedure is supported for IMA to test the ATM, T1, and E1 interfaces for irregularities. You can use the CLI to start and end the test pattern procedure.

The following options can be set according to the requirement at the **[edit interface *interface-name* ima-group-options test-procedure]** hierarchy level:

- **interface *interface-name***—Interface name of the IMA link to test.
- **pattern *number***—IMA test pattern that can be set from 1 through 254
- **period *number***—Length of the IMA test pattern that can be set from 1 second through 4,294,967,294 seconds.

To perform the test pattern procedure, execute the **test interface *interface-name* ima-test-start** and **test interface *interface-name* ima-test-stop** operational mode commands to start and to stop the IMA test, respectively.

Per-PIC Limit on the Number of Links

The per-PIC limit on the number of links with the 12-port E1/T1 Circuit Emulation PIC (PB-12T1E1-CE-TELCO) is up to 12 T1 or E1 links.

The per-PIC limits on the number of links with the 4-port Channelized OC3/STM1 Circuit Emulation PIC with SFP (PB-4CHOC3-CE-SFP) are:

- T1—0 through 168
- E1—0 through 126
- Mixed: total bandwidth limited to 2xOC3; 258,048,000 bps

The per-PIC limits on the number of links with the 4-port Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP (MIC-3D-4COC3-1COC12-CE) are:

- T1—0 through 336

- E1—0 through 252

IMA Group Alarms and Group Defects

Table 6 on page 88 shows the supported IMA group alarms and their associated IMA standard requirement numbers. This is displayed in the *group status and control* field of an ICP cell.

Table 6: IMA Group Alarms with IMA Standard Requirement Numbers

Alarm	IMA Standard Requirement Number
Start-up-FE	R-145
Config-Aborted	R-146
Config-Aborted-FE	R-147
Insufficient-Links	R-148
Insufficient-Links-FE	R-149
Blocked-FE	R-150
GR-Timing-Mismatch	R-151

Table 7 on page 88 shows the supported IMA group defects and their associated IMA standard requirement numbers. This is displayed in the *group status and control* field of an ICP cell.

Table 7: IMA Group Defects with IMA Standard Requirement Numbers

Defects	IMA Standard Requirement Number
Start-up-FE	R-145
Config-Aborted	R-146
Config-Aborted-FE	R-147
Insufficient-Links	R-148
Insufficient-Links-FE	R-149
Blocked-FE	R-150
GR-Timing-Mismatch	R-151

IMA Link Alarms and Link Defects

Table 8 on page 89 shows the supported IMA link alarms that are reported to the IMA unit management with their associated IMA standard requirement numbers.

Table 8: IMA Link Alarms with IMA Standard Requirement Numbers

Alarm	IMA Standard Requirement Number	Description
LIF	R-138	Loss of IMA frame
LODS	R-139	Link out of delay synchronization
RFI-IMA	R-140	Remote defect/failure
Tx-Mis-Connected	R-141	Transmit misconnected
Rx-Mis-Connected	R-142	Receive misconnected
Tx-Unusable-FE	R-143	Transmit unusable far end
Rx-Unusable-FE	R-144	Receive unusable far end
Link Fault		Link fault

An IMA unit management is defined by SNMP MIBs.

Table 9 on page 89 shows the supported IMA link defects that are reported to the unit management with their associated IMA standard requirement numbers.

Table 9: IMA Link Defects with IMA Standard Requirement Numbers

Defect	IMA Standard Requirement Number	Description
LIF	R-138	Loss of IMA frame
LODS	R-139	Link out of delay synchronization
RFI-IMA	R-140	Remote defect/failure
Tx-Mis-Connected	R-141	Transmit misconnected
Rx-Mis-Connected	R-142	Receive misconnected
Tx-Unusable-FE	R-143	Transmit unusable far end
Rx-Unusable-FE	R-144	Receive unusable far end
Link Fault		Link fault

IMA Group Statistics

You can use the **show interfaces** command to display the following IMA group statistics:

- Near-end failure count
- Far-end failure count
- Receive end (R_x) faulty cells due to address mismatch
- Running seconds
- Unavailable seconds

For more information about IMA group statistics, see the **show interfaces** command description in the CLI Explorer.

IMA Link Statistics

Table 10 on page 90 shows the IMA link statistics.

Table 10: IMA Link Statistics with IMA Standard Requirement Numbers

Performance Parameter	IMA Standard Requirement Number
Rx LIF	–
Rx ICP cells	–
Rx errored ICP cells	R-106
Rx LODS	R-106
Rx ICP violation	R-107
Rx stuff	O-17
Near-end Rx SES	R-108
Near-end Rx UAS	R-110
Near-end Rx UUS	R-113
Near-end Rx failure	R-117
Near-end Tx failure	–
Far-end Rx SES	R-109
Far-end Rx UAS	R-111
Far-end Rx UUS	R-115

Table 10: IMA Link Statistics with IMA Standard Requirement Numbers (continued)

Performance Parameter	IMA Standard Requirement Number
Far-end defects	–
Far-end Rx failure	–
Tx ICP cells	–
Tx stuff	O-16
Near-end Tx UUS	R-112
Far-end Tx UUS	R-114
Far-end Tx failure	–

IMA Clocking

Interface clock source is applicable only to IMA links.

You can set the interface clock source as external or internal with the **set interfaces *at-x/y/z* clocking (external | internal)** configuration command. Note that the **clocking** statement is not applicable to the **at-*x/y/g*** interface because the IMA group it represents is a virtual interface.

Differential Delay

You can set the maximum differential delay from 1 millisecond through 56 milliseconds among links in an IMA group. By default, a differential delay of 25 milliseconds is set. Execute the **set interfaces *interface-name* ima-group-options differential-delay *delay*** configuration command to set the differential delay.

Related Documentation

- ATM Support on Circuit Emulation PICs Overview on page 71
- Configuring ATM IMA on page 91
- Understanding Inverse Multiplexing for ATM on page 80

Configuring ATM IMA

The following sections explain how to create an ATM IMA group and to configure it according to your requirements:

- Creating an IMA Group (ATM Interfaces) on page 92
- Configuring Group ID for an IMA Link on a T1 Interface or an E1 Interface on page 92
- Configuring ATM Encapsulation Options on page 93
- Configuring IMA Group Options on page 93

Creating an IMA Group (ATM Interfaces)

To create an IMA group, perform the following steps:

1. In configuration mode, go to the **[edit chassis]** hierarchy level:

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

2. Configure the Flexible Port Concentrator (FPC) slot and the Physical Interface Card (PIC) slot as needed.

   ```
   [edit chassis]
   user@host# set fpc fpc-slot pic pic-slot
   ```

3. Configure the device count. The device count can be set starting from 1 through 42 in the aggregated device options for inverse multiplexing for ATM at the **[edit chassis fpc *fpc-slot* pic *pic-slot*]** hierarchy level.

   ```
   [edit chassis fpc fpc-slot pic pic-slot]
   user@host# set aggregated-devices ima device-count count
   ```

This results in the creation of interfaces from at-x/y/*g* through at-x/y/*g*+*count*–1, where the variable *count* is the number of interfaces and the variable *g* is chosen such that there is no conflict with non-IMA at-x/y/z interfaces on the same PIC.

The PIC is automatically rebooted when a configuration that changes the IMA group count is committed.

Configuring Group ID for an IMA Link on a T1 Interface or an E1 Interface

A group ID is assigned to all links in an IMA group.

To assign a group ID to a T1 or an E1 interface:

1. In configuration mode, go to the **[edit interfaces *interface-name*]** hierarchy level, where the interface name is **t1-*fpc/pic/port*:*m*:*n***, **e1-*fpc/pic/port*:*n***, or **t1|e1-*fpc/pic/port***.

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

2. Configure the encapsulation as **ima**.

   ```
   [edit interface interface-name]
   user@host# set encapsulation ima
   ```

3. Configure the IMA group ID from 16 through 57. Note that this group ID is the same for all T1/E1 interfaces for a particular ATM IMA interface.

   ```
   [edit interface interface-name]
   user@host# set ima-link-options group-id number
   ```

Implement the aforementioned procedure to apply a group ID for all applicable T1 or E1 interfaces.

Configuring ATM Encapsulation Options

To configure the logical link-layer encapsulation for an ATM interface to support IMA:

1. In configuration mode, go to the **[edit interfaces *interface-name*]** hierarchy level, where the interface name is **at-*fpc/pic/port***.

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

2. Configure the logical interface (unit) as 0 and set the encapsulation for this logical interface as either ATM cell relay for CCC or ATM VC for CCC.

   ```
   [edit interface interface-name]
   user@host# set unit 0 encapsulation (atm-ccc-cell-relay | atm-ccc-vc-mux)
   ```

Configuring IMA Group Options

To configure the various options for an IMA group on an ATM interface:

1. In configuration mode, go to the **[edit interfaces *interface-name* ima-group-options]** hierarchy level, where the interface name is **at-*fpc/pic/port***.

   ```
   [edit]
   user@host# edit interface interface-name ima-group-options
   ```

2. Configure the maximum differential delay between the links in the IMA group. You can configure the maximum differential delay from 1 millisecond through 56 milliseconds. By default, 25 milliseconds is set.

   ```
   [edit interface interface-name ima-atm-options]
   user@host# set differential-delay delay
   ```

3. Configure the frame length of the ICP cell as 32, 64, 128, or 256. By default, 128 is set.

   ```
   [edit interface interface-name ima-atm-options]
   user@host# set frame-length length
   ```

4. Configure the IMA group frame synchronization state parameters alpha, beta, and gamma.

   ```
   [edit interface interface-name ima-atm-options]
   user@host# set alpha number beta number gamma number
   ```

   For the default values and parameter range for alpha, beta, and gamma, see "ATM IMA Configuration Overview" on page 84.

5. Configure IMA group minimum active links.

   ```
   [edit interface interface-name ima-atm-options]
   user@host# set minimum-links links
   ```


6. Configure the symmetry of the IMA group as either *symmetrical configuration and operation* or *symmetrical configuration and asymmetrical operation*.

   [edit interface *interface-name* ima-atm-options]
   user@host# **set symmetry (symmetrical-config-and-operation | symmetrical-config-asymmetrical-operation)**

   For information about symmetry, see "ATM IMA Configuration Overview" on page 84.

7. Configure a test procedure to start and end the test pattern procedure.

   [edit interface *interface-name* ima-atm-options]
   user@host# **set ima-test-start**
   user@host# **ima-test-stop**
   user@host# **interface *interface-name***
   user@host# **pattern *number***
   user@host# **period *number***

   For information about test procedure, see "ATM IMA Configuration Overview" on page 84.

8. Configure a transmit clock to reflect the primary reference source (PRS) of the clock for each link in a group either in common timing mode or independent timing mode. By default, common timing mode is selected.

   [edit interface *interface-name* ima-atm-options]
   user@host# **set transmit-clock (common | independent)**

9. Configure the IMA specification version as either version 1.0 or version 1.1. By default, IMA version 1.1 is selected.

   [edit interface *interface-name* ima-atm-options]
   user@host# **set version (1.0|1.1)**

Related Documentation

- ATM IMA Configuration Overview on page 84
- ATM Support on Circuit Emulation PICs Overview on page 71
- Understanding Inverse Multiplexing for ATM on page 80

Configuring ATM Pseudowires

ATM pseudowires are described in RFC 4717. Pseudowire encapsulation is selected by configuring for a cell-relay pseudowire:

[edit interfaces at-*fpc/pic/port*:*unit n*]

```
encapsulation atm-ccc-cell-relay;
atm-l2circuit-mode cell;
```

Or for an AAL5 pseudowire:

```
encapsulation atm-ccc-vc-mux;
atm-l2circuit-mode aal5;
```

NOTE: **encapsulation atm-ccc-cell-relay** can be set at either the physical interface or logical interface level. **atm-ccc-vc-mux** can only be set at the logical interface level.

The following sections describe:

- Cell Relay Mode on page 95
- Configuring AAL5 SDU Mode on page 96

Cell Relay Mode

In cell relay mode, one or more cells are bundled together to form a packet that is sent across the PSN tunnel. N-to-one mode is used to encapsulate cell bundles. In this mode, 52 bytes of each cell are transported across the PSN (the HEC field of the ATM header is omitted). The optional one-to-one mode is not supported.

By default, each ATM cell is encapsulated into a pseudowire packet (per RFC 4717) and sent over the pseudowire (**cell-bundle-size** = 1). The pseudowire may be configured to aggregate a user-configured number of cells into a packet to increase network utilization efficiency.

```
[edit interfaces at-fpc/pic/port]
atm-options {
   cell-bundle-size cells;
}
```

where ***cells*** is the number of cells each pseudowire packet should contain.

- Configuring VP or Port Promiscuous Mode on page 95

Configuring VP or Port Promiscuous Mode

By default, all incoming cells are mapped from a single VC to an ATM pseudowire. For ATM physical interfaces configured with **atm-l2circuit-mode cell**, you can configure port or VP promiscuous mode.

In VP promiscuous mode, all cells with the same VPI are forwarded on a single pseudowire:

```
[edit interfaces at-fpc/pic/port]
atm-options {
   pic-type atm-ce;
   promiscuous-mode {
      vpi number;
   }
}
unit 0 {
   vpi number;
}
```

In port promiscuous mode, all cells received on a T1 or E1 ATM port are forwarded across a single pseudowire:

```
[edit interfaces at-fpc/pic/port]
```

```
encapsulation atm-ccc-cell-relay;
atm-options {
   pic-type atm-ce;
   promiscuous-mode
}
unit 0 {
   allow-any-vci;
}
```

Use the **show interface at-*x/y/z:n*** command to view cell relay statistics.

Configuring AAL5 SDU Mode

In AAL5 SDU mode, the ATM logical interface (VC) expects all data to be either AAL5 encapsulated packets or OAM cells. AAL5 packets are de-encapsulated (AAL5 trailer is stripped off), prepended with an ATM pseudowire control word (RFC 4717) and forwarded on the pseudowire.

OAM cells that are received while an AAL5 packet is being reassembled are forwarded on the pseudowire immediately (they are reordered ahead of the packet being reassembled).

Use the **show interface at-*x/y/z:n*** command to view AAL5 statistics.

Related Documentation

- ATM Support on Circuit Emulation PICs Overview on page 71

Configuring ATM Cell-Relay Pseudowire

In ATM cell-relay mode, one or more ATM cells are bundled together to form a packet that is sent across the packet-switched network (PSN) using MPLS. In this mode, each ATM cell and its header are transported over the MPLS cloud. The ATM header consisting of the VPI and VCI values is transported across the MPLS cloud or the backhaul network.

By default, all incoming cells are mapped from a single virtual circuit to an ATM pseudowire. For ATM logical interfaces configured with **atm-ccc-cell-relay** encapsulation, you can configure ATM cell-relay pseudowire in VP-promiscuous mode, port-promiscuous mode, and VCC mode.

Promiscuous mode allows you to map all incoming cells from either an interface port or a virtual path (VP) to a single LSP without restricting the VCI number. You can map traffic from all 65,535 VCIs to a single LSP, or from all 256 VPIs to a single LSP. For promiscuous-mode configuration guidelines, see *Configuring ATM Cell-Relay Promiscuous Mode*.

This topic includes the following tasks:

- Configuring ATM Cell-Relay Pseudowire in Port-Promiscuous Mode on page 97
- Configuring ATM Cell-Relay Pseudowire in VP-Promiscuous Mode on page 97
- Configuring ATM Cell-Relay Pseudowire in VCC Mode on page 98

Configuring ATM Cell-Relay Pseudowire in Port-Promiscuous Mode

To configure ATM cell-relay pseudowire in port-promiscuous mode:

1. In configuration mode, go to the **[edit interfaces]** hierarchy level and set the interface as at-0/2/2.

   ```
   [edit]
   user@host#edit interfaces at-0/2/2
   ```

2. To map incoming traffic, include the **promiscuous mode** statement at the **[edit interfaces *interface-name* atm-options]** hierarchy level.

   ```
   [edit interfaces at-0/2/2]
   user@host#set atm-options promiscuous-mode
   ```

3. To configure ATM encapsulation on unit 0, include the **encapsulation** statement at the **[edit interfaces *interface-name*]** hierarchy level.

   ```
   [edit interfaces at-0/2/2]
   user@host#set unit 0 encapsulation atm-ccc-cell-relay
   ```

4. Include the **allow-any-vci** statement at the **[edit interfaces *interface-name*]** hierarchy level.

   ```
   [edit interfaces at-0/2/2]
   user@host#set unit 0 allow-any-vci
   ```

5. To verify the configuration, you can issue the following operational mode command in configuration mode:

   ```
   [edit]
   user@host#show at-0/2/2
   ```

   ```
   atm-options{
   promiscuous-mode;
   }
   unit 0{
   encapsulation atm-ccc-cell-relay;
   allow-any-vci;
   }
   ```

Configuring ATM Cell-Relay Pseudowire in VP-Promiscuous Mode

To configure ATM cell-relay pseudowire in VP-promiscuous mode:

1. In configuration mode, go to the **[edit interfaces]** hierarchy level and set the interface as at-0/2/2.

   ```
   [edit]
   user@host#edit interfaces at-0/2/2
   ```

2. To map incoming traffic to a single LSP and to specify the VPI value as 8, include the **promiscuous mode** statement and **vpi *vpi-identifier*** statement at the **[edit interfaces *interface-name* atm-options]** hierarchy level.

   ```
   [edit interfaces at-0/2/2]
   user@host#set atm-options promiscuous-mode vpi 8
   ```

3. To configure ATM encapsulation on unit 0, include the **encapsulation** statement at the **[edit interfaces *interface-name*]** hierarchy level.

   ```
   [edit interfaces at-0/2/2]
   user@host#set unit 0 encapsulation atm-ccc-cell-relay
   ```

4. To specify 8 as the VPI value on unit 0, include the **vpi *vpi-identifier*** statement at the **[edit interfaces *interface-name*]** hierarchy level.

   ```
   [edit interfaces at-0/2/2]
   user@host#set unit 0 vpi 8
   ```

5. To verify the configuration, you can issue the following operational mode command in configuration mode:

   ```
   [edit]
   user@host#show at-0/2/2

   atm-options{
   vpi 8;
   promiscuous-mode;
   }
   unit 0{
   encapsulation atm-ccc-cell-relay;
   vpi 8;
   }
   ```

Configuring ATM Cell-Relay Pseudowire in VCC Mode

To configure ATM cell-relay pseudowire in VCC mode:

1. In configuration mode, go to the **[edit interfaces]** hierarchy level and set the interface as at-0/2/2.

   ```
   [edit]
   user@host#edit interfaces at-0/2/2
   ```

2. To map incoming traffic to a single LSP and to specify the VPI value as 9, include the **promiscuous mode** statement and **vpi *vpi-identifier*** statement at the **[edit interfaces *interface-name* atm-options]** hierarchy level.

   ```
   [edit interfaces at-0/2/2]
   user@host#set atm-options promiscuous-mode vpi 9
   ```

3. To configure ATM encapsulation on unit 0, include the **encapsulation** statement at the **[edit interfaces *interface-name*]** hierarchy level.

```
[edit interfaces at-0/2/2]
user@host#set unit 0 encapsulation atm-ccc-cell-relay
```

4. To specify the VCI value as 9.99 on unit 0, include the **vci *vci-identifier*** statement at the **[edit interfaces *interface-name*]** hierarchy level.

```
[edit interfaces at-0/2/2]
user@host#set unit 0 vci 9.99
```

5. To verify the configuration, you can issue the following operational mode command in configuration mode:

```
[edit]
user@host#show at-0/2/2

atm-options{
vpi 9;
promiscuous-mode;
}
unit 0{
encapsulation atm-ccc-cell-relay;
vci 9.99;
}
```

Related Documentation

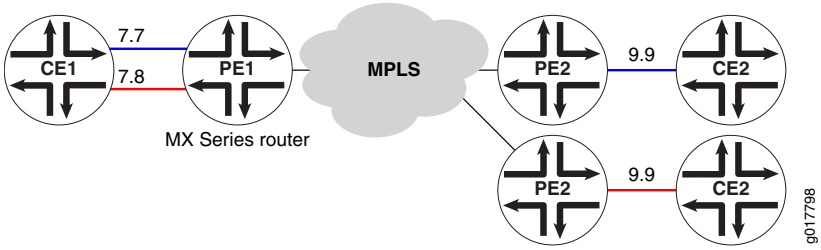
- ATM Cell Relay Pseudowire VPI/VCI Swapping Overview on page 100
- Configuring ATM Cell-Relay Pseudowire VPI/VCI Swapping on page 101
- *allow-any-vci*
- no-vpivci-swapping on page 129
- psn-vci (ATM CCC Cell-Relay Promiscuous Mode VPI/VCI Swapping) on page 130
- psn-vpi (ATM CCC Cell-Relay Promiscuous Mode VPI/VCI Swapping) on page 131
- *vci*
- *vpi*

ATM Cell Relay Pseudowire VPI/VCI Swapping Overview

In ATM cell-relay mode, one or more ATM cells are bundled together to form a packet that is sent across the packet-switched network (PSN) using MPLS. In this mode, each ATM cell and its header are transported over the MPLS cloud. The ATM header consisting of the VPI and VCI values is transported across the MPLS cloud or the backhaul network. You can configure the ATM MIC to swap the VPI value, the VCI value, or both. You can swap the VPI and VCI values in both directions (ingress and egress). You can also enable swapping only on the egress side. Further, you can disable swapping of the values.

Figure 13 on page 100 illustrates a sample application based on the mobile backhaul reference model.

Figure 13: ATM Cell Relay Pseudowire VPI/VCI Swapping



In the case of ingress swapping, PE1 (MX Series router with ATM MIC with SFP) swaps the ATM value (7.7 or 7.8) for the configured PSN value (9.9). PE2 transmits the cell without making any change.

In the case of egress swapping, PE1 (MX Series router with ATM MIC with SFP) swaps the PSN value (9.9) for the local ATM value. The local ATM value depends on the ATM pseudowire on which the value arrived. In this example, it can be either 7.7 or 7.8.

NOTE: **This feature is not supported in port-promiscuous mode.**

The following guidelines apply to configuring the ATM MIC for swapping:

NOTE: **In the case of promiscuous ports, no swapping is done because the feature is not supported. Values in the ATM cell are inserted into the pseudowire unchanged.**

Each locally configured virtual path connection (VPC) or virtual channel connection (VCC) might be assigned a PSN VPI value or a PSN VCI value such that:

- In the case of VCCs, the mapping is between the ATM identifier and the PSN identifier.
- In the case of VPCs, the mapping is between the ATM identifier and the PSN identifier. No change is made to the VCI.

The following rule applies when the MIC inserts the VPI or VCI values in the outgoing pseudowire cell headers—that is, in case of ingress swapping:

- VCCs or promiscuous VPCs—For a given ATM value, the specified PSN identifier is inserted in the outgoing pseudowire cell header.

  If no PSN value is specified, then the MIC does not perform ingress swapping. The value inserted in the pseudowire cell header is the one found the in ATM cell.

The following rule applies when the MIC inserts the VPI or VCI values in the outgoing ATM cells—that is, in case of egress swapping:

- VCCs or promiscuous VPCs—By default, the MIC performs egress swapping. The ATM identifier is inserted in the outgoing ATM cell irrespective of the value in the pseudowire cell header. If the **no-vpivci-swapping** statement is present, no swapping is performed and the value in the pseudowire is transmitted as is.

Related Documentation

- Configuring ATM Cell-Relay Pseudowire VPI/VCI Swapping on page 101
- **no-vpivci-swapping on page 129**
- **psn-vci on page 130**
- **psn-vpi on page 131**

Configuring ATM Cell-Relay Pseudowire VPI/VCI Swapping

Starting in Junos OS Release 12.1, on MX Series routers with ATM MIC with SFP, you can configure the ATM MIC to swap the VPI value, the VCI value, or both. You can also disable swapping of the VPI or VCI values. You can opt to swap the VPI and VCI values in both directions (ingress and egress). You can also enable swapping only on the egress side. In VPC mode, only the VPI values are swapped.

You can configure the ATM MIC on the local PE router to swap only VPI values in both directions when the remote PE router does not perform any swapping. If the remote PE router performs egress swapping by default, you can configure the ATM MIC on the local PE router to swap only in the egress direction. If you want to disable swapping, you can configure both the local and remote PE router to disable swapping.

This topic includes the following tasks:

- Configuring VPI Swapping on Egress and Ingress on ATM MICs on page 101
- Configuring Egress Swapping on ATM MICs on page 103
- Disabling Swapping on Local and Remote Provider Edge Routers on page 105

Configuring VPI Swapping on Egress and Ingress on ATM MICs

This procedure describes the steps to configure swapping on the local PE router where the ATM MIC swaps in both directions (egress and ingress). You can also explicitly disable swapping on the remote PE router.

NOTE: The configuration included here is specific to VPI or VCI swapping and does not include the entire ATM pseudowire configuration. For information on ATM pseudowire configuration, see "Configuring ATM Cell-Relay Pseudowire" on page 96

To configure the local PE router to perform swapping in both directions:

1. To specify the VPI value as 1 on unit 1, include the **vpi *vpi-identifier*** statement at the **[edit interfaces *interface-name*]** hierarchy level.

   ```
   [edit interfaces at-0/2/2]
   user@host#set unit 1 vpi 1
   ```

2. To specify the PSN identifier as 11 on unit 1, include the **psn-vpi *psn-vpi-identifier*** statement at the **[edit interfaces *interface-name*]** hierarchy level.

   ```
   [edit interfaces at-0/2/2 ]
   user@host#set unit 1 psn-vpi 11
   ```

3. To specify the VPI value as 2 on unit 2, include the **vpi *vpi-identifier*** statement at the **[edit interfaces *interface-name*]** hierarchy level.

   ```
   [edit interfaces at-0/2/2]
   user@host#set unit 2 vpi 2
   ```

4. To specify the PSN identifier as 11 on unit 2, include the **psn-vpi *psn-vpi-identifier*** statement at the **[edit interfaces *interface-name*]** hierarchy level.

   ```
   [edit interfaces at-0/2/2 ]
   user@host#set unit 2 psn-vpi 11
   ```

5. To verify the configuration, you can issue the following operational mode command in configuration mode:

   ```
   [edit]
   user@host#show at-0/2/2
   ```

   ```
   ..
   unit 1{
   vpi 1;
   psn-vpi 11;
   }
   unit 2 {
   vpi 2;
   psn-vpi 11;
   }
   ..
   ```

To disable swapping by the remote PE router:

1. To specify the VPI value as 11 on unit 1, include the **vpi *vpi-identifier*** statement at the **[edit interfaces *interface-name*]** hierarchy level.

```
[edit interfaces at-0/2/2]
user@host#set unit 1 vpi 11
```

2. To disable swapping on the remote PE router on unit 1, include the **no-vpivci-swapping** statement at the **[edit interfaces *interface-name*]** hierarchy level.

```
[edit interfaces at-0/2/2 ]
user@host#set unit 1 no-vpivci-swapping
```

3. To specify the VPI value as 11 on unit 2, include the **vpi *vpi-identifier*** statement at the **[edit interfaces *interface-name*]** hierarchy level.

```
[edit interfaces at-0/2/2]
user@host#set unit 2 vpi 11
```

4. To disable swapping on the remote PE router on unit 2, include the **no-vpivci-swapping** statement at the **[edit interfaces *interface-name*]** hierarchy level.

```
[edit interfaces at-0/2/2 ]
user@host#set unit 2 no-vpivci-swapping
```

5. To verify the configuration, you can issue the following operational mode command in configuration mode:

```
[edit]
user@host#show at-0/2/2
```

```
..
unit 1{
vpi 11;
no-vpivci-swapping;
}
unit 2 {
vpi 11;
no-vpivci-swapping ;
}
..
```

Configuring Egress Swapping on ATM MICs

If the remote PE router only performs egress swapping, you must configure the local PE router to perform egress swapping as well. This procedure describes the steps to configure egress swapping on both the local and remote PE routers.

NOTE: The configuration included here is specific to VPI or VCI swapping and does not include the entire ATM pseudowire configuration. For information on ATM pseudowire configuration, see "Configuring ATM Cell-Relay Pseudowire" on page 96

To configure the local PE router to perform egress swapping:

1. To specify the VPI value as 1 on unit 1, include the **vpi *vpi-identifier*** statement at the **[edit interfaces *interface-name*]** hierarchy level.

   ```
   [edit interfaces at-0/2/2]
   user@host#set unit 1 vpi 1
   ```

2. To specify the VPI value as 2 on unit 2, include the **vpi *vpi-identifier*** statement at the **[edit interfaces *interface-name*]** hierarchy level.

   ```
   [edit interfaces at-0/2/2]
   user@host#set unit 2 vpi 2
   ```

3. To verify the configuration, you can issue the following operational mode command in configuration mode:

   ```
   [edit]
   user@host#show at-0/2/2
   ```

   ```
   ..
   unit 1{
   vpi 1;
   }
   unit 2 {
   vpi 2;
   }
   ..
   ```

To configure the remote PE router:

1. To specify the VPI value as 11 on unit 1, include the **vpi *vpi-identifier*** statement at the **[edit interfaces *interface-name*]** hierarchy level:

   ```
   [edit interfaces at-0/2/2]
   user@host#set unit 1 vpi 11
   ```

2. To specify the VPI value as 11 on unit 2, include the **vpi *vpi-identifier*** statement at the **[edit interfaces *interface-name*]** hierarchy level:

   ```
   [edit interfaces at-0/2/2]
   user@host#set unit 2 vpi 11
   ```

3. To verify the configuration, you can issue the following operational mode command in configuration mode:

   ```
   [edit]
   user@host#show at-0/2/2
   ```

   ```
   ..
   unit 1{
   vpi 11;
   }
   unit 2 {
   vpi 11;
   ```

```
}
..
```

Disabling Swapping on Local and Remote Provider Edge Routers

To explicitly disable swapping, you must use the no-vpivci-swapping statement. When cell relay of many VPCs and VCCs happens over the same pseudowire, it is recommended that you explicitly disable swapping. This procedure describes the steps to explicitly disable swapping on both the local and remote provider edge (PE) routers.

NOTE: The configuration included here is specific to VPI or VCI swapping and does not include the entire ATM pseudowire configuration. For information on ATM pseudowire configuration, see "Configuring ATM Cell-Relay Pseudowire" on page 96

To disable swapping on the local PE router:

1. To specify the VPI value as 1 on unit 1, include the **vpi *vpi-identifier*** statement at the **[edit interfaces *interface-name*]** hierarchy level.

   ```
   [edit interfaces at-0/2/2]
   user@host#set unit 1 vpi 1
   ```

2. To disable swapping, include the **no-vpivci-swapping** statement at the **[edit interfaces *interface-name*]** hierarchy level.

   ```
   [edit interfaces at-0/2/2]
   user@host#set unit 1 no-vpivci-swapping
   ```

3. To specify the VPI value as 2 on unit 2, include the **vpi *vpi-identifier*** statement at the **[edit interfaces *interface-name*]** hierarchy level.

   ```
   [edit interfaces at-0/2/2]
   user@host#set unit 2 vpi 2
   ```

4. To disable swapping, include the **no-vpivci-swapping** statement at the **[edit interfaces *interface-name*]** hierarchy level.

   ```
   [edit interfaces at-0/2/2]
   user@host#set unit 2 no-vpivci-swapping
   ```

5. To verify the configuration, you can issue the following operational mode command in configuration mode:

   ```
   [edit]
   user@host#show at-0/2/2
   ```

   ```
   ..
   unit 1{
   vpi 1;
   no-vpivci-swapping
   ```

```
}
unit 2{
vpi 2;
no-vpivci-swapping;
}
..
```

To disable swapping on the remote PE router:

1. To specify the VPI value as 1 on unit 1, include the **vpi *vpi-identifier*** statement at the **[edit interfaces *interface-name*]** hierarchy level.

   ```
   [edit interfaces at-0/2/2]
   user@host#set unit 1 vpi 1
   ```

2. To disable swapping on unit 1, include the **no-vpivci-swapping** statement at the **[edit interfaces *interface-name*]** hierarchy level.

   ```
   [edit interfaces at-0/2/2]
   user@host#set unit 1 no-vpivci-swapping
   ```

3. To specify the VPI value as 2 on unit 2, include the **vpi *vpi-identifier*** statement at the **[edit interfaces *interface-name*]** hierarchy level.

   ```
   [edit interfaces at-0/2/2]
   user@host#set unit 2 vpi 2
   ```

4. To disable swapping on unit 2, include the **no-vpivci-swapping** statement at the **[edit interfaces *interface-name*]** hierarchy level.

   ```
   [edit interfaces at-0/2/2]
   user@host#set unit 2 no-vpivci-swapping
   ```

5. To verify the configuration, you can issue the following operational mode command in configuration mode:

   ```
   [edit]
   user@host#show at-0/2/2
   ```

```
..
unit 1{
vpi 1;
no-vpivci-swapping;
}
unit 2 {
vpi 2;
no-vpivci-swapping;
}
..
```

Related Documentation

- ATM Cell Relay Pseudowire VPI/VCI Swapping Overview on page 100
- *allow-any-vci*

- no-vpivci-swapping on page 129
- psn-vci on page 130
- psn-vpi on page 131
- *vci*
- *vpi*

Configuring Layer 2 Circuit and Layer 2 VPN Pseudowires

ATM Layer 2 circuit and Layer 2 VPN pseudowires are configured using the same syntax described for ATM2 PICs.

To configure an ATM Layer 2 circuit and a Layer 2 VPN pseudowire.

1. Go to the **[edit protocols]** hierarchy level.

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

2. Configure a Layer 2 circuit over MPLS with a neighbor IP address (that is loopback address on the remote router) with the interface name (that is, the Circuit Emulation PIC ATM interface configured for CCC encapsulation).

   ```
   [edit protocols]
   user@host# edit l2circuit neighbor ip-address interface interface-name
   ```

3. Configure a virtual circuit identifier for this Layer 2 circuit from 1 through 4294,967,295.

   ```
   [edit protocols l2circuit neighbor ip-address interface interface-name]
   user@host# set virtual-circuit-id id
   ```

Configure the MPLS parameters and the other routing configuration as needed.

Related Documentation

- ATM Support on Circuit Emulation PICs Overview on page 71

Configuring EPD Threshold

ATM encapsulations provide congestion control via early packet discard (EPD) thresholds on a per logical interface basis. For Circuit Emulation PICs, the EPD number specifies the number of packets (or frames or cell bundles). The EPD threshold is a limit on the number of transmit packets that can be queued. Packets that exceed the limit are discarded. For ATM2 IQ interfaces only, you must define the EPD threshold on a virtual circuit (VC).

To configure EPD threshold.

1. Go to the **[edit interfaces at-*fpc/pic/port*]** hierarchy level.

   ```
   [edit]
   user@host# edit interfaces at-fpc/pic/port
   ```

2. Configure a name for the **scheduler-maps** statement in the ATM interface-specific options.

   [edit interfaces at-*fpc/pic/port*]
   user@host# **edit atm-options scheduler-maps** *map-name*

3. Configure a forwarding class name which acts as a scheduling parameter associated with the forwarding class.

   [edit interfaces at-*fpc/pic/port* atm-options scheduler-maps *map-name*]
   user@host# **edit forwarding-class** *class-name*

4. Configure an EPD threshold value and an EPD threshold value for PLP 1.

   [edit interfaces at-*fpc/pic/port* atm-options scheduler-maps *map-name*
   forwarding-class *class-name*]
   user@host# **set epd-threshold** *cells* **plp1** *cells*

Related Documentation

- ATM Support on Circuit Emulation PICs Overview on page 71

Configuring ATM QoS or Shaping

M7i, M10i, M40e, M120, and M320 routers with 4-port channelized OC3/STM1 Circuit Emulation PICs and 12-port T1/E1 Circuit Emulation PICs and MX Series routers with Channelized OC3/STM1 (Multi-Rate) Circuit Emulation MIC with SFP and 16-Port Channelized E1/T1 Circuit Emulation MIC support ATM pseudowire service with QoS features for ingress and egress direction traffic shaping. Policing is performed by monitoring the configured parameters on the incoming traffic and is also referred to as ingress shaping. Egress shaping uses queuing and scheduling to shape the outgoing traffic. Classification is provided per virtual circuit (VC).

To configure QoS shaping for Circuit Emulation PICs, use the **shaping** statement and its subordinate statements at the **[edit interfaces at-*fpc/pic/port* unit *n*]** hierarchy level. Most Circuit Emulation PIC QoS CLI commands are similar to those used for the ATM2 PIC QoS features. The interface configuration is sent to the PIC and the PIC driver configures the PIC appropriately.

Example: Shaping for Logical Interfaces in Port Promiscuous Mode

Shaping for logical interfaces in port promiscuous mode is configured under the following hierarchy:

```
interfaces {
  at-fpc/pic/port{
    atm-options {
      pic-type atm-ce;
      promiscuous-mode {
        vpi 0;
        vpi 1;
      }
    }
    unit 0 {
      encapsulation atm-ccc-cell-relay;
```

```
      vpi 0;
    }
    unit 1 {
      encapsulation atm-ccc-cell-relay;
      vpi 1;
      shaping {
        cbr|rtvbr|vbr {
          <shaping specific parameters>
        }
      }
    }
  }
}
```

Example: Shaping for Logical Interfaces in VC Mode

Shaping for logical interfaces in VC mode is configured under the following hierarchy:

```
at-fpc/pic/port{
  atm-options {
    pic-type atm-ce;
    vpi 0;
    vpi 1;
  }
  unit 0 {
    encapsulation atm-ccc-cell-relay;
    vci 0.100;
  }
  unit 1 {
    encapsulation atm-ccc-cell-relay;
    vci 1.100;
    shaping {
      cbr|rtvbr|vbr {
        <shaping specific parameters>
      }
    }
  }
  }
}
```

The Routing Engine and the Packet Forwarding Engine prefix the packet with information including a field that indicates the queue number associated with the VC.

Circuit Emulation PICs internally define queue 0 for CBR, queue 1 for RTVBR, queue 2 for VBR, and queue 3 for UBR.

Example: Shaping for Logical Interfaces in VC Mode with a Policer

You can similarly configure shaping for a policer configuration under the following similar configuration, but you must additionally use the policer required **shaping specific parameters (cdvt)** statement option:

```
at-fpc/pic/port{
  atm-options {
    pic-type atm-ce;
    vpi 0;
    vpi 1;
  }
  unit 0 {
```

```
        encapsulation atm-ccc-cell-relay;
        vci 0.100;
      }
      unit 1 {
        encapsulation atm-ccc-cell-relay;
        vci 1.100;
        shaping {
          cbr|rtvbr|vbr {
            <shaping specific parameters> cdvt
          }
        }
      }
      }
    }
```

Related Documentation

- ATM Support on Circuit Emulation PICs Overview on page 71
- *shaping*

PART 3

Troubleshooting Information

CHAPTER 7

Troubleshooting Circuit Emulation Interfaces

Displaying Information About Circuit Emulation PICs

Use the CLI *show chassis hardware* command to display information about the PIC configuration.

- For a T1 Circuit Emulation PIC configuration, the output designation is **T1 CE**.
- For an E1 Circuit Emulation PIC configuration, the output designation is **E1 CE**.
- For a COC3 Circuit Emulation PIC configuration, the output designation is **COC1 CE**.
- For a CSTM1 Circuit Emulation PIC configuration, the output designation is **CSTM1 CE**.
- For a OC3/STM1 or OC12/STM4 Circuit Emulation ATM MIC configuration, the output designation is **2xOC12/8xOC3 CC-CE**.

Related Documentation

- Understanding Circuit Emulation Services and the Supported PIC Types on page 3
- Configuring the 4-Port Channelized COC3/STM1 Circuit Emulation PIC on page 74
- Configuring the 12-Port Channelized T1/E1 Circuit Emulation PIC on page 76

Configuring Interface Diagnostics Tools to Test the Physical Layer Connections

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, *N*xDS0, 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 11 on page 115 shows the loopback modes supported on the various interface types.

Table 11: Loopback Modes by Interface Type

Interface	Loopback Modes	Usage Guidelines
Aggregated Ethernet, Fast Ethernet, Gigabit Ethernet	Local	*Configuring Ethernet Loopback Capability*
Circuit Emulation E1	Local and remote	*Configuring E1 Loopback Capability*
Circuit Emulation T1	Local and remote	*Configuring T1 Loopback Capability*
E1 and E3	Local and remote	*Configuring E1 Loopback Capability* and *Configuring E3 Loopback Capability*
*N*xDS0	Payload	*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*
Serial (V.35 and X.21)	Local and remote	*Configuring Serial Loopback Capability*
Serial (EIA-530)	DCE local, DCE remote, local, and remote	*Configuring Serial Loopback Capability*
SONET/SDH	Local and remote	*Configuring SONET/SDH Loopback Capability to Identify a Problem as Internal or External*
T1 and T3	Local, payload, and remote	*Configuring T1 Loopback Capability* and *Configuring T3 Loopback Capability* See also *Configuring the T1 Remote Loopback Response*

To configure loopback testing, include the **loopback** statement:

```
user@host# loopback mode;
```

You can include this statement at the following hierarchy levels:

- **[edit interfaces *interface-name* aggregated-ether-options]**
- **[edit interfaces *interface-name* ds0-options]**
- **[edit interfaces *interface-name* e1-options]**
- **[edit interfaces *interface-name* e3-options]**
- **[edit interfaces *interface-name* fastether-options]**
- **[edit interfaces *interface-name* gigether-options]**
- **[edit interfaces *interface-name* serial-options]**

- **[edit interfaces *interface-name* sonet-options]**
- **[edit interfaces *interface-name* t1-options]**
- **[edit interfaces *interface-name* t3-options]**

Configuring BERT Testing

To configure BERT:

- Configure the duration of the test.

  [edit interfaces *interface-name interface-type*-options]
  user@host#bert-period *seconds*;

  You can configure the BERT period to last from 1 through 239 seconds on some PICs and from 1 through 240 seconds on other PICs. By default, the BERT period is 10 seconds.

- Configure the error rate to monitor when the inbound pattern is received.

  [edit interfaces *interface-name interface-type*-options]
  user@host#bert-error-rate *rate*;

  rate is the bit error rate. This can be an integer from 0 through 7, which corresponds to a bit error rate from 10^{-0} (1 error per bit) to 10^{-7} (1 error per 10 million bits).

- Configure the bit pattern to send on the transmit path.

  [edit interfaces *interface-name interface-type*-options]
  user@host#bert-algorithm *algorithm*;

  algorithm is the pattern to send in the bit stream. For a list of supported algorithms, enter a **?** after the **bert-algorithm** statement; for example:

```
[edit interfaces t1-0/0/0 t1-options]

user@host# set bert-algorithm ?
Possible completions:
  pseudo-2e11-o152     Pattern is 2^11 -1 (per 0.152 standard)
  pseudo-2e15-o151     Pattern is 2^15 - 1 (per 0.152 standard)
  pseudo-2e20-o151     Pattern is 2^20 - 1 (per 0.151 standard)
  pseudo-2e20-o153     Pattern is 2^20 - 1 (per 0.153 standard)
        ...
```

For specific hierarchy information, see the individual interface types.

NOTE: The four-port E1 PIC supports only the following algorithms:

```
pseudo-2e11-o152     Pattern is 2^11 -1 (per 0.152 standard)
pseudo-2e15-o151     Pattern is 2^15 - 1 (per 0.151 standard)
pseudo-2e20-o151     Pattern is 2^20 - 1 (per 0.151 standard)
pseudo-2e23-o151     Pattern is 2^23 (per 0.151 standard)
```

When you issue the help command from the CLI, all BERT algorithm options are displayed, regardless of the PIC type, and no commit check is available. Unsupported patterns for a PIC type can be viewed in system log messages.

NOTE: The 12-port T1/E1 Circuit Emulation (CE) PIC supports only the following algorithms:

```
all-ones-repeating   Repeating one bits
all-zeros-repeating  Repeating zero bits
alternating-double-ones-zeros  Alternating pairs of ones and zeros
alternating-ones-zeros  Alternating ones and zeros
pseudo-2e11-o152     Pattern is 2^11 -1 (per O.152 standard)
pseudo-2e15-o151     Pattern is 2^15 - 1 (per O.151 standard)
pseudo-2e20-o151     Pattern is 2^20 - 1 (per O.151 standard)
pseudo-2e7           Pattern is 2^7 - 1
pseudo-2e9-o153      Pattern is 2^9 - 1 (per O.153 standard)
repeating-1-in-4     1 bit in 4 is set
repeating-1-in-8     1 bit in 8 is set
repeating-3-in-24    3 bits in 24 are set
```

When you issue the help command from the CLI, all BERT algorithm options are displayed, regardless of the PIC type, and no commit check is available. Unsupported patterns for a PIC type can be viewed in system log messages.

NOTE: The IQE PICs support only the following algorithms:

```
all-ones-repeating   Repeating one bits
all-zeros-repeating  Repeating zero bits
alternating-double-ones-zeros  Alternating pairs of ones and zeros
alternating-ones-zeros  Alternating ones and zeros
pseudo-2e9-o153      Pattern is 2^9  -1 (per O.153 (511 type) standard)
pseudo-2e11-o152     Pattern is 2^11 -1 (per O.152 and O.153 (2047 type)
 standards)
pseudo-2e15-o151     Pattern is 2^15 -1 (per O.151 standard)
pseudo-2e20-o151     Pattern is 2^20 -1 (per O.151 standard)
pseudo-2e20-o153     Pattern is 2^20 -1 (per O.153 standard)
pseudo-2e23-o151     Pattern is 2^23 -1 (per O.151 standard)
repeating-1-in-4     1 bit in 4 is set
repeating-1-in-8     1 bit in 8 is set
repeating-3-in-24    3 bits in 24 are set
```

When you issue the help command from the CLI, all BERT algorithm options are displayed, regardless of the PIC type, and no commit check is available. Unsupported patterns for a PIC type can be viewed in system log messages.

NOTE: BERT is supported on the PDH interfaces of the Channelized SONET/SDH OC3/STM1 (Multi-Rate) MIC with SFP and the DS3/E3 MIC. The following BERT algorithms are supported:

```
all-ones-repeating             Repeating one bits
all-zeros-repeating            Repeating zero bits
alternating-double-ones-zeros  Alternating pairs of ones and zeros
alternating-ones-zeros         Alternating ones and zeros
repeating-1-in-4               1 bit in 4 is set
repeating-1-in-8               1 bit in 8 is set
repeating-3-in-24              3 bits in 24 are set
pseudo-2e9-o153                Pattern is 2^9 - 1 (per 0.153 standard)
pseudo-2e11-o152               Pattern is 2^11 - 1 (per 0.152 standard)
pseudo-2e15-o151               Pattern is 2^15 - 1 (per 0.151 standard)
pseudo-2e20-o151               Pattern is 2^20 - 1 (per 0.151 standard)
pseudo-2e20-o153               Pattern is 2^20 - 1 (per 0.153 standard)
pseudo-2e23-o151               Pattern is 2^23 (per 0.151 standard)
```

Table 12 on page 118 shows the BERT capabilities for various interface types.

Table 12: BERT Capabilities by Interface Type

Interface	T1 BERT	T3 BERT	Comments
12-port T1/E1 Circuit Emulation	Yes (ports 0–11)	—	• Limited algorithms
4-port Channelized OC3/STM1 Circuit Emulation	Yes (port 0–3)	—	• Limited algorithms
E1 or T1	Yes (port 0–3)	Yes (port 0–3)	• Single port at a time • Limited algorithms
E3 or T3	Yes (port 0–3)	Yes (port 0–3)	• Single port at a time
Channelized OC12	—	Yes (channel 0–11)	• Single channel at a time • Limited algorithms • No bit count
Channelized STM1	Yes (channel 0–62)	—	• Multiple channels • Only one algorithm • No error insert • No bit count
Channelized T3 and Multichannel T3	Yes (channel 0–27)	Yes (port 0–3 on channel 0)	• Multiple ports and channels • Limited algorithms for T1 • No error insert for T1 • No bit count for T1

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)*

PART 4

Configuration Statements and Operational Commands

CHAPTER 8

Configuration Statements

cesopsn-options

Syntax

```
cesopsn-options {
  excessive-packet-loss-rate {
    sample-period milliseconds;
    threshold percentile;
  }
  idle-pattern pattern;
  jitter-buffer-latency milliseconds;
  jitter-buffer-packets packets;
  packetization-latency microseconds;
}
```

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced in Junos OS Release 12.2R1.
Statement introduced in Junos OS Release 12.3R1 for ACX Series Universal Metro Routers.

Description Set Circuit Emulation Service over Packet-Switched Network (CESoPSN) protocol options.

Options You can configure the following CESoPSN options:

- **idle-pattern**—An 8-bit hexadecimal pattern to replace TDM data in a lost packet (from 0 through 255).
- **jitter-buffer-packets**—Number of packets in the jitter buffer (from 1 through 64 packets).
- **jitter-buffer-latency**—Time delay in the jitter buffer (from 1 through 1000 milliseconds).
- **packetization-latency**—Time required to create packets (from 1000 through 8000 microseconds).
- **excessive-packet-loss-rate**—Set packet loss options. The option is **sample-period**.
  - **sample-period**—Time required to calculate the excessive packet loss rate (from 1000 through 65,535 milliseconds).
  - **threshold**—Percentile designating the threshold of excessive packet loss rate (1–100 percent).

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Setting the CESoPSN Options on page 51

event (CFM)

Syntax

```
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*
- *interface-status-tlv*
- *port-status-tlv*

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*

ima-group-options

Syntax

```
ima-group-options {
  differential-delay number;
  frame-length (32 |64 |128 |256);
  frame-synchronization {
    alpha number;
    beta number;
    gamma number;
  }
  minimum-links number;
  symmetry (symmetrical-config-and-operation |
    symmetrical-config-asymmetrical-operation);
  test-procedure {
    ima-test-start;
    ima-test-stop;
    interface name;
    pattern number;
    period number;
  }
  transmit-clock (common |independent);
  version (1.0 |1.1);
}
```

Hierarchy Level [edit interfaces (t1-*fpc/pic/port*:*m*:*n* | e1-*fpc/pic/port*:*n* | t1|e1-*fpc/pic/port*)]

Release Information Statement introduced in Junos OS Release 10.0.
Statement introduced in Junos OS Release 12.2 for the ACX Series Universal Metro Routers.

Description Specify IMA group options.

Options

differential-delay *msec*—Maximum differential delay among links in msec.

Range: 1 through 56

Default: 25

frame-length (32 |64 |128 |256)—IMA frame length in number of cells.

Default: 128

frame-synchronization—IMA group frame synchronization selection.

alpha *number*—Number of consecutive invalid ICP cells for IFSM.

Range: 1 through 2

Default: 2

beta *number*—Number of consecutive errored ICP cells for IFSM.

Range: 1 through 2

Default: 2

gamma *number*—Number of consecutive valid ICP cells for IFSM.

Range: 1 through 5
Default: 1

minimum-links *number*—IMA group minimum active links.
Range: 1 through 8
Default: 1

symmetry (symmetrical-config-and-operation | symmetrical-config-asymmetrical-operation)—IMA group symmetry mode selection.

test-procedure—Specify an IMA link interface test.

ima-test-start—Start IMA group test.

ima-test-stop—Stop IMA group test.

interface *name*—Interface name of the IMA link to test.

pattern *number*—IMA test pattern.
Range: 1 through 254
Default: 170

period *seconds*—Length of IMA pattern test in seconds.
Range: 1 through 4,294,967,294.
Default: 10

transmit-clock (common |independent)—Transmit clock configuration.
Default: common

version (1.0 |1.1)—IMA specification version.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- ATM Support on Circuit Emulation PICs Overview on page 71
- **ima-link-options on page 129**
- Understanding Inverse Multiplexing for ATM on page 80

ima-link-options

Syntax ima-link-options group *g*

Hierarchy Level [edit interfaces (t1-*fpc/pic/port*:*m*:*n* | e1-*fpc/pic/port*:*n* | t1|e1-*fpc/pic/port*)]

Release Information Statement introduced in Junos OS Release 10.0.
Statement introduced in Junos OS Release 12.2 for the ACX Series Universal Metro Routers.

Description Specify an interface as a member of an IMA group.

Options **group *g***—Implying **at-*x/y/g***.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
- ATM Support on Circuit Emulation PICs Overview on page 71
- **ima-group-options on page 127**
- *Obsolete: Inverse Multiplexing for ATM (IMA) Overview*

no-vpivci-swapping

Syntax no-vpivci-swapping;

Hierarchy Level [edit interfaces at-*fpc/pic/port* unit *logical-unit-number*]

Release Information Statement introduced in Junos OS Release 12.1.

Description Disable the swapping of VPI and VCI values in ATM CCC cell-relay mode on ATM MICs. The VPI and VCI values are not modified on ingress or egress. This statement is compatible with the ATM policing feature.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
- *Configuring ATM Cell-Relay Promiscuous Mode*

payload-size

Syntax payload-size *bytes* ;

Hierarchy Level [edit interfaces *interface-name* satop-options]

Release Information Statement introduced in Junos OS Release 9.3.

Description Specify the **satop-options** payload size in integer number of bytes.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
- ATM Support on Circuit Emulation PICs Overview on page 71
- satop-options on page 132

psn-vci (ATM CCC Cell-Relay Promiscuous Mode VPI/VCI Swapping)

Syntax psn-vci *psn-vci-identifier*;

Hierarchy Level [edit interfaces at-*fpc/pic/port* unit *logical-unit-number*]

Release Information Statement introduced in Junos OS Release 12.1.
Statement introduced in Junos OS Release 12.2 for the ACX Series Universal Metro Routers.

Description (MX Series routers) Swap both the VPI and VCI values on both egress and ingress in ATM CCC cell-relay mode on ATM MICs. This statement is not compatible with the ATM policing feature.

Options ***psn-vci-identifier***—ATM PSN virtual circuit identifier.
Range: 0 through 255

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
- *Configuring ATM Cell-Relay Promiscuous Mode*

psn-vpi (ATM CCC Cell-Relay Promiscuous Mode VPI/VCI Swapping)

Syntax psn-vpi *psn-vpi-identifier*;

Hierarchy Level [edit interfaces at-*fpc/pic/port* unit *logical-unit-number*]

Release Information Statement introduced in Junos OS Release 12.1.
Statement introduced in Junos OS Release 12.2 for the ACX Series Universal Metro Routers.

Description (MX Series routers) Swap only the VPI values on both egress and ingress in ATM CCC cell-relay mode on ATM MICs. This statement is not compatible with the ATM policing feature.

Options ***psn-vpi-identifier***—ATM PSN virtual path identifier.

Range: 0 through 255

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- *Configuring ATM Cell-Relay Promiscuous Mode*

satop-options

Syntax

```
satop-options {
  excessive-packet-loss-rate {
    apply-groups group-name
    apply-groups-except group-name
    groups group-name
    sample-period milliseconds
    threshold percentile
  )
  idle-pattern pattern
  jitter-buffer-auto-adjust
  jitter-buffer-latency milliseconds
  jitter-buffer-packets packets
  payload-size bytes;
}
```

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced in Junos OS Release 9.3.
Statement introduced in Junos OS Release 12.2 for the ACX Series Universal Metro Routers.

Description Set Structure-Agnostic TDM over Packet (SAToP) protocol options.

On ACX Series routers, the following statements are not supported:

```
apply-groups group-name
apply-groups-except group-name
groups group-name
jitter-buffer-auto-adjust
```

Options **excessive-packet-loss-rate options**—Set packet loss options.

- **apply-groups *group-name***—Groups from which to inherit configuration data.
- **apply-groups-except *group-name***—Don't inherit configuration data from these groups.
- **groups *group-name***—Specify groups.
- **sample-period *milliseconds***—Number of milliseconds over which excessive packet loss rate is calculated.
- **threshold *percentile***—Percentile designating the threshold of excessive packet loss rate (from 1 to 100).

idle-pattern *pattern*—An 8–bit hexadecimal pattern to replace TDM data in a lost packet (from 0 to 255).

jitter-buffer-auto-adjust—Automatically adjust the jitter buffer.

NOTE: This option is not applicable on MX Series routers.

jitter-buffer-latency ***milliseconds***—Number of milliseconds delay in jitter buffer (from 1 to 1000 milliseconds).

jitter-buffer-packets ***packets***—Number of packets in jitter buffer (from 1 to 64).

payload-size ***bytes***—Payload size in integer number of bytes.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring SAToP on 4-Port Channelized OC3/STM1 Circuit Emulation MICs on page 19
- Configuring SAToP Emulation on T1/E1 Interfaces on 12-Port Channelized T1/E1 Circuit Emulation PICs on page 26
- ATM Support on Circuit Emulation PICs Overview on page 71

CHAPTER 9

Operational Commands

- show interfaces (ATM)
- show interfaces (T1, E1, or DS)
- show interfaces extensive

show interfaces (ATM)

Syntax

show interfaces at-*fpc/pic/port*
<brief | detail | extensive | terse>
<descriptions>
<media>
<snmp-index *snmp-index*>
<statistics>

Release Information

Command introduced before Junos OS Release 7.4.

Description

(M Series and T Series routers only) Display status information about the specified ATM interface.

Options

at-*fpc/pic/port*—Display standard information about the specified ATM 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 the SNMP index of the interface.

statistics—(Optional) Display static interface statistics.

Required Privilege Level

view

List of Sample Output

show interfaces (ATM, IMA Group) on page 151
show interfaces extensive (ATM IMA Group) on page 152
show interfaces (ATM1, SONET Mode) on page 153
show interfaces brief (ATM1, SONET Mode) on page 154
show interfaces detail (ATM1, SONET Mode) on page 154
show interfaces extensive (ATM1, SONET Mode) on page 155
show interfaces (ATM2, SDH Mode) on page 157
show interfaces brief (ATM2, SDH Mode) on page 158
show interfaces detail (ATM2, SDH Mode) on page 159
show interfaces extensive (ATM2, SDH Mode) on page 160
show interfaces (ATM2, SONET Mode) on page 163
show interfaces brief (ATM2, SONET Mode) on page 164
show interfaces detail (ATM2, SONET Mode) on page 165
show interfaces extensive (ATM2, SONET Mode) on page 167

Output Fields

Table 13 on page 137 lists the output fields for the **show interfaces** (ATM) command. Output fields are listed in the approximate order in which they appear.

Table 13: ATM show interfaces Output Fields

Field Name	Field Description	Level of Output
Physical Interface		
Physical interface	Name of the physical interface.	All levels
Enabled	State of the interface. Possible values are described in the "Enabled Field" section under *Common Output Fields Description*.	All levels
Description	Configured interface description.	All levels
Interface index	Physical interface's index number, which reflects its initialization sequence.	**detail extensive** none
SNMP ifIndex	SNMP index number for the physical interface.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Link-level type	Encapsulation being used on the physical interface: • **ATM-CCC-CELL-RELAY**—ATM cell relay for CCC. • **ATM-CCC-VC-MUX**—ATM virtual circuit (VC) for CCC. • **ATM-CISCO-NLPID**—Cisco-compatible ATM NLPID encapsulation. • **ATM-MIPP-LLC**—ATM MLPPP over ATM Adaptation Layer 5 (AAL5)/logical link control (LLC). • **ATM-NLPID**—ATM NLPID encapsulation. • **ATM-PPP-LLC**—ATM PPP over AAL5/LLC. • **ATM-PPP-VC-MUX**—ATM PPP over raw AAL5. • **ATM-PVC**—ATM permanent virtual circuits. • **ATM-SNAP**—ATM LLC/SNAP encapsulation. • **ATM-TCC-SNAP**—ATM LLC/SNAP for translational cross-connection. • **ATM-TCC-VC-MUX**—ATM VC for translational cross-connection. • **ATM-VC-MUX**—ATM VC multiplexing. • **ETHER-OVER-ATM-LLC**—Ethernet over ATM (LLC/SNAP) encapsulation. • **ETHER-VPLS-OVER-ATM-LLC**—Ethernet VPLS over ATM (bridging) encapsulation.	All levels
MTU	MTU size on the physical interface.	All levels
Clocking	Reference clock source: **Internal** or **External**.	All levels
***framing* Mode**	Framing mode: **SONET** or **SDH**.	All levels
Speed	Speed at which the interface is running as represented by the interface type (for example, **OC3**, **ADSL2+**, and **SHDSL(2-wire)**.	All levels
Loopback	Whether loopback is enabled and the type of loopback (**local** or **remote**).	All levels
Payload scrambler	Whether payload scrambling is enabled.	All levels

Table 13: ATM show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
Device flags	Information about the physical device. Possible values are described in the "Device Flags" section under *Common Output Fields Description*.	All levels
Link flags	Information about the link. Possible values are described in the "Link Flags" section under *Common Output Fields Description*.	All levels
CoS queues	Number of CoS queues configured.	**detail extensive** none
Hold-times	Current interface hold-time up and hold-time down, in milliseconds.	**detail extensive**
Current address	Ethernet MAC address for this interface for Ethernet over ATM encapsulation.	**detail extensive** none
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)**.	**detail extensive** none
Input Rate	Input rate in bits per second (bps) and packets per second (pps).	None specified
Output Rate	Output rate in bps and pps.	None specified
Statistics last cleared	Time when the statistics for the interface were last set to zero.	**detail extensive**
Traffic statistics	Statistics for traffic on the interface. • **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.	**detail extensive**

Table 13: ATM show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
Input errors	Input errors on the interface whose definitions are as follows: • **Errors**—Sum of the incoming frame aborts and frame check sequence (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 random early detection (RED) mechanism. • **Invalid VCs**—Number of cells that arrived for a nonexistent VC. • **Framing errors**—Sum of AAL5 packets that have FCS errors, reassembly timeout errors, and length errors. • **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. • **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. • **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. • **Resource errors**—Sum of transmit drops.	**extensive**
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 up, or another problem occurs. If the number of carrier transitions increments quickly, increasing only when the cable is unplugged, the far-end system is powered down and then up, or another problem occurs. If it 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. • **Aged packets**—Number of packets that remained so long in shared packet SDRAM 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. • **MTU errors**—Number of packets larger than the MTU threshold. • **Resource errors**—Sum of transmit drops.	**extensive**
Egress queues	Total number of egress queues supported on the specified interface.	**detail extensive**

Table 13: ATM show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
Queue counters	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: Physical interface queue counters of ATM2 PICs displayed by the **show interfaces at-*fpc/pic/port* detail** command show the packet forwarding stream statistics associated with the ATM2 ports. Since multiple ports of the ATM2 PICs (except for the ATM2 dual-port OC12) share one packet forwarding stream, the physical interface queue counters reflect the aggregate of ATM2 port statistics.	**detail extensive**
SONET alarms **SONET defects**	SONET media-specific defects that prevent the interface from passing packets. When a defect persists for a certain period, 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 light the red or yellow alarm LED on the craft interface. See these fields for possible alarms and defects: **SONET PHY**, **SONET section**, **SONET line**, and **SONET path**.	**detail extensive** none
SONET PHY	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. State other than **OK** indicates a problem. Subfields are: • **PLL Lock**—Phase-locked loop • **PHY Light**—Loss of optical signal	**extensive**
SONET section	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. 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**

Table 13: ATM show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
SONET line	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. 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**
SONET path	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. 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) • **ES-PFE**—Errored seconds (far-end STS path) • **SES-PFE**—Severely errored seconds (far-end STS path) • **UAS-PFE**—Unavailable seconds (far-end STS path)	**extensive**

Table 13: ATM show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
Received SONET overhead **Transmitted SONET overhead**	Values of the received and transmitted SONET overhead: • **C2**—Signal label. Allocated to identify the construction and content of the STS-level SPE and for PDI-P. • **F1**—Section user channel byte. This byte is set aside for the purposes of users. • **K1** and **K2**—These bytes are allocated for APS signaling for the protection of the multiplex section. • **J0**—Section trace. This byte is defined for STS-1 number 1 of an STS-*N* signal. Used to transmit a 1-byte fixed-length string or a 16-byte message so that a receiving terminal in a section can verify its continued connection to the intended transmitter. • **S1**—Synchronization status. The S1 byte is located in the first STS-1 of an STS-*N*. • **Z3** and **Z4**—Allocated for future use.	**extensive**
SDH alarms **SDH defects**	SDH media-specific defects that can prevent the interface from passing packets. When a defect persists for a certain period, 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 light the red or yellow alarm LED on the craft interface. See these fields for possible alarms and defects: **SDH PHY**, **SDH regenerator section**, **SDH multiplex section**, and **SDH path**.	All levels
SDH PHY	Active alarms and defects, plus counts of specific SDH 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. State other than **OK** indicates a problem. Subfields are: • **PLL Lock**—Phase-locked loop • **PHY Light**—Loss of optical signal	**extensive**
SDH regenerator section	Active alarms and defects, plus counts of specific SDH 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. State other than **OK** indicates a problem. Subfields are: • **RS-BIP8**—24-bit BIP for multiplex section overhead (B2 bytes) • **OOF**—Out of frame • **LOS**—Loss of signal • **LOF**—Loss of frame • **RS-ES**—Errored seconds (near-end regenerator section) • **RS-SES**—Severely errored seconds (near-end regenerator section) • **RS-SEFS**—Severely errored framing seconds (regenerator section)	**extensive**

Table 13: ATM show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
SDH multiplex section	Active alarms and defects, plus counts of specific SDH 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. State other than **OK** indicates a problem. Subfields are: • **MS-BIP24**—8-bit BIP for high-order path overhead (B3 byte) • **MS-FEBE**—Far-end block error (multiplex section) • **MS-FERF**—Far-end remote fail (multiplex section) • **MS-AIS**—Alarm indication signal (multiplex section) • **BERR-SF**—Bit error rate fault (signal failure) • **BERR-SD**—Bit error rate defect (signal degradation) • **MS-ES**—Errored seconds (near-end multiplex section) • **MS-SES**—Severely errored seconds (near-end multiplex section) • **MS-UAS**—Unavailable seconds (near-end multiplex section) • **MS-ES-FE**—Errored seconds (far-end multiplex section) • **MS-SES-FE**—Severely errored seconds (far-end multiplex section) • **MS-UAS-FE**—Unavailable seconds (far-end multiplex section)	**extensive**
SDH path	Active alarms and defects, plus counts of specific SDH 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. State other than **OK** indicates a problem. Subfields are: • **HP-BIP8**—8-bit BIP for regenerator section overhead (B1 byte) • **HP-FEBE**—Far-end block error (high-order path) • **HP-LOP**—Loss of pointer (high-order path) • **HP-AIS**—High-order-path alarm indication signal • **HP-FERF**—Far-end remote fail (high-order path) • **HP-UNEQ**—Unequipped (high-order path) • **HP-PLM**—Payload label mismatch (high-order path) • **HP-ES**—Errored seconds (near-end high-order path) • **HP-SES**—Severely errored seconds (near-end high-order path) • **HP-UAS**—Unavailable seconds (near-end high-order path) • **HP-ES-FE**—Errored seconds (far-end high-order path) • **HP-SES-FE**—Severely errored seconds (far-end high-order path) • **HP-UAS-FE**—Unavailable seconds (far-end high-order path)	**extensive**

Table 13: ATM show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
Received SDH overhead **Transmitted SDH overhead**	Values of the received and transmitted SONET overhead: • **C2**—Signal label. This byte is allocated to identify the construction and content of the STS-level SPE and for PDI-P. • **F1**—Section user channel byte. This byte is set aside for the purposes of users. • **K1** and **K2**—These bytes are allocated for APS signaling for the protection of the multiplex section. • **J0**—Section trace. This byte is defined for STS-1 number 1 of an STS-*N* signal. This bye is used to transmit a 1-byte fixed-length string or a 16-byte message so that a receiving terminal in a section can verify its continued connection to the intended transmitter. • **S1**—Synchronization status. The S1 byte is located in the first STS-1 of an STS-*N*. • **Z3** and **Z4**—These bytes are allocated for future use.	**extensive**
Received path trace **Transmitted path trace**	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.	**extensive**
ATM Status	ATM state information: • **HCS State**—Status of the header check sequence. ATM uses the HCS field in the cell header in the cell delineation process to frame ATM cell boundaries. The HCS is an FCS-8 calculation over the first four octets of the ATM cell header. • **LOC**—Current loss of cell (LOC) delineation state. **OK** means that no LOC is currently asserted.	**extensive**

Table 13: ATM show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
ATM Statistics	ATM statistics for the interface: • **Uncorrectable HCS errors**—Number of cells dropped because the cell delineation failed. These errors most likely indicate that a SONET/SDH layer problem has occurred. • **Correctable HCS errors**—Number of correctable HCS errors that occurred. The cell delineation process can recover from these errors and locate the ATM cell boundary, although the framing process is not quite stable. The ATM cell is not dropped. This counter increases when the cell delineation process changes its state from **present** to **sync** (for example, when a cable is plugged into the interface). The following error statistics are from the framer: • **Tx cell FIFO overruns**—Number of overruns in the transmit FIFO. • **Rx cell FIFO overruns**—Number of overruns in the receive FIFO. • **Rx cell FIFO underruns**—Number of underruns in the receive FIFO. • **Input cell count**—Number of ATM cells received by the interface (not including idle cells). • **Output cell count**—Number of ATM cells transmitted by the interface (including idle cells). • **Output idle cell count**—Number of idle cells sent by the port. When ATM has nothing to send, it sends idle cells to fill the time slot. • **Output VC queue drops**—Number of packets dropped by a port on the PIC. Packets are dropped because of queue limits on the VCs. The following error statistics are from the SAR: • **Input no buffers**—Number of AAL5 packets dropped because no channel blocks or buffers were available to handle them. • **Input length errors**—Number of AAL5 packets dropped because their length was incorrect. Usually, these errors occur because a cell has been corrupted or lost, or because the length field was corrupted. They can also mean the AAL5 length field was zero. • **Input timeouts**—Number of AAL5 packets dropped because of a reassembly timeout. • **Input invalid VCs**—Number of AAL5 packets dropped because the header was unrecognized (because the VC was not correct or not configured). • **Input bad CRCs**—Number of AAL5 packets dropped because of frame check sequence errors. • **Input OAM cell no buffers**—Number of received OAM cells or raw cells dropped because no buffers were available to handle them. • **L2 circuit out-of-sequence packets**—(Layer 2 AAL5 mode) Number of AAL5 packets that are out of sequential order. • **Denied packets count**—The number of packets dropped due to VLAN priority deny packets or due to an error forwarding configuration that might cause a negative frame length, that is, the stripping size is larger than the packet size.	**extensive**
Packet Forwarding Engine configuration	Information about the configuration of the Packet Forwarding Engine: • **Destination slot**—FPC slot number.	**extensive**

Table 13: ATM show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
CoS information	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.	**extensive**

Table 13: ATM show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output

VPI	(ATM2) Virtual path identifier information:
	• **Flags**—VPI flags can be one or more of the following:
	  • **Active** (virtual path is up)
	  • **OAM** (operation and maintenance is enabled)
	  • **Shaping** (shaping is configured)
	• **CBR, Peak**
	• **OAM, Period**—Interval at which OAM F4 loopback cells are sent.
	• **Up count**—Number of F4 OAM cells required to consider the virtual path up; the range is **1** through **255**.
	• **Down count**—Number of F4 OAM cells required to consider the virtual path down; the range is **1** through **255**.
	• **Total down time**—Total number of seconds the VPI has been down since it was opened, using the format **Total down time:** ***hh*:*mm*:*ss*** or **Never.**
	• **Last down**—Time of last **Down** transition, using the format **Last down:** ***hh*:*mm*:*ss*** **ago** or **Never**.
	• **OAM F4 cell statistics**—(Nonpromiscuous mode) OAM F4 statistics:
	  • **Total received**—Number of OAM F4 cells received.
	  • **Total sent**—Number of OAM F4 cells sent.
	  • **Loopback received**—Number of OAM F4 loopback cells received.
	  • **Loopback sent**—Number of OAM F4 loopback cells sent.
	  • **Last received**—Time at which the last OAM F4 cell was received.
	  • **Last sent**—Time at which the last OAM F4 cell was sent.
	  • **RDI received**—Number of OAM F4 cells received with the remote defect indication bit set.
	  • **RDI sent**—Number of OAM F4 cells sent with the RDI bit set.
	  • **AIS received**—Number of OAM F4 cells received with the alarm indication signal bit set.
	  • **AIS sent**—Number of OAM F4 cells sent with the AIS bit set.
	Traffic statistics:
	• **Input bytes**—Number of bytes received on the VPI.
	• **Output bytes**—Number of bytes transmitted on the VPI.
	• **Input packets**—Number of packets received on the VPI.
	• **Output packets**—Number of packets transmitted on the VPI.
		detail extensive none

Logical Interface		
Logical interface	Name of the logical interface.	All levels
Index	Logical interface index number, which reflects its initialization sequence.	**detail extensive** none
SNMP ifIndex	Logical interface SNMP interface index number.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**

Table 13: ATM show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
Flags	Information about the logical interface. Possible values are described in the "Logical Interface Flags" section under *Common Output Fields Description*.	All levels
Input packets	Number of packets received on the logical interface.	None specified
Output packets	Number of packets transmitted on the logical interface.	None specified
Encapsulation	Encapsulation on the logical interface.	All levels
Traffic statistics	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. It takes a while (generally, less than 1 second) for this counter to stabilize.	**detail extensive**
Local statistics	Statistics for traffic received from and transmitted to the Routing Engine. When a burst of traffic is received, the value in the output packet rate field might briefly exceed the peak cell rate. It takes a while (generally, less than 1 second) for this counter to stabilize.	**detail extensive**
Transit statistics	Statistics for traffic transiting the router. When a burst of traffic is received, the value in the output packet rate field might briefly exceed the peak cell rate. It takes a while (generally, less than 1 second) for this counter to stabilize.	**detail extensive**
Input packets	Number of packets received on the logical interface.	None specified
Output packets	Number of packets transmitted on the logical interface.	None specified
protocol-family	Protocol family configured on the logical interface. If the protocol is **inet**, the IP address of the interface is also displayed.	**brief**
Protocol	Protocol family configured on the logical interface.	**detail extensive** none
MTU	MTU size on the logical interface.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Route table	Routing table in which the logical interface address is located. For example, **0** refers to the routing table inet.0.	**detail extensive**
Flags	Information about the protocol family flags. Possible values are described in the "Family Flags" section under *Common Output Fields Description*.	**detail extensive** none
Addresses, Flags	Information about the address flags. Possible values are described in the "Addresses Flags" section under *Common Output Fields Description*.	**detail extensive** none
Destination	IP address of the remote side of the connection.	**detail extensive** none
Local	IP address of the logical interface.	**detail extensive** none

Table 13: ATM show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
Broadcast	Broadcast address.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**

VCI	Virtual circuit identifier number and information:
	• **Flags**—VCI flags:
	  • **Active**—VCI is up and in working condition.
	  • **CCC down**—VCI CCC is not in working condition.
	  • **Closed**—VCI is closed because the user disabled the logical or physical interface from the CLI.
	  • **Configured**—VCI is configured.
	  • **Down**—VCI is not in working condition. The VCI might have alarms, defects, F5 AIS/RDI, or no response to OAM loopback cells.
	  • **ILMI**—VCI is up and in working condition.
	  • **OAM**—OAM loopback is enabled.
	  • **Multicast**—VCI is a multicast VCI or DLCI.
	  • **Multipoint destination**—VCI is configured as a multipoint destination.
	  • **None**—No VCI flags.
	  • **Passive-OAM**—Passive OAM is enabled.
	  • **Shaping**—Shaping is enabled.
	  • **Sustained**—Shaping rate is set to **Sustained**.
	  • **Unconfigured**—VCI is not configured.
	• **Total down time**—Total number of seconds the VCI has been down, using the format **Total down time: *hh:mm:ss*** or**Never**.
	• **Last down**—Time of last **Down** transition, using the format **Last down: *hh:mm:ss***.
	• **EPD threshold**—(ATM2 only) Threshold at which a packet is dropped when the queue size (in number of cells) exceeds the early packet-discard (EPD) value.
		All levels

Table 13: ATM show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output

VCI (continued)	• **Transmit weight cells**—(ATM2 only) Amount of bandwidth assigned to this queue.
	• **ATM per-VC transmit statistics**:
	  • **Tail queue packet drops**—Number of packets dropped because of bandwidth constraints. This value indicates that packets are queued to send out at a rate faster than allowed.
	• **OAM F4 cell statistics**—(Nonpromiscuous mode) OAM F4 statistics:
	  • **Total received**—Number of OAM F4 cells received.
	  • **Total sent**—Number of OAM F4 cells sent.
	  • **Loopback received**—Number of OAM F4 loopback cells received.
	  • **Loopback sent**—Number of OAM F4 loopback cells sent.
	  • **Last received**—Time at which the last OAM F4 cell was received.
	  • **Last sent**—Time at which the last OAM F4 cell was sent.
	  • **RDI received**—Number of OAM F4 cells received with the remote defect indication bit set.
	  • **RDI sent**—Number of OAM F4 cells sent with the RDI bit set.
	  • **AIS received**—Number of OAM F4 cells received with the alarm indication signal bit set.
	  • **AIS sent**—Number of OAM F4 cells sent with the AIS bit set.
	• **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.
	  • **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.
		All levels

IMA group properties	• **Version**—The specified IMA specification version, either IMA 1.0 or IMA 1.1.
	• **Frame length**—The specified frame size, which can be 32, 64, 128, or 256.
	• **Differential delay**—Maximum differential delay among links in milliseconds.
	• **Symmetry**—Either Common Transmit Clock or Independent Transmit Clock timing mode.
	• **Transmit clock**—The specified IMA clock mode, either common or independent.
	• **Minimum links**—The number of minimum active links specified in both transmit and receive directions.
	  • **Transmit**—The per-PIC limit on the number of minimum active links in the transmit direction.
	  • **Receive**—The per-PIC limit on the number of minimum active links in the receive direction.
	• **Frame synchronization**—The specified IMA frame synchronization state transition variables (Alpha, Beta, and Gamma) and their specified values.
	  • **Alpha**—The number of consecutive invalid ICP cells for IFSM.
	  • **Beta**—The number of consecutive errored ICP cells for IFSM.
	  • **Gamma**—The number of consecutive valid ICP cells for IFSM.
	• **Links**—The number of IMA links assigned to the IMA group.
		detail extensive none

Table 13: ATM show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
IMA group alarms	• **Start-up-FE**—Far-end group alarm status • **Config-Aborted**—Near-end configuration aborted group alarm status • **Config-Aborted-FE**—Far-end configuration aborted group alarm status • **Insufficient-Links**—Near-end insufficient links group alarm status • **Insufficient-Links-FE**—Far-end insufficient links group alarm status • **Blocked-FE**—Far-end blocked group alarm status • **GR-Timing-Mismatch**—Group timing mismatch alarm status	**detail extensive** none
IMA group defects	• **Start-up-FE**—Far-end group defect status • **Config-Aborted**—Near-end configuration aborted group defect status • **Config-Aborted-FE**—Far-end configuration aborted group defect status • **Insufficient-Links**—Near-end insufficient links group defect status • **Insufficient-Links-FE**—Far-end insufficient links group defect status • **Blocked-FE**—Far-end blocked group defect status • **GR-Timing-Mismatch**—Group timing mismatch defect status	**detail extensive** none
IMA Group state	Near-end and far-end group status	**detail extensive** none
IMA group media	IMA group media status, including seconds, count and state for the following media parameters: • **FC** • **FC-FE** • **Addr-Mismatch** • **Running** • **UAS**	**detail extensive** none

Sample Output

show interfaces (ATM, IMA Group)

```
user@host> show interfaces at-1/0/0
Physical interface: at-1/0/0, Enabled, Physical link is Up
  IMA group properties:
    Version              : 1.1
    Frame length         : 128
    Differential delay   : 25 milliseconds
    Symmetry             : Symmetrical Configuration and Operation
    Transmit clock       : Common
    Minimum links        : Transmit: 1, Receive: 1
    Frame synchronization: Alpha: 2, Beta: 2, Gamma: 1
    Links                : None
  IMA group alarms  : Start-up-FE Config-Aborted Config-Aborted-FE
Insufficient-Links Insufficient-Links-FE Blocked-FE GR-Timing-Mismatch
  IMA group defects : Start-up-FE Config-Aborted Config-Aborted-FE
Insufficient-Links Insufficient-Links-FE Blocked-FE GR-Timing-Mismatch
  IMA Group state:
    Near end : Start up
    Far  end : Start up
```

```
  IMA group media:         Seconds        Count  State
    FC                                        0
    FC-FE                                     0
    Addr-Mismatch                             0
    Running                      0
    UAS                          0
```

show interfaces extensive (ATM IMA Group)

```
user@host> show interfaces at-0/0/10 extensive
Physical interface: at-0/0/10, Enabled, Physical link is Up
   Interface index: 178, SNMP ifIndex: 540, Generation: 531
  Link-level type: ATM-PVC, MTU: 2048, Speed: Unspecified, Loopback: None, Payload
 scrambler: Enabled
   Device flags   : Present Running
   Link flags     : None
   CoS queues     : 8 supported, 4 maximum usable queues
   Hold-times     : Up 0 ms, Down 0 ms
   Current address: 00:00:5e:00:53:0a
   Last flapped   : 2012-03-16 16:49:15 PDT (2d 07:12 ago)
   Statistics last cleared: 2012-03-16 16:56:58 PDT (2d 07:05 ago)
   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, Invalid VCs: 0, Framing errors: 0, Policed discards:
0, L3 incompletes: 0, L2 channel errors: 0,
     L2 mismatch timeouts: 0, Resource errors: 0
   Output errors:
     Carrier transitions: 0, Errors: 0, Drops: 0, Aged packets: 0, MTU errors:
0, Resource errors: 0
   IMA group properties:
     Version              : 1.1
     Frame length         : 128
     Differential delay   : 25 milliseconds
     Symmetry             : Symmetrical Configuration and Operation
     Transmit clock       : Common
     Minimum links        : Transmit: 1, Receive: 1
     Frame synchronization: Alpha: 2, Beta: 2, Gamma: 1
     Link #1              : t1-0/0/4             up
   IMA Group alarms   : None
   IMA Group defects  : None

   IMA Group state:
     Near end : Operational
     Far  end : Operational
   IMA group media:         Seconds        Count  State
     FC                                        0
     FC-FE                                     0
     Addr-Mismatch                             0
     Running                 198306
     UAS                          0
   ATM status:
     HCS state:     Sync
```

```
    LOC      :       OK
  ATM Statistics:
   Uncorrectable HCS errors: 0, Correctable HCS errors: 0, Tx cell FIFO overruns:
0, Rx cell FIFO overruns: 0,
    Rx cell FIFO underruns: 0, Input cell count: 0, Output cell count: 0, Output
idle cell count: 0,
    Output VC queue drops: 0, Input no buffers: 0, Input length errors: 0, Input
timeouts: 0, Input invalid VCs: 0,
    Input bad CRCs: 0, Input OAM cell no buffers: 0
  Packet Forwarding Engine configuration:
    Destination slot: 0
    VPI 2
      Flags: Active
      Total down time: 0 sec, Last down: Never
        Traffic statistics:
         Input  bytes  :                    0
         Output bytes  :                    0
         Input  packets:                    0
         Output packets:                    0

  Logical interface at-0/0/10.602 (Index 71) (SNMP ifIndex 1057) (Generation
17226)
    Flags: Point-To-Point SNMP-Traps CCC-Down 0x0 Encapsulation:
ATM-CCC-Cell-Relay
    L2 circuit cell bundle size: 1, bundle timeout: 125 usec, timeout count: 0
    L2 circuit out-of-sequence count: 0, denied packets count: 0
```

show interfaces (ATM1, SONET Mode)

```
user@host> show interfaces at-1/0/0
Physical interface: at-1/0/0, Enabled, Physical link is Up
  Interface index: 300, SNMP ifIndex: 194
  Description: to allspice at-1/0/0
  Link-level type: ATM-PVC, MTU: 4482, Clocking: Internal, SONET mode,
  Speed: OC3, Loopback: None, Payload scrambler: Enabled
  Device flags   : Present Running
  Link flags     : None
  CoS queues     : 4 supported, 4 maximum usable queues
  Current address: 00:00:5e:00:53:fe
  Last flapped   : 2006-02-24 14:28:12 PST (6d 01:51 ago)
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)
  SONET alarms   : None
  SONET defects  : None

  Logical interface at-1/0/0.0 (Index 64) (SNMP ifIndex 204)
    Flags: Point-To-Point SNMP-Traps Encapsulation: ATM-SNAP
    Input packets : 0
    Output packets: 0
    Protocol inet, MTU: 4470
      Flags: None
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 192.168.220.24/30, Local: 192.168.220.26,
        Broadcast: 192.168.220.27
    Protocol iso, MTU: 4470
      Flags: None
    VCI 0.128
      Flags: Active
      Total down time: 0 sec, Last down: Never
        Input packets : 0
        Output packets: 0
```

show interfaces brief (ATM1, SONET Mode)

```
user@host> show interfaces at-1/0/0 brief
Physical interface: at-1/0/0, Enabled, Physical link is Up
  Description: to allspice at-1/0/0
  Link-level type: ATM-PVC, MTU: 4482, Clocking: Internal, SONET mode,
  Speed: OC3, Loopback: None, Payload scrambler: Enabled
  Device flags   : Present Running
  Link flags     : None

  Logical interface at-1/0/0.0
    Flags: Point-To-Point SNMP-Traps Encapsulation: ATM-SNAP
    inet  192.168.220.26/30
    iso
    VCI 0.128
      Flags: Active
      Total down time: 0 sec, Last down: Never
```

show interfaces detail (ATM1, SONET Mode)

```
user@host> show interfaces at-1/0/0 detail
Physical interface: at-1/0/0, Enabled, Physical link is Up
  Interface index: 300, SNMP ifIndex: 194, Generation: 183
  Description: to allspice at-1/0/0
  Link-level type: ATM-PVC, MTU: 4482, Clocking: Internal, SONET mode,
  Speed: OC3, Loopback: None, Payload scrambler: Enabled
  Device flags   : Present Running
  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:fe
  Last flapped   : 2006-02-24 14:28:12 PST (6d 01:55 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: 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

  SONET alarms   : None
  SONET defects  : None

  Logical interface at-1/0/0.0 (Index 64) (SNMP ifIndex 204) (Generation 5)
    Flags: Point-To-Point SNMP-Traps Encapsulation: ATM-SNAP
    Traffic statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Local statistics:
```

```
    Input  bytes  :                    0
    Output bytes  :                    0
    Input  packets:                    0
    Output packets:                    0
  Transit statistics:
    Input  bytes  :                    0                    0 bps
    Output bytes  :                    0                    0 bps
    Input  packets:                    0                    0 pps
    Output packets:                    0                    0 pps
  Protocol inet, MTU: 4470, Generation: 13, Route table: 0
    Flags: None
    Addresses, Flags: Is-Preferred Is-Primary
      Destination: 192.168.220.24/30, Local: 192.168.220.26,
      Broadcast: 192.168.220.27, Generation: 14
  Protocol iso, MTU: 4470, Generation: 14, Route table: 0
    Flags: None
  VCI 0.128
    Flags: Active
    Total down time: 0 sec, Last down: Never
    ATM per-VC transmit statistics:
     Tail queue packet drops: 0
    Traffic statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
```

show interfaces extensive (ATM1, SONET Mode)

```
user@host> show interfaces at-1/0/0 extensive
Physical interface: at-1/0/0, Enabled, Physical link is Up
  Interface index: 300, SNMP ifIndex: 194, Generation: 183
  Description: to allspice at-1/0/0
  Link-level type: ATM-PVC, MTU: 4482, Clocking: Internal, SONET mode,
  Speed: OC3, Loopback: None, Payload scrambler: Enabled
  Device flags   : Present Running
  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:fe
  Last flapped   : 2006-02-24 14:28:12 PST (6d 01:56 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, Invalid VCs: 0, Framing errors: 0, Policed discards: 0,

    L3 incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0,
    Resource errors: 0
  Output errors:
    Carrier transitions: 1, Errors: 0, Drops: 0, Aged packets: 0, MTU errors: 0,

    Resource errors: 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

SONET alarms   : None
SONET defects  : None
SONET PHY:            Seconds        Count  State
  PLL Lock                  0            0  OK
  PHY Light                 0            0  OK
SONET section:
  BIP-B1                    0            0
  SEF                       0            0  OK
  LOS                       0            0  OK
  LOF                       0            0  OK
  ES-S                      0
  SES-S                     0
  SEFS-S                    0
SONET line:
  BIP-B2                    0            0
  REI-L                     0            0
  RDI-L                     0            0  OK
  AIS-L                     0            0  OK
  BERR-SF                   0            0  OK
  BERR-SD                   0            0  OK
  ES-L                      0
  SES-L                     0
  UAS-L                     0
  ES-LFE                    0
  SES-LFE                   0
  UAS-LFE                   0
SONET path:
  BIP-B3                    0            0
  REI-P                     0            0
  LOP-P                     0            0  OK
  AIS-P                     0            0  OK
  RDI-P                     0            0  OK
  UNEQ-P                    1            1  OK
  PLM-P                     0            0  OK
  ES-P                      1
  SES-P                     1
  UAS-P                     0
  ES-PFE                    0
  SES-PFE                   0
  UAS-PFE                   0
Received SONET overhead:
  F1      : 0x00, J0      : 0x00, K1      : 0x00, K2      : 0x00
  S1      : 0x00, C2      : 0x13, C2(cmp) : 0x13, F2      : 0x00
  Z3      : 0x00, Z4      : 0x00, S1(cmp) : 0x00
Transmitted SONET overhead:
  F1      : 0x00, J0      : 0x01, K1      : 0x00, K2      : 0x00
  S1      : 0x00, C2      : 0x13, F2      : 0x00, Z3      : 0x00
  Z4      : 0x00
ATM status:
  HCS state:     Sync
  LOC      :       OK
ATM Statistics:
  Uncorrectable HCS errors: 0, Correctable HCS errors: 0,
  Tx cell FIFO overruns: 0, Rx cell FIFO overruns: 0,
  Rx cell FIFO underruns: 0, Input cell count: 0, Output cell count: 0,
```

```
  Output idle cell count: 0, Output VC queue drops: 0, Input no buffers: 0,
  Input length errors: 0, Input timeouts: 0, Input invalid VCs: 0,
  Input bad CRCs: 0, Input OAM cell no buffers: 0
Packet Forwarding Engine configuration:
  Destination slot: 1
CoS information:
  CoS transmit queue         Bandwidth          Buffer      Priority    Limit
                        %            bps     %     usec
  0 best-effort        95      147744000    95        0           low    none
  3 network-control     5        7776000     5        0           low    none

Logical interface at-1/0/0.0 (Index 64) (SNMP ifIndex 204) (Generation 5)
  Flags: Point-To-Point SNMP-Traps Encapsulation: ATM-SNAP
  Traffic statistics:
   Input  bytes  :                   0
   Output bytes  :                   0
   Input  packets:                   0
   Output packets:                   0
  Local statistics:
   Input  bytes  :                   0
   Output bytes  :                   0
   Input  packets:                   0
   Output packets:                   0
  Transit statistics:
   Input  bytes  :                   0                  0 bps
   Output bytes  :                   0                  0 bps
   Input  packets:                   0                  0 pps
   Output packets:                   0                  0 pps
  Protocol inet, MTU: 4470, Generation: 13, Route table: 0
    Flags: None
    Addresses, Flags: Is-Preferred Is-Primary
      Destination: 192.168.220.24/30, Local: 192.168.220.26,
      Broadcast: 192.168.220.27, Generation: 14
  Protocol iso, MTU: 4470, Generation: 14, Route table: 0
    Flags: None
  VCI 0.128
    Flags: Active
    Total down time: 0 sec, Last down: Never
    ATM per-VC transmit statistics:
     Tail queue packet drops: 0
    Traffic statistics:
     Input  bytes  :                 0
     Output bytes  :                 0
     Input  packets:                 0
     Output packets:                 0
```

show interfaces (ATM2, SDH Mode)

```
user@host> show interfaces at-0/2/1
Physical interface: at-0/2/1, Enabled, Physical link is Up
  Interface index: 154, SNMP ifIndex: 42
  Link-level type: ATM-PVC, MTU: 4482, Clocking: Internal, SDH mode, Speed: OC3,

  Loopback: None, Payload scrambler: Enabled
  Device flags   : Present Running
  Link flags     : None
  CoS queues     : 4 supported, 4 maximum usable queues
  Current address: 00:00:5e:00:53:3f
  Last flapped   : 2006-03-24 13:29:58 PST (00:04:48 ago)
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)
```

```
  SDH   alarms   : None
  SDH   defects  : None
    VPI 0
      Flags: Active
      Total down time: 0 sec, Last down: Never
  Traffic statistics:
         Input  packets:                  0
         Output packets:                  0

  Logical interface at-0/2/1.0 (Index 75) (SNMP ifIndex 51)
    Flags: Point-To-Point SNMP-Traps 0x4000 Encapsulation: ATM-SNAP
    Input packets : 0
    Output packets: 0
    Protocol inet, MTU: 4470
      Flags: None
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 10.0.12.6, Local: 10.0.12.5
    Protocol iso, MTU: 4470
      Flags: None
    VCI 0.128
      Flags: Active
      Total down time: 0 sec, Last down: Never
      EPD threshold: 2129, Transmit weight cells: 0
        Input packets : 0
        Output packets: 0

  Logical interface at-0/2/1.32767 (Index 76) (SNMP ifIndex 50)
    Flags: Point-To-Multipoint No-Multicast SNMP-Traps 0x4000
    Encapsulation: ATM-VCMUX
    Input packets : 0
    Output packets: 0
    VCI 0.4
      Flags: Active
      Total down time: 0 sec, Last down: Never
      EPD threshold: 0, Transmit weight cells: 0
        Input packets : 0
        Output packets: 0
```

show interfaces brief (ATM2, SDH Mode)

```
user@host> show interfaces at-0/2/1 brief
Physical interface: at-0/2/1, Enabled, Physical link is Up
  Link-level type: ATM-PVC, MTU: 4482, Clocking: Internal, SDH mode,
  Speed: OC3, Loopback: None, Payload scrambler: Enabled
  Device flags   : Present Running
  Link flags     : None
  Logical interface at-0/2/1.0
    Flags: Point-To-Point SNMP-Traps 0x4000 Encapsulation: ATM-SNAP
    inet  10.0.12.5        --> 10.0.12.6
    iso
    VCI 0.128
      Flags: Active
      Total down time: 0 sec, Last down: Never
      EPD threshold: 2129, Transmit weight cells: 0

  Logical interface at-0/2/1.32767
    Flags: Point-To-Multipoint No-Multicast SNMP-Traps 0x4000
    Encapsulation: ATM-VCMUX
    VCI 0.4
      Flags: Active
```

```
    Total down time: 0 sec, Last down: Never
    EPD threshold: 0, Transmit weight cells: 0
```

show interfaces detail (ATM2, SDH Mode)

```
user@host> show interfaces at-0/2/1 detail
Physical interface: at-0/2/1, Enabled, Physical link is Up
  Interface index: 154, SNMP ifIndex: 42, Generation: 40
  Link-level type: ATM-PVC, MTU: 4482, Clocking: Internal, SDH mode, Speed: OC3,

  Loopback: None, Payload scrambler: Enabled
  Device flags   : Present Running
  Link flags     : None
  CoS queues     : 4 supported, 4 maximum usable queues
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:00:5e:00:53:3f
  Last flapped   : 2006-03-24 13:29:58 PST (00:05:10 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: 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

  SDH   alarms   : None
  SDH   defects  : None
    VPI 0
      Flags: Active
      Total down time: 0 sec, Last down: Never
        Traffic statistics:
         Input  bytes  :                   0
         Output bytes  :                   0
         Input  packets:                   0
         Output packets:                   0

  Logical interface at-0/2/1.0 (Index 75) (SNMP ifIndex 51) (Generation 25)
    Flags: Point-To-Point SNMP-Traps 0x4000 Encapsulation: ATM-SNAP
    Traffic statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Local statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Transit statistics:
     Input  bytes  :                   0                   0 bps
     Output bytes  :                   0                   0 bps
     Input  packets:                   0                   0 pps
```

```
     Output packets:                    0                    0 pps
    Protocol inet, MTU: 4470, Generation: 62, Route table: 0
      Flags: None
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 10.0.12.6, Local: 10.0.12.5, Broadcast: Unspecified,
        Generation: 58
    Protocol iso, MTU: 4470, Generation: 63, Route table: 0
      Flags: None
    VCI 0.128
      Flags: Active
      Total down time: 0 sec, Last down: Never
      EPD threshold: 2129, Transmit weight cells: 0
      ATM per-VC transmit statistics:
       Tail queue packet drops: 0
      Traffic statistics:
       Input  bytes  :                   0
       Output bytes  :                   0
       Input  packets:                   0
       Output packets:                   0
  Logical interface at-0/2/1.32767 (Index 76) (SNMP ifIndex 50) (Generation 26)
    Flags: Point-To-Multipoint No-Multicast SNMP-Traps 0x4000
    Encapsulation: ATM-VCMUX
    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
    VCI 0.4
      Flags: Active
      Total down time: 0 sec, Last down: Never
      EPD threshold: 0, Transmit weight cells: 0
      ATM per-VC transmit statistics:
       Tail queue packet drops: 0
      Traffic statistics:
       Input  bytes  :                   0
       Output bytes  :                   0
       Input  packets:                   0
       Output packets:                   0
```

show interfaces extensive (ATM2, SDH Mode)

```
user@host> show interfaces at-0/2/1 extensive
Physical interface: at-0/2/1, Enabled, Physical link is Up
  Interface index: 154, SNMP ifIndex: 42, Generation: 40
  Link-level type: ATM-PVC, MTU: 4482, Clocking: Internal, SDH mode, Speed: OC3,

  Loopback: None, Payload scrambler: Enabled
  Device flags   : Present Running
  Link flags     : None
  CoS queues     : 4 supported, 4 maximum usable queues
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:00:5e:00:53:3f
  Last flapped   : 2006-03-24 13:29:58 PST (00:06:49 ago)
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :                   0                    0 bps
```

```
 Output bytes  :                    0                    0 bps
 Input  packets:                    0                    0 pps
 Output packets:                    0                    0 pps
Input errors:
  Errors: 0, Drops: 0, Invalid VCs: 0, Framing errors: 0, Policed discards: 0,

  L3 incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0,
  Resource errors: 0
Output errors:
  Carrier transitions: 3, Errors: 0, Drops: 0, Aged packets: 0, MTU errors: 0,

  Resource errors: 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

SDH   alarms   : None
SDH   defects  : None
SDH PHY:              Seconds        Count  State
  PLL Lock                  0            0  OK
  PHY Light                 1            1  OK
SDH regenerator section:
  RS-BIP8                   2         8828
  OOF                       2            2  OK
  LOS                       2            1  OK
  LOF                       2            1  OK
  RS-ES                     4
  RS-SES                    3
  RS-SEFS                   2
SDH multiplex section:
  MS-BIP24                  2          771
  MS-FEBE                   1        17476
  MS-FERF                   2            1  OK
  MS-AIS                    2            1  OK
  BERR-SF                   0            0  OK
  BERR-SD                   0            0  OK
  MS-ES                     4
  MS-SES                    2
  MS-UAS                    0
  MS-ES-FE                  3
  MS-SES-FE                 2
  MS-UAS-FE                 0
SDH path:
  HP-BIP8                   1            6
  HP-FEBE                   1          251
  HP-LOP                    0            0  OK
  HP-AIS                    2            1  OK
  HP-FERF                   3            2  OK
  HP-UNEQ                   1            1  OK
  HP-PLM                    2            1  OK
  HP-ES                     4
  HP-SES                    3
  HP-UAS                    0
  HP-ES-FE                  3
```

```
  HP-SES-FE                3
  HP-UAS-FE                0
Received SDH overhead:
  F1      : 0x00, J0      : 0x00, K1      : 0x00, K2      : 0x00
  S1      : 0x00, C2      : 0x13, C2(cmp) : 0x13, F2      : 0x00
  Z3      : 0x00, Z4      : 0x00, S1(cmp) : 0x00
Transmitted SDH overhead:
  F1      : 0x00, J0      : 0x01, K1      : 0x00, K2      : 0x00
  S1      : 0x00, C2      : 0x13, F2      : 0x00, Z3      : 0x00
  Z4      : 0x00
ATM status:
  HCS state:     Sync
  LOC      :       OK
ATM Statistics:
  Uncorrectable HCS errors: 0, Correctable HCS errors: 0,
  Tx cell FIFO overruns: 0, Rx cell FIFO overruns: 0,
  Rx cell FIFO underruns: 0, Input cell count: 0, Output cell count: 0,
  Output idle cell count: 0, Output VC queue drops: 0, Input no buffers: 0,
  Input length errors: 0, Input timeouts: 0, Input invalid VCs: 0,
  Input bad CRCs: 0, Input OAM cell no buffers: 0
Packet Forwarding Engine configuration:
  Destination slot: 0
  VPI 0
    Flags: Active
    Total down time: 0 sec, Last down: Never
      Traffic statistics:
       Input  bytes  :                   0
       Output bytes  :                   0
       Input  packets:                   0
       Output packets:                   0

Logical interface at-0/2/1.0 (Index 75) (SNMP ifIndex 51) (Generation 25)
  Flags: Point-To-Point SNMP-Traps 0x4000 Encapsulation: ATM-SNAP
  Traffic statistics:
   Input  bytes  :                   0
   Output bytes  :                   0
   Input  packets:                   0
   Output packets:                   0
  Local statistics:
   Input  bytes  :                   0
   Output bytes  :                   0
   Input  packets:                   0
   Output packets:                   0
  Transit statistics:
   Input  bytes  :                   0                   0 bps
   Output bytes  :                   0                   0 bps
   Input  packets:                   0                   0 pps
   Output packets:                   0                   0 pps
  Protocol inet, MTU: 4470, Generation: 62, Route table: 0
    Flags: None
    Addresses, Flags: Is-Preferred Is-Primary
      Destination: 10.0.12.6, Local: 10.0.12.5, Broadcast: Unspecified,
      Generation: 58
  Protocol iso, MTU: 4470, Generation: 63, Route table: 0
    Flags: None
  VCI 0.128
    Flags: Active
    Total down time: 0 sec, Last down: Never
    EPD threshold: 2129, Transmit weight cells: 0
    ATM per-VC transmit statistics:
     Tail queue packet drops: 0
```

```
    Traffic statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
  Logical interface at-0/2/1.32767 (Index 76) (SNMP ifIndex 50) (Generation 26)
    Flags: Point-To-Multipoint No-Multicast SNMP-Traps 0x4000
    Encapsulation: ATM-VCMUX
    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
    VCI 0.4
      Flags: Active
      Total down time: 0 sec, Last down: Never
      EPD threshold: 0, Transmit weight cells: 0
      ATM per-VC transmit statistics:
       Tail queue packet drops: 0
      Traffic statistics:
       Input  bytes  :                   0
       Output bytes  :                   0
       Input  packets:                   0
       Output packets:                   0
```

show interfaces (ATM2, SONET Mode)

```
user@host> show interfaces at-0/3/1
Physical interface: at-0/3/1, Enabled, Physical link is Up
  Interface index: 139, SNMP ifIndex: 67
  Link-level type: ATM-PVC, MTU: 4482, Clocking: Internal, SONET mode,
  Speed: OC3, Loopback: None, Payload scrambler: Enabled
  Device flags   : Present Running
  Link flags     : None
  CoS queues     : 4 supported, 4 maximum usable queues
  Current address: 00:00:5e:00:53:5e
  Last flapped   : 2006-03-13 17:46:36 PST (16:01:12 ago)
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)
  SONET alarms   : None
  SONET defects  : None
    VPI 0
      Flags: Active, OAM, Shaping
      CBR, Peak: 50kbps
      OAM, Period 30 sec, Up count: 10, Down count: 10
      Total down time: 0 sec, Last down: Never
     OAM F4 cell statistics:
      Total received: 4, Total sent: 4
      Loopback received: 4, Loopback sent: 4
      RDI received: 0, RDI sent: 0
      AIS received: 0
  Traffic statistics:
         Input  packets:                    4
         Output packets:                   30
    VPI 10
      Flags: Active
```

```
    Total down time: 0 sec, Last down: Never
  Traffic statistics:
       Input  packets:                    0
       Output packets:                    0
  Logical interface at-0/3/1.0 (Index 78) (SNMP ifIndex 77)
    Flags: Point-To-Point Copy-PLP-To-CLP SNMP-Traps 0x4000
    Encapsulation: ATM-SNAP
    Input packets : 0
    Output packets: 0
    Protocol inet, MTU: 4470
      Flags: None
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 10.0.59.5, Local: 10.0.59.6
    Protocol iso, MTU: 4470
      Flags: None
    VCI 0.128
      Flags: Active
      Total down time: 0 sec, Last down: Never
      EPD threshold: 2129, Transmit weight cells: 10
        Input packets : 0
        Output packets: 0

  Logical interface at-0/3/1.32767 (Index 79) (SNMP ifIndex 76)
    Flags: Point-To-Multipoint Copy-PLP-To-CLP No-Multicast SNMP-Traps 0x4000
    Encapsulation: ATM-VCMUX
    Input packets : 4
    Output packets: 30
    VCI 0.16
      Flags: Active, ILMI
      Total down time: 0 sec, Last down: Never
      EPD threshold: 0, Transmit weight cells: 0
        Input packets : 0
        Output packets: 26
    VCI 0.4
      Flags: Active, OAM
      OAM, Period 30 sec, Up count: 10, Down count: 10
      Total down time: 0 sec, Last down: Never
      EPD threshold: 2129, Transmit weight cells: 0
        Input packets : 4
        Output packets: 4
     OAM F4 cell statistics:
      Total received: 4, Total sent: 4
      Loopback received: 4, Loopback sent: 4
      RDI received: 0, RDI sent: 0
      AIS received: 0, AIS sent: 0
```

show interfaces brief (ATM2, SONET Mode)

```
user@host> show interfaces at-0/3/1 brief
Physical interface: at-0/3/1, Enabled, Physical link is Up
  Link-level type: ATM-PVC, MTU: 4482, Clocking: Internal, SONET mode,
  Speed: OC3, Loopback: None, Payload scrambler: Enabled
  Device flags   : Present Running
  Link flags     : None

  Logical interface at-0/3/1.0
    Flags: Point-To-Point Copy-PLP-To-CLP SNMP-Traps 0x4000
    Encapsulation: ATM-SNAP
    inet  10.0.59.6        --> 10.0.59.5
    iso
    VCI 0.128
```

```
    Flags: Active
    Total down time: 0 sec, Last down: Never
    EPD threshold: 2129, Transmit weight cells: 10

  Logical interface at-0/3/1.32767
    Flags: Point-To-Multipoint Copy-PLP-To-CLP No-Multicast SNMP-Traps 0x4000
    Encapsulation: ATM-VCMUX
    VCI 0.16
      Flags: Active, ILMI
      Total down time: 0 sec, Last down: Never
      EPD threshold: 0, Transmit weight cells: 0
    VCI 0.4
      Flags: Active, OAM
      Total down time: 0 sec, Last down: Never
      EPD threshold: 2129, Transmit weight cells: 0
```

show interfaces detail (ATM2, SONET Mode)

```
user@host> show interfaces at-0/3/1 detail
Physical interface: at-0/3/1, Enabled, Physical link is Up
  Interface index: 139, SNMP ifIndex: 67, Generation: 22
  Link-level type: ATM-PVC, MTU: 4482, Clocking: Internal, SONET mode,
  Speed: OC3, Loopback: None, Payload scrambler: Enabled
  Device flags   : Present Running
  Link flags     : None
  CoS queues     : 4 supported, 4 maximum usable queues
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:00:5e:00:53:5e
  Last flapped   : 2006-03-13 17:46:36 PST (16:02:39 ago)
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :                  312                    0 bps
   Output bytes  :                 2952                    0 bps
   Input  packets:                    6                    0 pps
   Output packets:                   50                    0 pps
  Egress queues: 4 supported, 4 in use
  Queue counters:       Queued packets  Transmitted packets      Dropped packets

    0 best-effort                   44                   44                    0

    1 expedited-fo                   0                    0                    0

    2 assured-forw                   0                    0                    0

    3 network-cont                   6                    6                    0

  SONET alarms   : None
  SONET defects  : None
    VPI 0
      Flags: Active, OAM, Shaping
      CBR, Peak: 50kbps
      OAM, Period 30 sec, Up count: 10, Down count: 10
      Total down time: 0 sec, Last down: Never
     OAM F4 cell statistics:
      Total received: 6, Total sent: 6
      Loopback received: 6, Loopback sent: 6
      Last received: 00:00:29, Last sent: 00:00:29
      RDI received: 0, RDI sent: 0
      AIS received: 0
        Traffic statistics:
         Input  bytes  :                 312
```

```
      Output bytes  :                2952
      Input  packets:                   6
      Output packets:                  50
  VPI 10
    Flags: Active
    Total down time: 0 sec, Last down: Never
      Traffic statistics:
       Input  bytes  :                   0
       Output bytes  :                   0
       Input  packets:                   0
       Output packets:                   0

Logical interface at-0/3/1.0 (Index 78) (SNMP ifIndex 77) (Generation 20)
  Flags: Point-To-Point Copy-PLP-To-CLP SNMP-Traps 0x4000
  Encapsulation: ATM-SNAP
  Traffic statistics:
   Input  bytes  :                   0
   Output bytes  :                   0
   Input  packets:                   0
   Output packets:                   0
  Local statistics:
   Input  bytes  :                   0
   Output bytes  :                   0
   Input  packets:                   0
   Output packets:                   0
  Transit statistics:
   Input  bytes  :                   0                   0 bps
   Output bytes  :                   0                   0 bps
   Input  packets:                   0                   0 pps
   Output packets:                   0                   0 pps
  Protocol inet, MTU: 4470, Generation: 38, Route table: 0
    Flags: None
    Addresses, Flags: Is-Preferred Is-Primary
      Destination: 10.0.59.5, Local: 10.0.59.6, Broadcast: Unspecified,
      Generation: 44
  Protocol iso, MTU: 4470, Generation: 39, Route table: 0
    Flags: None
  VCI 0.128
    Flags: Active
    Total down time: 0 sec, Last down: Never
    EPD threshold: 2129, Transmit weight cells: 10
    ATM per-VC transmit statistics:
     Tail queue packet drops: 0
    Traffic statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
Logical interface at-0/3/1.32767 (Index 79) (SNMP ifIndex 76) (Generation 21)
  Flags: Point-To-Multipoint Copy-PLP-To-CLP No-Multicast SNMP-Traps 0x4000
  Encapsulation: ATM-VCMUX
  Traffic statistics:
   Input  bytes  :                 360
   Output bytes  :                3302
   Input  packets:                   6
   Output packets:                  50
  Local statistics:
   Input  bytes  :                 360
   Output bytes  :                3302
   Input  packets:                   6
   Output packets:                  50
```

```
  VCI 0.16
    Flags: Active, ILMI
    Total down time: 0 sec, Last down: Never
    EPD threshold: 0, Transmit weight cells: 0
    ATM per-VC transmit statistics:
     Tail queue packet drops: 0
    Traffic statistics:
     Input  bytes  :                    0
     Output bytes  :                 2640
     Input  packets:                    0
     Output packets:                   44
  VCI 0.4
    Flags: Active, OAM
    OAM, Period 30 sec, Up count: 10, Down count: 10
    Total down time: 0 sec, Last down: Never
    EPD threshold: 2129, Transmit weight cells: 0
    ATM per-VC transmit statistics:
     Tail queue packet drops: 0
    Traffic statistics:
     Input  bytes  :                  312
     Output bytes  :                  312
     Input  packets:                    6
     Output packets:                    6
   OAM F4 cell statistics:
    Total received: 6, Total sent: 6
    Loopback received: 6, Loopback sent: 6
    Last received: 00:00:29, Last sent: 00:00:29
    RDI received: 0, RDI sent: 0
    AIS received: 0, AIS sent: 0
```

show interfaces extensive (ATM2, SONET Mode)

```
user@host> show interfaces at-0/3/1 extensive
Physical interface: at-0/3/1, Enabled, Physical link is Up
  Interface index: 139, SNMP ifIndex: 67, Generation: 22
  Link-level type: ATM-PVC, MTU: 4482, Clocking: Internal, SONET mode,
  Speed: OC3, Loopback: None, Payload scrambler: Enabled
  Device flags   : Present Running
  Link flags     : None
  CoS queues     : 4 supported, 4 maximum usable queues
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:00:5e:00:53:5e
  Last flapped   : 2006-03-13 17:46:36 PST (16:04:12 ago)
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :                 520                   0 bps
   Output bytes  :                4240                   0 bps
   Input  packets:                  10                   0 pps
   Output packets:                  72                   0 pps
  Input errors:
    Errors: 0, Drops: 0, Invalid VCs: 0, Framing errors: 0, Policed discards: 0,

    L3 incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0,
    Resource errors: 0
  Output errors:
    Carrier transitions: 1, Errors: 0, Drops: 0, Aged packets: 0, MTU errors: 0,

    Resource errors: 0
  Egress queues: 4 supported, 4 in use
  Queue counters:       Queued packets  Transmitted packets      Dropped packets
```

```
  0 best-effort                   62                  62                  0

  1 expedited-fo                   0                   0                  0

  2 assured-forw                   0                   0                  0

  3 network-cont                  10                  10                  0

SONET alarms   : None
SONET defects  : None
SONET PHY:            Seconds        Count  State
  PLL Lock                  0            0  OK
  PHY Light                 0            0  OK
SONET section:
  BIP-B1                    0            0
  SEF                       0            0  OK
  LOS                       0            0  OK
  LOF                       0            0  OK
  ES-S                      0
  SES-S                     0
  SEFS-S                    0
SONET line:
  BIP-B2                    0            0
  REI-L                     0            0
  RDI-L                     0            0  OK
  AIS-L                     0            0  OK
  BERR-SF                   0            0  OK
  BERR-SD                   0            0  OK
  ES-L                      0
  SES-L                     0
  UAS-L                     0
  ES-LFE                    0
  SES-LFE                   0
  UAS-LFE                   0
SONET path:
  BIP-B3                    0            0
  REI-P                     0            0
  LOP-P                     0            0  OK
  AIS-P                     0            0  OK
  RDI-P                     0            0  OK
  UNEQ-P                    1            1  OK
  PLM-P                     0            0  OK
  ES-P                      1
  SES-P                     1
  UAS-P                     0
  ES-PFE                    0
  SES-PFE                   0
  UAS-PFE                   0
Received SONET overhead:
  F1      : 0x00, J0      : 0x00, K1      : 0x00, K2      : 0x00
  S1      : 0x00, C2      : 0x13, C2(cmp) : 0x13, F2      : 0x00
  Z3      : 0x00, Z4      : 0x00, S1(cmp) : 0x00
Transmitted SONET overhead:
  F1      : 0x00, J0      : 0x01, K1      : 0x00, K2      : 0x00
  S1      : 0x00, C2      : 0x13, F2      : 0x00, Z3      : 0x00
  Z4      : 0x00
ATM status:
  HCS state:     Sync
  LOC      :       OK
ATM Statistics:
  Uncorrectable HCS errors: 0, Correctable HCS errors: 0,
```

```
  Tx cell FIFO overruns: 0, Rx cell FIFO overruns: 0,
  Rx cell FIFO underruns: 0, Input cell count: 0, Output cell count: 0,
  Output idle cell count: 0, Output VC queue drops: 0, Input no buffers: 0,
  Input length errors: 0, Input timeouts: 0, Input invalid VCs: 0,
  Input bad CRCs: 0, Input OAM cell no buffers: 0
Packet Forwarding Engine configuration:
  Destination slot: 0
  VPI 0
    Flags: Active, OAM, Shaping
    CBR, Peak: 50kbps
    OAM, Period 30 sec, Up count: 10, Down count: 10
    Total down time: 0 sec, Last down: Never
   OAM F4 cell statistics:
    Total received: 10, Total sent: 10
    Loopback received: 10, Loopback sent: 10
    Last received: 00:00:02, Last sent: 00:00:02
    RDI received: 0, RDI sent: 0
    AIS received: 0
      Traffic statistics:
       Input  bytes  :                 520
       Output bytes  :                4240
       Input  packets:                  10
       Output packets:                  72
  VPI 10
    Flags: Active
    Total down time: 0 sec, Last down: Never
      Traffic statistics:
       Input  bytes  :                   0
       Output bytes  :                   0
       Input  packets:                   0
       Output packets:                   0

Logical interface at-0/3/1.0 (Index 78) (SNMP ifIndex 77) (Generation 20)
  Flags: Point-To-Point Copy-PLP-To-CLP SNMP-Traps 0x4000
  Encapsulation: ATM-SNAP
  Traffic statistics:
   Input  bytes  :                   0
   Output bytes  :                   0
   Input  packets:                   0
   Output packets:                   0
  Local statistics:
   Input  bytes  :                   0
   Output bytes  :                   0
   Input  packets:                   0
   Output packets:                   0
  Transit statistics:
   Input  bytes  :                   0                   0 bps
   Output bytes  :                   0                   0 bps
   Input  packets:                   0                   0 pps
   Output packets:                   0                   0 pps
  Protocol inet, MTU: 4470, Generation: 38, Route table: 0
    Flags: None
    Addresses, Flags: Is-Preferred Is-Primary
      Destination: 10.0.59.5, Local: 10.0.59.6, Broadcast: Unspecified,
      Generation: 44
  Protocol iso, MTU: 4470, Generation: 39, Route table: 0
    Flags: None
  VCI 0.128
    Flags: Active
    Total down time: 0 sec, Last down: Never
    EPD threshold: 2129, Transmit weight cells: 10
```

```
    ATM per-VC transmit statistics:
     Tail queue packet drops: 0
    Traffic statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0

Logical interface at-0/3/1.32767 (Index 79) (SNMP ifIndex 76) (Generation 21)
  Flags: Point-To-Multipoint Copy-PLP-To-CLP No-Multicast SNMP-Traps 0x4000
  Encapsulation: ATM-VCMUX
  Traffic statistics:
   Input  bytes  :                 660
   Output bytes  :                5473
   Input  packets:                  11
   Output packets:                  83
  Local statistics:
   Input  bytes  :                 660
   Output bytes  :                5473
   Input  packets:                  11
   Output packets:                  83
  VCI 0.16
    Flags: Active, ILMI
    Total down time: 0 sec, Last down: Never
    EPD threshold: 0, Transmit weight cells: 0
    ATM per-VC transmit statistics:
     Tail queue packet drops: 0
    Traffic statistics:
     Input  bytes  :                   0
     Output bytes  :                4320
     Input  packets:                   0
     Output packets:                  72
  VCI 0.4
    Flags: Active, OAM
    OAM, Period 30 sec, Up count: 10, Down count: 10
    Total down time: 0 sec, Last down: Never
    EPD threshold: 2129, Transmit weight cells: 0
    ATM per-VC transmit statistics:
     Tail queue packet drops: 0
    Traffic statistics:
     Input  bytes  :                 572
     Output bytes  :                 572
     Input  packets:                  11
     Output packets:                  11
   OAM F4 cell statistics:
    Total received: 11, Total sent: 11
    Loopback received: 11, Loopback sent: 11
    Last received: 00:00:18, Last sent: 00:00:18
    RDI received: 0, RDI sent: 0
    AIS received: 0, AIS sent: 0
```

show interfaces (T1, E1, or DS)

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 T1, E1, or DS interface.

Options

interface-type—On ACX Series, M Series, MX Series, and T Series routers, the T1 interface type is **t1-*fpc/pic/port***, whereas the E1 interface type is **e1-*fpc/pic/port***, and DS interface type is **ds-*fpc/pic/port*:<channel>**.

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.

Required Privilege Level

view

Related Documentation

- *Understanding Interfaces on ACX Series Universal Metro Routers*

List of Sample Output

show interfaces (T1, IMA Link) on page 183
show interfaces (T1, PPP) on page 184
show interfaces detail (T1, PPP) on page 184
show interfaces extensive (T1 CRC Errors) on page 185
show interfaces extensive (T1, PPP) on page 185
show interfaces (E1, Frame Relay) on page 187
show interfaces detail (E1, Frame Relay) on page 188
show interfaces extensive (E1, Frame Relay) on page 189
show interfaces (E1, IMA Link) on page 191
show interfaces extensive (T1, TDM-CCC-SATOP) on page 192
show interfaces extensive (DS, TDM-CCC-CESoPSN) on page 194

Output Fields

Table 14 on page 172 lists the output fields for the **show interfaces** (T1 or E1) command. Output fields are listed in the approximate order in which they appear.

Table 14: T1 or E1 show interfaces Output Fields

Field Name	Field Description	Level of Output
Physical Interface		
Physical interface	Name of the physical interface.	All levels
Enabled	State of the interface. Possible values are described in the "Enabled Field" section under *Common Output Fields Description*.	All levels
Interface index	Physical interface's index number, which reflects its initialization sequence.	**detail extensive** none
SNMP ifIndex	SNMP index number for the physical interface.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Link-level type	Encapsulation being used on the physical interface.	All levels
MTU	MTU size on the physical interface.	All levels
Clocking	Reference clock source: **Internal** or **External**.	All levels
Speed	Speed at which the interface is running.	All levels
Loopback	Whether loopback is enabled and the type of loopback (**local** or **remote**).	All levels
FCS	Frame check sequence on the interface (either **16** or **32**). The default is **16** bits.	All levels
Framing	Physical layer framing format used for the E1 interface on the link: **G704**, **G704-NO-CRC4**, or **Unframed**. The default is **G704**. Physical layer framing format used for the T1 interface on the link: **SF** and **ESF**. The default is **ESF**.	All levels
Device flags	Information about the physical device. Possible values are described in the "Device Flags" section under *Common Output Fields Description*.	All levels
Interface flags	Information about the interface. Possible values are described in the "Interface Flags" section under *Common Output Fields Description*.	All levels
Link flags	Information about the link. Possible values are described in the "Link Flags" section under *Common Output Fields Description*.	All levels
Hold-times	Current interface hold-time up and hold-time down, in milliseconds.	**detail extensive**

Table 14: T1 or E1 show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
IMA Link alarms	Current active IMA link alarms, including the following: • **LIF** • **LODS** • **RFI-IMA** • **Tx-Mis-Connected** • **Tx-Unusable-FE** • **Rx-Unusable-FE** • **Link Fault**	**detail extensive** none
IMA Link defects	Current active IMA link defects, including the following: • **LIF** • **LODS** • **RFI-IMA** • **Tx-Mis-Connected** • **Tx-Unusable-FE** • **Rx-Unusable-FE** • **Link Fault**	**detail extensive** none

IMA Link state	Current active IMA link status, including the following:
	• **Line:** synchronized or not synchronized
	• **Near end:**—Status of near-end receive and transmit links
	  ◦ **Rx:** Usable or Unusable
	  ◦ **Tx:** Usable or Unusable
	• **Far end:**—Status of far-end receive and transmit links
	  ◦ **Rx:** Usable or Unusable
	  ◦ **Tx:** Usable or Unusable
		detail extensive none

Table 14: T1 or E1 show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
IMA link media	IMA Link Media Status, which provides the seconds and count state for the following link media parameters: • LIF • LODS • Err-ICP • IV • Rx-FC • Tx-FC • FE-Defects • FE-Rx-FC • FE-Tx-FC • Rx-ICP • Rx-Stuff • Tx-ICP • Tx-Stuff • Rx-SES • Rx-UAS • Rx-UUS • Tx-UUS • FE-Rx-SES • FE-Rx-UAS • FE-Rx-UUS • FE-Tx-UUS	**detail extensive** none
Keepalive settings	(PPP and HDLC) Configured settings for keepalives. • **interval** ***seconds***—The time in seconds between successive keepalive requests. The range is **10** seconds through **32,767** seconds, with a default of **10** seconds. • **down-count** ***number***—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**. • **up-count** ***number***—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**.	**detail extensive** none

Keepalive statistics	(PPP and HDLC) Information about keepalive packets. (When no level of output is specified, the word **statistics** is not part of the field name and the **last seen** text is not displayed.)
	• **Input**—Number of keepalive packets received by PPP.
	  • **(last seen 00:00:00 ago)**—Time since the last keepalive packet was received, in the format ***hh:mm:ss***.
	• **Output**—Number of keepalive packets sent by PPP and how long ago the last keepalive packets were sent and received.
	  • **(last seen 00:00:00 ago)**—Time since the last keepalive packet was sent, in the format ***hh:mm:ss***.
		detail extensive none

Table 14: T1 or E1 show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
LMI settings	(Frame Relay) Settings for Local Management Interface (LMI) which can be either ANSI LMI settings or ITU LMI settings. ANSI LMI settings is the default. The format is **(ANSI or ITU) LMI settings: *value*, *value*... *xx*** seconds, where *value* can be: • **n391dte**—DTE full status polling interval (1–255) • **n392dce**—DCE error threshold (1–10) • **n392dte**—DTE error threshold (1–10) • **n393dce**—DCE monitored event count (1–10) • **n393dte**—DTE monitored event count (1–10) • **t391dte**—DTE polling timer (5–30 seconds) • **t392dce**—DCE polling verification timer (5–30 seconds)	**detail extensive** none
LMI	(Frame Relay) Local Management Interface (LMI) packet statistics: • **Input**—Number of packets coming in on the interface (***nn***) and how much time has passed since the last packet arrived. The format is **Input: *nn* (last seen *hh*:*mm*:*ss* ago)**. • **Output**—Number of packets sent out on the interface (*nn*) and how much time has passed since the last packet was sent. The format is **Output: *nn* (last sent *hh*:*mm*:*ss* ago)**.	**detail extensive** none
DTE statistics	(Frame Relay) Statistics about messages transmitted from the data terminal equipment (DTE) to the data communications equipment (DCE): • **Enquiries sent**—Number of link status enquiries sent from the DTE to the DCE. • **Full enquiries sent**—Number of full enquiries sent from the DTE to the DCE. • **Enquiry responses received**—Number of enquiry responses received by the DTE from the DCE. • **Full enquiry responses received**—Number of full enquiry responses sent from the DTE to the DCE.	**detail extensive** none
DCE statistics	(Frame Relay) Statistics about messages transmitted from the DCE to the DTE: • **Enquiries received**—Number of enquiries received by the DCE from the DTE. • **Full enquiries received**—Number of full enquiries received by the DCE from the DTE. • **Enquiry responses sent**—Number of enquiry responses sent from the DCE to the DTE. • **Full enquiry responses sent**—Number of full enquiry responses sent from the DCE to the DTE.	**detail extensive** none

Table 14: T1 or E1 show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
Common statistics	(Frame Relay) Statistics about messages sent between the DTE and the DCE: • **Unknown messages received**—Number of received packets that do not fall into any category. • **Asynchronous updates received**—Number of link status peer changes received. • **Out-of-sequence packets received**—Number of packets for which the sequence of the packets received is different from the expected sequence. • **Keepalive responses timedout**—Number of keepalive responses that timed out when no Local Management Interface (LMI) packet was reported for **n392dte** or **n393dce** intervals. (See **LMI settings**.)	**detail extensive** none
Nonmatching DCE-end DLCIs	(Frame Relay. Displayed only from the DTE.) Number of DLCIs configured from the DCE.	**detail extensive** none
LCP state	(PPP) Link Control Protocol state. • **Conf-ack-received**—Acknowledgement was received. • **Conf-ack-sent**—Acknowledgement was sent. • **Conf-req-sent**—Request was sent. • **Down**—LCP negotiation is incomplete (not yet completed or has failed). • **Not configured**—LCP is not configured on the interface. • **Opened**—LCP negotiation is successful.	**detail extensive** none
NCP state	(PPP) Network Control Protocol state. • **Conf-ack-received**—Acknowledgement was received. • **Conf-ack-sent**—Acknowledgement was sent. • **Conf-req-sent**—Request was sent. • **Down**—NCP negotiation is incomplete (not yet completed or has failed). • **Not configured**—NCP is not configured on the interface. • **Opened**—NCP negotiation is successful.	**detail extensive** none
CHAP state	(PPP) State of the Challenge Handshake Authentication Protocol (CHAP) during its transaction. • **Chap-Chal-received**—Challenge was received but response is not yet sent. • **Chap-Chal-sent**—Challenge was sent. • **Chap-Resp-received**—Response was received for the challenge sent, but CHAP has not yet moved into the Success state. (Most likely with RADIUS authentication.) • **Chap-Resp-sent**—Response was sent for the challenge received. • **Down**—CHAP authentication is incomplete (not yet completed or has failed). • **Not-configured**—CHAP is not configured on the interface. • **Opened**—CHAP authentication was successful.	**detail extensive** none
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).**	**detail extensive** none

Table 14: T1 or E1 show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
CoS Queues	Number of CoS queues configured.	**detail extensive** none
Input rate	Input rate in bits per second (bps) and packets per second (pps).	None specified
Output rate	Output rate in bps and pps.	None specified
Statistics last cleared	Time when the statistics for the interface were last set to zero.	**detail extensive**
Traffic statistics	Number and rate of bytes and packets received and transmitted on the physical interface. • **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.	**detail extensive**
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). • **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. • **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. • **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. • **HS link CRC errors**—Number of errors on the high-speed links between the ASICs responsible for handling the router interfaces. • **SRAM errors**—Number of hardware errors that occurred in the static RAM (SRAM) on the PIC or PIM. If the value of this field increments, the PIC or PIM is malfunctioning. • **Resource errors**—Sum of transmit drops.	**extensive**

Table 14: T1 or E1 show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
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 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. • **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. • **MTU errors**—Number of packets whose size exceeded the MTU of the interface. • **Resource errors**—Sum of transmit drops.	**extensive**
Queue counters	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.	**detail extensive**
DS1 alarms **DS1 defects**	E1 media-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. The following lists all possible alarms and defects. For complete explanations of most of these alarms and defects, see *Bellcore Telcordia GR-499-CORE*. • **AIS**—Alarm indication signal. • **LOF**—Loss of frame. • **LOS**—Loss of signal. • **YLW**—Yellow alarm. Indicates errors at the remote site receiver.	**detail extensive** none

Table 14: T1 or E1 show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
T1 media or **E1 media**	Counts of T1 or E1 media-specific errors. • **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. State other than **OK** indicates a problem. The T1 or E1 media-specific error types are: • **SEF**—Severely errored framing • **BEE**—Bit error • **AIS**—Alarm indication signal • **LOF**—Loss of frame • **LOS**—Loss of signal • **YELLOW**—Errors at the remote site receiver • **CRC Major**—Cyclic redundancy check major alarm threshold exceeded • **CRC Minor**—Cyclic redundancy check minor alarm threshold exceeded • **BPV**—Bipolar violation • **EXZ**—Excessive zeros • **LCV**—Line code violation • **PCV**—Pulse code violation • **CS**—Carrier state • **CRC**—Cyclic redundancy check • **FEBE**—Far-end block error (E1 only) • **LES**—Line error seconds • **ES**—Errored seconds • **BES**—Bursty errored seconds • **SES**—Severely errored seconds • **SEFS**—Severely errored framing seconds • **UAS**—Unavailable seconds	**extensive**
SAToP Configuration	Information about the SAToP configuration. • **payload-size**—Configure the payload size, in bytes (from 32 through 1024 bytes). • **idle-pattern**—An 8-bit hexadecimal pattern to replace TDM data in a lost packet (from 0 through 255). • **jitter-buffer-packets**—Number of packets in the jitter buffer (from 1 through 64 packets). • **jitter-buffer-latency**—Time delay in the jitter buffer (from 1 through 1000 milliseconds). • **excessive-packet-loss-rate**—Set packet loss options. The options are **groups**, **sample-period**, and **threshold**. • **sample-period**—Time required to calculate excessive packet loss rate (from 1000 through 65,535 milliseconds). • **threshold**—Percentile designating the threshold of excessive packet loss rate (1–100 percent).	**extensive**

Table 14: T1 or E1 show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
CESoPSN Configuration	Information about the CESoPSN configuration. • **packetization-latency**—Time required to create packets (from 1000 through 8000 microseconds). • **idle-pattern**—An 8-bit hexadecimal pattern to replace TDM data in a lost packet (from 0 through 255). • **jitter-buffer-packets**—Number of packets in the jitter buffer (from 1 through 64 packets). • **jitter-buffer-latency**—Time delay in the jitter buffer (from 1 through 1000 milliseconds). • **excessive-packet-loss-rate**—Set packet loss options. The options are **sample-period** and **threshold**. • **sample-period**—Time required to calculate excessive packet loss rate (from 1000 through 65,535 milliseconds). • **threshold**—Percentile designating the threshold of excessive packet loss rate (1–100 percent).	**extensive**
HDLC configuration	Information about the HDLC configuration. • **Policing bucket**—Configured state of the receiving policer. • **Shaping bucket**—Configured state of the transmitting shaper. • **Giant threshold**—Giant threshold programmed into the hardware. • **Runt threshold**—Runt threshold programmed into the hardware. • **Timeslots**—Time slots configured on the interface. • **Buildout**—(T1 only) Buildout setting: 0-132, 133-265, 266-398, 399-531, or 532-655 feet. • **Timeslots**—Configured time slots for the interface. • **Byte encoding**—(T1 only) Byte encoding used: **Nx64K** or **Nx56K**. • **Line encoding**—Line encoding used. For T1, the value can be **B8ZS** or **AMI**. For E1, the value is **HDB3**. • **Data inversion**—HDLC data inversion setting: **Enabled** or **Disabled**. • **Idle cycle flag**—Idle cycle flags. • **Start end flag**—Start and end flag.	**extensive**
DS1 BERT configuration	BERT (bit error rate test) checks the quality of the line. This output appears only when a BERT is run on the interface. • **BERT time period**—Configured total time period that the BERT is to run. • **Elapsed**—Actual time elapsed since the start of the BERT (in seconds). • **Induced error rate**—Configured rate at which the bit errors are induced in the BERT pattern. • **Algorithm**—Type of algorithm selected for the BERT.	**detail extensive** none
Packet Forwarding Engine configuration	Information about the configuration of the Packet Forwarding Engine: • **Destination slot**—FPC slot number. • **PLP byte**—Packet Level Protocol byte.	**extensive**

Table 14: T1 or E1 show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
CoS information	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.	**extensive**
Logical Interface		
Logical interface	Name of the logical interface.	All levels
Index	Logical interface index number, which reflects its initialization sequence.	**detail extensive** none
SNMP ifIndex	Logical interface SNMP interface index number.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Flags	Information about the interface. Possible values are described in the "Interface Flags" section under *Common Output Fields Description*.	All levels
Encapsulation	Encapsulation on the logical interface.	All levels
Input packets	Number of packets received on the logical interface.	None specified
Output packets	Number of packets transmitted on the logical interface.	None specified
Traffic statistics	(Frame Relay) Number and rate of bytes and packets received and transmitted on the logical interface. • **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.	**detail extensive**
Local statistics	(Frame Relay) Statistics for traffic received from and transmitted to the Routing Engine. When a burst of traffic is received, the value in the output packet rate field might briefly exceed the peak cell rate. It takes a while (generally, less than 1 second) for this counter to stabilize.	**detail extensive**

Table 14: T1 or E1 show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
Transit statistics	(Frame Relay) 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 normally stabilizes in less than 1 second.	**detail extensive**
Protocol	Protocol family configured on the logical interface, such as **iso**, **inet6**, **mlfr**, or **mpls**.	**detail extensive** none
Multilink bundle	Interface name for the multilink bundle, if configured.	**detail extensive** none
MTU	MTU size on the logical interface.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Route table	Routing table in which the logical interface address is located. For example, **0** refers to the routing table inet.0.	**detail extensive**
Flags	Information about the protocol family flags. Possible values are described in the "Family Flags" section under *Common Output Fields Description*.	**detail extensive** none
Addresses, Flags	Information about the address flags. Possible values are described in the "Addresses Flags" section under *Common Output Fields Description*.	**detail extensive** none
Destination	IP address of the remote side of the connection.	**detail extensive** none
Local	IP address of the logical interface.	**detail extensive** none
Broadcast	Broadcast address.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive** none
DLCI	(Frame Relay) DLCI number of the logical interface. The following DLCI information is displayed: **Flags**, **Total down time**, **Last down**, and **Traffic statistics** or (**Input packets, Output packets**). **Flags** can be one or more of the following: • **Active**—Set when the link is active and the DTE and DCE are exchanging information. • **Down**—Set when the link is active, but no information is received from the DCE. • **DCE-Unconfigured**—Set when the corresponding DLCI in the DCE is not configured. • **Configured**—Set when the corresponding DLCI in the DCE is configured. • **DCE-configured**—Displayed when the command is issued from the DTE.	**detail extensive** none
DLCI statistics	(Frame Relay) Data-link connection identifier (DLCI) statistics. • **Active DLCI**—Number of active DLCIs. • **Inactive DLCI**—Number of inactive DLCIs.	**detail extensive** none

Table 14: T1 or E1 show interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
CE Info	Information related to the circuit emulation statistics. • **CE Tx**—Number of transmitted packets and bytes (TDM to PSN flow). • **CE Rx**—Number of received packets and bytes and forward bytes (PSN to TDM flow). • **CE Rx Forwarded**—Number of forwarded bytes. • **CE Strayed**—Number of stray packets. • **CE Lost**—Number of lost packets. • **CE Malformed**—Number of malformed packets • **CE Misinserted**—Number of misinserted packets. • **CE AIS dropped**—Number of dropped bytes due to buffer overrun (PSN to TDM). • **CE Dropped**—Number of dropped packets during resynchronization • **CE Overrun Events**—Number of overrun events. • **CE Underrun Events**—Number of underrun events.	**extensive**

Sample Output

show interfaces (T1, IMA Link)

```
user@host> show interfaces t1-1/0/0
  IMA Link alarms   : None
  IMA Link defects  : LIF, LODS
  IMA Link state:
    Line     : Not synchronized
    Near end : Rx: Unusable, Tx: Usable
    Far  end : Rx: Unusable, Tx: Usable
  IMA link media:          Seconds        Count  State
    LIF                                       0  OK
    LODS                                      0  OK
    Err-ICP                                   0  OK
    IV                                        0  OK
    Rx-FC                                     0  OK
    Tx-FC                                     0  OK
    FE-Defects                                0
    FE-Rx-FC                                  0
    FE-Tx-FC                                  0
    Rx-ICP                                    0
    Rx-Stuff                                  0
    Tx-ICP                                   11
    Tx-Stuff                                  0
    Rx-SES                    0
    Rx-UAS                    0
    Rx-UUS                    1
    Tx-UUS                    0
    FE-Rx-SES                 0
    FE-Rx-UAS                 0
    FE-Rx-UUS                 0
    FE-Tx-UUS                 0
```

show interfaces (T1, PPP)

```
user@host> show interfaces t1-1/1/0
Physical interface: t1-1/1/0, Enabled, Physical link is Up
  Interface index: 149, SNMP ifIndex: 45
  Link-level type: PPP, MTU: 1504, Clocking: Internal, Speed: T1,
  Loopback: None, FCS: 16, Framing: ESF
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps Internal: 0x4000
  Link flags     : Keepalives
  Keepalive settings: Interval 10 seconds, Up-count 1, Down-count 3
  Keepalive: Input: 0 (never), Output: 0 (never)
  LCP state: Opened
  NCP state: Opened
  CHAP state: Opened
  CoS queues     : 4 supported, 4 in use
  Last flapped   : 2005-12-05 08:43:06 PST (02:13:35 ago)
  Input rate     : 0 bps (0 pps)
  Output rate    : 72 bps (0 pps)
  DS1   alarms   : None
  DS1   defects  : None

  Logical interface t1-1/1/0.0 (Index 66) (SNMP ifIndex 51)
    Flags: Hardware-Down Point-To-Point SNMP-Traps Encapsulation: PPP
    Protocol inet, MTU: 1500
      Flags: Protocol-Down
      Addresses, Flags: Dest-route-down Is-Preferred Is-Primary
        Destination: 198.51.100.0/24, Local: 198.51.100.1, Broadcast:
198.51.100.255
```

show interfaces detail (T1, PPP)

```
user@host> show interfaces t1-1/1/0 detail
Physical interface: t1-1/1/0, Enabled, Physical link is Up
  Interface index: 149, SNMP ifIndex: 45, Generation: 32
  Link-level type: PPP, MTU: 1504, Clocking: Internal, Speed: T1,
  Loopback: None, FCS: 16, Framing: ESF
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps Internal: 0x4000
  Link flags     : Keepalives
  Hold-times     : Up 0 ms, Down 0 ms
  Keepalive settings: Interval 10 seconds, Up-count 1, Down-count 3
  Keepalive statistics:
    Input : 0 (last seen: never)
    Output: 0 (last sent: never)
  LCP state: Opened
  NCP state: Opened
  CHAP state: Opened
  CoS queues     : 4 supported, 4 in use
  Last flapped   : 2005-12-05 08:43:06 PST (02:13:52 ago)
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :                    0                    0 bps
   Output bytes  :                  798                    0 bps
   Input  packets:                    0                    0 pps
   Output packets:                   42                    0 pps
  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                40                40                 0

  DS1   alarms   : None
  DS1   defects  : None
  DS1 BERT configuration:
    BERT time period: 10 seconds, Elapsed: 0 seconds
    Induced Error rate: 10e-0, Algorithm: 2^15 - 1
  Logical interface t1-1/1/0.0 (Index 66) (SNMP ifIndex 51) (Generation 5)
    Flags: Hardware-Down Point-To-Point SNMP-Traps Encapsulation: PPP
    Protocol inet, MTU: 1500, Generation: 14, Route table: 0
      Flags: Protocol-Down
      Addresses, Flags: Dest-route-down Is-Preferred Is-Primary
        Destination: 198.51.100.0/24, Local: 198.51.100.1, Broadcast:
198.51.100.255,
        Generation: 18
```

show interfaces extensive (T1 CRC Errors)

```
user@host> show interfaces t1-3/2/0:1:1 extensive
Physical interface: t1-3/2/0:1:1, Enabled, Physical link is Down
  Interface index: 179, SNMP ifIndex: 79, Generation: 180
  :
  :
  DS1   alarms   : AIS, LOF, CRC Major, CRC Minor
  DS1   defects  : AIS, LOF, CRC Major, CRC Minor
  T1  media:            Seconds        Count  State
    SEF                       1            1  OK
    BEE                       1            1  OK
    AIS                    1128            1  Defect Active
    LOF                    1128            1  Defect Active
    LOS                       0            0  OK
    YELLOW                    0            0  OK
    CRC Major               154            1  Defect Active
    CRC Minor               154            1  Defect Active
    BPV                       0            0
    EXZ                       0            0
    LCV                       0            0
    PCV                       0            0
    CS                        0            0
    CRC                     154        15400
    ...
```

show interfaces extensive (T1, PPP)

```
user@host> show interfaces t1-1/1/0 extensive
Physical interface: t1-1/1/0, Enabled, Physical link is Up
  Interface index: 149, SNMP ifIndex: 45, Generation: 32
  Link-level type: PPP, MTU: 1504, Clocking: Internal, Speed: T1,
  Loopback: None, FCS: 16, Framing: ESF
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps Internal: 0x4000
  Link flags     : Keepalives
  Hold-times     : Up 0 ms, Down 0 ms
  Keepalive settings: Interval 10 seconds, Up-count 1, Down-count 3
  Keepalive statistics:
    Input : 0 (last seen: never)
```

```
  Output: 0 (last sent: never)
LCP state: Down
NCP state: inet: Not-configured, inet6: Not-configured, iso: Not-configured,
mpls: Not-configured
CHAP state: Closed
CoS queues     : 4 supported, 4 in use
Last flapped   : 2005-12-05 08:43:06 PST (02:13:54 ago)
Statistics last cleared: Never
Traffic statistics:
 Input  bytes  :                    0                    0 bps
 Output bytes  :                  817                   72 bps
 Input  packets:                    0                    0 pps
 Output packets:                   43                    0 pps
Input errors:
  Errors: 0, Drops: 0, Framing errors: 0, Policed discards: 0,
  L3 incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0,
  HS link CRC errors: 0, SRAM errors: 0, Resource errors: 0
Output errors:
  Carrier transitions: 1, Errors: 0, Drops: 0, Aged packets: 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                 42                   42                    0

DS1   alarms   : None
DS1   defects  : None
T1  media:            Seconds        Count  State
  SEF                       1            1  OK
  BEE                       0            0  OK
  AIS                       0            0  OK
  LOF                       1            1  OK
  LOS                       0            0  OK
  YELLOW                    1            1  OK
  BPV                       1            1
  EXZ                       1            1
  LCV                       1        65535
  PCV                       1         1023
  CS                        0            0
  LES                       1
  ES                        1
  SES                       1
  SEFS                      1
  BES                       0
  UAS                       0
HDLC configuration:
  Policing bucket: Disabled
  Shaping bucket : Disabled
  Giant threshold: 1514, Runt threshold: 3
  Timeslots      : All active
  Line encoding: B8ZS
  Buildout       : 0 to 132 feet
  Byte encoding: Nx64K, Data inversion: Disabled, Idle cycle flag: flags,
  Start end flag: shared
DS1 BERT configuration:
```

```
    BERT time period: 10 seconds, Elapsed: 0 seconds
    Induced Error rate: 10e-0, Algorithm: 2^15 - 1
  Packet Forwarding Engine configuration:
    Destination slot: 1, PLP byte: 1 (0x00)
  CoS information:
    CoS transmit queue       Bandwidth          Buffer   Priority    Limit
                          %          bps     %     usec
    0 best-effort        95      1459200    95        0        low    none
    3 network-control     5        76800     5        0        low    none

  Logical interface t1-1/1/0.0 (Index 66) (SNMP ifIndex 51) (Generation 5)
    Flags: Hardware-Down Point-To-Point SNMP-Traps Encapsulation: PPP
    Protocol inet, MTU: 1500, Generation: 14, Route table: 0
      Flags: Protocol-Down
      Addresses, Flags: Dest-route-down Is-Preferred Is-Primary
        Destination: 198.51.100.0/24, Local: 198.51.100.1, Broadcast:
198.51.100.255,
        Generation: 18
```

show interfaces (E1, Frame Relay)

```
user@host> show interfaces e1-3/0/0
Physical interface: e1-3/0/0, Enabled, Physical link is Up
  Interface index: 146, SNMP ifIndex: 37
  Link-level type: Frame-Relay, MTU: 1504, Clocking: Internal, Speed: E1,
  Loopback: None, FCS: 16, Framing: G704
  Device flags   : Present Running
  Interface flags: Link-Layer-Down Point-To-Point SNMP-Traps 16384
  Link flags     : Keepalives DTE
  ANSI LMI settings: n391dte 6, n392dte 3, n393dte 4, t391dte 10 seconds
  LMI: Input: 0 (never), Output: 11 (00:00:05 ago)
  DTE statistics:
    Enquiries sent                      : 10
    Full enquiries sent                 : 1
    Enquiry responses received          : 0
    Full enquiry responses received     : 0
  DCE statistics:
    Enquiries received                  : 0
    Full enquiries received             : 0
    Enquiry responses sent              : 0
    Full enquiry responses sent         : 0
  Common statistics:
    Unknown messages received           : 0
    Asynchronous updates received       : 0
    Out-of-sequence packets received    : 0
    Keepalive responses timedout        : 1
  CoS queues     : 8 supported
  Last flapped   : 2005-11-30 14:50:34 PST (4d 20:33 ago)
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)
  DS1   alarms   : None
  DS1   defects  : None
  Logical interface e1-3/0/0.0 (Index 72) (SNMP ifIndex 32)
    Flags: Device-Down Point-To-Point SNMP-Traps Encapsulation: FR-NLPID
  Input packets : 0
  Output packets: 0
    Protocol inet, MTU: 1500
      Flags: None
      Addresses, Flags: Dest-route-down Is-Preferred Is-Primary
        Destination: 10.1.3/24, Local: 10.1.3.1, Broadcast: 10.1.3.255
    DLCI 100
```

```
    Flags: Down, DCE-Unconfigured
    Total down time: 00:01:13 sec, Last down: 00:01:13 ago
    Input packets : 0
    Output packets: 0
  DLCI statistics:
    Active DLCI  :0  Inactive DLCI  :1
```

show interfaces detail (E1, Frame Relay)

```
user@host> show interfaces e1-3/0/0 detail
Physical interface: e1-3/0/0, Enabled, Physical link is Up
  Interface index: 146, SNMP ifIndex: 37, Generation: 69
  Link-level type: Frame-Relay, MTU: 1504, Clocking: Internal, Speed: E1,
  Loopback: None, FCS: 16, Framing: G704
  Device flags   : Present Running
  Interface flags: Link-Layer-Down Point-To-Point SNMP-Traps 16384
  Link flags     : Keepalives DTE
  Hold-times     : Up 0 ms, Down 0 ms
  ANSI LMI settings: n391dte 6, n392dte 3, n393dte 4, t391dte 10 seconds
  LMI statistics:
    Input : 0 (last seen: never)
    Output: 12 (last sent 00:00:02 ago)
  DTE statistics:
    Enquiries sent                     : 10
    Full enquiries sent                : 2
    Enquiry responses received         : 0
    Full enquiry responses received    : 0
  DCE statistics:
    Enquiries received                 : 0
    Full enquiries received            : 0
    Enquiry responses sent             : 0
    Full enquiry responses sent        : 0
  Common statistics:
    Unknown messages received          : 0
    Asynchronous updates received      : 0
    Out-of-sequence packets received   : 0
    Keepalive responses timedout       : 1
  CoS queues     : 8 supported
  Last flapped   : 2005-11-30 14:50:34 PST (4d 20:33 ago)
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :                   0                   0 bps
   Output bytes  :                 225                  56 bps
   Input  packets:                   0                   0 pps
   Output packets:                  15                   0 pps
  Queue counters:       Queued packets  Transmitted packets      Dropped packets

    0 limited                        0                   0                   0

    1 expedited-fo                   0                   0                   0

    2 real-plus                      0                   0                   0

    3 network-cont                  15                  15                   0

  DS1   alarms   : None
  DS1   defects  : None
  DS1 BERT configuration:
    BERT time period: 10 seconds, Elapsed: 0 seconds
    Induced Error rate: 10e-0, Algorithm: 2^15 - 1, O.151, Pseudorandom (9)
  Logical interface e1-3/0/0.0 (Index 72) (SNMP ifIndex 32) (Generation 26)
```

```
  Flags: Device-Down Point-To-Point SNMP-Traps Encapsulation: FR-NLPID
  Traffic statistics:
   Input  bytes  :                   0
   Output bytes  :                   0
   Input  packets:                   0
   Output packets:                   0
  Local statistics:
   Input  bytes  :                   0
   Output bytes  :                   0
   Input  packets:                   0
   Output packets:                   0
  Transit statistics:
   Input  bytes  :                   0                    0 bps
   Output bytes  :                   0                    0 bps
   Input  packets:                   0                    0 pps
   Output packets:                   0                    0 pps
  Protocol inet, MTU: 1500, Generation: 32, Route table: 0
    Flags: None
    Addresses, Flags: Dest-route-down Is-Preferred Is-Primary
      Destination: 10.1.3/24, Local: 10.1.3.1, Broadcast: 10.1.3.255,
      Generation: 42
  DLCI 100
    Flags: Down, DCE-Unconfigured
    Total down time: 00:01:18 sec, Last down: 00:01:18 ago
    Traffic statistics:
     Input  bytes  :                  0
     Output bytes  :                  0
     Input  packets:                  0
     Output packets:                  0
DLCI statistics:
  Active DLCI  :0  Inactive DLCI  :1
```

show interfaces extensive (E1, Frame Relay)

```
user@host> show interfaces e1-3/0/0 extensive
Physical interface: e1-3/0/0, Enabled, Physical link is Up
  Interface index: 146, SNMP ifIndex: 37, Generation: 69
  Link-level type: Frame-Relay, MTU: 1504, Clocking: Internal, Speed: E1,
  Loopback: None, FCS: 16, Framing: G704
  Device flags   : Present Running
  Interface flags: Link-Layer-Down Point-To-Point SNMP-Traps 16384
  Link flags     : Keepalives DTE
  Hold-times     : Up 0 ms, Down 0 ms
  ANSI LMI settings: n391dte 6, n392dte 3, n393dte 4, t391dte 10 seconds
  LMI statistics:
    Input : 0 (last seen: never)
    Output: 12 (last sent 00:00:05 ago)
  DTE statistics:
    Enquiries sent                     : 10
    Full enquiries sent                : 2
    Enquiry responses received         : 0
    Full enquiry responses received    : 0
  DCE statistics:
    Enquiries received                 : 0
    Full enquiries received            : 0
    Enquiry responses sent             : 0
    Full enquiry responses sent        : 0
  Common statistics:
    Unknown messages received          : 0
    Asynchronous updates received      : 0
    Out-of-sequence packets received   : 0
```

```
  Keepalive responses timedout         : 1
CoS queues     : 8 supported
Last flapped   : 2005-11-30 14:50:34 PST (4d 20:33 ago)
Statistics last cleared: Never
Traffic statistics:
 Input  bytes  :                    0                    0 bps
 Output bytes  :                  225                    0 bps
 Input  packets:                    0                    0 pps
 Output packets:                   15                    0 pps
Input errors:
  Errors: 0, Drops: 0, Framing errors: 0, Policed discards: 0,
  L3 incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0,
  HS link CRC errors: 0, SRAM errors: 0, Resource errors: 0
Output errors:
  Carrier transitions: 17, Errors: 0, Drops: 0, Aged packets: 0,
  MTU errors: 0, Resource errors: 0
Queue counters:       Queued packets  Transmitted packets      Dropped packets

  0 limited                        0                    0                    0

  1 expedited-fo                   0                    0                    0

  2 real-plus                      0                    0                    0

  3 network-cont                  15                   15                    0

DS1   alarms   : None
DS1   defects  : None
E1  media:            Seconds        Count  State
  SEF                       0            0  OK
  BEE                       5            5  OK
  AIS                       0            0  OK
  LOF                     245           15  OK
  LOS                     245            4  OK
  YELLOW                    0           11  OK
  BPV                       0            0
  EXZ                       9            9
  LCV                       0            0
  PCV                       0            0
  CS                        0            0
  FEBE                      0            0
  LES                       0
  ES                        0
  SES                       0
  SEFS                      0
  BES                       0
  UAS                     271
HDLC configuration:
  Policing bucket: Disabled
  Shaping bucket : Disabled
  Giant threshold: 1506, Runt threshold: 0
  Timeslots      : All active
  Line encoding: HDB3, Data inversion: Disabled, Idle cycle flag: flags,
  Start end flag: shared
DS1 BERT configuration:
  BERT time period: 10 seconds, Elapsed: 0 seconds
  Induced Error rate: 10e-0, Algorithm: 2^15 - 1, O.151, Pseudorandom (9)
Packet Forwarding Engine configuration:
  Destination slot: 3, PLP byte: 1 (0x00)
CoS information:
  CoS transmit queue       Bandwidth          Buffer   Priority    Limit
```

```
                      %          bps     %     usec
  0 limited           95     1945600    95        0        low     none
  3 network-control    5     102400      5        0        low     none
Logical interface e1-3/0/0.0 (Index 72) (SNMP ifIndex 32) (Generation 26)
  Flags: Device-Down Point-To-Point SNMP-Traps Encapsulation: FR-NLPID
  Traffic statistics:
   Input  bytes  :                   0
   Output bytes  :                   0
   Input  packets:                   0
   Output packets:                   0
  Local statistics:
   Input  bytes  :                   0
   Output bytes  :                   0
   Input  packets:                   0
   Output packets:                   0
  Transit statistics:
   Input  bytes  :                   0                   0 bps
   Output bytes  :                   0                   0 bps
   Input  packets:                   0                   0 pps
   Output packets:                   0                   0 pps
  Protocol inet, MTU: 1500, Generation: 32, Route table: 0
    Flags: None
    Addresses, Flags: Dest-route-down Is-Preferred Is-Primary
      Destination: 10.1.3/24, Local: 10.1.3.1, Broadcast: 10.1.3.255,
      Generation: 42
  DLCI 100
    Flags: Down, DCE-Unconfigured
    Total down time: 00:01:21 sec, Last down: 00:01:21 ago
    Traffic statistics:
     Input  bytes  :                  0
     Output bytes  :                  0
     Input  packets:                  0
     Output packets:                  0
DLCI statistics:
  Active DLCI  :0  Inactive DLCI  :1
```

show interfaces (E1, IMA Link)

```
user@host> show interfaces e1-1/0/0
  IMA Link alarms   : None
  IMA Link defects  : LIF, LODS
  IMA Link state:
    Line     : Not synchronized
    Near end : Rx: Unusable, Tx: Usable
    Far  end : Rx: Unusable, Tx: Usable
  IMA link media:          Seconds        Count  State
    LIF                                       0
    LODS                                      0
    Err-ICP                                   0
    IV                                        0
    Rx-FC                                     0
    Tx-FC                                     0
    FE-Defects                                0
    FE-Rx-FC                                  0
    FE-Tx-FC                                  0
    Rx-ICP                                    0
    Rx-Stuff                                  0
    Tx-ICP                                   11
    Tx-Stuff                                  0
    Rx-SES                      0
    Rx-UAS                      0
```

```
    Rx-UUS                      1
    Tx-UUS                      0
    FE-Rx-SES                   0
    FE-Rx-UAS                   0
    FE-Rx-UUS                   0
    FE-Tx-UUS                   0
```

show interfaces extensive (T1, TDM-CCC-SATOP)

```
user@host> show interfaces t1-1/0/0:1:1 extensive
Physical interface: t1-1/0/0:1:1, Enabled, Physical link is Down
  Interface index: 153, SNMP ifIndex: 579, Generation: 817
  Link-level type: TDM-CCC-SATOP, MTU: 1504, Clocking: Internal, Speed: T1,
Loopback: None, FCS: 16, Framing: ESF,
  Parent: coc1-1/0/0:1 Interface index 152
  Device flags   : Present Running Down
  Interface flags: Hardware-Down Point-To-Point SNMP-Traps Internal: 0x0
  Link flags     : None
  Hold-times     : Up 0 ms, Down 0 ms
  CoS queues     : 8 supported, 8 maximum usable queues
  Last flapped   : 2012-10-28 02:12:40 PDT (22:32:13 ago)
  Statistics last cleared: 2012-10-29 00:44:52 PDT (00:00:01 ago)
  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
  DS1   alarms   : None
  DS1   defects  : None
  T1  media:            Seconds        Count  State
    SEF                          0            0  OK
    BEE                          0            0  OK
    AIS                          0            0  OK
    LOF                          0            0  OK
    LOS                          0            0  OK
    YELLOW                       0            0  OK
    CRC Major                    0            0  OK
    CRC Minor                    0            0  OK
    BPV                          0            0
    EXZ                          0            0
    LCV                          0            0
    PCV                          0            0
    CS                           0            0
    CRC                          0            0
    LES                          0
    ES                           0
    SES                          0
    SEFS                         0
    BES                          0
    UAS                          0
```

```
  SAToP configuration:
    Payload size: 192
    Idle pattern: 0xFF
    Octet aligned: Disabled
    Jitter buffer: packets: 8, latency: 7 ms, auto adjust: Disabled
    Excessive packet loss rate: sample period: 10000 ms, threshold: 30%
  DS1 BERT configuration:
    BERT time period: 10 seconds, Elapsed: 0 seconds
    Induced Error rate: 0, Algorithm: 2^15 - 1, O.151, Pseudorandom (9)
  SONET alarms   : None
  SONET defects  : AIS-V, RDI-V
  SONET vt:
    BIP-BIP2                    0           0
    REI-V                       0           0
    LOP-V                       0           0  OK
    AIS-V                       2           0  Defect Active
    RDI-V                       2           0  Defect Active
    UNEQ-V                      0           0  OK
    PLM-V                       0           0  OK
    ES-V                        0
    SES-V                       0
    UAS-V                       2
    ES-VFE                      0
    SES-VFE                     0
    UAS-VFE                     0
  Received SONET overhead:
V5      : 0x07
V5(cmp) : 0x02
  Transmitted SONET overhead:
V5      : 0x02
  Packet Forwarding Engine configuration:
    Destination slot: 1
  CoS information:
    Direction : Output
    CoS transmit queue              Bandwidth              Buffer Priority
Limit
                              %           bps     %          usec
    0 best-effort            95       1459200    95             0      low
none
    3 network-control         5         76800     5             0      low
none

  Logical interface t1-1/0/0:1:1.0 (Index 69) (SNMP ifIndex 580) (Generation 525)

    Flags: Device-Down Point-To-Point SNMP-Traps Encapsulation: TDM-CCC-SATOP
  CE info               Packets        Bytes  Count
    CE Tx                  1005       192960
    CE Rx                  1004       192768
    CE Rx Forwarded                       0
    CE Strayed                0
    CE Lost                   0
    CE Malformed              0
    CE Misinserted            0
    CE AIS dropped            0
    CE Dropped             1005       192960
    CE Overrun Events                      0
    CE Underrun Events                     0
    Protocol ccc, MTU: 1504, Generation: 814, Route table: 0
      Flags: Is-Primary
```

show interfaces extensive (DS, TDM-CCC-CESoPSN)

```
user@host> show interfaces ds-1/0/0:1:1:1 extensive
Physical interface: ds-1/0/0:1:1:1, Enabled, Physical link is Down
  Interface index: 154, SNMP ifIndex: 597, Generation: 819
  Link-level type: TDM-CCC-CESoPSN, MTU: 1504, Speed: 1536kbps, Loopback: None,
FCS: 16, Parent: ct1-1/0/0:1:1 Interface index 153
  Device flags   : Present Running Down
  Interface flags: Hardware-Down Point-To-Point SNMP-Traps Internal: 0x0
  Link flags     : None
  Hold-times     : Up 0 ms, Down 0 ms
  CoS queues     : 8 supported, 8 maximum usable queues
  Last flapped   : 2012-10-29 00:49:03 PDT (00:00:35 ago)
  Statistics last cleared: Never
  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
  CESoPSN configuration:
    Packetization latency: 1000 us
    Idle pattern: 0xFF
    Jitter buffer: packets: 8, latency: 8 ms, auto adjust: Disabled
    Excessive packet loss rate: sample period: 10000 ms, threshold: 30%
  DS0 BERT configuration:
    BERT time period: 10 seconds, Elapsed: 0 seconds
    Induced Error rate: 0, Algorithm: 2^15 - 1, O.151, Pseudorandom (9)
  Packet Forwarding Engine configuration:
    Destination slot: 1
  CoS information:
    Direction : Output
    CoS transmit queue              Bandwidth              Buffer Priority
Limit
                              %           bps     %           usec
    0 best-effort            95       1459200    95              0      low
none
    3 network-control         5         76800     5              0      low
none

  Logical interface ds-1/0/0:1:1:1.0 (Index 69) (SNMP ifIndex 598) (Generation
549)
    Flags: Device-Down Point-To-Point SNMP-Traps Encapsulation: TDM-CCC-CESoPSN
  CE info               Packets        Bytes  Count
    CE Tx                     0            0
    CE Rx                 35712       6856704
    CE Rx Forwarded                       0
    CE Strayed                0
    CE Lost                   0
    CE Malformed              0
    CE Misinserted            0
```

```
CE AIS dropped            0
CE Dropped                0            0
CE Overrun Events                         0
CE Underrun Events                        1
Protocol ccc, MTU: 1504, Generation: 857, Route table: 0
  Flags: Is-Primary
```

show interfaces extensive

Syntax show interfaces extensive

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 12.1x48 for PTX Series Packet Transport Routers.
Command introduced in Junos OS Release 17.2 for PT1000 and PTX10008 Packet Transport Routers.

Description Display extensive information about all interfaces configured on the router.

NOTE:

- At some times, the cumulative byte counters displayed with the **show interfaces extensive** command on the 10-Gigabit Ethernet MPC with SFP+ is not always increasing and cumulative and does not give the correct results. There is a time lag in collecting these statistics, during which the display might decrease or go from a nonzero number to zero. Eventually, the counter will display the correct result.
- When the **show interfaces extensive** command is executed on a router with an MPC or a T4000 Type 5 FPC, the **Input packet rejects** counter of the **Filter statistics** field also displays statistics related to the following packet errors:
  - Invalid VLAN range
  - Tagged packet received on an untagged interface
- When the **show interfaces extensive** command is executed on an interface that is configured on a T4000 Type 5 FPC, the **IPv6 transit statistics** field displays:
  - Total statistics (sum of transit and local statistics) at the physical interface level
  - Transit statistics at the logical interface level
- When the **show interfaces extensive** command is executed on an aggregate interface in a T1600 Core Router, the IPv6 **Input bytes** is displayed for an aggregate interface. However, the IPv6 **Input bytes** is always zero on a member link of an aggregated bundle even when there is IPv6 transit traffic on the member link. This is because the logical interface index of the aggregate logical interface is updated but not the logical interface of the member links in the channel lookup table.
- The **Output packets** field under the **Traffic statistics** section in the output of the **show interfaces extensive** command includes both IPv4 and IPv6 packets. For example, in a scenario in which both IPv4 and IPv6 packets are being mirrored on the same interface and when you deactivate an IPv4 port-mirroring instance on the chassis, the output of the **show interfaces extensive** command shows a value in the Output packets field of the Traffic statistics section, which is the value of IPv6 packets that are mirrored and not of the IPv4 packets. This behavior is expected.
- For IQ2 PIC interfaces, the output of the **show interfaces extensive** command displays byte statistics that includes Layer 2 headers.
- If there are active OTN defects when an ISSU is performed, and the defect persists after the upgrade completes, the OTN alarm count is incremented by 1. For example, if an OTN alarm is active with a count of 1 and the defect remains after ISSU, the alarm count is incremented to 2. This behavior is expected.

Options This command has no options.

Required Privilege Level view

List of Sample Output

Output Fields For more information, see the output fields table for the particular interface type in which you are interested. For information about destination class and source class statistics, see the “Destination Class Field” section and the “Source Class Field” section under *Common Output Fields Description*. For sample output for specific interfaces, see the other topics in this collection.

Sample Output

show interfaces extensive (Circuit Emulation)

If a Circuit Emulation (CE) PIC is configured for SAToP pseudowire, then pseudowire statistics are displayed in the CE information section of the **show interface extensive** output. If SAToP pseudowire is not configured on the CE PIC, then all CE information counters display 0 (zero).

```
user@host> show interface t1-0/0/0 extensive
Physical interface :t1-0/0/0, Enabled, Physical Link : Up
        Interface index:61441
```



```
Speed : 1.54 Mbps, Loopback: Disabled
Operational state : Enabled,    Encapsulation : Trans
Encoding : b8zs,        Framing    : unframe,   Build-out : 0-30
Inversion    : enable,  Clock source : master
Description :
Traffic statistics:
T1 media:       Seconds
ES              1643
SES             1643

CE Info         Packets             Bytes
CE Rx     :     2395529             306627712
CE Tx     :     2396259             306721152
CE Rx Drop:     0                   0
CE Tx Drop:     0                   0

CE Overrun  Events: 0
CE Underrun Events: 0
```

Sample Output

show interfaces extensive (Fast Ethernet)

```
user@host> show interfaces fe-0/2/1 extensive
Physical interface: fe-0/2/0, Enabled, Physical link is Up
  Interface index: 129, SNMP ifIndex: 23, Generation: 130
  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:00:53:00, Hardware address: 00:00:5E:00:53:00
  Last flapped   : 2006-04-16 23:00:41 PDT (02:08:05 ago)
  Statistics last cleared: 2006-04-16 21:42:00 PDT (03:26:46 ago)
  Traffic statistics:
   Input  bytes  :                17539                 152 bps
   Output bytes  :                92968                 224 bps
   Input  packets:                  348                   0 pps
   Output packets:                 1349                   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
  Egress queues: 4 supported, 4 in use
  Queue counters:       Queued packets  Transmitted packets      Dropped packets

    0 best-effort                  66                   66                    0

    1 expedited-fo                  0                    0                    0

    2 assured-forw                  0                    0                    0

    3 network-cont               1283                 1283                    0

  Active alarms  : None
  Active defects : None
```

```
MAC statistics:                      Receive         Transmit
  Total octets                         24721           105982
  Total packets                          348             1349
  Unicast packets                        347              430
  Broadcast packets                        1               37
  Multicast packets                        0              882
  CRC/Align errors                         0                0
  FIFO errors                              0                0
  MAC control frames                       0                0
  MAC pause frames                         0                0
  Oversized frames                         0
  Jabber frames                            0
  Fragment frames                          0
  VLAN tagged frames                       0
  Code violations                          0
Filter statistics:
  Input packet count                     348
  Input packet rejects                     0
  Input DA rejects                         0
  Input SA rejects                         0
  Output packet count                             1349
  Output packet pad count                            0
  Output packet error count                          0
  CAM destination filters: 3, CAM source filters: 0
Autonegotiation information:
  Negotiation status: Complete
  Link partner:
      Link mode: Full-duplex, Flow control: None, Remote fault: OK
Packet Forwarding Engine configuration:
  Destination slot: 0
CoS information:
  CoS transmit queue                Bandwidth      Buffer    Priority    Limit

                                %           bps   %   usec
  0 best-effort                95      95000000  95    0            low    none
  3 network-control             5       5000000   5    0            low    none
Logical interface fe-0/2/0.0 (Index 66) (SNMP ifIndex 46) (Generation 133)
  Flags: SNMP-Traps Encapsulation: ENET2
  Protocol inet, MTU: 1500, Generation: 142, Route table: 0
    Flags: DCU, SCU-out
                                              Packets                 Bytes
    Destination class              (packet-per-second)    (bits-per-second)
                      silv1_new                       0                    0
                                (                     0) (                   0)
                      silv2_new                       0                    0
                                (                     0) (                   0)
                      silv_misc                       0                    0
                                (                     0) (                   0)
                        silver0                       0                    0
                                (                     0) (                   0)
                        silver2                       0                    0
                                (                     0) (                   0)
                        silver3                       0                    0
                                (                     0) (                   0)
                        silver4                       0                    0
                                (                     0) (                   0)
                        silver5                       0                    0
                                (                     0) (                   0)
                        silver6                       0                    0
                                (                     0) (                   0)
                        silver7                       0                    0
```

```
                                        (                  0) (                  0)
                                silver9                    0                     0
                                        (                  0) (                  0)
                                                        Packets                 Bytes
      Source class                       (packet-per-second)    (bits-per-second)
                                  gold1                    0                     0
                                        (                  0) (                  0)
                                  gold2                16600               1062400
                                        (                  0) (                  0)
                                  gold3                    0                     0
                                        (                  0) (                  0)
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 192.168.220.24/30, Local: 192.168.220.26, Broadcast:
192.168.220.27,         Generation: 150
```

show interfaces extensive (Gigabit Ethernet)

```
user@host> show interfaces ge-5/0/0.0 extensive

  Logical interface ge-5/0/0.0 (Index 71) (SNMP ifIndex 1030) (Generation 139)
    Flags: SNMP-Traps 0x4000 Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :                   0
     Output bytes  :                  42
     Input  packets:                   0
     Output packets:                   1
    Local statistics:
     Input  bytes  :                   0
     Output bytes  :                  42
     Input  packets:                   0
     Output packets:                   1
    Transit statistics:
     Input  bytes  :                   0                   0 bps
     Output bytes  :                   0                   0 bps
     Input  packets:                   0                   0 pps
     Output packets:                   0                   0 pps
    Output Filters: f-any
    Protocol inet, MTU: 1500, Generation: 155, Route table: 0
      Output Filters: f-inet,
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 192.168.220.24/30, Local: 192.168.220.26, Broadcast:
192.168.220.27,
        Generation: 170
    Protocol multiservice, MTU: Unlimited, Generation: 156, Route table: 0
      Flags: Is-Primary
      Policer: Input: __default_arp_policer__
```

show interfaces extensive (10-Gigabit Ethernet)

```
user@host> show interfaces xe-2/1/0 extensive

Physical interface: xe-2/1/0, Enabled, Physical link is Up
  Interface index: 258, SNMP ifIndex: 762, Generation: 2046
  Link-level type: Ethernet, MTU: 1514, LAN-PHY mode, Speed: 10Gbps, BPDU Error:
 None, Loopback: None, Source filtering: Disabled,
  Flow control: Enabled
  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:00:53:00, Hardware address: 00:00:5E:00:53:00
  Last flapped   : 2011-12-17 00:19:02 PST (07:36:37 ago)
  Statistics last cleared: 2011-12-17 07:55:24 PST (00:00:15 ago)
  Traffic statistics:
   Input  bytes  :               110000                    0 bps
   Output bytes  :                    0                    0 bps
   Input  packets:                 1000                    0 pps
   Output packets:                    0                    0 pps
   IPv6 transit statistics:
    Input  bytes  :               110000
    Output bytes  :                    0
    Input  packets:                 1000
    Output packets:                    0
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0, L3
incompletes: 0, L2 channel errors: 0,
    L2 mismatch timeouts: 0, FIFO errors: 0, Resource errors: 0
  Output errors:
    Carrier transitions: 0, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,
 FIFO errors: 0, HS link CRC errors: 0,
    MTU errors: 0, Resource errors: 0
  Egress queues: 8 supported, 4 in use
  Queue counters:       Queued packets  Transmitted packets      Dropped packets

    0 best-effort                    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
  PCS statistics                      Seconds
    Bit errors                             0
    Errored blocks                         0
  MAC statistics:                     Receive         Transmit
    Total octets                       128000                0
    Total packets                        1000                0
    Unicast packets                      1000                0
    Broadcast packets                       0                0
    Multicast packets                       0                0
    CRC/Align errors                        0                0
    FIFO errors                             0                0
    MAC control frames                      0                0
    MAC pause frames                        0                0
    Oversized frames                        0
    Jabber frames                           0
    Fragment frames                         0
    VLAN tagged frames                      0
    Code violations                         0
  Filter statistics:
    Input packet count                   1000
    Input packet rejects                    0
```

```
    Input DA rejects                          0
    Input SA rejects                          0
    Output packet count                                    0
    Output packet pad count                                0
    Output packet error count                              0
    CAM destination filters: 0, CAM source filters: 0
  Packet Forwarding Engine configuration:
    Destination slot: 2
  CoS information:
    Direction : Output
    CoS transmit queue               Bandwidth               Buffer Priority
Limit
                              %            bps     %           usec
    0 best-effort            95     9500000000    95              0      low
none
    3 network-control         5      500000000     5              0      low
none
  Interface transmit statistics: Disabled

  Logical interface xe-2/1/0.0 (Index 83) (SNMP ifIndex 1677) (Generation 10082)

    Flags: SNMP-Traps 0x4004000 Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :               110000
     Output bytes  :                    0
     Input  packets:                 1000
     Output packets:                    0
     IPv6 transit statistics:
      Input  bytes  :               55000
      Output bytes  :                   0
      Input  packets:                 500
      Output packets:                   0
    Local statistics:
     Input  bytes  :               55000
     Output bytes  :                   0
     Input  packets:                 500
     Output packets:                   0
    Transit statistics:
     Input  bytes  :               55000                    0 bps
     Output bytes  :                   0                    0 bps
     Input  packets:                 500                    0 pps
     Output packets:                   0                    0 pps
     IPv6 transit statistics:
      Input  bytes  :               55000
      Output bytes  :                   0
      Input  packets:                 500
      Output packets:                   0
    Protocol inet6, MTU: 1500, Generation: 23739, Route table: 0
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 2001:0db8:0a0b:12f0:0000:0000:0000/112, Local:
2001:0db8:0a0b:12f0:0000:0000:0000:0001
    Generation: 506
      Addresses, Flags: Is-Preferred
        Destination: 0db8::/64, Local: 0db8::21d:b5ff:fef8:6deb
    Protocol multiservice, MTU: Unlimited, Generation: 508
    Generation: 23740, Route table: 0
      Policer: Input: __default_arp_policer__
```

show interfaces extensive (IQ2 and IQ2E)

```
user@host> show interfaces ge-3/2/2 extensive
```

```
    Physical interface: ge-3/2/2, Enabled, Physical link is Up
      Interface index: 156, SNMP ifIndex: 548, Generation: 159
      Link-level type: Ethernet, MTU: 1518, Speed: 1000mbps, BPDU Error: None,
MAC-REWRITE Error: None, Loopback: Disabled, Source filtering: Disabled,
      Flow control: Enabled, Auto-negotiation: Enabled, Remote fault: Online
      Device flags   : Present Running
      Interface flags: SNMP-Traps Internal: 0x4000
      CoS queues     : 8 supported, 8 maximum usable queues
      Schedulers     : 128
      Hold-times     : Up 0 ms, Down 0 ms
      Current address: 00:00:5E:00:53:00, Hardware address: 00:00:5E:00:53:00
      Last flapped   : 2010-03-17 04:03:11 PDT (00:45:30 ago)
      Statistics last cleared: Never
      Traffic statistics:
       Input  bytes  :              1716096                    0 bps
       Output bytes  :              1716448                    0 bps
       Input  packets:                13407                    0 pps
       Output packets:                13411                    0 pps
       IPv6 total statistics:
        Input  bytes  :             1716096
        Output bytes  :             1716096
        Input  packets:               13407
        Output packets:               13407
      Ingress traffic statistics at Packet Forwarding Engine:
       Input  bytes  :              1716096                    0 bps
       Input  packets:                13407                    0 pps
       Drop   bytes  :                    0                    0 bps
       Drop   packets:                    0                    0 pps
      Input errors:
        Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0,
L3 incompletes: 0, L2 channel errors: 1, 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: 8 supported, 4 in use
      Queue counters:       Queued packets  Transmitted packets      Dropped
packets
        0 best-effort               13407               13407
   0
        1 expedited-fo                  0                   0
   0
        2 assured-forw                  0                   0
   0
        3 network-cont                  0                   0
   0
      Egress queues: 8 supported, 4 in use
      Queue counters:       Queued packets  Transmitted packets      Dropped
packets
        0 best-effort               13407               13407
   0
        1 expedited-fo                  0                   0
   0
        2 assured-forw                  0                   0
   0
        3 network-cont                  4                   4
   0
      Active alarms  : None
      Active defects : None
      MAC statistics:                     Receive         Transmit
```



```
      Total octets                       1716096          1716448
      Total packets                        13407            13411
      Unicast packets                      13407            13407
      Broadcast packets                        0                0
      Multicast packets                        0                4
      CRC/Align errors                         0                0
      FIFO errors                              0                0
      MAC control frames                       0                0
      MAC pause frames                         0                0
      Oversized frames                         0
      Jabber frames                            0
      Fragment frames                          0
      VLAN tagged frames                       0
      Code violations                          0
    Filter statistics:
      Input packet count                   13407
      Input packet rejects                     0
      Input DA rejects                         0
      Input SA rejects                         0
      Output packet count                              13411
      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: None, Remote fault: OK
      Local resolution:
          Flow control: Symmetric, Remote fault: Link OK
    Packet Forwarding Engine configuration:
      Destination slot: 3
    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-3/2/2.0 (Index 83) (SNMP ifIndex 6080) (Generation
148)
      Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.100 ]  Encapsulation: ENET2
      Traffic statistics:
       Input  bytes  :                   0
       Output bytes  :                 336
       Input  packets:                   0
       Output packets:                   4
       IPv6 total statistics:
        Input  bytes  :             1716096
        Output bytes  :             1716096
        Input  packets:               13407
```

```
    Output packets:               13407
  Local statistics:
   Input  bytes  :                    0
   Output bytes  :                  336
   Input  packets:                    0
   Output packets:                    4
  Transit statistics:
   Input  bytes  :                    0                    0 bps
   Output bytes  :                    0                    0 bps
   Input  packets:                    0                    0 pps
   Output packets:                    0                    0 pps
   IPv6 total statistics:
    Input  bytes  :             1716096
    Output bytes  :             1716096
    Input  packets:               13407
    Output packets:               13407
  Protocol inet6, MTU: 1500, Generation: 159, Route table: 0
    Flags: Is-Primary
    Addresses, Flags: Is-Default Is-Primary
      Destination: Unspecified, Local: 2000::2
  Generation: 146
    Addresses, Flags: Is-Preferred
      Destination: fe80::/64, Local: fe80::214:f600:6412:86fa
  Protocol multiservice, MTU: Unlimited, Generation: 148
  Generation: 160, Route table: 0
    Policer: Input: __default_arp_policer__

Logical interface ge-3/2/2.32767 (Index 84) (SNMP ifIndex 6081) (Generation
149)
  Flags: SNMP-Traps 0x4000 VLAN-Tag [ 0x0000.0 ]  Encapsulation: ENET2
  Traffic statistics:
   Input  bytes  :                    0
   Output bytes  :                    0
   Input  packets:                    0
   Output packets:                    0
  Local statistics:
   Input  bytes  :                    0
   Output bytes  :                    0
   Input  packets:                    0
   Output packets:                    0
  Transit statistics:
   Input  bytes  :                    0                    0 bps
   Output bytes  :                    0                    0 bps
   Input  packets:                    0                    0 pps
   Output packets:                    0                    0 pps
  Protocol multiservice, MTU: Unlimited, Generation: 161, Route table: 0
    Flags: None
    Policer: Input: __default_arp_policer__
```

show interfaces extensive (100-Gigabit Ethernet Type 4 PIC with CFP)

```
user@host> show interfaces et-0/0/0:0 extensive
Physical interface: et-0/0/0:0, Enabled, Physical link is Down
  Interface index: 156, SNMP ifIndex: 516, Generation: 163
  Link-level type: Ethernet, MTU: 9192, Speed: 50000mbps, BPDU Error: None,
MAC-REWRITE Error: None,
  Loopback: Disabled, Source filtering: Disabled, Flow control: Enabled
  Device flags   : Present Running Down
  Interface flags: Hardware-Down SNMP-Traps Internal: 0x4000
  Link flags     : None
  CoS queues     : 8 supported, 8 maximum usable queues
```



```
  Hold-times     : Up 0 ms, Down 0 ms
  Damping      : half-life: 5 sec, max-suppress: 20 sec, reuse 1000, suppress:
2000, state: enabled
  Current address: 00:00:5E:00:53:00, Hardware address: 00:00:5E:00:53:00
  Last flapped   : 2010-01-07 16:36:49 PST (18:02:35 ago)
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :                   0                   0 bps
   Output bytes  :                   0                   0 bps
   Input  packets:                   0                   0 pps
   Output packets:                   0                   0 pps
   IPv6 transit statistics:
    Input  bytes  :                  0
    Output bytes  :                  0
    Input  packets:                  0
    Output packets:                  0
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0, L3
incompletes: 0,
    L2 channel errors: 0, L2 mismatch timeouts: 0, FIFO errors: 0, Resource errors:
 0
  Output errors:
    Carrier transitions: 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, 8 in use
  Queue counters:       Queued packets  Transmitted packets      Dropped packets

    0 DEFAULT, NC-                  0                   0                   0

    1 REALTIME                      0                   0                   0

    2 PRIVATE, NC-                  0                   0                   0

    3 CONTROL                    1253                1253                   0

    4 BC-H, CLASS_                  0                   0                   0

    5 BC-M, CLASS_                  0                   0                   0

    6 IA, CLASS_V_                  0                   0                   0

    7 CLASS_S_OUTP                  0                   0                   0

  Queue       Mapped Forwarding Class
  0        DEFAULT, NC-Q0
    1        REALTIME
    2        PRIVATE, NC-Q1
    3        CONTROL
    4        BC-H, CLASS-Q4
    5        BC-M, CLASS-Q5
    6        IA, CLASS_V_OUTPUT
    7        CLASS_S_OUTPUT
  Active alarms  : None
  Active defects : None
  MAC statistics:                      Receive         Transmit
    Total octets                             0                0
    Total packets                            0                0
    Unicast packets                          0                0
    Broadcast packets                        0                0
    Multicast packets                        0                0
```

```
    CRC/Align errors                          0                0
    FIFO errors                               0                0
    MAC control frames                        0                0
    MAC pause frames                          0                0
    Oversized frames                          0
    Jabber frames                             0
    Fragment frames                           0
    VLAN tagged frames                        0
    Code violations                           0
  Packet Forwarding Engine configuration:
    Destination slot: 0
  CoS information:
    Direction : Output
    CoS transmit queue               Bandwidth              Buffer Priority Limit

                                   %            bps     %           usec
    0 best-effort                 95    47500000000    95              0      low none

    3 network-control              5     2500000000     5              0      low none


  Logical interface et-0/0/0:0.0 (Index 68) (SNMP ifIndex 546) (Generation 161)
    Flags: Deviet-Down SNMP-Traps 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
    Protocol inet, MTU: 9178, Generation: 220, Route table: 0
      Addresses, Flags: Dest-route-down Is-Preferred Is-Primary
        Destination: 192.168.220.24/30, Local: 192.168.220.26, Broadcast:
192.168.220.27, Generation: 192
    Protocol mpls, MTU: 9166, Maximum labels: 3, Generation: 221, Route table: 0

    Protocol multiservice, MTU: Unlimited, Generation: 222, Route table: 0
      Policer: Input: __default_arp_policer
```

show interfaces extensive (PTX5000 Packet Transport Router)

```
user@host> show interfaces et-0/0/6 extensive
Physical interface: et-0/0/6, Enabled, Physical link is Up
  Interface index: 347, SNMP ifIndex: 531, Generation: 350
  Link-level type: Ethernet, MTU: 1514, Speed: 40Gbps, BPDU Error: None, Loop
Detect PDU Error: None, Loopback: Disabled, Source filtering: Disabled, Flow
control: Enabled
  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
  Damping        : half-life: 0 sec, max-suppress: 0 sec, reuse: 0, suppress: 0,
```

```
 state: unsuppressed
  Current address: 30:b6:4f:02:29:06, Hardware address: 30:b6:4f:02:29:06
  Last flapped   : 2017-02-15 21:40:06 PST (22:55:13 ago)
  Statistics last cleared: 2017-02-16 20:33:02 PST (00:02:17 ago)
  Traffic statistics:
   Input  bytes  :              1760000                    0 bps
   Output bytes  :              1540000                    0 bps
   Input  packets:                16000                    0 pps
   Output packets:                14000                    0 pps
   IPv6 transit statistics:
    Input  bytes  :               880000
    Output bytes  :               770000
    Input  packets:                 8000
    Output packets:                 7000
  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                            7000                7000                    0

    1                               0                   0                    0

    2                               0                   0                    0

    3                            7000                7000                    0

  Queue number:         Mapped forwarding classes
    0                   best-effort
    1                   expedited-forwarding
    2                   assured-forwarding
    3                   network-control
  Active alarms  : None
  Active defects : None
  PCS statistics                      Seconds
    Bit errors                             0
    Errored blocks                         0
  MAC statistics:                     Receive         Transmit
    Total octets                      2048000          1792000
    Total packets                       16000            14000
    Unicast packets                     16000            14000
    Broadcast packets                       0                0
    Multicast packets                       0                0
    CRC/Align errors                        0                0
    FIFO errors                             0                0
    MAC control frames                      0                0
    MAC pause frames                        0                0
    Oversized frames                        0
    Jabber frames                           0
    Fragment frames                         0
    VLAN tagged frames                      0
    Code violations                         0
  Filter statistics:
    Input packet count                      0
    Input packet rejects                    0
    Input DA rejects                        0
```

```
    Input SA rejects                          0
    Output packet count                                    0
    Output packet pad count                                0
    Output packet error count                              0
    CAM destination filters: 0, CAM source filters: 0
  Packet Forwarding Engine configuration:
    Destination slot: 0 (0x00)
  CoS information:
    Direction : Output
    CoS transmit queue               Bandwidth               Buffer Priority
Limit
                              %           bps     %           usec
    0 best-effort            95    38000000000    95              0      low
none
    3 network-control         5     2000000000     5              0      low
none
  Preclassifier statistics:
    Traffic Class        Received Packets   Transmitted  Packets      Dropped
Packets
    best-effort                         0                     0
    0
    best-effort                         0                     0
    0
    best-effort                         0                     0
    0
    best-effort                         0                     0
    0
    best-effort                         0                     0
    0
    best-effort                         0                     0
    0
    best-effort                         0                     0
    0
  Link Degrade :
    Link Monitoring                   :  Disable
  Interface transmit statistics: Disabled

  Logical interface et-0/0/6.0 (Index 93) (SNMP ifIndex 841) (Generation 158)
    Flags: Up SNMP-Traps 0x4004000 Encapsulation: ENET2
    Traffic statistics:
     Input  bytes  :              1760000
     Output bytes  :              1540000
     Input  packets:                16000
     Output packets:                14000
     IPv6 transit statistics:
      Input  bytes  :               880000
      Output bytes  :               770000
      Input  packets:                 8000
      Output packets:                 7000
    Local statistics:
     Input  bytes  :                    0
     Output bytes  :                    0
     Input  packets:                    0
     Output packets:                    0
    Transit statistics:
     Input  bytes  :              1760000                    0 bps
     Output bytes  :              1540000                    0 bps
     Input  packets:                16000                    0 pps
     Output packets:                14000                    0 pps
```

```
     IPv6 transit statistics:
      Input  bytes  :              880000
      Output bytes  :              770000
      Input  packets:                8000
      Output packets:                7000
    Protocol inet, MTU: 1500
    Max nh cache: 100000, New hold nh limit: 100000, Curr nh cnt: 1, Curr new
hold cnt: 0, NH drop cnt: 0
    Generation: 206, Route table: 0
      Flags: Sendbcast-pkt-to-re
      Addresses, Flags: Is-Preferred Is-Primary
       Destination: 11.0.0/24, Local: 11.0.0.2, Broadcast: 11.0.0.255, Generation:
 228
    Protocol inet6, MTU: 1500
    Max nh cache: 100000, New hold nh limit: 100000, Curr nh cnt: 1, Curr new
hold cnt: 0, NH drop cnt: 0
    Generation: 207, Route table: 0
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 1100::/120, Local: 1100::2
    Generation: 230
      Addresses, Flags: Is-Preferred
        Destination: fe80::/64, Local: fe80::32b6:4fff:fe02:2906
    Protocol multiservice, MTU: Unlimited, Generation: 232
    Generation: 208, Route table: 0
      Policer: Input: __default_arp_policer__
```

sshow interfaces extensive (PTX Routers)

```
user@host> show interfaces ae31 extensive
Physical interface: ae31, Enabled, Physical link is Up
  Interface index: 137, SNMP ifIndex: 511, Generation: 140
  Link-level type: Ethernet, MTU: 1518, Speed: 3Gbps, 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, LAG_Enhanced
```

show interfaces extensive (PTX10008 Routers)

```
user@host> show interfaces ae0 extensive
Physical interface: ae0, Enabled, Physical link is Up
  Interface index: 917, SNMP ifIndex: 817, Generation: 4436
  Link-level type: Ethernet, MTU: 1518, Speed: 20Gbps, BPDU Error: None,
MAC-REWRITE Error: None, Loopback: Disabled, Source filtering: Disabled, Flow
control: Disabled, Minimum links needed: 1,
  Minimum bandwidth needed: 1bps
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x4000
  Current address: 30:b6:4f:e9:7c:05, Hardware address: 30:b6:4f:e9:7c:05
  Last flapped   : 2017-04-10 05:20:29 PDT (00:03:52 ago)
  Statistics last cleared: 2017-04-10 05:21:52 PDT (00:02:29 ago)
  Traffic statistics:
   Input  bytes  :          36463816334                    0 bps
   Output bytes  :          36463816334                    0 bps
   Input  packets:             24671053                    0 pps
   Output packets:             24671053                    0 pps
   IPv6 transit statistics:
```

```
    Input  bytes  :         18231905950
    Output bytes  :         18231905950
    Input  packets:            12335525
    Output packets:            12335525
  MAC statistics:                      Receive         Transmit
    Broadcast packets                        0                0
    Multicast packets                        0                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
  Egress queues: 8 supported, 4 in use
  Queue counters:       Queued packets  Transmitted packets      Dropped packets

    0                         24671053             24671053                    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 ae0.0 (Index 99) (SNMP ifIndex 832) (Generation 43813)
    Flags: Up SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.2 ]  Encapsulation: ENET2
    Statistics        Packets        pps         Bytes          bps
    Bundle:
        Input :       4934211          0    7292763858            0
        Output:       4934211          0    7292763858            0
    Adaptive Statistics:
        Adaptive Adjusts:          0
        Adaptive Scans  :          0
        Adaptive Updates:          0
    Link:
      et-0/0/28:0.0
        Input :       4934211          0    7292763858            0
        Output:       4934211          0    7292763858            0
      et-0/0/28:3.0
        Input :             0          0             0            0
        Output:             0          0             0            0


    Aggregate member links: 2

    Marker Statistics:   Marker Rx     Resp Tx   Unknown Rx   Illegal Rx
      et-0/0/28:0.0             0           0            0            0
      et-0/0/28:3.0             0           0            0            0
    Protocol inet, MTU: 1500
    Max nh cache: 100000, New hold nh limit: 100000, Curr nh cnt: 1, Curr new
hold cnt: 0, NH drop cnt: 0
    Generation: 89219, Route table: 0
      Flags: Sendbcast-pkt-to-re
      Addresses, Flags: Is-Preferred Is-Primary
       Destination: 21.0.0.0/30, Local: 21.0.0.1, Broadcast: 21.0.0.3, Generation:
```

```
 62420
    Protocol inet6, MTU: 1500
    Max nh cache: 100000, New hold nh limit: 100000, Curr nh cnt: 2, Curr new
hold cnt: 0, NH drop cnt: 0
    Generation: 89220, Route table: 0
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 3001::1500:0/126, Local: 3001::1500:1
    Generation: 62422
      Addresses, Flags: Is-Preferred
        Destination: fe80::/64, Local: fe80::32b6:4f00:2e9:7c05
    Protocol multiservice, MTU: Unlimited, Generation: 62424
    Generation: 89221, Route table: 0
      Policer: Input: __default_arp_policer__

  Logical interface ae0.1 (Index 100) (SNMP ifIndex 833) (Generation 43814)
    Flags: Up SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.3 ]  Encapsulation: ENET2
    Statistics        Packets        pps         Bytes          bps
    Bundle:
        Input :       4934211          0    7292763858            0
        Output:       4934211          0    7292763858            0
    Adaptive Statistics:
        Adaptive Adjusts:          0
        Adaptive Scans  :          0
        Adaptive Updates:          0
    Link:
      et-0/0/28:0.1
        Input :             0          0             0            0
        Output:       4934211          0    7292763858            0
      et-0/0/28:3.1
        Input :       4934211          0    7292763858            0
        Output:             0          0             0            0
    Marker Statistics:   Marker Rx     Resp Tx   Unknown Rx   Illegal Rx
      et-0/0/28:0.1              0           0            0            0
      et-0/0/28:3.1              0           0            0            0
    Protocol inet, MTU: 1500
    Max nh cache: 100000, New hold nh limit: 100000, Curr nh cnt: 1, Curr new
hold cnt: 0, NH drop cnt: 0
    Generation: 89222, Route table: 0
      Flags: Sendbcast-pkt-to-re
      Addresses, Flags: Is-Preferred Is-Primary
       Destination: 21.0.0.4/30, Local: 21.0.0.5, Broadcast: 21.0.0.7, Generation:
 62426
    Protocol inet6, MTU: 1500
    Max nh cache: 100000, New hold nh limit: 100000, Curr nh cnt: 2, Curr new
hold cnt: 0, NH drop cnt: 0
    Generation: 89223, Route table: 0
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 3001::1500:4/126, Local: 3001::1500:5
    Generation: 62428
      Addresses, Flags: Is-Preferred
        Destination: fe80::/64, Local: fe80::32b6:4f00:3e9:7c05
    Protocol multiservice, MTU: Unlimited, Generation: 62430
    Generation: 89224, Route table: 0
      Policer: Input: __default_arp_policer__

  Logical interface ae0.2 (Index 101) (SNMP ifIndex 834) (Generation 43815)
    Flags: Up SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.4 ]  Encapsulation: ENET2
    Statistics        Packets        pps         Bytes          bps
    Bundle:
        Input :       4934211          0    7292763858            0
        Output:       4934211          0    7292763858            0
```

```
    Adaptive Statistics:
        Adaptive Adjusts:          0
        Adaptive Scans  :          0
        Adaptive Updates:          0
    Link:
      et-0/0/28:0.2
        Input :       2467106          0    3646382668            0
        Output:       4934211          0    7292763858            0
      et-0/0/28:3.2
        Input :       2467105          0    3646381190            0
        Output:             0          0             0            0
    Marker Statistics:   Marker Rx     Resp Tx   Unknown Rx   Illegal Rx
      et-0/0/28:0.2              0           0            0            0
      et-0/0/28:3.2              0           0            0            0
    Protocol inet, MTU: 1500
    Max nh cache: 100000, New hold nh limit: 100000, Curr nh cnt: 1, Curr new
hold cnt: 0, NH drop cnt: 0
    Generation: 89225, Route table: 0
      Flags: Sendbcast-pkt-to-re
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 21.0.0.8/30, Local: 21.0.0.9, Broadcast: 21.0.0.11,
Generation: 62432
    Protocol inet6, MTU: 1500
    Max nh cache: 100000, New hold nh limit: 100000, Curr nh cnt: 1, Curr new
hold cnt: 0, NH drop cnt: 0
    Generation: 89226, Route table: 0
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 3001::1500:8/126, Local: 3001::1500:9
    Generation: 62434
      Addresses, Flags: Is-Preferred
        Destination: fe80::/64, Local: fe80::32b6:4f00:4e9:7c05
    Protocol multiservice, MTU: Unlimited, Generation: 62436
    Generation: 89227, Route table: 0
      Policer: Input: __default_arp_policer__

  Logical interface ae0.3 (Index 102) (SNMP ifIndex 835) (Generation 43816)
    Flags: Up SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.5 ]  Encapsulation: ENET2
    Statistics        Packets        pps         Bytes          bps
    Bundle:
        Input :       4934210          0    7292762380            0
        Output:       4934210          0    7292762380            0
    Adaptive Statistics:
        Adaptive Adjusts:          0
        Adaptive Scans  :          0
        Adaptive Updates:          0
    Link:
      et-0/0/28:0.3
        Input :       4934210          0    7292762380            0
        Output:             0          0             0            0
      et-0/0/28:3.3
        Input :             0          0             0            0
        Output:       4934210          0    7292762380            0
    Marker Statistics:   Marker Rx     Resp Tx   Unknown Rx   Illegal Rx
      et-0/0/28:0.3              0           0            0            0
      et-0/0/28:3.3              0           0            0            0
    Protocol inet, MTU: 1500
    Max nh cache: 100000, New hold nh limit: 100000, Curr nh cnt: 1, Curr new
hold cnt: 0, NH drop cnt: 0
    Generation: 89228, Route table: 0
      Flags: Sendbcast-pkt-to-re
      Addresses, Flags: Is-Preferred Is-Primary
```

```
        Destination: 21.0.0.12/30, Local: 21.0.0.13, Broadcast: 21.0.0.15,
Generation: 62438
    Protocol inet6, MTU: 1500
    Max nh cache: 100000, New hold nh limit: 100000, Curr nh cnt: 2, Curr new
hold cnt: 0, NH drop cnt: 0
    Generation: 89229, Route table: 0
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 3001::1500:c/126, Local: 3001::1500:d
    Generation: 62440
      Addresses, Flags: Is-Preferred
        Destination: fe80::/64, Local: fe80::32b6:4f00:5e9:7c05
    Protocol multiservice, MTU: Unlimited, Generation: 62442
    Generation: 89230, Route table: 0
      Policer: Input: __default_arp_policer__

  Logical interface ae0.4 (Index 103) (SNMP ifIndex 836) (Generation 43817)
    Flags: Up SNMP-Traps 0x4000 VLAN-Tag [ 0x8100.6 ]  Encapsulation: ENET2
    Statistics        Packets        pps         Bytes          bps
    Bundle:
        Input :       4934210          0    7292762380            0
        Output:       4934210          0    7292762380            0
    Adaptive Statistics:
        Adaptive Adjusts:          0
        Adaptive Scans  :          0
        Adaptive Updates:          0
    Link:
      et-0/0/28:0.4
        Input :       2467105          0    3646381190            0
        Output:       2467105          0    3646381190            0
      et-0/0/28:3.4
        Input :       2467105          0    3646381190            0
        Output:       2467105          0    3646381190            0
    Marker Statistics:   Marker Rx     Resp Tx   Unknown Rx   Illegal Rx
      et-0/0/28:0.4             0           0            0            0
      et-0/0/28:3.4             0           0            0            0
    Protocol inet, MTU: 1500
    Max nh cache: 100000, New hold nh limit: 100000, Curr nh cnt: 1, Curr new
hold cnt: 0, NH drop cnt: 0
    Generation: 89231, Route table: 0
      Flags: Sendbcast-pkt-to-re
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 21.0.0.16/30, Local: 21.0.0.17, Broadcast: 21.0.0.19,
Generation: 62444
    Protocol inet6, MTU: 1500
    Max nh cache: 100000, New hold nh limit: 100000, Curr nh cnt: 2, Curr new
hold cnt: 0, NH drop cnt: 0
    Generation: 89232, Route table: 0
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 3001::1500:10/126, Local: 3001::1500:11
    Generation: 62446
      Addresses, Flags: Is-Preferred
        Destination: fe80::/64, Local: fe80::32b6:4f00:6e9:7c05
    Protocol multiservice, MTU: Unlimited, Generation: 62448
    Generation: 89233, Route table: 0
      Policer: Input: __default_arp_policer__

  Logical interface ae0.32767 (Index 104) (SNMP ifIndex 5645) (Generation 43818)

    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:
      et-0/0/28:0.32767
      Input :             0          0             0            0
      Output:             0          0             0            0
      et-0/0/28:3.32767
      Input :             0          0             0            0
      Output:             0          0             0            0
    Marker Statistics:   Marker Rx     Resp Tx   Unknown Rx   Illegal Rx
      et-0/0/28:0.32767          0           0            0            0
      et-0/0/28:3.32767          0           0            0            0
    Protocol multiservice, MTU: Unlimited, Generation: 89234, Route table: 0
      Flags: None
      Policer: Input: __default_arp_policer__
```

show interfaces extensive (PTX1000 Routers)

```
user@host> show interfaces et-0/0/48:1 extensive
Physical interface: et-0/0/48:1, Enabled, Physical link is Up
  Interface index: 306, SNMP ifIndex: 697, Generation: 311
  Link-level type: Ethernet, MTU: 1514, 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
  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
  Damping        : half-life: 0 sec, max-suppress: 0 sec, reuse: 0, suppress: 0,
 state: unsuppressed
  Current address: ec:13:db:62:4a:f6, Hardware address: ec:13:db:62:4a:f6
  Last flapped   : 2017-05-08 11:07:59 PDT (12:08:13 ago)
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :                   0                   0 bps
   Output bytes  :                   0                   0 bps
   Input  packets:                   0                   0 pps
   Output packets:                   0                   0 pps
   IPv6 transit statistics:
    Input  bytes  :                  0
    Output bytes  :                  0
    Input  packets:                  0
    Output packets:                  0
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0, L3
incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0, FIFO errors: 0,
Resource errors: 0
  Output errors:
    Carrier transitions: 3, 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                                 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
  Active alarms  : None
  Active defects : None
  PCS statistics                      Seconds
    Bit errors                             3
    Errored blocks                         3
  MAC statistics:                      Receive         Transmit
    Total octets                             0                0
    Total packets                            0                0
    Unicast packets                          0                0
    Broadcast packets                        0                0
    Multicast packets                        0                0
    CRC/Align errors                         0                0
    FIFO errors                              0                0
    MAC control frames                       0                0
    MAC pause frames                         0                0
    Oversized frames                         0
    Jabber frames                            0
    Fragment frames                          0
    VLAN tagged frames                       0
    Code violations                          0
  Filter statistics:
    Input packet count                       0
    Input packet rejects                     0
    Input DA rejects                         0
    Input SA rejects                         0
    Output packet count                                       0
    Output packet pad count                                   0
    Output packet error count                                 0
    CAM destination filters: 0, CAM source filters: 0
  Packet Forwarding Engine configuration:
    Destination slot: 0 (0x00)
  CoS information:
    Direction : Output
    CoS transmit queue               Bandwidth               Buffer Priority
Limit
                                %           bps     %           usec
    0 best-effort              95     9500000000    95              0      low
none
    3 network-control           5      500000000     5              0      low
none
  Link Degrade :
    Link Monitoring                   :  Disable
  Interface transmit statistics: Disabled
```

show interfaces extensive (MX Series Routers)

```
user@host> show interfaces xe-0/0/0 extensive
Physical interface: xe-0/0/0, Enabled, Physical link is Up
  Interface index: 145, SNMP ifIndex: 592, Generation: 148
  Link-level type: Ethernet, MTU: 1514, LAN-PHY mode, Speed: 10Gbps, BPDU Error:
```

```
None,
 Loopback: None, Source filtering: Disabled, Flow control: Enabled
 Pad to minimum frame size: Enabled
 Device flags   : Present Running
 Interface flags: 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:00:53:00, Hardware address: 00:00:5E:00:53:00
 Last flapped   : 2013-10-26 03:20:40 test (2w3d 03:15 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: 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                                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
 Active alarms  : LINK
 Active defects : LINK
 PCS statistics                      Seconds
   Bit errors                           109
   Errored blocks                       109
 MAC statistics:                     Receive         Transmit
   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
  Active alarms  : LINK
  Active defects : LINK
  PCS statistics                      Seconds
    Bit errors                           109
    Errored blocks                       109
  MAC statistics:                      Receive         Transmit
    Total octets                             0                0
    Total packets                            0                0
    Unicast packets                          0                0
    Broadcast packets                        0                0
    Multicast packets                        0                0
    CRC/Align errors                         0                0
    FIFO errors                              0                0
    MAC control frames                       0                0
    MAC pause frames                         0                0
    Oversized frames                         0
    Jabber frames                            0
    Fragment frames                          0
    VLAN tagged frames                       0
    Code violations                          0
    Total errors                             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: 0, CAM source filters: 0
  Packet Forwarding Engine configuration:
    Destination slot: 0
  CoS information:
    Direction : Output
    CoS transmit queue               Bandwidth               Buffer Priority
Limit
                               %            bps     %           usec
    0 best-effort             95     9500000000    95              0      low
none
    3 network-control          5      500000000     5              0      low
none
  Interface transmit statistics: Disabled
```

When an ASIC is wedged, the interfaces are brought down along with the IFD. The reason for the link down is displayed as **ASIC-Error** in the **Device flags**.

```
user@host> show interfaces xe-1/0/0 extensive
Physical interface: xe-1/0/0, Administratively down, Physical link is Down
  Interface index: 147, SNMP ifIndex: 563, Generation: 150
  Link-level type: Ethernet, MTU: 1514, MRU: 0, LAN-PHY mode, Speed: 10Gbps, BPDU
 Error: None, Loop Detect PDU Error: None,
  MAC-REWRITE Error: None, Loopback: None, Source filtering: Disabled, Flow
control: Disabled
  Pad to minimum frame size: Disabled
```

```
  Device flags   : Present Running Down ASIC-Error
  Interface flags: Hardware-Down Down 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: cc:e1:7f:a8:05:4a, Hardware address: cc:e1:7f:a8:05:4a
  Last flapped   : 2017-06-05 17:20:54 PDT (00:03:51 ago)
  Statistics last cleared: Never
```

show interfaces extensive (MX480 Router with MPC5E and 10-Gigabit Ethernet OTN Interface)

```
user@host> show interfaces xe-0/0/3 extensive
Physical interface: xe-0/0/3, Enabled, Physical link is Up
  Interface index: 200, SNMP ifIndex: 577, Generation: 203
  Link-level type: Ethernet, MTU: 1514, MRU: 1522, LAN-PHY mode, Speed: 10Gbps,
BPDU Error: None, MAC-REWRITE Error: None, Loopback: None, 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
  Current address: 00:00:5E:00:53:00, Hardware address: 00:00:5E:00:53:00
  Last flapped   : 2014-06-26 18:16:50 PDT (04:58:35 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: 5, 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                                 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
  Active alarms  : None
  Active defects : None
  PCS statistics                      Seconds
    Bit errors                             0
    Errored blocks                         4
  MAC statistics:                     Receive         Transmit
    Total octets                            0                0
    Total packets                           0                0
    Unicast packets                         0                0
    Broadcast packets                       0                0
    Multicast packets                       0                0
    CRC/Align errors                        0                0
    FIFO errors                             0                0
    MAC control frames                      0                0
    MAC pause frames                        0                0
    Oversized frames                        0
    Jabber frames                           0
    Fragment frames                         0
    VLAN tagged frames                      0
    Code violations                         0
    Total errors                            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: 0, CAM source filters: 0
  Packet Forwarding Engine configuration:
    Destination slot: 0 (0x00)
  CoS information:
    Direction : Output
    CoS transmit queue               Bandwidth               Buffer Priority
Limit
                                 %           bps     %           usec
    0 best-effort               95     9500000000    95              0      low
none
    3 network-control            5      500000000     5              0      low
none
  Interface transmit statistics: Disabled
```

show interfaces extensive (MX480 Router with MPC5E and 100-Gigabit Ethernet OTN Interface)

```
user@host> show interfaces et-2/1/0 extensive
Physical interface: et-2/1/0, Enabled, Physical link is Up
  Interface index: 215, SNMP ifIndex: 872, Generation: 218
  Link-level type: Ethernet, MTU: 1514, MRU: 1522, Speed: 100Gbps, BPDU 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
  Current address: 00:00:5E:00:53:00, Hardware address: 00:00:5E:00:53:00
  Last flapped   : 2014-06-26 18:42:04 PDT (04:36:58 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: 263, 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                                 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
  Active alarms  : None
  Active defects : None
  PCS statistics                      Seconds
    Bit errors                             0
    Errored blocks                       754
  MAC statistics:                     Receive         Transmit
    Total octets                        14960                0
    Total packets                         104                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                           2
```

```
  Fragment frames                          6
  VLAN tagged frames                       0
  Code violations                          0
  Total errors                            98                0
 Filter statistics:
  Input packet count                     104
  Input packet rejects                     0
  Input DA rejects                         0
  Input SA rejects                         0
  Output packet count                                        0
  Output packet pad count                                    0
  Output packet error count                                  0
  CAM destination filters: 0, CAM source filters: 0
 OTN alarms        : None
 OTN defects       : None
 OTN FEC Mode      : GFEC
 OTN Rate          :     OTU4 100Gbps
 OTN Line Loopback : None
 OTN Local Loopback: None
 OTN Payload PRBS   : None
 OTN FEC statistics:
  Corrected Errors                          169828399453
  Uncorrected Words                          28939961456
  Corrected Error Ratio (      17963 sec average)  8.46e-05
 OTN FEC alarms:          Seconds        Count  State
  FEC Degrade              1180            3  OK
  FEC Excessive            1160            5  OK
 OTN OC:                  Seconds        Count  State
  LOS                       129            1  OK
  LOF                         2            1  OK
  LOM                         0            0  OK
  Wavelength Lock             0            0  OK
 OTN OTU:
  AIS                         0            0  OK
  BDI                         7            1  OK
  IAE                         0            0  OK
  TTIM                      168           45  OK
  BIAE                        0            0  OK
  TSF                         0            0  OK
  SSF                         0            0  OK
  Received DAPI:
  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
  Received SAPI:
  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
  Transmitted DAPI:
  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
  Transmitted SAPI:
  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
 OTN ODU:
  AIS                       130            1  OK
  OCI                         0            0  OK
  LCK                         0            0  OK
BDI                         7            1  OK
  TTIM                      133            1  OK
  IAE                         0            0  OK
  LTC                         0            0  OK
  CSF                         8            4  OK
  TSF                         0            0  OK
  SSF                         0            0  OK
  PTIM                      130            1  OK
  Received DAPI:
```

```
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
    Received SAPI:
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
    Transmitted DAPI:
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
    Transmitted SAPI:
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
  OTN Received Overhead Bytes:
    APS/PCC0: 0x00, APS/PCC1: 0x00, APS/PCC2: 0x00, APS/PCC3: 0x00
    Payload Type: 0x00
  ODU Delay Management :
    Result  : 0x00
  PRBS:
    Result: Test not enabled
  OTN Transmitted Overhead Bytes:
    APS/PCC0: 0x00, APS/PCC1: 0x00, APS/PCC2: 0x00, APS/PCC3: 0x00
    Payload Type: 0x00
  Packet Forwarding Engine configuration:
    Destination slot: 0 (0x00)
  CoS information:
    Direction : Output
    CoS transmit queue               Bandwidth               Buffer Priority
Limit
                                 %            bps     %           usec
    0 best-effort              95    95000000000    95              0      low
none
    3 network-control           5     5000000000     5              0      low
none
  Interface transmit statistics: Disabled
```

show interfaces extensive ((MX960 Router with MPC3E and 100-Gigabit DWDM OTN MIC)

```
user@host> show interfaces et-3/0/0 extensive
Physical interface: et-3/0/0, Enabled, Physical link is Up
  Interface index: 163, SNMP ifIndex: 564, Generation: 166
  Link-level type: Ethernet, MTU: 1514, MRU: 1522, Speed: 100Gbps, BPDU 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
  Wavelength     : 1550.12 nm, Frequency: 193.40 THz
  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: 00:00:5E:00:53:00, Hardware address: 00:00:5E:00:53:00
  Last flapped   : 2016-02-17 14:26:31 PST (09:04:28 ago)
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :                   0                   0 bps
   Output bytes  :                   0                   0 bps
   Input  packets:                   0                   0 pps
   Output packets:                   0                   0 pps
   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: 5, 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                                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
  Active alarms  : None
  Active defects : None
  PCS statistics                      Seconds
    Bit errors                             8
    Errored blocks                        10
  MAC statistics:                      Receive         Transmit
    Total octets                             0                0
    Total packets                            0                0
    Unicast packets                          0                0
    Broadcast packets                        0                0
    Multicast packets                        0                0
    CRC/Align errors                         0                0
    FIFO errors                              0                0
    MAC control frames                       0                0
    MAC pause frames                         0                0
    Oversized frames                         0
    Jabber frames                            0
    Fragment frames                          0
    VLAN tagged frames                       0
    Code violations                          0
    Total errors                             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: 0, CAM source filters: 0
```

```
  OTN alarms        : None
  OTN defects       : None
  OTN FEC Mode      : SDFEC
  OTN Rate          :     OTU4 (120.5Gbps)
  OTN Line Loopback : None
  OTN Local Loopback: None
  OTN Payload PRBS   : None
  OTN Laser Enable   : On
  OTN FEC statistics:
    Corrected Errors                              7065332638
    Uncorrected Words                                3412572
    Corrected Error Ratio (      32785 sec average)  1.79e-06 (INVALID)
 OTN FEC alarms:          Seconds        Count  State
    FEC Degrade                 0            0  OK
    FEC Excessive               3            1  OK
  OTN OC:                  Seconds        Count  State
    LOS                         3            1  OK
    LOF                        50            3  OK
    LOM                         3            3  OK
    Wavelength Lock             0            0  OK
  OTN OTU:
    AIS                         0            0  OK
    BDI                         4            4  OK
    IAE                         4            4  OK
    TTIM                        1            1  OK
    BIAE                        3            3  OK
    TSF                        50            3  OK
    SSF                        50            3  OK
    Received DAPI:
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
    Received SAPI:
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
    Transmitted DAPI:
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
    Transmitted SAPI:
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
  OTN ODU:
    AIS                        20            2  OK
    OCI                         4            4  OK
    LCK                         4            4  OK
    BDI                         2            2  OK
    TTIM                       20            2  OK
    IAE                         0            0  OK
    LTC                         0            0  OK
    CSF                        18            2  OK
    TSF                        66            2  OK
    SSF                        66            2  OK
    PTIM                       43            2  OK
    Received DAPI:
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
    Received SAPI:
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
    Transmitted DAPI:
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
    Transmitted SAPI:
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
  OTN Received Overhead Bytes:
APS/PCC0: 0x00, APS/PCC1: 0x00, APS/PCC2: 0x00, APS/PCC3: 0x00
    Payload Type: 0x07
  ODU Delay Management :
    Result  : 0ms
```

```
  PRBS:
    Result: Test not enabled
  OTN Transmitted Overhead Bytes:
    APS/PCC0: 0x00, APS/PCC1: 0x00, APS/PCC2: 0x00, APS/PCC3: 0x00
    Payload Type: 0x07
  Packet Forwarding Engine configuration:
    Destination slot: 0 (0x00)
  CoS information:
    Direction : Output
    CoS transmit queue               Bandwidth               Buffer Priority
Limit
                                 %            bps     %           usec
    0 best-effort              95    95000000000    95              0      low
none
    3 network-control           5     5000000000     5              0      low
none
  Interface transmit statistics: Disabled
```

show interfaces extensive (PTX3000 Router with 5-port 100-Gigabit DWDM OTN PIC)

```
user@host > show interfaces extensive et-4/0/0
Physical interface: et-4/0/0, Enabled, Physical link is Up
  Interface index: 148, SNMP ifIndex: 544, Generation: 161
  Link-level type: Ethernet, MTU: 1514, Speed: 100Gbps, BPDU Error: None, Loopback:
 Disabled, Source filtering: Disabled,
  Flow control: Enabled
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x4000
  Link flags     : None
  Wavelength     : 1550.12 nm, Frequency: 193.40 THz
  CoS queues     : 8 supported, 8 maximum usable queues
  Hold-times     : Up 0 ms, Down 0 ms
  Damping        : half-life: 0 sec, max-suppress: 0 sec, reuse: 0, suppress: 0,
 state: unsuppressed
  Current address: 00:00:5E:00:53:00, Hardware address: 00:00:5E:00:53:00
  Last flapped   : 2016-06-04 21:42:42 PDT (1d 05:09 ago)
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :                    0                    0 bps
   Output bytes  :                    0                    0 bps
   Input  packets:                    0                    0 pps
   Output packets:                    0                    0 pps
   IPv6 transit statistics:
    Input  bytes  :                   0
    Output bytes  :                   0
    Input  packets:                   0
    Output packets:                   0
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0, L3
incompletes: 0, L2 channel errors: 0,
    L2 mismatch timeouts: 0, FIFO errors: 0, Resource errors: 0
  Output errors:
    Carrier transitions: 3, 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                                 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
 Active alarms  : None
 Active defects : None
 PCS statistics                      Seconds
   Bit errors                             7
Errored blocks                         10
 MAC statistics:                       Receive         Transmit
   Total octets                              0                0
   Total packets                             0                0
   Unicast packets                           0                0
   Broadcast packets                         0                0
   Multicast packets                         0                0
   CRC/Align errors                          0                0
   FIFO errors                               0                0
   MAC control frames                        0                0
   MAC pause frames                          0                0
   Oversized frames                          0
   Jabber frames                             0
   Fragment frames                           0
   VLAN tagged frames                        0
   Code violations                           0
 Filter statistics:
   Input packet count                        0
   Input packet rejects                      0
   Input DA rejects                          0
   Input SA rejects                          0
   Output packet count                                        0
   Output packet pad count                                    0
   Output packet error count                                  0
   CAM destination filters: 0, CAM source filters: 0
 OTN alarms        : None
 OTN defects       : None
 OTN FEC Mode      : SDFEC
 OTN Rate          :     OTU4 (120.5Gbps)
 OTN Line Loopback : None
 OTN Local Loopback: None
 OTN Payload PRBS   : None
 OTN Laser Enable   : On
 OTN FEC statistics:
   Corrected Errors                                  19637746
   Uncorrected Words                                        0
   Corrected Error Ratio (     104923 sec average)  1.55e-09
 OTN FEC alarms:          Seconds        Count  State
   FEC Degrade                   0            0  OK
   FEC Excessive                 0            0  OK
 OTN OC:                  Seconds        Count  State
   LOS                           0            0  OK
   LOF                           2            1  OK
   LOM                           2            1  OK
   Wavelength Lock               0            0  OK
OTN OTU:
   AIS                           0            0  OK
```

```
    BDI                          2            1  OK
    IAE                          0            0  OK
    TTIM                         0            0  OK
    BIAE                         0            0  OK
    TSF                          2            1  OK
    SSF                          0            0  OK
    Received DAPI:
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
    Received SAPI:
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
    Transmitted DAPI:
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
    Transmitted SAPI:
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
  OTN ODU:
    AIS                          0            0  OK
    OCI                          0            0  OK
    LCK                          0            0  OK
    BDI                          2            1  OK
    TTIM                         0            0  OK
    IAE                          0            0  OK
    LTC                          0            0  OK
    CSF                          0            0  OK
    TSF                          2            1  OK
    SSF                          0            0  OK
    PTIM                         2            1  OK
    Received DAPI:
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
    Received SAPI:
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
    Transmitted DAPI:
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
    Transmitted SAPI:
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
  OTN Received Overhead Bytes:
    APS/PCC0: 0x00, APS/PCC1: 0x00, APS/PCC2: 0x00, APS/PCC3: 0x00
    Payload Type: 0x07
  ODU Delay Management :
    Result  : 0ms
  PRBS:
    Result: Test not enabled
  OTN Transmitted Overhead Bytes:
    APS/PCC0: 0x00, APS/PCC1: 0x00, APS/PCC2: 0x00, APS/PCC3: 0x00
 Payload Type: 0x07
  Packet Forwarding Engine configuration:
    Destination slot: 0 (0x00)
  CoS information:
    Direction : Output
    CoS transmit queue               Bandwidth               Buffer Priority
Limit
                               %           bps     %           usec
    0 best-effort             95    95000000000    95              0      low
none
    3 network-control          5     5000000000     5              0      low
none
  Interface transmit statistics: Disabled
```

show interfaces extensive (MX2020 Router with MPC6E and OTN MIC)

```
user@host> show interfaces xe-3/0/0 extensive
```

```
Physical interface: xe-3/0/0, Enabled, Physical link is Up
  Interface index: 166, SNMP ifIndex: 516, Generation: 169
  Link-level type: Ethernet, MTU: 1514, MRU: 1522, LAN-PHY mode, Speed: 10Gbps,
BPDU Error:
None, MAC-REWRITE Error: None, Loopback: None, 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
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:00:5E:00:53:00, Hardware address: 00:00:5E:00:53:00
  Last flapped   : 2014-05-28 17:53:12 PDT (05:56:24 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: 3, 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-forwarding                   0                   0
       0
    2 assured-forwarding                   0                   0
     0
    3 network-control                   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
  PCS statistics                      Seconds
    Bit errors                             2
    Errored blocks                         2
```

```
 MAC statistics:                      Receive         Transmit
   Total octets                             0                0
   Total packets                            0                0
   Unicast packets                          0                0
   Broadcast packets                        0                0
   Multicast packets                        0                0
   CRC/Align errors                         0                0
FIFO errors                               0                0
   MAC control frames                       0                0
   MAC pause frames                         0                0
   Oversized frames                         0
   Jabber frames                            0
   Fragment frames                          0
   VLAN tagged frames                       0
   Code violations                          0
   Total errors                             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: 0, CAM source filters: 0
 OTN alarms        : None
 OTN defects       : None
 OTN FEC Mode      : GFEC
 OTN Rate          : Fixed Stuff Bytes 11.0957Gbps
 OTN Line Loopback : None
 OTN Local Loopback: None
 OTN Payload PRBS   : None
 OTN FEC statistics:
   Corrected Errors                                        0
   Uncorrected Words                                       0
   Corrected Error Ratio (      21387 sec average)  0.00e+00
 OTN FEC alarms:          Seconds        Count  State
   FEC Degrade                  0            0  OK
   FEC Excessive                0            0  OK
 OTN OC:                  Seconds        Count  State
   LOS                          0            0  OK
   LOF                          0            0  OK
   LOM                          0            0  OK
   Wavelength Lock              0            0  OK
 OTN OTU:
   AIS                          0            0  OK
   BDI                          0            0  OK
   IAE                          0            0  OK
   TTIM                         0            0  OK
   BIAE                         0            0  OK
   TSF                          0            0  OK
   SSF                          0            0  OK
   Received DAPI:
   00 53 4d 2d 54 52 43 20 44 41 50 49 2d 53 45 43   .SM-TRC DAPI-SEC
   Received SAPI:
   00 53 4d 2d 54 52 43 20 53 41 50 49 2d 53 45 43   .SM-TRC SAPI-SEC
   Transmitted DAPI:
   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
   Transmitted SAPI:
   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
 OTN ODU:
```

```
    AIS                          0            0  OK
    OCI                          0            0  OK
 LCK                          0            0  OK
    BDI                          0            0  OK
    TTIM                         0            0  OK
    IAE                          0            0  OK
    LTC                          0            0  OK
    CSF                          0            0  OK
    TSF                          0            0  OK
    SSF                          0            0  OK
    PTIM                         0            0  OK
    Received DAPI:
    00 50 4d 2d 54 52 43 20 44 41 50 49 2d 53 45 43   .PM-TRC DAPI-SEC
    Received SAPI:
    00 50 4d 2d 54 52 43 20 53 41 50 49 2d 53 45 43   .PM-TRC SAPI-SEC
    Transmitted DAPI:
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
    Transmitted SAPI:
    00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
  OTN Received Overhead Bytes:
    APS/PCC0: 0x00, APS/PCC1: 0x00, APS/PCC2: 0x00, APS/PCC3: 0x00
    Payload Type: 0x00
  ODU Delay Management :
    Result  : 0x00
  PRBS:
    Result: Test not enabled
  OTN Transmitted Overhead Bytes:
    APS/PCC0: 0x00, APS/PCC1: 0x00, APS/PCC2: 0x00, APS/PCC3: 0x00
    Payload Type: 0x00
  Packet Forwarding Engine configuration:
    Destination slot: 0 (0x00)
  CoS information:
    Direction : Output
    CoS transmit queue               Bandwidth               Buffer Priority
Limit
                              %           bps     %           usec
    0 best-effort            95     9500000000    95              0      low
none
    3 network-control         5      500000000     5              0      low
none
  Interface transmit statistics: Disabled
```

show interfaces extensive (MX2010 Router with MPC6E and 100-Gigabit Ethernet OTN Interface)

```
user@host> show interfaces et-9/0/0 extensive
Physical interface: et-9/0/0, Enabled, Physical link is Up
  Interface index: 196, SNMP ifIndex: 623, Generation: 199
  Link-level type: Ethernet, MTU: 1514, MRU: 1522, Speed: 100Gbps, BPDU 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
  Hold-times     : Up 0 ms, Down 0 ms
  Current address: 00:00:5E:00:53:00, Hardware address: 00:00:5E:00:53:00
  Last flapped   : 2014-06-26 18:18:34 PDT (04:17:07 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                                 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
  Active alarms  : None
  Active defects : None
  PCS statistics                      Seconds
    Bit errors                             0
    Errored blocks                         0
  MAC statistics:                      Receive         Transmit
    Total octets                             0                0
    Total packets                            0                0
    Unicast packets                          0                0
    Broadcast packets                        0                0
    Multicast packets                        0                0
    CRC/Align errors                         0                0
    FIFO errors                              0                0
    MAC control frames                       0                0
    MAC pause frames                         0                0
    Oversized frames                         0
    Jabber frames                            0
    Fragment frames                          0
    VLAN tagged frames                       0
    Code violations                          0
    Total errors                             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: 0, CAM source filters: 0
  Packet Forwarding Engine configuration:
    Destination slot: 0 (0x00)
  CoS information:
    Direction : Output
    CoS transmit queue               Bandwidth               Buffer Priority
Limit
                               %            bps     %           usec
    0 best-effort             95    95000000000    95              0      low
none
    3 network-control          5     5000000000     5              0      low
none
  Interface transmit statistics: Disabled
```

show interfaces extensive (MX2010 Router with MPC6E and 10-Gigabit Ethernet Interface)

```
user@host> show interfaces xe-6/1/0 extensive
Physical interface: xe-6/1/0, Enabled, Physical link is Up
  Interface index: 159, SNMP ifIndex: 603, Generation: 162
  Link-level type: Ethernet, MTU: 1514, MRU: 1522, LAN-PHY mode, Speed: 10Gbps,
BPDU Error: None, MAC-REWRITE Error: None, Loopback: None, 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
  Current address: 00:00:5E:00:53:00, Hardware address: 00:00:5E:00:53:00
  Last flapped   : 2014-06-26 18:16:50 PDT (04:21:04 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                                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
  Active alarms  : None
  Active defects : None
  PCS statistics                      Seconds
    Bit errors                             0
    Errored blocks                         1
  MAC statistics:                      Receive         Transmit
    Total octets                             0                0
    Total packets                            0                0
    Unicast packets                          0                0
    Broadcast packets                        0                0
    Multicast packets                        0                0
    CRC/Align errors                         0                0
    FIFO errors                              0                0
 MAC control frames                        0                0
    MAC pause frames                         0                0
    Oversized frames                         0
    Jabber frames                            0
    Fragment frames                          0
    VLAN tagged frames                       0
    Code violations                          0
    Total errors                             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: 0, CAM source filters: 0
  Packet Forwarding Engine configuration:
    Destination slot: 0 (0x00)
  CoS information:
    Direction : Output
    CoS transmit queue               Bandwidth               Buffer Priority
Limit
                              %           bps     %           usec
    0 best-effort            95     9500000000    95              0      low
none
    3 network-control         5      500000000     5              0      low
none
  Interface transmit statistics: Disabled
```

show interfaces extensive (T4000 Routers with Type 5 FPCs)

The output fields for the **show interfaces *interface* extensive** command remains the same for 12-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PF-12XGE-SFPP), 24-port 10-Gigabit Ethernet LAN/WAN PIC with SFP+ (PF-24XGE-SFPP), and 100-Gigabit Ethernet Type 5 PIC with CFP (PF-1CGE-CFP).

```
user@host> show interfaces xe-4/0/0 extensive
Physical interface: xe-4/0/0, Enabled, Physical link is Up
  Interface index: 200, SNMP ifIndex: 592, Generation: 203
  Link-level type: Ethernet, MTU: 1514, LAN-PHY mode, Speed: 10Gbps, BPDU Error:
 None, Loopback: None, Source filtering: Disabled, Flow control: Enabled
  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
  Damping      : half-life: 5 sec, max-suppress: 20 sec, reuse 1000, suppress:
2000, state: enabled
  Current address: 00:00:5E:00:53:00, Hardware address: 00:00:5E:00:53:00
  Last flapped   : 2013-06-03 16:01:56 PDT (06:04:07 ago)
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :                   0                   0 bps
   Output bytes  :                   0                   0 bps
   Input  packets:                   0                   0 pps
   Output packets:                   0                   0 pps
   IPv6 transit statistics:
    Input  bytes  :                  0
    Output bytes  :                  0
    Input  packets:                  0
    Output packets:                  0
  Input errors:
    Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0, L3
incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0, FIFO errors: 0,
Resource errors: 0
  Output errors:
    Carrier transitions: 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
  PCS statistics                      Seconds
    Bit errors                             0
    Errored blocks                         0
```

```
  MAC statistics:                      Receive         Transmit
    Total octets                             0                0
    Total packets                            0                0
    Unicast packets                          0                0
    Broadcast packets                        0                0
    Multicast packets                        0                0
    CRC/Align errors                         0                0
    FIFO errors                              0                0
    MAC control frames                       0                0
    MAC pause frames                         0                0
    Oversized frames                         0
    Jabber frames                            0
    Fragment frames                          0
    VLAN tagged frames                       0
    Code violations                          0
  Filter statistics:
    Input packet count                       0
    Input packet rejects                     0
    Input DA rejects                         0
    Input SA rejects                         0
    Output packet count                                       0
    Output packet pad count                                   0
    Output packet error count                                 0
    CAM destination filters: 0, CAM source filters: 0
  Packet Forwarding Engine configuration:
    Destination slot: 0 (0x00)
  CoS information:
    Direction : Output
    CoS transmit queue             Bandwidth             Buffer Priority  Limit
                              %          bps     %         usec
    0 best-effort            95   9500000000    95            0      low    none
    3 network-control         5    500000000     5            0      low    none
  Preclassifier statistics:
   Traffic Class      Received Packets   Transmitted Packets     Dropped Packets

   real-time                        0                   0                   0
   network-control                  0                   0                   0
   best-effort                      0                   0                   0
  Interface transmit statistics: Disabled
```

show interfaces extensive (Aggregated Ethernet)

```
user@host> show interfaces ae0 extensive
Physical interface: ae0, Enabled, Physical link is Up
  Interface index: 199, SNMP ifIndex: 570, Generation: 202
  Link-level type: Ethernet, MTU: 1514, Speed: 2Gbps, BPDU Error: None,
  MAC-REWRITE Error: None, Loopback: Disabled, Source filtering: Disabled,
  Flow control: Disabled, Minimum links needed: 1, Minimum bandwidth needed: 0
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x4000
  Current address: 00:00:5E:00:53:00, Hardware address: 00:00:5E:00:53:00
  Last flapped   : 2012-06-06 23:33:03 PDT (00:00:58 ago)
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :                18532                 1984 bps
   Output bytes  :                    0                    0 bps
   Input  packets:                  158                    2 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, 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 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: 8 supported, 4 in use
 Queue counters:       Queued packets  Transmitted packets      Dropped packets

   0 best-effort                  57                  57                   0

   1 expedited-fo                  0                   0                   0

   2 assured-forw                  0                   0                   0

   3 network-cont              63605               63605                   0

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

 Logical interface ae0.0 (Index 331) (SNMP ifIndex 583) (Generation 142)
   Flags: SNMP-Traps 0x4004000 Encapsulation: ENET2
   Statistics        Packets        pps         Bytes          bps
   Bundle:
       Input :           149          2         17416         1984
       Output:             0          0             0            0
   Link:
     ge-3/2/5.0
       Input :            90          1         10100          992
       Output:             0          0             0            0
     ge-3/3/9.0
       Input :            59          1          7316          992
       Output:             0          0             0            0
   LACP info:        Role             System             System         Port
    Port  Port
                           priority          identifier  priority        number
     key
     ge-3/2/5.0     Actor           100   00:00:00:00:00:01        127       1
   1
```

```
     ge-3/2/5.0   Partner        127  00:24:dc:98:67:c0       127       1     1

     ge-3/3/9.0     Actor          100  00:00:00:00:00:01       127       2
1
     ge-3/3/9.0   Partner        127  00:24:dc:98:67:c0       127       2     1

   LACP Statistics:       LACP Rx     LACP Tx   Unknown Rx   Illegal Rx
     ge-3/2/5.0                38         137            0            0
     ge-3/3/9.0                36         139            0            0
   Marker Statistics:   Marker Rx     Resp Tx   Unknown Rx   Illegal Rx
     ge-3/2/5.0                 0           0            0            0
     ge-3/3/9.0                 0           0            0            0
   Protocol inet, MTU: 1500, Generation: 169, Route table: 0
     Flags: Sendbcast-pkt-to-re
     Addresses, Flags: Is-Preferred Is-Primary
       Destination: 1.1.1/24, Local: 1.1.1.2, Broadcast: 1.1.1.255, Generation:
153
   Protocol multiservice, MTU: Unlimited, Generation: 170, Route table: 0
     Flags: Is-Primary
     Policer: Input: __default_arp_policer__
```