JUNOS® Software

Network Interfaces Configuration Guide

Release 9.5

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

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About This Guide

This preface provides the following guidelines for using the *JUNOS® Software Network Interfaces Configuration Guide*:

JUNOS Documentation and Release Notes

For a list of related JUNOS documentation, see http://www.juniper.net/techpubs/software/junos/.

If the information in the latest *JUNOS Release Notes* differs from the information in the documentation, follow the *JUNOS Release Notes*.

To obtain the most current version of all Juniper Networks technical documentation, see the product documentation page on the Juniper Networks Web site at http://www.juniper.net/.

Table 1 on page lix lists additional books on Juniper Networks solutions that you can order through your bookstore. A complete list of such books is available at http://www.juniper.net/books.

Table 1: Additional Books Available Through http://www.juniper.net/books

Book	Description
Interdomain Multicast Routing	Provides background and in-depth analysis of multicast routing using Protocol Independent Multicast sparse mode (PIM SM) and Multicast Source Discovery Protocol (MSDP); details any-source and source-specific multicast delivery models; explores multiprotocol BGP (MBGP) and multicast IS-IS; explains Internet Gateway Management Protocol (IGMP) versions 1, 2, and 3; lists packet formats for IGMP, PIM, and MSDP; and provides a complete glossary of multicast terms.

Table 1: Additional Books Available Through http://www.juniper.net/books *(continued)*

Book	Description
JUNOS Cookbook	Provides detailed examples of common JUNOS software configuration tasks, such as basic router configuration and file management, security and access control, logging, routing policy, firewalls, routing protocols, MPLS, and VPNs.
MPLS-Enabled Applications	Provides an overview of Multiprotocol Label Switching (MPLS) applications (such as Layer 3 virtual private networks [VPNs], Layer 2 VPNs, virtual private LAN service [VPLS], and pseudowires), explains how to apply MPLS, examines the scaling requirements of equipment at different points in the network, and covers the following topics: point-to-multipoint label switched paths (LSPs), DiffServ-aware traffic engineering, class of service, interdomain traffic engineering, path computation, route target filtering, multicast support for Layer 3 VPNs, and management and troubleshooting of MPLS networks.
OSPF and IS-IS: Choosing an IGP for Large-Scale Networks	Explores the full range of characteristics and capabilities for the two major link-state routing protocols: Open Shortest Path First (OSPF) and IS-IS. Explains architecture, packet types, and addressing; demonstrates how to improve scalability; shows how to design large-scale networks for maximum security and reliability; details protocol extensions for MPLS-based traffic engineering, IPv6, and multitopology routing; and covers troubleshooting for OSPF and IS-IS networks.
Routing Policy and Protocols for Multivendor IP Networks	Provides a brief history of the Internet, explains IP addressing and routing (Routing Information Protocol [RIP], OSPF, IS-IS, and Border Gateway Protocol [BGP]), explores ISP peering and routing policies, and displays configurations for both Juniper Networks and other vendors' routers.
The Complete IS-IS Protocol	Provides the insight and practical solutions necessary to understand the IS-IS protocol and how it works by using a multivendor, real-world approach.

Objectives

This guide provides an overview of the network interfaces features of the JUNOS software and describes how to configure these properties on the routing platform.

NOTE: For additional information about the JUNOS software—either corrections to or information that might have been omitted from this guide—see the software release notes at http://www.juniper.net/.

Audience

This guide is designed for network administrators who are configuring and monitoring a Juniper Networks M-series, MX-series, T-series, EX-series, or J-series router or switch.

To use this guide, you need a broad understanding of networks in general, the Internet in particular, networking principles, and network configuration. You must also be familiar with one or more of the following Internet routing protocols:

- Border Gateway Protocol (BGP)
- Distance Vector Multicast Routing Protocol (DVMRP)

- Intermediate System-to-Intermediate System (IS-IS)
- Internet Control Message Protocol (ICMP) router discovery
- Internet Group Management Protocol (IGMP)
- Multiprotocol Label Switching (MPLS)
- Open Shortest Path First (OSPF)
- Protocol-Independent Multicast (PIM)
- Resource Reservation Protocol (RSVP)
- Routing Information Protocol (RIP)
- Simple Network Management Protocol (SNMP)

Personnel operating the equipment must be trained and competent; must not conduct themselves in a careless, willfully negligent, or hostile manner; and must abide by the instructions provided by the documentation.

Supported Routing Platforms

For the features described in this manual, the JUNOS software currently supports the following routing platforms:

- J-series
- M-series
- MX-series
- T-series

Using the Indexes

This reference contains two indexes: a complete index that includes topic entries, and an index of statements and commands only.

In the index of statements and commands, an entry refers to a statement summary section only. In the complete index, the entry for a configuration statement or command contains at least two parts:

- The primary entry refers to the statement summary section.
- The secondary entry, *usage guidelines,* refers to the section in a configuration guidelines chapter that describes how to use the statement or command.

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. 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 the *JUNOS CLI User Guide*.

Documentation Conventions

Table 2 on page lxiii defines notice icons used in this guide.

Table 2: Notice Icons

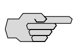
Icon	Meaning	Description
	Informational note	Indicates important features or instructions.
	Caution	Indicates a situation that might result in loss of data or hardware damage.
	Warning	Alerts you to the risk of personal injury or death.
	Laser warning	Alerts you to the risk of personal injury from a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

Table 3 on page lxiii defines the text and syntax conventions used in this guide.

Table 3: 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 3: Text and Syntax Conventions *(continued)*

<table>
<tr><th>Convention</th><th>Description</th><th>Examples</th></tr>
<tr><td>`Fixed-width text like this`</td><td>Represents output that appears on the terminal screen.</td><td>`user@host>` **`show chassis alarms`**
`No alarms currently active`</td></tr>
<tr><td>*Italic text like this*</td><td>■ Introduces important new terms.
■ Identifies book names.
■ Identifies RFC and Internet draft titles.</td><td>■ A policy *term* is a named structure that defines match conditions and actions.
■ *JUNOS System Basics Configuration Guide*
■ RFC 1997, *BGP Communities Attribute*</td></tr>
<tr><td>*Italic text like this*</td><td>Represents variables (options for which you substitute a value) in commands or configuration statements.</td><td>Configure the machine's domain name:

[edit]
root@# **set system domain-name** *domain-name*</td></tr>
<tr><td>Plain text like this</td><td>Represents names of configuration statements, commands, files, and directories; IP addresses; configuration hierarchy levels; or labels on routing platform components.</td><td>■ To configure a stub area, include the stub statement at the [edit protocols ospf area area-id] hierarchy level.
■ The console port is labeled CONSOLE.</td></tr>
<tr><td>< > (angle brackets)</td><td>Enclose optional keywords or variables.</td><td>stub <default-metric *metric*>;</td></tr>
<tr><td>| (pipe symbol)</td><td>Indicates a choice between the mutually exclusive keywords or variables on either side of the symbol. The set of choices is often enclosed in parentheses for clarity.</td><td>broadcast | multicast

(*string1* | *string2* | *string3*)</td></tr>
<tr><td># (pound sign)</td><td>Indicates a comment specified on the same line as the configuration statement to which it applies.</td><td>rsvp { # Required for dynamic MPLS only</td></tr>
<tr><td>[ ] (square brackets)</td><td>Enclose a variable for which you can substitute one or more values.</td><td>community name members [*community-ids*]</td></tr>
<tr><td>Indention and braces ({ })</td><td>Identify a level in the configuration hierarchy.</td><td rowspan="2">[edit]
routing-options {
  static {
    route default {
      nexthop *address*;
      retain;
    }
  }
}</td></tr>
<tr><td>; (semicolon)</td><td>Identifies a leaf statement at a configuration hierarchy level.</td></tr>
<tr><td colspan="3">**J-Web GUI Conventions**</td></tr>
<tr><td>**Bold text like this**</td><td>Represents J-Web graphical user interface (GUI) items you click or select.</td><td>■ In the Logical Interfaces box, select **All Interfaces**.
■ To cancel the configuration, click **Cancel**.</td></tr>
</table>

Table 3: Text and Syntax Conventions *(continued)*

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

Documentation Feedback

We encourage you to provide feedback, comments, and suggestions so that we can improve the documentation. You can send your comments to techpubs-comments@juniper.net, or fill out the documentation feedback form at https://www.juniper.net/cgi-bin/docbugreport/. If you are using e-mail, be sure to include the following information with your comments:

- Document name
- Document part number
- Page number
- Software release version (not required for *Network Operations Guides [NOGs])*

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- JTAC policies—For a complete understanding of our JTAC procedures and policies, review the JTAC User Guide located at http://www.juniper.net/customers/support/downloads/710059.pdf.
- Product warranties—For product warranty information, visit http://www.juniper.net/support/warranty/.
- JTAC Hours of Operation —The JTAC centers have resources available 24 hours a day, 7 days a week, 365 days a year.

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- Find product documentation: http://www.juniper.net/techpubs/
- Find solutions and answer questions using our Knowledge Base: http://kb.juniper.net/

- Download the latest versions of software and review release notes: http://www.juniper.net/customers/csc/software/
- Search technical bulletins for relevant hardware and software notifications: https://www.juniper.net/alerts/
- Join and participate in the Juniper Networks Community Forum: http://www.juniper.net/company/communities/
- Open a case online in the CSC Case Management tool: http://www.juniper.net/cm/

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

Opening a Case with JTAC

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

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

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

Part 1

Network Interfaces Configuration Statements Overview

Chapter 1

Network Interfaces Configuration Statements and Hierarchy

This chapter shows the complete configuration statement hierarchy, listing all possible configuration statements and showing their level in the configuration hierarchy. When you are configuring the JUNOS software, your current hierarchy level is shown in the banner on the line preceding the user@host# prompt.

This section contains the following topics:

[edit chassis] Hierarchy Level

```
chassis {
  aggregated-devices {
    ethernet {
      device-count number;
    }
    sonet {
      device-count number;
    }
  }
  channel-group number {
    ethernet {
      device-count number;
    }
    fpc slot-number{
```

```
                pic pic-number {
                    aggregate-ports;
                    atm-cell-relay-accumulation;
                    atm-l2circuit-mode (aal5 | cell | trunk trunk);
                    ce1 {
                        e1 link-number {
                            channel-group group-number;
                            timeslots time-slot-range;
                        }
                    }
                    ct1 {
                        t1 link-number {
                            channel-group group-number;
                            timeslots time-slot-range;
                        }
                    }
                    ct3 {
                        port port-number {
                            t1 link-number {
                                channel-group group-number;
                                timeslots time-slot-range;
                            }
                        }
                        framing sdh;
                    }
                    max-queues-per-interface number;
                    no-concatenate;
                    shdsl {
                        pic-mode (1-port-atm | 2-port-atm);
                    }
                    vtmapping (klm | itu-t);
                }
            }
        }
    }
```

[edit interfaces] Hierarchy Level

The statements at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level can also be configured at the [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*] hierarchy level.

NOTE: The accounting-profile statement is an exception to this rule. The accounting-profile statement can be configured at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level, but it cannot be configured at the [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*] hierarchy level.

```
interfaces {
    traceoptions {
        file filename <files number> <match regular-expression> <size size>
            <world-readable | no-world-readable> ;
```

```
    flag flag <disable>;
}
interface-name {
    accounting-profile name;
    aggregated-ether-options {
        (flow-control | no-flow-control);
        lacp {
            (active | passive);
            link-protection{
                disable;
            (revertive | non-revertive);
            periodic interval;
            system-priority priority;
        }
        link-protection;
        link-speed speed;
        (loopback | no-loopback);
        minimum-links number;
        source-address-filter {
            mac-address;
        }
        (source-filtering | no-source-filtering);
    }
    aggregated-sonet-options {
        link-speed speed | mixed;
        minimum-links number;
    }
    atm-options {
        cell-bundle-size cells;
        ilmi;
        linear-red-profiles profile-name {
            high-plp-max-threshold percent;
            low-plp-max-threshold percent;
            queue-depth cells high-plp-threshold percent low-plp-threshold percent;
        }
        mpls {
            pop-all-labels {
                required-depth number;
            }
        }
        pic-type (atm1 | atm2);
        plp-to-clp;
        promiscuous-mode {
            vpi vpi-identifier;
        }
        scheduler-maps map-name {
            forwarding-class class-name {
                epd-threshold cells plp1 cells;
                linear-red-profile profile-name;
                priority (high | low);
                transmit-weight (cells number | percent number);
            }
            vc-cos-mode (alternate | strict);
        }
        vpi vpi-identifier {
            maximum-vcs maximum-vcs;
```

```
            oam-liveness {
                down-count cells;
                up-count cells;
            }
            oam-period (seconds | disable);
            shaping {
                (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate
                    sustained rate burst length);
                queue-length number;
            }
        }
    }
    clocking clock-source;
    data-input (system | interface interface-name);
    dce;
    serial-options {
        clock-rate rate;
        clocking-mode (dce | internal | loop);
        control-polarity (negative | positive);
        cts-polarity (negative | positive);
        dcd-polarity (negative | positive);
        dce-options {
            control-signal (assert | de-assert | normal);
            cts (ignore | normal | require);
            dcd (ignore | normal | require);
            dsr (ignore | normal | require);
            dtr signal-handling-option;
            ignore-all;
            indication (ignore | normal | require);
            rts (assert | de-assert | normal);
            tm (ignore | normal | require);
        }
        dsr-polarity (negative | positive);
        dte-options {
            control-signal (assert | de-assert | normal);
            cts (ignore | normal | require);
            dcd (ignore | normal | require);
            dsr (ignore | normal | require);
            dtr signal-handling-option;
            ignore-all;
            indication (ignore | normal | require);
            rts (assert | de-assert | normal);
            tm (ignore | normal | require);
        }
        dtr-circuit (balanced | unbalanced);
        dtr-polarity (negative | positive);
        encoding (nrz | nrzi);
        indication-polarity (negative | positive);
        line-protocol protocol;
        loopback mode;
        rts-polarity (negative | positive);
        tm-polarity (negative | positive);
        transmit-clock invert;
    }
    description text;
    dialer-options {
```

```
    pool pool-name <priority priority>;
}
disable;
ds0-options {
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    byte-encoding (nx56 | nx64);
    fcs (16 | 32);
    idle-cycle-flag (flags | ones);
    invert-data;
    loopback payload;
    start-end-flag (filler | shared);
}
e1-options {
    bert-error-rate rate;
    bert-period seconds;
    fcs (16 | 32);
    framing (g704 | g704-no-crc4 | unframed);
    idle-cycle-flag (flags | ones);
    invert-data;
    loopback (local | remote);
    start-end-flag (filler | shared);
    timeslots time-slot-range;
}
e3-options {
    atm-encapsulation (direct | plcp);
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    buildout feet;
    compatibility-mode (digital-link | kentrox | larscom) <subrate value>;
    fcs (16 | 32);
    framing (g.751 | g.832);
    idle-cycle-flag (filler | shared);
    invert-data;
    loopback (local | remote);
    (payload-scrambler | no-payload-scrambler);
    start-end-flag (filler | shared);
    (unframed | no-unframed);
}
encapsulation type;
es-options {
    backup-interface es-fpc/pic/port;
}
fastether-options {
    802.3ad aex;
    (flow-control | no-flow-control);
    ignore-l3-incompletes;
    ingress-rate-limit rate;
    (loopback | no-loopback);
    mpls {
        pop-all-labels {
            required-depth number;
        }
    }
```

```
    source-address-filter {
        mac-address;
    }
    (source-filtering | no-source-filtering);
}
flexible-vlan-tagging;
gigether-options {
    802.3ad aex;
    (asynchronous-notification | no-asynchronous-notification);
    (auto-negotiation | no-auto-negotiation) remote-fault <local-interface-online |
        local-interface-offline>;
    auto-reconnect seconds;
    (flow-control | no-flow-control);
    ignore-l3-incompletes;
    (loopback | no-loopback);
    mpls {
        pop-all-labels {
            required-depth number;
        }
    }
    no-auto-mdix;
    source-address-filter {
        mac-address;
    }
    (source-filtering | no-source-filtering);
    ethernet-switch-profile {
        (mac-learn-enable | no-mac-learn-enable);
        tag-protocol-id [ tpids ];
        ethernet-policer-profile {
            input-priority-map {
                ieee802.1p premium [ values ];
            }
            output-priority-map {
                classifier {
                    premium {
                        forwarding-class class-name {
                            loss-priority (high | low);
                        }
                    }
                }
            }
            policer cos-policer-name {
                aggregate {
                    bandwidth-limit (ethernet) bps;
                    burst-size-limit (ethernet) bytes;
                }
                premium {
                    bandwidth-limit (ethernet) bps;
                    burst-size-limit (ethernet) bytes;
                }
            }
        }
    }
}
(gratuitous-arp-reply | no-gratuitous-arp-reply);
hold-time up milliseconds down milliseconds;
```

```
interface-set interface-set-name {
    interface ethernet-interface-name {
        (unit unit-number | vlan-tags-outer vlan-tag);
    }
    interface interface-name {
        (unit unit-number);
    }
}
isdn-options {
    bchannel-allocation (ascending | descending);
    calling-number number;
    pool pool-name <priority priority>;
    spid1 spid-string;
    spid2 spid-string;
    static-tei-val value;
    switch-type (att5e | etsi | ni1 | ntdms100 | ntt);
    t310 seconds;
    tei-option (first-call | power-up);
}
keepalives <down-count number> <interval seconds> <up-count number>;
link-mode mode;
lmi (interfaces) {
    lmi-type (ansi | itu);
    n391dte number;
    n392dce number;
    n392dte number;
    n393dce number;
    n393dte number;
    t391dte seconds;
    t392dce seconds;
}
lsq-failure-options {
    no-termination-request;
    [ trigger-link-failure interface-name ];
}
mac mac-address;
mlfr-uni-nni-bundle-options {
    acknowledge-retries number;
    acknowledge-timer milliseconds;
    action-red-differential-delay (disable-tx | remove-link);
    drop-timeout milliseconds;
    fragment-threshold bytes;
    cisco-interoperability send-lip-remove-link-for-link-reject;
    hello-timer milliseconds;
    link-layer-overhead percent;
    lmi-type (ansi | itu);
    minimum-links number;
    mrru bytes;
    n391 number;
    n392 number;
    n393 number;
    red-differential-delay milliseconds;
    t391 seconds;
    t392 seconds;
    yellow-differential-delay milliseconds;
```

```
   encapsulation type;
}
modem-options {
   dialin (console | routable);
   init-command-string initialization-command-string;
}
mtu bytes;
multiservice-options {
   (core-dump | no-core-dump);
   (syslog | no-syslog);
}
native-vlan-id number;
no-gratuitous-arp-request;
no-keepalives;
no-partition {
   interface-type type;
}
optics-options {
   wavelength nm;
}
partition partition-number oc-slice oc-slice-range interface-type type;
timeslots time-slot-range;
passive-monitor-mode;
per-unit-scheduler;
ppp-options {
   chap {
      access-profile name;
      default-chap-secret name;
      local-name name;
      passive;
   }
   compression {
      acfc;
      pfc;
   }
   dynamic-profile profile-name;
   no-termination-request;
   pap {
      access-profile name;
      local-name name;
      local-password password;
      passive;
   }
}
receive-bucket {
   overflow (discard | tag);
   rate percentage;
   threshold bytes;
}
redundancy-options {
   primary sp-fpc/pic/port;
   secondary sp-fpc/pic/port;
}
satop-options {
   payload-size n;
}
```

```
schedulers number;
serial-options {
    clock-rate rate;
    clocking-mode (dce | internal | loop);
    control-polarity (negative | positive);
    cts-polarity (negative | positive);
    dcd-polarity (negative | positive);
    dce-options {
        control-signal (assert | de-assert | normal);
        cts (ignore | normal | require);
        dcd (ignore | normal | require);
        dsr (ignore | normal | require);
        dtr signal-handling-option;
        ignore-all;
        indication (ignore | normal | require);
        rts (assert | de-assert | normal);
        tm (ignore | normal | require);
    }
    dsr-polarity (negative | positive);
    dte-options {
        control-signal (assert | de-assert | normal);
        cts (ignore | normal | require);
        dcd (ignore | normal | require);
        dsr (ignore | normal | require);
        dtr signal-handling-option;
        ignore-all;
        indication (ignore | normal | require);
        rts (assert | de-assert | normal);
        tm (ignore | normal | require);
    }
    dtr-circuit (balanced | unbalanced);
    dtr-polarity (negative | positive);
    encoding (nrz | nrzi);
    indication-polarity (negative | positive);
    line-protocol protocol;
    loopback mode;
    rts-polarity (negative | positive);
    tm-polarity (negative | positive);
    transmit-clock invert;
}
services-options {
    inactivity-timeout seconds;
    open-timeout seconds;
    syslog {
        host hostname {
            facility-override facility-name;
            log-prefix prefix-number;
            services priority-level;
        }
    }
}
shdsl-options {
    annex (annex-a | annex-b);
    line-rate line-rate;
    loopback (local | remote);
    snr-margin {
```

```
        current margin;
        snext margin;
    }
}
sonet-options {
    aggregate asx;
    aps {
        advertise-interval milliseconds;
        annex-b
        authentication-key key;
        force;
        hold-time milliseconds;
        lockout;
        neighbor address;
        paired-group group-name;
        preserve-interface;
        protect-circuit group-name;
        request;
        revert-time seconds;
        switching-mode (bidirectional | unidirectional);
        working-circuit group-name;
    }
    bytes {
        c2 value;
        e1-quiet value;
        f1 value;
        f2 value;
        s1 value;
        z3 value;
        z4 value;
    }
    fcs (16 | 32);
    loopback (local | remote);
    mpls {
        pop-all-labels {
            required-depth number;
        }
    }
    path-trace trace-string;
    (payload-scrambler | no-payload-scrambler);
    rfc-2615;
    trigger {
        defect ignore;
        hold-time up milliseconds down milliseconds;
    }
    vtmapping (itu-t | klm);
    (z0-increment | no-z0-increment);
}
speed (10m | 100m | 1g | oc3 | oc12 | oc48);
stacked-vlan-tagging;
switch-options {
    switch-port port-number {
        (auto-negotiation | no-auto-negotiation);
        speed (10m | 100m | 1g);
        link-mode (full-duplex | half-duplex);
    }
```

```
}
t1-options {
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    buildout value;
    byte-encoding (nx56 | nx64);
    crc-major-alarm-threshold (1e-3 | 5e-4 | 1e-4 | 5e-5 | 1e-5);
    crc-minor-alarm-threshold (1e-3 | 5e-4 | 1e-4 | 5e-5 | 1e-5 | 5e-6 | 1e-6);
    fcs (16 | 32);
    framing (esf | sf);
    idle-cycle-flag (flags | ones);
    invert-data;
    line-encoding (ami | b8zs);
    loopback (local | payload | remote);
    remote-loopback-respond;
    start-end-flag (filler | shared);
    timeslots time-slot-range;
}
t3-options {
    atm-encapsulation (direct | plcp);
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    buildout feet;
    (cbit-parity | no-cbit-parity);
    compatibility-mode (adtran | digital-link | kentrox | larscom | verilink) <subrate
        value>;
    fcs (16 | 32);
    (feac-loop-respond | no-feac-loop-respond);
    idle-cycle-flag value;
    (long-buildout | no-long-buildout);
    (loop-timing | no-loop-timing);
    loopback (local | payload | remote);
    (mac | no-mac);
    (payload-scrambler | no-payload-scrambler);
    start-end-flag (filler | shared);
}
traceoptions {
    flag flag <flag-modifier> <disable>;
}
transmit-bucket {
    overflow discard;
    rate percentage;
    threshold bytes;
}
(traps | no-traps);
unidirectional;
vlan-tagging;
vlan-vci-tagging;
unit logical-unit-number {
    accept-source-mac {
        mac-address mac-address {
            policer {
                input cos-policer-name;
                output cos-policer-name;
```

```
        }
    }
}
accounting-profile name;
allow-any-vci;
atm-scheduler-map (map-name | default);
backup-options {
    interface interface-name;
}
bandwidth rate;
cell-bundle-size cells;
clear-dont-fragment-bit;
compression {
    rtp {
        f-max-period number;
        maximum-contexts number <force>;
        queues [ queue-numbers ];
        port {
            minimum port-number;
            maximum port-number;
        }
    }
}
compression-device interface-name;
copy-tos-to-outer-ip-header;
demux-destination family;
demux-source family;
demux-options {
    underlying-interface interface-name;
}
description text;
dial-options {
    l2tp-interface-id name;
    (dedicated | shared);
}
dialer-options {
    activation-delay seconds;
    callback;
    callback-wait-period time;
    deactivation-delay seconds;
    dial-string [ dial-string-numbers ];
    idle-timeout seconds;
    incoming-map {
        caller caller-id) | accept-all;
        initial-route-check seconds;
        load-interval seconds;
        load-threshold percent;
        pool pool-name;
        redial-delay time;
        watch-list {
            [ routes ];
        }
    }
}
disable;
disable-mlppp-inner-ppp-pfc;
```

```
dlci dlci-identifier;
drop-timeout milliseconds;
dynamic-call-admission-control {
   activation-priority priority;
   bearer-bandwidth-limit kilobits-per-second;
}
encapsulation type;
epd-threshold cells plp1 cells;
fragment-threshold bytes;
inner-vlan-id-range start start-id end end-id;
input-vlan-map {
   (pop | pop-pop | pop-swap | push | push-push | swap | swap-push | swap-swap);
   inner-tag-protocol-id tpid;
   inner-vlan-id number;
   tag-protocol-id tpid;
   vlan-id number;
}
interleave-fragments;
inverse-arp;
layer2-policer {
   input-policer policer-name;
   input-three-color policer-name;
   output-policer policer-name;
   output-three-color policer-name;
}
link-layer-overhead percent;
minimum-links number;
mrru bytes;
multicast-dlci dlci-identifier;
multicast-vci vpi-identifier.vci-identifier;
multilink-max-classes number;
multipoint;
oam-liveness {
   down-count cells;
   up-count cells;
}
oam-period (seconds | disable);
output-vlan-map {
   (pop | pop-pop | pop-swap | push | push-push | swap | swap-push | swap-swap);
   inner-tag-protocol-id tpid;
   inner-vlan-id number;
   tag-protocol-id tpid;
   vlan-id number;
}
passive-monitor-mode;
peer-unit unit-number;
plp-to-clp;
point-to-point;
ppp-options {
   chap {
      access-profile name;
      default-chap-secret name;
      local-name name;
      passive;
   }
   compression {
```

```
        acfc;
        pfc;
        pap;
        default-pap-password password;
        local-name name;
        local-password password;
        passive;
    }
    dynamic-profile profile-name;
    lcp-restart-timer milliseconds;
    loopback-clear-timer seconds;
    ncp-restart-timer milliseconds;
}
pppoe-options {
    access-concentrator name;
    auto-reconnect seconds;
    (client | server);
    service-name name;
    underlying-interface interface-name;
}
proxy-arp;
service-domain (inside | outside);
shaping {
    (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained
        rate burst length);
    queue-length number;
}
short-sequence;
transmit-weight number;
(traps | no-traps);
trunk-bandwidth rate;
trunk-id number;
tunnel {
    backup-destination address;
    destination address;
    key number;
    routing-instance {
        destination routing-instance-name;
    }
    source source-address;
    ttl number;
}
vci vpi-identifier.vci-identifier;
vci-range start start-vci end end-vci;
vpi vpi-identifier;
vlan-id number;
vlan-id-list [vlan-id vlan-id–vlan-id]
vlan-id-range number-number;
vlan-tags inner tpid.vlan-id outer tpid.vlan-id;
vlan-tags outer <tpid.>vlan-id inner-list [vlan-id vlan-id–vlan-id]
family family {
    accounting {
        destination-class-usage;
        source-class-usage {
            direction;
```

```
    }
}
address address {
    destination address;
}
bundle ml-fpc-pic/port | ls-fpc/pic/port);
filter {
    group filter-group-number;
    input filter-name;
    input-list {
        [ filter-names ];
        output filter-name;
    }
    output-list {
        [ filter-names ];
    }
}
ipsec-sa sa-name;
keep-address-and-control;
mtu bytes;
multicast-only;
negotiate-address;
no-redirects;
policer {
    arp policer-template-name;
    input policer-template-name;
    output policer-template-name;
}
primary;
proxy inet-address address;
receive-options-packets;
receive-ttl-exceeded;
remote (inet-address address | mac-address address);
rpf-check <fail-filter filter-name> {
    <mode loose>;
}
sampling {
    direction;
}
service {
    input {
        service-set service-set-name <service-filter filter-name>;
        post-service-filter filter-name;
    }
    output {
        service-set service-set-names <service-filter filter-name>;
    }
}
(translate-discard-eligible | no-translate-discard-eligible);
(translate-fecn-and-becn | no-translate-fecn-and-becn);
unnumbered-address interface-name <destination address destination-profile
    profile-name | preferred-source-address address>;
address address {
    arp ip-address (mac | multicast-mac) mac-address <publish>;
    broadcast address;
    destination address;
```

```
                    destination-profile name;
                    eui-64;
                    multipoint-destination address (dlci dlci-identifier | vci vci-identifier);
                    multipoint-destination address {
                      epd-threshold cells plp1 cells;
                      inverse-arp;
                      oam-liveness {
                        up-count cells;
                        down-count cells;
                      }
                      oam-period (seconds | disable);
                      shaping {
                        (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate
                          sustained rate burst length);
                        queue-length number;
                      }
                      vci vpi-identifier.vci-identifier;
                    }
                    preferred;
                    primary;
                    (vrrp-group | vrrp-inet6-group) group-number {
                      (accept-data | no-accept-data);
                      advertise–interval seconds;
                      authentication-type authentication;
                      authentication-key key;
                      fast-interval milliseconds;
                      (preempt | no-preempt) {
                        hold-time seconds;
                      }
                      priority-number number;
                      track {
                        priority-cost seconds;
                        priority-hold-time interface-name {
                          bandwidth-threshold bits-per-second {
                            priority;
                          }
                          interface priority;
                        }
                        route ip-address/mask routing-instance instance-name priority-cost
                          cost;
                      }
                      virtual-address [ addresses ];
                    }
                  }
                }
              }
            }
          }
```

[edit logical-systems] Hierarchy Level

The following lists the statements that can be configured at the [edit logical-systems] hierarchy level that are also documented in this manual. For more information about logical systems, see the *JUNOS Routing Protocols Configuration Guide*.

```
logical-systems logical-system-name {
    interfaces interface-name {
        unit logical-unit-number {
            accept-source-mac {
                mac-address mac-address {
                    policer {
                        input cos-policer-name;
                        output cos-policer-name;
                    }
                }
            }
            allow-any-vci;
            atm-scheduler-map (map-name | default);
            bandwidth rate;
            backup-options {
                interface interface-name;
            }
            cell-bundle-size cells;
            clear-dont-fragment-bit;
            compression {
                rtp {
                    f-max-period number;
                    port {
                        minimum port-number;
                        maximum port-number;
                    }
                    queues [ queue-numbers ];
                }
            }
            compression-device interface-name;
            description text;
            dial-options {
                l2tp-interface-id name;
                (dedicated | shared);
            }
            dialer-options {
                activation-delay seconds;
                deactivation-delay seconds;
                dial-string [ dial-string-numbers ];
                idle-timeout seconds;
                initial-route-check seconds;
                load-threshold number;
                pool pool;
                remote-name remote-callers;
                watch-list {
                    [ routes ];
                }
            }
            disable;
            dlci dlci-identifier;
            drop-timeout milliseconds;
            dynamic-call-admission-control {
                activation-priority priority;
                bearer-bandwidth-limit kilobits-per-second;
            }
            encapsulation type;
```

```
epd-threshold cells plp1 cells;
fragment-threshold bytes;
input-vlan-map {
   inner-tag-protocol-id;
   inner-vlan-id;
   (pop | pop-pop | pop-swap | push | push-push | swap | swap-push | swap-swap);
   tag-protocol-id tpid;
   vlan-id number;
}
interleave-fragments;
inverse-arp;
layer2-policer {
   input-policer policer-name;
   input-three-color policer-name;
   output-policer policer-name;
   output-three-color policer-name;
}
link-layer-overhead percent;
minimum-links number;
mrru bytes;
multicast-dlci dlci-identifier;
multicast-vci vpi-identifier.vci-identifier;
multilink-max-classes number;
multipoint;
oam-liveness {
   up-count cells;
   down-count cells;
}
oam-period (seconds | disable);
output-vlan-map {
   inner-tag-protocol-id;
   inner-vlan-id;
   (pop | pop-pop | pop-swap | push | push-push | swap | swap-swap);
   tag-protocol-id tpid;
   vlan-id number;
}
passive-monitor-mode;
peer-unit unit-number;
plp-to-clp;
point-to-point;
ppp-options {
   chap {
      access-profile name;
      default-chap-secret name;
      local-name name;
      passive;
   }
   compression {
      acfc;
      pfc;
      }
   }
   dynamic-profile profile-name;
   pap {
      default-pap-password password;
```

```
        local-name name;
        local-password password;
        passive;
    }
}
proxy-arp;
service-domain (inside | outside);
shaping {
    (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained
        rate burst length);
    queue-length number;
}
short-sequence;
transmit-weight number;
(traps | no-traps);
trunk-bandwidth rate;
trunk-id number;
tunnel {
    backup-destination address;
    destination address;
    key number;
    routing-instance {
        destination routing-instance-name;
    }
    source source-address;
    ttl number;
}
vci vpi-identifier.vci-identifier;
vlan-id number;
vlan-id-list [vlan-id vlan-id–vlan-id]
vlan-tags inner tpid.vlan-id outer tpid.vlan-id;
vlan-tags outer <tpid.>vlan-id inner-list [vlan-id vlan-id–vlan-id]
vpi vpi-identifier;
family family {
    accounting {
        destination-class-usage;
        source-class-usage {
            direction;
        }
    }
    bundle interface-name;
    filter {
        group filter-group-number;
        input filter-name;
        input-list {
            [ filter-names ];
        }
        output filter-name;
        output-list {
            [ filter-names ];
        }
    }
    ipsec-sa sa-name;
    keep-address-and-control;
    llc2 {
        ack-delay-time time;
```

```
        ack-max count;
        idle-time time;
        local-window count;
        max-retry count;
        p-bit-timeout time;
        redundancy-group group-number {
            advertise-interval seconds;
            map {
                local-mac mac-address request mac-address;
            }
            preempt hold-time seconds;
            no-preempt;
            priority priority;
            track {
                dlsw {
                    peer ip-address priority-cost priority;
                    destination mac-address priority-cost priority;
                }
                interface interface-name priority-cost priority;
            }
        }
        t1-time time;
        t2-time time;
        trej-time time;
    }
    mtu bytes;
    multicast-only;
    no-redirects;
    policer {
        arp policer-template-name;
        input policer-template-name;
        output policer-template-name;
    }
    primary;
    proxy inet-address address;
    receive-options-packets;
    receive-ttl-exceeded;
    remote (inet-address address | mac-address address);
    rpf-check <fail-filter filter-name> {
        <mode loose>;
    }
    sampling {
        direction;
    }
    service {
        input {
            service-set service-set-name <service-filter filter-name>;
            post-service-filter filter-name;
        }
        output {
            service-set service-set-name <service-filter filter-name>;
        }
    }
    (translate-discard-eligible | no-translate-discard-eligible);
    (translate-fecn-and-becn | no-translate-fecn-and-becn);
```

```
                unnumbered-address interface-name destination address destination-profile
                  profile-name;
                address address {
                  arp ip-address (mac | multicast-mac) mac-address <publish>;
                  broadcast address;
                  destination address;
                  destination-profile name;
                  eui-64;
                  multipoint-destination address (dlci dlci-identifier | vci vci-identifier);
                  multipoint-destination address {
                    epd-threshold cells plp1 cells;
                    inverse-arp;
                    oam-liveness {
                      up-count cells;
                      down-count cells;
                    }
                    oam-period (seconds | disable);
                    shaping {
                      (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate
                        sustained rate burst length);
                      queue-length number;
                    }
                    vci vpi-identifier.vci-identifier;
                  }
                  preferred;
                  primary;
                  (vrrp-group | vrrp-inet6-group) group-number {
                    (accept-data | no-accept-data);
                    advertise–interval seconds;
                    authentication-type authentication;
                    authentication-key key;
                    fast-interval milliseconds;
                    (preempt | no-preempt) {
                      hold-time seconds;
                    }
                    priority-number number;
                    track {
                      priority-cost seconds;
                      priority-hold-time interface-name {
                        interface priority;
                        bandwidth-threshold bits-per-second {
                          priority;
                        }
                      }
                      route ip-address/mask routing-instance instance-name priority-cost
                        cost;
                    }
                  }
                  virtual-address [ addresses ];
                }
              }
            }
          }
        }
```

[edit protocols connections] Hierarchy Level

The following statements can also be configured at the [edit logical-systems *logical-system-name* protocols connections] hierarchy level.

```
interface-switch connection-name {
    interface interface-name.unit-number;
    interface interface-name.unit-number;
}
```

[edit protocols dot1x] Hierarchy Level

```
dot1x {
   authenticator
      authentication-profile-name access-profile-name;
      interface interface-ids {
         maximum-requests integer;
         retries integer;
         quiet-period seconds;
         transmit-period seconds;
         reauthentication (disable | interval seconds);
         server-timeout seconds;
         supplicant (single);
         supplicant-timeout seconds;
      }
   }
}
```

[edit protocols lacp] Hierarchy Level

```
traceoptions {
   file filename <files number> <size size> <world-readable | no-world-readable>;
   flag flag <disable>;
}
```

[edit protocols oam] Hierarchy Level

```
ethernet {
   connectivity-fault-management {
      action-profile profile-name {
         default-action {
            interface-down;
         }
      }
      linktrace {
         age (30m | 10m | 1m | 30s | 10s);
         path-database-size path-database-size;
      }
      maintenance-domain domain-name {
         bridge-domain name;
         routing-instance r1 {
         bridge-domain name;
         instance vpls-instance;
         level number;
         mip-half-function (none | default | explicit);
         name-format (character-string | none | dns | mac+2oct);
         short-name-format (character-string | vlan | 2octet | rfc-2685-vpn-id);
            continuity-check {
               hold-interval minutes;
               interval (10m | 10s | 1m | 1s | 100ms);
               loss-threshold number;
```

```
                }
                maintenance-association ma-name {
                mip-half-function (none | default | explicit);
                mep mep-id {
                    auto-discovery;
                    direction (up | down);
                    interface interface-name;
                    priority number;
                    remote-mep mep-id {
                        action-profile profile-name;
                    }
                }
            }
        }
        performance-monitoring {
            hardware-assisted-timestamping;
        }
    }
    link-fault-management {
        action-profile profile-name {
            action {
                syslog;
                link-down;
                send-critical-event;
            }
            event {
                link-adjacency-loss;
                link-event-rate {
                    frame-error count;
                    frame-period count;
                    frame-period-summary count;
                    symbol-period count;
                }
                protocol-down;
            }
        }
        interface interface-name {
            apply-action-profile profile-name;
            event-thresholds {
                frame-error count;
                frame-period count;
                frame-period-summary count;
                symbol-period count;
            }
            link-discovery (active | passive);
            negotiation-options {
                allow-remote-loopback;
                no-allow-link-events;
            }
            pdu-interval interval;
            pdu-threshold threshold-value;
            remote-loopback;
        }
    }
}
```

[edit protocols ppp] Hierarchy Level

```
monitor-session (interface-name | all);
traceoptions {
    file filename <files number> <match regular-expression> <size size> <world-readable |
        no-world-readable> ;
    flag flag <disable>;
}
```

[edit protocols protection-group] Hierarchy Level

```
ethernet-ring ring-name {
    east-interface {
        control-channel channel-name {
            vlan number;
            }
    }
    guard-interval number;
    node-id mac-address;
    restore-interval number;
    ring-protection-link-owner;
    west-interface {
        control-channel channel-name {
            vlan number;
            }
    }
}
```

[edit protocols vrrp] Hierarchy Level

```
traceoptions {
    file {
        filename filename;
        files number;
        size size;
        match regex;
        microsecond-stamp;
        (world-readable | no-world-readable);
    }
    flag flag;
}
```

[edit system processes] Hierarchy Level

```
dialer-services {
    disable;
}
isdn-signaling {
    disable;
    reject-incoming;
}
```

Part 2
Router Interfaces Configuration Concepts

This part of the *Network Interfaces Configuration Guide* describes the various interface types and the processes used to configure them for typical usage.

Chapter 2

Router Interfaces Overview

Routers typically contain several different types of interfaces suited to various functions. For the interfaces on a routing platform to function, you must configure them, specifying properties such as the interface location (that is, the slot in which the Flexible PIC Concentrator [FPC] or Dense Port Concentrator [DPC] is installed, and the location where the Physical Interface Card [PIC] is installed), the interface type (such as SONET/SDH, Asynchronous Transfer Mode [ATM], or Ethernet), encapsulation, and interface-specific properties. You can configure the interfaces that are currently present in the routing platform, and you can also configure interfaces that are not currently present but that you might add in the future. When a configured interface appears, the JUNOS software detects its presence and applies the appropriate configuration to it.

To determine which interfaces are currently installed in the routing platform, issue the show interfaces terse operational mode command. If an interface is listed in the output, it is installed in the routing platform. If an interface is not listed in the output, it is not installed in the routing platform.

For information about which PICs are supported on your platform, see your platform's PIC guide.

You can configure JUNOS class-of-service (CoS) properties to provide a variety of classes of service for different applications, including multiple forwarding classes for managing packet transmission, congestion management, and CoS-based forwarding. For more information about configuring CoS properties, see the *JUNOS Class of Service Configuration Guide*.

This chapter discusses the following topics:

Types of Interfaces

Interfaces can be permanent or transient, and are used for networking or services:

- Permanent interfaces—Interfaces that are always present in the routing platform.
- Transient interfaces—Interfaces that can be inserted into or removed from the routing platform depending on your network configuration needs.
- Networking interfaces—Interfaces, such as Ethernet or SONET/SDH interfaces, that primarily provide traffic connectivity.
- Services interfaces—Interfaces that provide specific capabilities for manipulating traffic before it is delivered to its destination.
- Container interfaces—Interfaces that support APS on physical SONET links using a virtual container infrastructure.

Permanent Interfaces

Each routing platform uses multiple permanent interfaces as follows:

- Management Ethernet interface—For M-series, T-series, and MX-series routing platforms, the JUNOS software automatically creates the routing platform's management Ethernet interface, fxp0. The management Ethernet interface provides an out-of-band method for connecting to the routing platform. To use fxp0 as a management port, you must configure its logical port, fxp0.0, with a valid IP address. You can connect to the management interface over the network using utilities such as ssh and telnet. Simple Network Management Protocol (SNMP) can use the management interface to gather statistics from the routing platform.
- For the J-series Services Routers, you can use any of the built-in Ethernet ports as a management interface. To use a built-in interface as a management Ethernet interface, configure it with a valid IP address. The factory configuration for the J4350 and J6350 Services Routers automatically enables the J-Web user interface on the ge-0/0/0, ge-0/0/1, ge-0/0/2, and ge-0/0/3 interfaces. To manually configure J-Web access, include the interface *interface-name* statement at the [edit system services web-management http] hierarchy level. For information about establishing basic connectivity and configuring a management port, see the *Getting Started* guide for your router.
- Internal Ethernet interface—The JUNOS software creates the internal Ethernet interface fxp1. The internal Ethernet interface connects the Routing Engine re0 (the portion of the routing platform running the JUNOS software) to the Packet Forwarding Engine. If the routing platform has redundant Routing Engines, another internal Ethernet interface, fxp2, is created on each Routing Engine (re0 and re1) in order to support fault tolerance. Two physical links between re0 and re1 connect the independent control planes. If one of the links fails, both Routing Engines can use the other link for IP communication.

The JUNOS software boots the packet forwarding component hardware. When these components are running, the control board uses the internal Ethernet interface to transmit hardware status information to the JUNOS software. Information transmitted includes the internal routing platform temperature, the condition of the fans, whether an FPC has been removed or inserted, and information from the craft interface on the LCD panel. The internal Ethernet interface is configured automatically when the JUNOS software boots.

Each routing platform also has two serial ports, labeled *console* and *auxiliary*, for connecting tty-type terminals to the routing platform using standard PC-type tty cables. Although these ports are not network interfaces, they do provide access to the routing platform.

Transient Interfaces

The M-series, MX-series, and T-series routing platforms contain slots for installing FPCs. PICs can be installed in FPCs. The number of PICs that can be installed varies by router and type of FPC. The PICs provide the actual physical interfaces to the network. The MX-series routing platforms contain slots for installing either DPC boards that provide the physical interfaces to the network or for installing FPCs in which PICs can be installed. These physical interfaces are transient interfaces of the routing platform. They are referred to as transient because you can hot-swap a DPC or FPC and its PICs at any time.

You can insert any DPC or FPC into any slot, that supports them, of the appropriate routing platform. Typically, you can place any combination of PICs, compatible with your routing platform, in any location on an FPC. (You are limited by the total FPC bandwidth, and by the fact that some PICs physically require two or four of the PIC locations on the FPC. In some cases, power limitations or microcode limitations may also apply.) To determine DPC and PIC compatibility, see the *Hardware Guide*,*DPC Guide*, and *PIC Guide* for your routing platform.

You must configure each of the transient interfaces based on the slot in which the FPC is installed, the location in which the PIC is installed, and for multiple port PICs, the port to which you are connecting.

You can configure the interfaces on PICs that are already installed in the routing platform as well as interfaces on PICs that you plan to install later. The JUNOS software detects which interfaces are actually present, so when the software activates its configuration, it activates only present interfaces and retains the configuration information for the interfaces that are not present. When the JUNOS software detects that an FPC containing PICs has been inserted into the routing platform, the software activates the configuration for those interfaces.

Services Interfaces

Services interfaces enable you to incrementally add services to your network. The JUNOS software supports the following services PICs:

- Adaptive Services (AS) PICs—Allow you to provide multiple services on a single PIC by configuring a set of services and applications. The AS PICs offer a special range of services you configure in one or more service sets.
- ES PIC—Provides a security suite for the IP version 4 (IPv4) and IP version 6 (IPv6) network layers. The suite provides functionality such as authentication of origin, data integrity, confidentiality, replay protection, and nonrepudiation of

source. It also defines mechanisms for key generation and exchange, management of security associations, and support for digital certificates.

- Monitoring Services PICs—Enable you to monitor traffic flow and export the monitored traffic. Monitoring traffic allows you to gather and export detailed information about IPv4 traffic flows between source and destination nodes in your network; sample all incoming IPv4 traffic on the monitoring interface and present the data in cflowd record format; perform discard accounting on an incoming traffic flow; encrypt or tunnel outgoing cflowd records, intercepted IPv4 traffic, or both; and direct filtered traffic to different packet analyzers and present the data in its original format. On a Monitoring Services II PIC, you can configure either monitoring interfaces or collector interfaces. A collector interface allows you to combine multiple cflowd records into a compressed ASCII data file and export the file to an FTP server.
- Multilink Services, MultiServices, Link Services, and Voice Services PICs—Enable you to split, recombine, and sequence datagrams across multiple logical data links. The goal of multilink operation is to coordinate multiple independent links between a fixed pair of systems, providing a virtual link with greater bandwidth than any of the members.
- Tunnel Services PIC—By encapsulating arbitrary packets inside a transport protocol, tunneling provides a private, secure path through an otherwise public network. Tunnels connect discontinuous subnetworks and enable encryption interfaces, virtual private networks (VPNs), and Multiprotocol Label Switching (MPLS).
- On M-series and T-series routing platforms, logical tunnel interfaces allow you to connect logical systems, virtual routers, or VPN instances. For more information about VPNs, see the *JUNOS VPNs Configuration Guide*. For more information about configuring tunnels, see the *JUNOS Services Interfaces Configuration Guide*.
- Services (J-series)—On J-series Services Routers, the lt interface is an internal interface only and is not associated with a physical medium or PIM. You can configure the logical tunnel interface to provide class-of-service (CoS) support for data link switching (DLSw) traffic and real-time performance monitoring (RPM) probe packets. For more information, see the *J-series Services Router Basic LAN and WAN Access Configuration Guide*.

NOTE: The lt interface on the J-series Services Router does not support logical systems.

Container Interfaces

Container interfaces provide the following features:

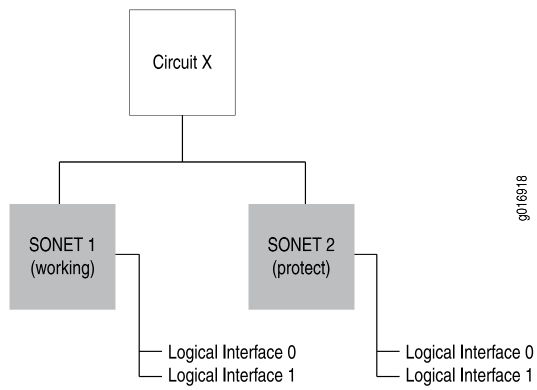
- APS on SONET links are supported using container infrastructure.
- Container physical interfaces and logical interfaces remain up on switchover.
- APS parameters are auto-copied from the container interface to the member links.

NOTE: Paired groups and true unidirectional APS are not currently supported.

Traditional APS Concept

Traditional APS is configured on two independent physical SONET interfaces: one configured as the working circuit and the other as the protect circuit (see Figure 1 on page 35). The circuit, named Circuit X in the figure, is the link between the two SONET interfaces.

Figure 1: APS Interface

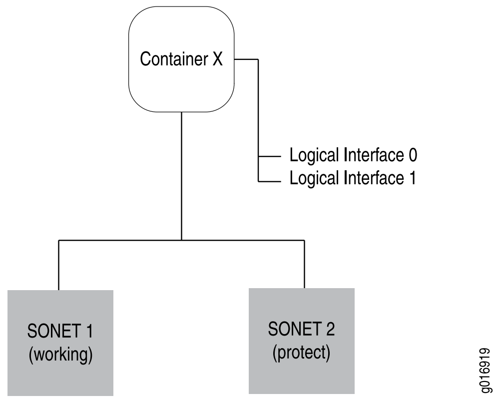


Traditional APS uses routing protocols that run on each individual SONET interface (since circuit is an abstract construct, instead of being an actual interface). When the working link goes down, the APS infrastructure brings up the protect link and its underlying logical interfaces, and brings down the working link and its underlying logical interfaces, causing the routing protocols to reconverge. This consumes time and leads to traffic loss even though the APS infrastructure has performed the switch quickly.

Container Interfaces Concept

To solve this problem, the JUNOS software provides a soft interface construct called a container interface (see Figure 2 on page 36).

Figure 2: Container Interface



The container interface allows routing protocols to run on the logical interfaces associated with a virtual *container interface* instead of on the physical SONET interfaces. When APS switches the underlying physical link based on a fault condition, the container interface remains up, and the logical interface on the container interface does not flap. The routing protocols remain unaware of the APS switching.

APS Support for Container-Based Interfaces

With the container interface, APS is configured on the container interface itself. Individual member SONET links are either marked as primary (corresponding to the working circuit) or standby (corresponding to the protect circuit) in the configuration. No circuit or group name is specified in the container interface model; physical SONET links are put in an APS group by linking them to a single container interface. APS parameters are specified at the container interface level, and are propagated to the individual SONET links by the APS daemon.

Autocopy of APS Parameters

Typical applications require copying APS parameters from the working circuit to the protect circuit, since most of the parameters must be the same for both circuits. This is automatically done in the container interface. APS parameters are specified only once under the container physical interface configuration, and are internally copied over to the individual physical SONET links.

For more information, see “Configuring Container Interfaces” on page 817.

Interface Encapsulations

Table 4 on page 37 lists encapsulation support by interface type.

Table 4: Encapsulation Support by Interface Type

Interface Type	Physical Interface Encapsulation	Logical Interface Encapsulation
ae—Aggregated Ethernet interface	ethernet-ccc—Ethernet cross-connect extended-vlan-ccc—Nonstandard TPID tagging for a cross-connect extended-vlan-vpls—Extended VLAN virtual private LAN service vlan-ccc—802.1Q tagging for a cross-connect ethernet-vpls—Ethernet virtual private LAN service vlan-vpls—VLAN virtual private LAN service	dix—Ethernet DIXv2 (RFC 894) vlan-ccc—802.1Q tagging for a cross-connect
as—Aggregated SONET/SDH interface	cisco-hdlc—Cisco-compatible HDLC framing ppp—Serial PPP device	NA
at—ATM1 interface	atm-ccc-cell-relay—ATM cell relay encapsulation for a cross-connect atm-pvc—ATM permanent virtual circuits ethernet-over-atm—Ethernet over ATM encapsulation	atm-ccc-cell-relay—ATM cell relay for CCC atm-ccc-vc-mux—ATM VC for CCC atm-cisco-nlpid—Cisco-compatible ATM NLPID encapsulation atm-nlpid—ATM NLPID encapsulation atm-snap—ATM LLC/SNAP encapsulation atm-tcc-snap—ATM LLC/SNAP for a translational cross-connect atm-tcc-vc-mux—ATM VC for a translational cross-connect atm-vc-mux—ATM VC multiplexing ether-over-atm-llc—Ethernet over ATM (LLC/SNAP) encapsulation

Table 4: Encapsulation Support by Interface Type *(continued)*

Interface Type	Physical Interface Encapsulation	Logical Interface Encapsulation
at—ATM2 intelligent queuing (IQ) interface	atm-ccc-cell-relay—ATM cell relay encapsulation for a cross-connect atm-pvc—ATM permanent virtual circuits ethernet-over-atm—Ethernet over ATM encapsulation	atm-ccc-cell-relay—ATM cell relay for CCC atm-ccc-vc-mux—ATM VC for CCC 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 a translational cross-connect atm-tcc-vc-mux—ATM VC for a translational cross-connect 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
br—Integrated Services Digital Network (ISDN) interface	NA	NA
ci—Container Interface	cisco-hdlc—Cisco-compatible HDLC framing ppp—Serial PPP device	aps—SONET interface required for APS configuration.

Table 4: Encapsulation Support by Interface Type *(continued)*

Interface Type	Physical Interface Encapsulation	Logical Interface Encapsulation
ds—DS0 interface	cisco-hdlc—Cisco-compatible HDLC framing cisco-hdlc-ccc—Cisco-compatible HDLC framing for a cross-connect cisco-hdlc-tcc—Cisco-compatible HDLC framing for a translational cross-connect extended-frame-relay-ccc—Any Frame Relay DLCI for cross-connect extended-frame-relay-tcc—Any Frame Relay DLCI for translational cross-connect flexible-frame-relay—Multiple Frame Relay encapsulations frame-relay—Frame Relay encapsulation frame-relay-ccc—Frame Relay for a cross-connect frame-relay-port-ccc—Frame Relay port encapsulation for a cross-connect frame-relay-tcc—Frame Relay for a translational cross-connect multilink-frame-relay-uni-nni—Multilink Frame Relay UNI NNI (FRF.16) encapsulation ppp—Serial PPP device ppp-ccc—Serial PPP device for a cross-connect ppp-tcc—Serial PPP device for a translational cross-connect	frame-relay-ccc—Frame Relay DLCI for CCC frame-relay-ppp—PPP over Frame Relay frame-relay-tcc—Frame Relay DLCI for a translational cross-connect
dsc—Discard interface	NA	NA

Table 4: Encapsulation Support by Interface Type *(continued)*

Interface Type	Physical Interface Encapsulation	Logical Interface Encapsulation
e1—E1 interface (including channelized STM1-to-E1 interfaces)	cisco-hdlc—Cisco-compatible HDLC framing cisco-hdlc-ccc—Cisco-compatible HDLC framing for a cross-connect cisco-hdlc-tcc—Cisco-compatible HDLC framing for a translational cross-connect extended-frame-relay-ccc—Any Frame Relay DLCI for a cross-connect extended-frame-relay-tcc—Any Frame Relay DLCI for a translational cross-connect flexible-frame-relay—Multiple Frame Relay encapsulations frame-relay—Frame Relay encapsulation frame-relay-ccc—Frame Relay for a cross-connect frame-relay-port-ccc—Frame Relay port encapsulation for a cross-connect frame-relay-tcc—Frame Relay for a translational cross-connect multilink-frame-relay-uni-nni—Multilink Frame Relay UNI NNI (FRF.16) encapsulation ppp—Serial PPP device ppp-ccc—Serial PPP device for a cross-connect ppp-tcc—Serial PPP device for a translational cross-connect	frame-relay-ccc—Frame Relay DLCI for CCC frame-relay-ppp—PPP over Frame Relay frame-relay-tcc—Frame Relay DLCI for a translational cross-connect

Table 4: Encapsulation Support by Interface Type *(continued)*

Interface Type	Physical Interface Encapsulation	Logical Interface Encapsulation
e3—E3 interface (including E3 IQ and IQE interfaces)	cisco-hdlc—Cisco-compatible HDLC framing cisco-hdlc-ccc—Cisco-compatible HDLC framing for a cross-connect cisco-hdlc-tcc—Cisco-compatible HDLC framing for a translational cross-connect extended-frame-relay-ccc—Any Frame Relay DLCI for a cross-connect extended-frame-relay-tcc—Any Frame Relay DLCI for a translational cross-connect flexible-frame-relay—Multiple Frame Relay encapsulations frame-relay—Frame Relay encapsulation frame-relay-ccc—Frame Relay for a cross-connect frame-relay-port-ccc—Frame Relay port encapsulation for a cross-connect frame-relay-tcc—Frame Relay for a translational cross-connect ppp—Serial PPP device ppp-ccc—Serial PPP device for a cross-connect ppp-tcc—Serial PPP device for a translational cross-connect	frame-relay-ccc—Frame Relay DLCI for CCC frame-relay-ppp—PPP over Frame Relay frame-relay-tcc—Frame Relay DLCI for a translational cross-connect

Table 4: Encapsulation Support by Interface Type *(continued)*

Interface Type	Physical Interface Encapsulation	Logical Interface Encapsulation
fe—Fast Ethernet interface	ethernet-ccc—Ethernet cross-connect ethernet-tcc—Ethernet translational cross-connect ethernet-vpls—Ethernet virtual private LAN service extended-vlan-ccc—Nonstandard TPID tagging for a cross-connect extended-vlan-tcc—802.1Q tagging for a translational cross-connect extended-vlan-vpls—Extended VLAN virtual private LAN service vlan-ccc—802.1Q tagging for a cross-connect vlan-vpls—VLAN virtual private LAN service	dix—Ethernet DIXv2 (RFC 894) vlan-ccc—802.1Q tagging for a cross-connect vlan-vpls—VLAN virtual private LAN service
fxp—Management and internal Ethernet interfaces	NA	NA
ge—Gigabit Ethernet interface (including Gigabit Ethernet IQ interfaces)	ethernet-ccc—Ethernet cross-connect ethernet-tcc—Ethernet translational cross-connect ethernet-vpls—Ethernet virtual private LAN service extended-vlan-ccc—Nonstandard TPID tagging for a cross-connect extended-vlan-tcc—802.1Q tagging for a translational cross-connect extended-vlan-vpls—Extended VLAN virtual private LAN service flexible-ethernet-services—Allows per-unit Ethernet encapsulation configuration vlan-ccc—802.1Q tagging for a cross-connect vlan-vpls—VLAN virtual private LAN service	dix—Ethernet DIXv2 (RFC 894) vlan-ccc—802.1Q tagging for a cross-connect vlan-tcc—802.1Q tagging for a translational cross-connect vlan-vpls—VLAN virtual private LAN service
lo—Loopback interface; the JUNOS software automatically configures one loopback interface (lo0)	NA	NA

Table 4: Encapsulation Support by Interface Type *(continued)*

Interface Type	Physical Interface Encapsulation	Logical Interface Encapsulation
ls—Link services interface	multilink-frame-relay-uni-nni—Multilink Frame Relay UNI NNI (FRF.16) encapsulation	multilink-frame-relay-end-to-end—Multilink Frame Relay end-to-end (FRF.15) multilink-ppp—Multilink PPP
lsq—Link services IQ interface	multilink-frame-relay-uni-nni—Multilink Frame Relay UNI NNI (FRF.16) encapsulation	multilink-frame-relay-end-to-end—Multilink Frame Relay end-to-end (FRF.15) multilink-ppp—Multilink PPP
lt—Logical tunnel interface	NA	ethernet—Ethernet service ethernet-vpls—Ethernet virtual private LAN service ethernet-ccc—Ethernet cross-connect frame-relay—Frame Relay encapsulation frame-relay-ccc—Frame Relay for a cross-connect vlan—VLAN service vlan-ccc—802.1Q tagging for a cross-connect vlan-vpls—VLAN virtual private LAN service
ml—Multilink interface (including Multilink Frame Relay and MLPPP)	NA	multilink-frame-relay-end-to-end—Multilink Frame Relay end-to-end (FRF.15) multilink-ppp—Multilink PPP

Table 4: Encapsulation Support by Interface Type *(continued)*

Interface Type	Physical Interface Encapsulation	Logical Interface Encapsulation
se—Serial interface (including EIA-530, V.35, and X.21 interfaces)	cisco-hdlc—Cisco-compatible HDLC framing cisco-hdlc-ccc—Cisco-compatible HDLC framing for a cross-connect cisco-hdlc-tcc—Cisco-compatible HDLC framing for a translational cross-connect frame-relay—Frame Relay encapsulation frame-relay-ccc—Frame Relay for a cross-connect frame-relay-port-ccc—Frame Relay port encapsulation for a cross-connect frame-relay-tcc—Frame Relay for a translational cross-connect ppp—Serial PPP device ppp-ccc—Serial PPP device for a cross-connect ppp-tcc—Serial PPP device for a translational cross-connect	frame-relay-ccc—Frame Relay DLCI for CCC frame-relay-ppp—PPP over Frame Relay frame-relay-tcc—Frame Relay DLCI for a translational cross-connect

Table 4: Encapsulation Support by Interface Type *(continued)*

Interface Type	Physical Interface Encapsulation	Logical Interface Encapsulation
so—SONET/SDH interface	cisco-hdlc—Cisco-compatible HDLC framing cisco-hdlc-ccc—Cisco-compatible HDLC framing for a cross-connect cisco-hdlc-tcc—Cisco-compatible HDLC framing for a translational cross-connect extended-frame-relay-ccc—Any Frame Relay DLCI for a cross-connect extended-frame-relay-tcc—Any Frame Relay DLCI for a translational cross-connect flexible-frame-relay—Multiple Frame Relay encapsulations frame-relay—Frame Relay encapsulation frame-relay-ccc—Frame Relay for a cross-connect frame-relay-port-ccc—Frame Relay port encapsulation for a cross-connect frame-relay-tcc—Frame Relay for a translational cross-connect ppp—Serial PPP device ppp-ccc—Serial PPP device for a cross-connect ppp-tcc—Serial PPP device for a translational cross-connect	frame-relay-ccc—Frame Relay DLCI for CCC frame-relay-ppp—PPP over Frame Relay frame-relay-tcc—Frame Relay DLCI for a translational cross-connect multilink-frame-relay-end-to-end—IQE SONET PICs support Multilink Frame Relay end-to-end (FRF.15) multilink-ppp—IQE SONET PICs support Multilink PPP

Table 4: Encapsulation Support by Interface Type *(continued)*

Interface Type	Physical Interface Encapsulation	Logical Interface Encapsulation
t1—T1 interface (including channelized DS3-to-DS1 interfaces)	cisco-hdlc—Cisco-compatible HDLC framing cisco-hdlc-ccc—Cisco-compatible HDLC framing for a cross-connect cisco-hdlc-tcc—Cisco-compatible HDLC framing for a translational cross-connect extended-frame-relay-ccc—Any Frame Relay DLCI for a cross-connect extended-frame-relay-tcc—Any Frame Relay DLCI for a translational cross-connect flexible-frame-relay—Multiple Frame Relay encapsulations frame-relay—Frame Relay encapsulation frame-relay-ccc—Frame Relay for a cross-connect frame-relay-port-ccc—Frame Relay port encapsulation for a cross-connect frame-relay-tcc—Frame Relay for a translational cross-connect multilink-frame-relay-uni-nni—Multilink Frame Relay UNI NNI (FRF.16) encapsulation ppp—Serial PPP device ppp-ccc—Serial PPP device for a cross-connect ppp-tcc—Serial PPP device for a translational cross-connect	frame-relay-ccc—Frame Relay DLCI for CCC frame-relay-ppp—PPP over Frame Relay frame-relay-tcc—Frame Relay DLCI for a translational cross-connect

Table 4: Encapsulation Support by Interface Type *(continued)*

Interface Type	Physical Interface Encapsulation	Logical Interface Encapsulation
t3—T3 interface (including channelized OC12-to-DS3 interfaces)	cisco-hdlc—Cisco-compatible HDLC framing cisco-hdlc-ccc—Cisco-compatible HDLC framing for a cross-connect cisco-hdlc-tcc—Cisco-compatible HDLC framing for a translational cross-connect extended-frame-relay-ccc—Any Frame Relay DLCI for a cross-connect extended-frame-relay-tcc—Any Frame Relay DLCI for a translational cross-connect flexible-frame-relay—Multiple Frame Relay encapsulations frame-relay—Frame Relay encapsulation frame-relay-ccc—Frame Relay for a cross-connect frame-relay-port-ccc—Frame Relay port encapsulation for a cross-connect frame-relay-tcc—Frame Relay for a translational cross-connect ppp—Serial PPP device ppp-ccc—Serial PPP device for a cross-connect ppp-tcc—Serial PPP device for a translational cross-connect	frame-relay-ccc—Frame Relay DLCI for CCC frame-relay-ppp—PPP over Frame Relay frame-relay-tcc—Frame Relay DLCI for a translational cross-connect
Controller-level channelized IQ interfaces (cau4, coc1, coc3, coc12, cstm1, ct1, ct3, ce1)	NA	NA
Services interfaces (cp, gr, ip, mo, vt, es, mo, rsp, sp)	NA	NA
Unconfigurable, internally generated interfaces (gre, ipip, learning-chip (lc), lsi, tap, mt, mtun, pd, pe, pimd, pime)	NA	NA

Interface Descriptors

When you configure an interface, you are effectively specifying the properties for a physical interface descriptor. In most cases, the physical interface descriptor corresponds to a single physical device and consists of the following parts:

- The interface name, which defines the media type
- The slot in which the FPC or DPC is located
- The location on the FPC in which the PIC is installed
- The PIC or DPC port
- The interface's channel and logical unit numbers (optional)

Each physical interface descriptor can contain one or more logical interface descriptors. These allow you to map one or more logical (or virtual) interfaces to a single physical device. Creating multiple logical interfaces is useful for ATM, Frame Relay, and Gigabit Ethernet networks, in which you can associate multiple virtual circuits, data-link connections, or virtual LANs (VLANs) with a single interface device.

Each logical interface descriptor can have one or more family descriptors to define the protocol family that is associated with and allowed to run over the logical interface.

The following protocol families are supported:

- Internet Protocol version 4 (IPv4) suite (inet)
- Internet Protocol version 6 (IPv6) suite (inet6)
- Circuit cross-connect (CCC)
- Translational cross-connect (TCC)
- International Organization for Standardization (ISO)
- Multilink Frame Relay end-to-end (MLFR end-to-end)
- Multilink Frame Relay user-to-network interface network-to-network interface (MLFR UNI NNI)
- Multilink Point-to-Point Protocol (MLPPP)
- Multiprotocol Label Switching (MPLS)
- Trivial Network Protocol (TNP)
- (M-series, T-series, and MX-series routing platforms only) Virtual private LAN service (VPLS)

Finally, each family descriptor can have one or more address entries, which associate a network address with a logical interface and hence with the physical interface.

You configure the various interface descriptors as follows:

- You configure the physical interface descriptor by including the interfaces *interface-name* statement.
- You configure the logical interface descriptor by including the unit statement within the interfaces *interface-name* statement or by including the .*logical* descriptor at the end of the interface name, as in t3-0/0/0.1, where the logical unit number is 1, as shown in the following examples:

```
[edit]
user@host# set interfaces t3-0/0/0 unit 1
[edit]
user@host# edit interfaces t3-0/0/0.1
[edit interfaces t3-0/0/0]
user@host# set unit 1
```

- You configure the family descriptor by including the family statement within the unit statement.
- You configure address entries by including the address statement within the family statement.
- You configure tunnels by including the tunnel statement within the unit statement.

Interface Naming

Each interface has an interface name, which specifies the media type, the slot in which the FPC or DPC is located, the location on the FPC where the PIC is installed, and the PIC or DPC port. The interface name uniquely identifies an individual network connector in the system. You use the interface name when configuring interfaces and when enabling various functions and properties, such as routing protocols, on individual interfaces. The system uses the interface name when displaying information about the interface, for example, in the show interfaces command.

The interface name is represented by a physical part, a channel part, and a logical part in the following format:

```
physical<:channel>.logical
```

The channel part of the name is optional for all interfaces except channelized DS3, E1, OC12, and STM1 interfaces.

The following sections provide interface naming configuration guidelines:

Physical Part of an Interface Name

The physical part of an interface name identifies the physical device, which corresponds to a single physical network connector. This part of the interface name has the following format:

type-fpc/pic/port

type is the media type, which identifies the network device where it can be one of the following:

- ae—Aggregated Ethernet interface. This is a virtual aggregated link and has a different naming format from most PICs; for more information, see "Configuring Aggregated Ethernet Interfaces" on page 593.
- as—Aggregated SONET/SDH interface. This is a virtual aggregated link and has a different naming format from most PICs; for more information, see "Configuring Aggregated SONET/SDH Interfaces" on page 835.
- at—ATM1 or ATM2 intelligent queuing (IQ) interface.
- br—Integrated Services Digital Network (ISDN) interface (configured on a 1-port or 4-port Basic Rate Interface (BRI) card). This interface has a different naming format from most PICs: br-*pim*/0/*port*. The second number is always 0. For more information, see "Configuring ISDN Physical Interface Properties" on page 775.
- cau4—Channelized AU-4 IQ interface (configured on the Channelized STM1 IQ or IQE PIC or Channelized OC12 IQ and IQE PICs).
- ce1—Channelized E1 IQ interface (configured on the Channelized E1 IQ PIC or Channelized STM1 IQ or IQE PIC).
- ci—Container interface.
- coc1—Channelized OC1 IQ interface (configured on the Channelized OC12 IQ and IQE or Channelized OC3 IQ and IQE PICs).
- coc3—Channelized OC3 IQ interface (configured on the Channelized OC3 IQ and IQE PICs).
- coc12—Channelized OC12 IQ interface (configured on the Channelized OC12 IQ and IQE PICs).
- coc48—Channelized OC48 interface (configured on the Channelized OC48 and Channelized OC48 IQE PICs).
- cp—Collector interface (configured on the Monitoring Services II PIC).
- cstm1—Channelized STM1 IQ interface (configured on the Channelized STM1 IQ or IQE PIC).
- cstm4—Channelized STM4 IQ interface (configured on the Channelized OC12 IQ and IQE PICs).
- cstm16—Channelized STM16 IQ interface (configured on the Channelized OC48/STM16 and Channelized OC48/STM16 IQE PICs).

- ct1—Channelized T1 IQ interface (configured on the Channelized DS3 IQ and IQE PICs, Channelized OC3 IQ and IQE PICs, Channelized OC12 IQ and IQE PICs, or Channelized T1 IQ PIC).
- ct3—Channelized T3 IQ interface (configured on the Channelized DS3 IQ and IQE PICs, Channelized OC3 IQ and IQE PICs, or Channelized OC12 IQ and IQE PICs).
- demux—Interface that supports logical IP interfaces that use the IP source or destination address to demultiplex received packets. Only one demux interface (demux0) exists per chassis. All demux logical interfaces must be associated with an underlying logical interface.
- dfc—Interface that supports dynamic flow capture processing on T-series or M320 routing platforms containing one or more Monitoring Services III PICs. Dynamic flow capture enables you to capture packet flows on the basis of dynamic filtering criteria. Specifically, you can use this feature to forward passively monitored packet flows that match a particular filter list to one or more destinations using an on-demand control protocol.
- ds—DS0 interface (configured on the Multichannel DS3 PIC, Channelized E1 PIC, Channelized OC3 IQ and IQE PICs, Channelized OC12 IQ and IQE PICs, Channelized DS3 IQ and IQE PICs, Channelized E1 IQ PIC, Channelized STM1 IQ or IQE PIC, or Channelized T1 IQ).
- dsc—Discard interface.
- e1—E1 interface (including channelized STM1-to-E1 interfaces).
- e3—E3 interface (including E3 IQ interfaces).
- es—Encryption interface.
- fe—Fast Ethernet interface.
- fxp—Management and internal Ethernet interfaces. The JUNOS software automatically configures the routing platform's management Ethernet interface, fxp0, which is an out-of-band management interface, and the internal Ethernet interface, fxp1, which connects the Routing Engine with the routing platform's packet forwarding components. If the routing platform has redundant Routing Engines, another internal Ethernet interface, fxp2, is created on each Routing Engine (re0 and re1) in order to support fault tolerance. Two physical links between re0 and re1 connect the independent control planes. If one of the links fails, both Routing Engines can use the other link for IP communication.
- ge—Gigabit Ethernet interface. Some older 10-Gigabit Ethernet interfaces use the ge media type to identify the physical part of the network device, but newer 10-Gigabit Ethernet interfaces use the xe media type.
- gr—Generic routing encapsulation (GRE) tunnel interface.
- gre—Internally generated interface that is configurable only as the control channel for Generalized MPLS (GMPLS). For more information about GMPLS, see the *JUNOS MPLS Applications Configuration Guide* and the *JUNOS Feature Guide*.
- ip—IP-over-IP encapsulation tunnel interface.
- ipip—Internally generated interface that is not configurable.
- lc—Internally generated interface that is not configurable.

- lo—Loopback interface. The JUNOS software automatically configures one loopback interface (lo0). The logical interface lo0.16383 is a nonconfigurable interface for routing platform control traffic.
- ls—Link services interface.
- lsi—Internally generated interface that is not configurable.
- ml—Multilink interface (including Multilink Frame Relay and MLPPP).
- mo—Monitoring services interface (including monitoring services and monitoring services II). The logical interface mo-*fpc/pic/port*.16383 is an internally generated, nonconfigurable interface for routing platform control traffic.
- mt—Multicast tunnel interface (internal routing platform interface for VPNs). If your routing platform has a Tunnel PIC, the JUNOS software automatically configures one multicast tunnel interface (mt) for each virtual private network (VPN) you configure. Although it is not necessary to configure multicast interfaces, you can use the multicast-only statement to configure the unit and family so that the tunnel can transmit and receive multicast traffic only. For more information, see multicast-only.
- mtun—Internally generated interface that is not configurable.
- oc3—OC3 IQ interface (configured on the Channelized OC12 IQ and IQE PICs or Channelized OC3 IQ and IQE PICs).
- pd—Interface on the rendezvous point (RP) that de-encapsulates packets.
- pe—Interface on the first-hop RP that encapsulates packets destined for the RP routing platform.
- pimd—Internally generated interface that is not configurable.
- pime—Internally generated interface that is not configurable.
- rlsq—Container interface, numbered from 0 through 127, used to tie the primary and secondary LSQ PICs together in high availability configurations. Any failure of the primary PIC results in a switch to the secondary PIC and vice versa.
- rsp—Redundant interface for the adaptive services interface.
- se—Serial interface (including EIA-530, V.35, and X.21 interfaces).
- so—SONET/SDH interface.
- sp—Adaptive services interface. The logical interface sp-*fpc/pic/port*.16383 is an internally generated, nonconfigurable interface for routing platform control traffic.
- stm1—STM1 interface (configured on the OC3/STM1 interfaces).
- stm4—STM4 interface (configured on the OC12/STM4 interfaces).
- stm16—STM16 interface (configured on the OC48/STM16 interfaces).
- t1—T1 interface (including channelized DS3-to-DS1 interfaces).
- t3—T3 interface (including channelized OC12-to-DS3 interfaces).
- tap—Internally generated interface that is not configurable.
- umd—USB modem interface.

- vsp—Voice services interface.
- vc4—Virtually concatenated interface.
- vt—Virtual loopback tunnel interface.
- xe—10-Gigabit Ethernet interface. Some older 10-Gigabit Ethernet interfaces use the ge media type (rather than xe) to identify the physical part of the network device.
- xt—Logical interface for Protected System Domains to establish a Layer 2 tunnel connection.

fpc identifies the number of the FPC or DPC card on which the physical interface is located. Specifically, it is the number of the slot in which the card is installed.

M40, M40e, M160, M320, M120, T320, T640, and T1600 platforms each have eight FPC slots that are numbered 0 through 7, from left to right as you are facing the front of the chassis. For information about compatible FPCs and PICs, see the *Hardware Guide* for your router.

The M20 routing platform has four FPC slots that are numbered 0 through 3, from top to bottom as you are facing the front of the chassis. The slot number is printed adjacent to each slot.

MX-series routing platforms support DPCs and FPCs. Each FPC occupies two DPC slots and combinations are permitted. The MX960 router has slots that support up to 12 DPCs or up to 6 FPCs (without redudant SCB) or 5 FPCs (with redundant SCB). The MX480 router has slots that support up to three FPCs. The MX240 router has slots that support up to three DPCs or one FPC. FPCs use the lower DPC slot number for FPC slot numbering. For information about compatible FPCs and PICs, see the *MX-series PIC Guide*. For information about DPCs, see the *MX-series DPC Guide*.

MX-series routing platforms support Type 2 and Type 3 FPCs. On MX-series platforms, the Type 2 and Type 3 FPCs support Type 2 and Type 3 SONET/SDH PICs, respectively. Type 1 PICs are not supported on MX-series platforms. For a complete list of supported PICs, see the *MX-series Hardware Guide*.

For M5, M7i, M10, and M10i routing platforms, the FPCs are built into the chassis; you install the PICs into the chassis.

The M5 and M7i routing platforms have space for up to four PICs. The M7i routing platform also comes with an integrated Tunnel PIC, or an optional integrated AS PIC, or optional integrated MS PIC.

The M10 and M10i routing platforms have space for up to eight PICs.

A routing matrix can have up to 32 FPCs (numbered 0 through 31).

For more information about interface naming for a routing matrix, see "Interface Naming for a Routing Matrix" on page 55.

pic identifies the number of the PIC on which the physical interface is located. Specifically, it is the number of the PIC location on the FPC. FPCs with four PIC slots are numbered 0 through 3. FPCs with three PIC slots are numbered 0 through 2. The

PIC location is printed on the FPC carrier board. For PICs that occupy more than one PIC slot, the lower PIC slot number identifies the PIC location.

port identifies a specific port on a PIC or DPC. The number of ports varies depending on the PIC. The port numbers are printed on the PIC.

Logical Part of an Interface Name

The logical unit part of the interface name corresponds to the logical unit number, which can be a number from 0 through 16384.

Separators in an Interface Name

There is a separator between each element of an interface name.

In the physical part of the name, a hyphen (-) separates the media type from the FPC number, and a slash (/) separates the FPC, PIC, and port numbers.

In the virtual part of the name, a period (.) separates the channel and logical unit numbers.

A colon (:) separates the physical and virtual parts of the interface name.

Channel Part of an Interface Name

The channel identifier part of the interface name is required only on channelized interfaces. For channelized interfaces, channel 0 identifies the first channelized interface. For channelized IQ and channelized IQE interfaces, channel 1 identifies the first channelized interface. A nonconcatenated (that is, channelized) SONET/SDH OC48 interface has four OC12 channels, numbered 0 through 3.

To determine which types of channelized PICs are currently installed in the routing platform, use the show chassis hardware command from the top level of the command-line interface (CLI). Channelized IQ and IQE PICs are listed in the output with "intelligent queuing IQ" or "enhanced intelligent queuing IQE" in the description. For more information, see "Channelized Interfaces" on page 371.

For ISDN interfaces, you specify the B-channel in the form bc-*pim*/0/*port*:*n*. *n* is the B-channel ID and can be 1 or 2. You specify the D-channel in the form dc-*pim*/0/*port*:0.

NOTE: For ISDN, the B- and D-channel interfaces do not have any configurable parameters. However, when interface statistics are displayed, B- and D-channel interfaces have statistical values.

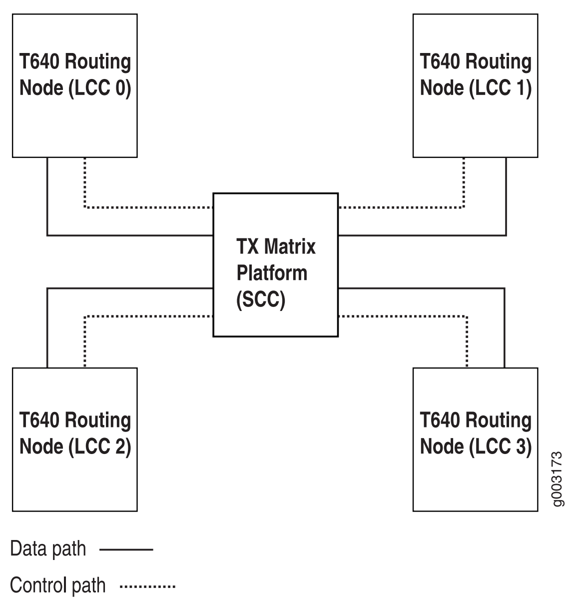
NOTE: In the JUNOS software implementation, the term *logical interfaces* generally refers to interfaces you configure by including the unit statement at the [edit interfaces *interface-name*] hierarchy level. Logical interfaces have the *.logical* descriptor at the end of the interface name, as in ge-0/0/0.1 or t1-0/0/0:0.1, where the logical unit number is 1.

Although channelized interfaces are generally thought of as logical or virtual, the JUNOS software sees T3, T1, and NxDS0 interfaces within a channelized IQ or IQE PIC as physical interfaces. For example, both t3-0/0/0 and t3-0/0/0:1 are treated as physical interfaces by the JUNOS software. In contrast, t3-0/0/0.2 and t3-0/0/0:1.2 are considered logical interfaces because they have the .2 at the end of the interface names.

Interface Naming for a Routing Matrix

A routing matrix is a multichassis architecture composed of one TX Matrix platform, to which you can connect from one to four T640 routing nodes, as shown in Figure 3 on page 55.

Figure 3: Routing Matrix



A TX Matrix platform is also referred to as a *switch-card chassis* (SCC). The CLI uses scc to refer to the TX Matrix platform. A T640 routing node in a routing matrix is also referred to as a *line-card chassis* (LCC). The CLI uses lcc as a prefix to refer to a specific T640 routing node.

LCCs are assigned numbers, 0 through 3, depending on the hardware setup and connectivity to the TX Matrix platform. For more information, see the *TX Matrix Platform Hardware Guide*. A routing matrix can have up to four T640 routing nodes, and each T640 routing node has up to eight FPCs. Therefore, the routing matrix as a whole can have up to 32 FPCs (0 through 31).

In the JUNOS CLI, an interface name has the following format:

type-fpc/pic/port

When you specify the *fpc* number, the JUNOS software determines which T640 routing node contains the specified FPC based on the following assignment:

- On LCC 0, FPC hardware slots 0 through 7 are configured as 0 through 7.
- On LCC 1, FPC hardware slots 0 through 7 are configured as 8 through 15.
- On LCC 2, FPC hardware slots 0 through 7 are configured as 16 through 23.
- On LCC 3, FPC hardware slots 0 through 7 are configured as 24 through 31.

For example, the 1 in se-1/0/0 refers to FPC hardware slot 1 on the T640 routing node labeled lcc0. The 11 in t1-11/2/0 refers to FPC hardware slot 3 on the T640 routing node labeled lcc1. The 20 in so-20/0/1 refers to FPC hardware slot 4 on the T640 routing node labeled lcc2. The 31 in t3-31/1/0 refers to FPC hardware slot 7 on the T640 routing node labeled lcc3.

Table 5 on page 56 summarizes the FPC numbering for a routing matrix.

Table 5: FPC Numbering for T640 Routing Nodes in a Routing Matrix

LCC Numbers Assigned to the T640 Routing Nodes	Configuration Numbers
0	0 through 7
1	8 through 15
2	16 through 23
3	24 through 31

Table 6 on page 56 lists each FPC hardware slot and the corresponding configuration numbers for LCCs 0 through 3.

Table 6: One-to-One FPC Numbering for T640 Routing Nodes in a Routing Matrix

FPC Numbering	T640 Routing Nodes							
	LCC 0							
Hardware Slots	0	1	2	3	4	5	6	7
Configuration Numbers	0	1	2	3	4	5	6	7
	LCC 1							
Hardware Slots	0	1	2	3	4	5	6	7

Table 6: One-to-One FPC Numbering for T640 Routing Nodes in a Routing Matrix *(continued)*

FPC Numbering	T640 Routing Nodes							
Configuration Numbers	8	9	10	11	12	13	14	15
	LCC 2							
Hardware Slots	0	1	2	3	4	5	6	7
Configuration Numbers	16	17	18	19	20	21	22	23
	LCC 3							
Hardware Slots	0	1	2	3	4	5	6	7
Configuration Numbers	24	25	26	27	28	29	30	31

Chassis Interface Naming

You configure some PIC properties, such as framing, at the [edit chassis] hierarchy level. Chassis interface naming varies depending on the routing hardware. For standalone routing platforms, you must specify the FPC and PIC numbers.

For routing matrixes, you must specify the LCC, FPC, and PIC numbers, as follows:

- Standalone routing platform interface naming:

```
[edit chassis]
fpc slot-number {
    pic pic-number {
        ...
    }
}
```

- Routing matrix interface naming:

```
[edit chassis]
lcc lcc-number {
    fpc slot-number { # Use the hardware FPC slot number
    pic pic-number {
        ...
    }
}
```

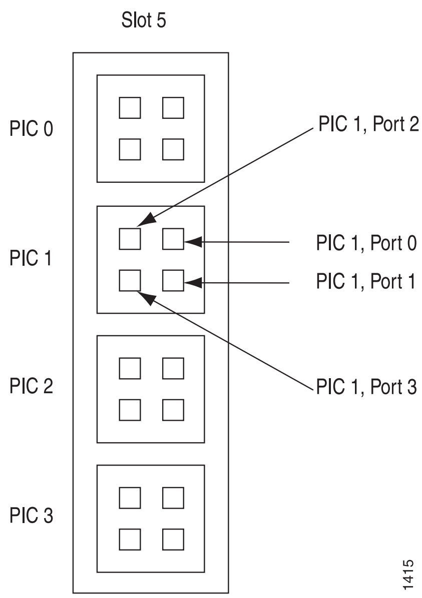
For the FPC slot number, specify the actual hardware slot number, as labeled on the T640 routing node chassis. Do not use the corresponding software FPC configuration numbers shown in Table 6 on page 56.

For more information about the [edit chassis] hierarchy, see the *JUNOS System Basics Configuration Guide*.

Examples: Interface Naming

This section provides examples of naming interfaces. For an illustration of where slots, PICs, and ports are located, see Figure 4 on page 58.

Figure 4: Interface Slot, PIC, and Port Locations



For an FPC in slot 1 with two OC3 SONET/SDH PICs in PIC positions 0 and 1, each PIC with two ports uses the following names:

```
so-1/0/0.0
so-1/0/1.0
so-1/1/0.0
so-1/1/1.0
```

An OC48 SONET/SDH PIC in slot 1 and in concatenated mode appears as a single FPC with a single PIC, which has a single port. If this interface has a single logical unit, it has the following name:

```
so-1/0/0.0
```

An OC48 SONET/SDH PIC in slot 1 and in channelized mode has a number for each channel. For example:

```
so-1/0/0:0
so-1/0/0:1
```

For an FPC in slot 1 with a Channelized OC12 PIC in PIC position 2, the DS3 channels have the following names:

```
t3-1/2/0:0
t3-1/2/0:1
```

t3-1/2/0:2
...
t3-1/2/0:11

For an FPC in slot 1 with four OC12 ATM PICs (the FPC is fully populated), the four PICs, each with a single port and a single logical unit, have the following names:

at-1/0/0.0
at-1/1/0.0
at-1/2/0.0
at-1/3/0.0

In a routing matrix on the T640 routing node labeled lcc1, for an FPC in slot 5 with four SONET OC192 PICs, the four PICs, each with a single port and a single logical unit, have the following names:

so-13/0/0.0
so-13/1/0.0
so-13/2/0.0
so-13/3/0.0

For an FPC in slot 1 with one 4-port BRI interface card, port 4 has the following name:

br-1/0/4

The first B channel, the second B channel, and the control channel have the following names:

bc-1/0/4:1
bc-1/0/4:2
dc-1/0/4:0

Displaying Interface Configurations

To display a configuration, use either the show command in configuration mode or the show configuration top-level command. Interfaces are listed in numerical order, from lowest to highest slot number, then from lowest to highest PIC number, and finally from lowest to highest port number.

Interface and Router Clock Sources

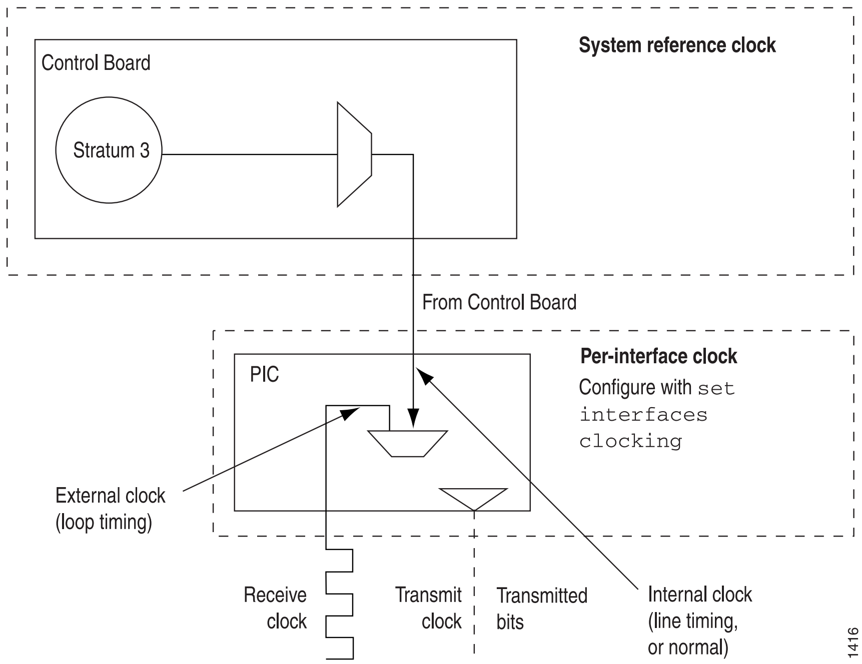
When configuring the routing platform, you can configure the *transmit clock* on each interface; the transmit clock aligns each outgoing packet transmitted over the routing platform's interfaces. For both the routing platform and interfaces, the clock source can be the routing platform's internal Stratum 3 clock, which resides on the control board, or an external clock that is received from the interface you are configuring. For example, interface A can transmit on interface A's received clock (external, loop timing) or the Stratum 3 clock (internal, line timing). Interface A cannot use a clock from any other source.

By default, each interface uses the routing platform's internal Stratum 3 clock. To configure the clock source of each interface, include the clocking statement at the [edit interfaces *interface-name*] hierarchy level:

[edit interfaces *interface-name*]
clocking (internal | external);

Figure 5 on page 60 illustrates the different clock sources.

Figure 5: Clock Sources



Configuring an External Synchronization Interface

The M-series 320 routing platform supports an external synchronization interface that can be configured to synchronize the internal Stratum 3 clock to an external source, and then synchronize the chassis interface clock to the external source.

This feature can be configured for external primary and secondary interfaces that use Building Integrated Timing System (BITS) or SDH Equipment Timing Source (SETS) timing sources. When internal timing is set for SONET/SDH, Plesiochronous Digital Hierarchy (PDH), and digital hierarchy (DS1) interfaces on the Physical Interface Cards (PICs), the transmit clock of the interface is synchronized to BITS/SETS timing and traceable to timing within the network.

To configure external synchronization on the M-series 320 router, include the synchronization statement at the [edit chassis] hierarchy level.

For more information about the external synchronization interface, see the *JUNOS System Basics Configuration Guide*.

Chapter 3

Configuring Physical Interface Properties

The software driver for each network media type sets reasonable default values for general interface properties, such as the interface's maximum transmission unit (MTU) size, receive and transmit leaky bucket properties, link operational mode, and clock source.

This chapter discusses configuration of the following physical interface properties:

Physical Interface Configuration Statements

M-series, MX-series, T-series, and J-series routers are factory configured according to the specific router, its features, and its physical interfaces. This section includes a default configuration example showing the statements used to configure the physical interfaces properties. Additional statements are used to set properties for specific interface types and are described in "Physical Interfaces Properties Statements List" on page 71.

To modify any of the default general interface properties, include the appropriate statements at the [edit interfaces *interface-name*] hierarchy level:

```
interfaces {
  traceoptions {
    file filename <files number> <match regular-expression> <size size>
      <world-readable | no-world-readable>;
    flag flag <disable>;
  }
  interface-name {
    accounting-profile name;
    aggregated-ether-options {
      (flow-control | no-flow-control);
      lacp {
        (active | passive);
        link-protection{
          disable;
        (revertive | non-revertive);
        periodic interval;
        system-priority priority;
      }
      link-protection;
      link-speed speed;
      (loopback | no-loopback);
      minimum-links number;
      source-address-filter {
        mac-address
      }
      (source-filtering | no-source-filtering);
    }
    aggregated-sonet-options {
      link-speed speed | mixed;
      minimum-links number;
    }
    atm-options {
      cell-bundle-size cells;
      ilmi;
      linear-red-profiles profile-name {
        high-plp-max-threshold percent;
```

```
        low-plp-max-threshold percent;
        queue-depth cells high-plp-threshold percent low-plp-threshold percent;
    }
    mpls {
        pop-all-labels {
            required-depth number;
        }
    }
    pic-type (atm1 | atm2);
    plp-to-clp;
    promiscuous-mode {
        vpi vpi-identifier;
    }
    scheduler-maps map-name {
        forwarding-class class-name {
            epd-threshold cells plp1 cells;
            linear-red-profile profile-name;
            priority (high | low);
            transmit-weight (cells number | percent number);
        }
        vc-cos-mode (alternate | strict);
    }
    vpi vpi-identifier {
        maximum-vcs maximum-vcs;
        oam-liveness {
            up-count cells;
            down-count cells;
        }
        oam-period (seconds | disable);
        shaping {
            (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate
                sustained rate burst length);
            queue-length number;
        }
    }
}
clocking clock-source;
data-input (system | interface interface-name);
dce;
serial-options {
    clock-rate rate;
    clocking-mode (dce | internal | loop);
    control-polarity (negative | positive);
    cts-polarity (negative | positive);
    dcd-polarity (negative | positive);
    dce-options {
        control-signal (assert | de-assert | normal);
        cts (ignore | normal | require);
        dcd (ignore | normal | require);
        dsr (ignore | normal | require);
        dtr signal-handling-option;
        ignore-all;
        indication (ignore | normal | require);
        rts (assert | de-assert | normal);
        tm (ignore | normal | require);
    }
```

```
    dsr-polarity (negative | positive);
    dte-options {
        control-signal (assert | de-assert | normal);
        cts (ignore | normal | require);
        dcd (ignore | normal | require);
        dsr (ignore | normal | require);
        dtr signal-handling-option;
        ignore-all;
        indication (ignore | normal | require);
        rts (assert | de-assert | normal);
        tm (ignore | normal | require);
    }
    dtr-circuit (balanced | unbalanced);
    dtr-polarity (negative | positive);
    encoding (nrz | nrzi);
    indication-polarity (negative | positive);
    line-protocol protocol;
    loopback mode;
    rts-polarity (negative | positive);
    tm-polarity (negative | positive);
    transmit-clock invert;
}
description text;
dialer-options {
    pool pool-name <priority priority>;
}
disable;
ds0-options {
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    byte-encoding (nx56 | nx64);
    fcs (16 | 32);
    idle-cycle-flag (flags | ones);
    invert-data;
    loopback payload;
    start-end-flag (filler | shared);
}
e1-options {
    bert-error-rate rate;
    bert-period seconds;
    fcs (16 | 32);
    framing (g704 | g704-no-crc4 | unframed);
    idle-cycle-flag (flags | ones);
    invert-data;
    loopback (local | remote);
    start-end-flag (filler | shared);
    timeslots time-slot-range;
}
e3-options {
    atm-encapsulation (direct | plcp);
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    buildout feet;
    compatibility-mode (digital-link | kentrox | larscom) <subrate value>;
```

```
    fcs (16 | 32);
    framing (g.751 | g.832);
    idle-cycle-flag (filler | shared);
    invert-data;
    loopback (local | remote);
    (payload-scrambler | no-payload-scrambler);
    start-end-flag (filler | shared);
    (unframed | no-unframed);
}
encapsulation type;
es-options {
    backup-interface es-fpc/pic/port;
}
fastether-options {
    802.3ad aex;
    (flow-control | no-flow-control);
    ignore-l3-incompletes;
    ingress-rate-limit rate;
    (loopback | no-loopback);
    mpls {
        pop-all-labels {
            required-depth number;
        }
    }
    source-address-filter {
        mac-address;
    }
    (source-filtering | no-source-filtering);
}
flexible-vlan-tagging;
gigether-options {
    802.3ad aex;
    (asynchronous-notification | no-asynchronous-notification);
    (auto-negotiation | no-auto-negotiation) remote-fault <local-interface-online |
        local-interface-offline>;
    auto-reconnect seconds;
    (flow-control | no-flow-control);
    ignore-l3-incompletes;
    (loopback | no-loopback);
    mpls {
        pop-all-labels {
            required-depth number;
        }
    }
    source-address-filter {
        mac-address;
    }
    (source-filtering | no-source-filtering);
    ethernet-switch-profile {
        (mac-learn-enable | no-mac-learn-enable);
        tag-protocol-id [ tpids ];
        ethernet-policer-profile {
            input-priority-map {
                ieee802.1p premium [ values ];
            }
            output-priority-map {
```

```
                classifier {
                    premium {
                        forwarding-class class-name {
                            loss-priority (high | low);
                        }
                    }
                }
            }
            policer cos-policer-name {
                aggregate {
                    bandwidth-limit (ethernet) bps;
                    burst-size-limit (ethernet) bytes;
                }
                premium {
                    bandwidth-limit (ethernet) bps;
                    burst-size-limit (ethernet) bytes;
                }
            }
        }
    }
}
(gratuitous-arp-reply | no-gratuitous-arp-reply);
hold-time up milliseconds down milliseconds;
interface-set interface-set-name {
    interface ethernet-interface-name {
        (unit unit-number | vlan-tags-outer vlan-tag);
    }
}
isdn-options {
    bchannel-allocation (ascending | descending);
    calling-number number;
    pool pool-name <priority priority>;
    spid1 spid-string;
    spid2 spid-string;
    static-tei-val value;
    switch-type (att5e | etsi | ni1 | ntdms100 | ntt);
    t310 seconds;
    tei-option (first-call | power-up);
}
keepalives <down-count number> <interval seconds> <up-count number>;
link-mode mode;
lmi (interfaces) {
    lmi-type (ansi | itu);
    n391dte number;
    n392dce number;
    n392dte number;
    n393dce number;
    n393dte number;
    t391dte seconds;
    t392dce seconds;
}
lsq-failure-options {
    no-termination-request;
    [ trigger-link-failure interface-name ];
}
mac mac-address;
```

```
mlfr-uni-nni-bundle-options {
    acknowledge-retries number;
    acknowledge-timer milliseconds;
    action-red-differential-delay (disable-tx | remove-link);
    cisco-interoperability send-lip-remove-link-for-link-reject;
    drop-timeout milliseconds;
    fragment-threshold bytes;
    hello-timer milliseconds;
    link-layer-overhead percent;
    lmi-type (ansi | itu);
    minimum-links number;
    mrru bytes;
    n391 number;
    n392 number;
    n393 number;
    red-differential-delay milliseconds;
    t391 seconds;
    t392 seconds;
    yellow-differential-delay milliseconds;
    encapsulation type;
}
modem-options {
    dialin (console | routable);
    init-command-string initialization-command-string;
}
mtu bytes;
multiservice-options {
    (core-dump | no-core-dump);
    (syslog | no-syslog);
    (dump-on-flow-control);
}
native-vlan-id number;
no-gratuitous-arp-request;
no-keepalives;
no-partition {
    interface-type type;
}
optics-options {
    wavelength nm;
}
partition partition-number oc-slice oc-slice-range interface-type type;
timeslots time-slot-range;
passive-monitor-mode;
per-unit-scheduler;
ppp-options {
    chap {
        access-profile name;
        default-chap-secret name;
        local-name name;
        passive;
    }
    compression {
        acfc;
        pfc;
    }
```

```
        dynamic-profile profile-name;
        no-termination-request;
        pap {
            access-profile name;
            local-name name;
            local-password password;
            passive;
        }
    }
    receive-bucket {
        overflow (discard | tag);
        rate percentage;
        threshold bytes;
    }
    redundancy-options {
        primary sp-fpc/pic/port;
        secondary sp-fpc/pic/port;
    }
    schedulers number;
    serial-options {
        clock-rate rate;
        clocking-mode (dce | internal | loop);
        control-polarity (negative | positive);
        cts-polarity (negative | positive);
        dcd-polarity (negative | positive);
        dce-options {
            control-signal (assert | de-assert | normal);
            cts (ignore | normal | require);
            dcd (ignore | normal | require);
            dsr (ignore | normal | require);
            dtr signal-handling-option;
            ignore-all;
            indication (ignore | normal | require);
            rts (assert | de-assert | normal);
            tm (ignore | normal | require);
        }
        dsr-polarity (negative | positive);
        dte-options {
            control-signal (assert | de-assert | normal);
            cts (ignore | normal | require);
            dcd (ignore | normal | require);
            dsr (ignore | normal | require);
            dtr signal-handling-option;
            ignore-all;
            indication (ignore | normal | require);
            rts (assert | de-assert | normal);
            tm (ignore | normal | require);
        }
        dtr-circuit (balanced | unbalanced);
        dtr-polarity (negative | positive);
        encoding (nrz | nrzi);
        indication-polarity (negative | positive);
        line-protocol protocol;
        loopback mode;
        rts-polarity (negative | positive);
        tm-polarity (negative | positive);
```

```
    transmit-clock invert;
}
services-options {
    inactivity-timeout seconds;
    open-timeout seconds;
    syslog {
        host hostname {
            facility-override facility-name;
            log-prefix prefix-number;
            services priority-level;
        }
    }
}
shdsl-options {
    annex (annex-a | annex-b);
    line-rate line-rate;
    loopback (local | remote);
    snr-margin {
        current margin;
        snext margin;
    }
}
sonet-options {
    aggregate asx;
    aps {
        advertise-interval milliseconds;
        authentication-key key;
        force;
        hold-time milliseconds;
        lockout;
        neighbor address;
        paired-group group-name;
        preserve-interface;
        protect-circuit group-name;
        request;
        revert-time seconds;
        switching-mode (bidirectional | unidirectional);
        working-circuit group-name;
    }
    bytes {
        c2 value;
        e1-quiet value;
        f1 value;
        f2 value;
        s1 value;
        z3 value;
        z4 value;
    }
    fcs (16 | 32);
    loopback (local | remote);
    mpls {
        pop-all-labels {
            required-depth number;
        }
    }
    path-trace trace-string;
```

```
    (payload-scrambler | no-payload-scrambler);
    rfc-2615;
    trigger {
        defect ignore;
        hold-time up milliseconds down milliseconds;
    }
    vtmapping (itu-t | klm);
    (z0-increment | no-z0-increment);
}
speed (10m | 100m | 1g | oc3 | oc12 | oc48);
stacked-vlan-tagging;
switch-options {
    switch-port port-number {
        (auto-negotiation | no-auto-negotiation);
        speed (10m | 100m | 1g);
        link-mode (full-duplex | half-duplex);
    }
}
t1-options {
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    buildout value;
    byte-encoding (nx56 | nx64);
    crc-major-alarm-threshold (1e-3 | 5e-4 | 1e-4 | 5e-5 | 1e-5);
    crc-minor-alarm-threshold (1e-3 | 5e-4 | 1e-4 | 5e-5 | 1e-5 | 5e-6 | 1e-6);
    fcs (16 | 32);
    framing (esf | sf);
    idle-cycle-flag (flags | ones);
    invert-data;
    line-encoding (ami | b8zs);
    loopback (local | payload | remote);
    remote-loopback-respond;
    start-end-flag (filler | shared);
    timeslots time-slot-range;
}
t3-options {
    atm-encapsulation (direct | plcp);
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    buildout feet;
    (cbit-parity | no-cbit-parity);
    compatibility-mode (adtran | digital-link | kentrox | larscom | verilink) <subrate
        value>;
    fcs (16 | 32);
    (feac-loop-respond | no-feac-loop-respond);
    idle-cycle-flag value;
    (long-buildout | no-long-buildout);
    (loop-timing | no-loop-timing);
    loopback (local | payload | remote);
    (mac | no-mac);
    (payload-scrambler | no-payload-scrambler);
    start-end-flag (filler | shared);
}
traceoptions {
```

```
            flag flag <flag-modifier> <disable>;
        }
        transmit-bucket {
            overflow discard;
            rate percentage;
            threshold bytes;
        }
        (traps | no-traps);
        unidirectional;
        vlan-tagging;
        vlan-vci-tagging;
        unit logical-unit-number {
            logical-interface-statements;
        }
    }
}
```

For information about interface-specific physical properties, see "Physical Interfaces Properties Statements List" on page 71.

Physical Interfaces Properties Statements List

Table 7 on page 71 lists statements that you can use to configure physical interfaces.

Table 7: Statements for Physical Interface Properties

Statement	Interface Types	Usage Guidelines
802.3ad ae*x*	Aggregated Ethernet interfaces	"Configuring Ethernet Link Aggregation" on page 595 or "Configuring Aggregated Ethernet Interfaces" on page 593
access-profile *name*	Interfaces with Point-to-Point Protocol (PPP) encapsulation	"Configuring the PPP Challenge Handshake Authentication Protocol" on page 106
accounting-profile *name*	All	"Configuring Accounting for the Physical Interface" on page 124
acfc	Interfaces with PPP encapsulation	"Identifying the Access Concentrator" on page 746
acknowledge-retries *number*	Link services and voice services interfaces	*JUNOS Services Interfaces Configuration Guide*
acknowledge-timer *milliseconds*	Link services and voice services interfaces	*JUNOS Services Interfaces Configuration Guide*
action-red-differential-delay (disable-tx | remove-link)	Link services and voice services interfaces	*JUNOS Services Interfaces Configuration Guide*
advertise-interval *milliseconds*	SONET/SDH interfaces	"Configuring APS and MSP" on page 813

Table 7: Statements for Physical Interface Properties *(continued)*

Statement	Interface Types	Usage Guidelines
aggregate	Gigabit Ethernet intelligent queuing (IQ and IQE) interfaces and Gigabit Ethernet interfaces with small form-factor pluggable transceivers (SFPs) (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform)	"Configuring Gigabit Ethernet Policers" on page 709
aggregate as*x*	Aggregated SONET/SDH interfaces	"Configuring Aggregated SONET/SDH Interfaces" on page 835
aggregated-ether-options	Aggregated Ethernet interfaces	"Configuring Aggregated Ethernet Interfaces" on page 593
aggregate-ports	SONET/SDH interfaces	"Specifying OC768-over-OC192 Mode" on page 89
aggregated-sonet-options	Aggregated SONET/SDH interfaces	"Configuring Aggregated SONET/SDH Interfaces" on page 835
annex (annex-a | annex-b)	ATM interfaces on J-series Services Routers SONET interfaces using annex-b for MSP switching on M320 and M120 Routers	"Configuring SHDSL Operating Mode on an ATM Physical Interface" on page 350 Configuring APS and MSP
aps	SONET/SDH interfaces	"Configuring APS and MSP" on page 813
atm-encapsulation (direct | plcp)	E3 and T3 traffic over Asynchronous Transfer Mode (ATM) interfaces	"Configuring E3 and T3 Parameters on ATM Interfaces" on page 323
atm-options	ATM1 and ATM2 IQ interfaces	"Configuring ATM Interfaces" on page 265
authentication-key *key*	SONET/SDH interfaces	"Configuring APS and MSP" on page 813
backup-interface	E1, E3, T1, T3 and Fast Ethernet	"Configuring an ISDN Dialer Interface as a Backup Interface" on page 780
bandwidth-limit (ethernet) *bps*	Gigabit Ethernet and Gigabit Ethernet IQ and IQE PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform)	"Configuring Gigabit Ethernet Policers" on page 709
bchannel-allocation (ascending | descending)	J-series Services Routers equipped with a Dual-Port Channelized T1/E1 PIM; for Integrated Services Digital Network Primary Rate Interfaces (ISDN PRI)	"Allocating B-Channels for Dialout" on page 497
bert-algorithm *algorithm*	E3, T1, T3, multichannel DS3, channelized interfaces (DS3, OC12, and STM1), and channelized IQ and IQE interfaces (E1 and DS3)	"Interface Diagnostics" on page 127
bert-error-rate *rate*	E1, E3, T1, T3, and channelized interfaces (DS3, OC3, OC12, and STM1)	"Interface Diagnostics" on page 127

Table 7: Statements for Physical Interface Properties *(continued)*

Statement	Interface Types	Usage Guidelines
bert-period *seconds*	E1, E3, T1, T3, and channelized interfaces (DS3, OC12, and STM1)	“Interface Diagnostics” on page 127
buildout *value*	T1 interfaces	“Configuring the T1 Buildout” on page 531
buildout *feet*	E3 and T3 traffic over ATM interfaces	“Configuring E3 and T3 Parameters on ATM Interfaces” on page 323
burst-size-limit (ethernet) *bytes*	Gigabit Ethernet and Gigabit Ethernet IQ and IQE PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform)	“Configuring Gigabit Ethernet Policers” on page 709
byte-encoding (nx56 | nx64)	DS0 and T1 interfaces	“Configuring T1 Byte Encoding” on page 531
bytes [*values*	SONET/SDH interfaces	“Configuring SONET/SDH Header Byte Values” on page 803
cbit-parity | no-cbit-parity	T3 interfaces	“Disabling T3 C-Bit Parity Mode” on page 541
cbr *rate*	ATM interfaces	“Defining the ATM Traffic-Shaping Profile” on page 305
cell-bundle-size *cells*	ATM2 IQ interfaces using ATM Layer 2 circuit cell-relay transport mode	“Configuring the Layer 2 Circuit Cell-Relay Cell Maximum” on page 299
chap	Interfaces with PPP encapsulation	“Configuring the PPP Challenge Handshake Authentication Protocol” on page 106
cisco-interoperability send-lip-remove-link-for-link-reject	link services IQ (lsq) interfaces	*JUNOS Services Interfaces Configuration Guide*
classifier	Gigabit Ethernet IQ interfaces	“Specifying an Output Priority Map” on page 710
clocking *clock-source*	ATM, DS0, E1, E3, SONET/SDH, T1, and T3 interfaces	“Configuring the Clock Source” on page 121
clocking-mode (dce | internal | loop)	Serial interfaces (EIA-530 and V.35)	“Configuring the Serial Clocking Mode” on page 255
clock-rate *rate*	Serial interfaces (EIA-530 and V.35)	“Configuring the DTE Clock Rate” on page 256
compatibility-mode *mode*	E3 and T3 interfaces	“Configuring the E3 CSU Compatibility Mode” on page 523 and “Configuring the T3 CSU Compatibility Mode” on page 542
compression	Interfaces with PPP encapsulation	“Configuring the PPP Protocol Field Compression” on page 115

Table 7: Statements for Physical Interface Properties *(continued)*

Statement	Interface Types	Usage Guidelines
control-polarity (negative | positive)	Serial interfaces (X.21)	"Configuring Serial Signal Polarities" on page 260
control-signal (assert | de-assert | normal)	Serial interfaces (X.21)	"Configuring the Serial Signal Handling" on page 257
core-dump | no-core-dump)	Adaptive services, monitoring services, and collector interfaces	"Configuring Multiservice Physical Interface Properties" on page 132
cts (ignore | normal | require)	Serial interfaces (EIA-530 and V.35)	"Configuring the Serial Signal Handling" on page 257
cts-polarity (negative | positive)	Serial interfaces (EIA-530 and V.35)	"Configuring Serial Signal Polarities" on page 260
current *margin*	ATM interfaces on J-series Services Routers	"Configuring SHDSL Operating Mode on an ATM Physical Interface" on page 350
dcd (ignore | normal | require)	Serial interfaces (EIA-530 and V.35)	"Configuring the Serial Signal Handling" on page 257
dcd-polarity (negative | positive)	Serial interfaces (EIA-530 and V.35)	"Configuring Serial Signal Polarities" on page 260
dce	Interfaces with Frame Relay encapsulation	"Configuring the Router as a DCE" on page 122
dce-options	Serial interfaces (EIA-530, V.35, and X.21) on J-series Services Routers	"Configuring the Serial Signal Handling" on page 257
default-chap-secret *name*	Interfaces with Point-to-Point Protocol (PPP) encapsulation	"Configuring a Default CHAP Secret" on page 107
description *text*	All	"Adding an Interface Description to the Configuration" on page 90
dialer-options	ISDN interfaces	"Configuring ISDN Physical Interface Properties" on page 775
disable	All	"Disabling a Physical Interface" on page 133, "Tracing Operations of an Individual Router Interface" on page 231, and "Tracing Operations of an Individual Router Interface" on page 131
dot1x	802.1x Port-Based Network Access Control	"Configuring IEEE 802.1x Port-Based Network Access Control" on page 693
down-count	ATM interfaces	"Configuring the ATM OAM F5 Loopback Cell Threshold" on page 316
drop-timeout *milliseconds*	Multilink, link services, and voice services interfaces	*JUNOS Services Interfaces Configuration Guide*
ds0-options	DS0 interfaces	"Channelized Interfaces" on page 371

Table 7: Statements for Physical Interface Properties *(continued)*

Statement	Interface Types	Usage Guidelines
dsr (ignore | normal | require)	Serial interfaces (EIA-530 and V.35)	"Configuring the Serial Signal Handling" on page 257
dsr-polarity (negative | positive)	Serial interfaces (EIA-530 and V.35)	"Configuring Serial Signal Polarities" on page 260
dte-options	Serial interfaces (EIA-530, V.35, and X.21) on M-series and T-series routing platforms	"Configuring the Serial Signal Handling" on page 257
dtr *signal-handling-option*	Serial interfaces (EIA-530 and V.35)	"Configuring the Serial Signal Handling" on page 257
dtr-circuit (balanced | unbalanced)	Serial interfaces (EIA-530 and V.35)	"Configuring the Serial DTR Circuit" on page 260
dtr-polarity (negative | positive)	Serial interfaces (EIA-530 and V.35)	"Configuring Serial Signal Polarities" on page 260
e1-options	E1 interfaces	"Configuring E1 Interfaces" on page 513
e3-options	E3 interfaces	"Configuring E3 Interfaces" on page 521
encapsulation *type*	All interfaces, except loopback and multicast tunnel	"Configuring Interface Encapsulation on Physical Interfaces" on page 100
encoding (nrz | nrzi)	Serial interfaces (EIA-530, V.35, and X.21)	"Configuring Serial Line Encoding" on page 263
epd-threshold *cells*	ATM2 interfaces	"Configuring ATM2 IQ VC Tunnel CoS Components" on page 325
es-options	ES interfaces	*JUNOS Services Interfaces Configuration Guide*
ethernet-policer-profile	Gigabit Ethernet and Gigabit Ethernet IQ and IQE PICs with SFPs (except the 10-port Gigabit Ethernet PIC, and the built-in Gigabit Ethernet port on the M7i platform)	"Configuring Gigabit Ethernet Policers" on page 709
ethernet-switch-profile	Gigabit Ethernet and Gigabit Ethernet IQ and IQE PICs with SFPs (except the 10-port Gigabit Ethernet PIC, Aggregated Ethernet with Gigabit Ethernet IQ interfaces, and the built-in Gigabit Ethernet port on the M7i platform)	"Configuring Gigabit Ethernet Policers" on page 709, "Configuring MAC Address Filtering" on page 713, and Configuring the Management Ethernet Interface
facility-override *facility-name*	Adaptive services interfaces	*JUNOS Services Interfaces Configuration Guide*
fastether-options	Fast Ethernet interfaces	"Configuring Ethernet Interfaces" on page 555

Table 7: Statements for Physical Interface Properties *(continued)*

Statement	Interface Types	Usage Guidelines
fcs (16 | 32)	E1/E3, SONET/SDH, and T1/T3 interfaces	"Configuring the E1 Frame Checksum" on page 515, "Configuring the E3 Frame Checksum" on page 524, "Configuring the SONET/SDH Frame Checksum" on page 805, "Configuring the T1 Frame Checksum" on page 533, and "Configuring the T3 Frame Checksum" on page 544
feac-loop-respond | no-feac-loop-respond)	T3 interfaces	"Configuring the T3 FEAC Response" on page 545
flow-control | no-flow-control)	Aggregated Ethernet, Fast Ethernet, and Gigabit Ethernet interfaces	"Configuring Flow Control" on page 564
force	SONET/SDH interfaces	"Configuring APS and MSP" on page 813
forwarding-class *class-name*	Gigabit Ethernet IQ and ATM2 interfaces	"Configuring ATM2 IQ VC Tunnel CoS Components" on page 325 and "Specifying an Output Priority Map" on page 710
fragment-threshold *bytes*	Multilink, link services, and voice services interfaces	*JUNOS Services Interfaces Configuration Guide*
framing *framing-type*	10-Gigabit Ethernet, SONET, E1, E3, and T1 interfaces	"Configuring E3 and T3 Parameters on ATM Interfaces" on page 323, "Configuring E1 Framing" on page 515, and "Configuring T1 Framing" on page 534, "Configuring 10-Gigabit Ethernet Framing" on page 735, and "Configuring SONET Options for 10-Gigabit Ethernet Interfaces" on page 826
gigether-options	Gigabit Ethernet and Tri-Rate Ethernet copper interfaces	"Configuring Ethernet Interfaces" on page 555
(gratuitous-arp-reply | no-gratuitous-arp-reply)	Ethernet interfaces	"Configuring Gratuitous ARP" on page 565
hello-timer *milliseconds*	Link services and voice services interfaces	*JUNOS Services Interfaces Configuration Guide*
high-plp-max-threshold	ATM2 interfaces	"Configuring Linear RED Profiles" on page 326
high-plp-threshold *percent*	ATM2 interfaces	= "Configuring ATM2 IQ VC Tunnel CoS Components" on page 325
hold-time *milliseconds*	SONET/SDH interfaces	"Configuring APS and MSP" on page 813
hold-time up *milliseconds* down *milliseconds*	All interfaces, except aggregated SONET/SDH, generalized routing encapsulation (GRE) tunnel, and IP tunnel	"Damping Interface Transitions" on page 131 and "Configuring SONET/SDH Defect Triggers to Be Ignored" on page 809

Table 7: Statements for Physical Interface Properties *(continued)*

Statement	Interface Types	Usage Guidelines
host *hostname*	Adaptive services interfaces	*JUNOS Services Interfaces Configuration Guide*
ieee802.1p premium [*values*]	Gigabit Ethernet IQ interfaces	"Specifying an Input Priority Map" on page 710
idle-cycle-flag *value*	E1, E3, T1, and T3 interfaces	"Configuring the E1 Idle Cycle Flag" on page 516, "Configuring the E3 Idle Cycle Flag" on page 525, "Configuring the T1 Idle Cycle Flag" on page 536, and "Configuring the T3 Idle Cycle Flag" on page 545
ignore-all	Serial interfaces (EIA-530, V.35, and X.21)	"Configuring the Serial Signal Handling" on page 257
ilmi	ATM interfaces	"Configuring Communication with Directly Attached ATM Switches and Routers" on page 277
inactivity-timeout *seconds*	Adaptive services interfaces	*JUNOS Services Interfaces Configuration Guide*
indication (ignore | normal | require)	Serial interfaces (X.21)	"Configuring the Serial Signal Handling" on page 257
indication-polarity (negative | positive)	Serial interfaces (X.21)	"Configuring Serial Signal Polarities" on page 260
ingress-rate-limit *rate*	8-port, 12-port, and 48-port Fast Ethernet interfaces	"Configuring the Ingress Rate Limit" on page 567
init-command-string *initialization-command-string;*	For USB ports (umd0) on J4350 and J6350 Services Routers	"Specifying a USB Modem Interface on J-series Routers" on page 87
input-priority-map	Gigabit Ethernet IQ interfaces	"Specifying an Input Priority Map" on page 710
interface-type *type*	Channelized IQ and IQE interfaces, ISDN interfaces	"Channelized Interfaces" on page 371 and "Configuring ISDN Physical Interface Properties" on page 775
invert-data	DS0, E1, E3, and T1 interfaces	"Configuring E1 Data Inversion" on page 516 , "Configuring E3 Data Inversion" on page 525, and "Configuring T1 Data Inversion" on page 533
isdn-options	ISDN interfaces	"Configuring ISDN Logical Interface Properties" on page 777
keepalives <down-count *number* <interval *seconds*> <up-count *number*>	Aggregated SONET/SDH, DS0, E1, E3, SONET/SDH, T1, and T3 interfaces	"Configuring Keepalives" on page 120

Table 7: Statements for Physical Interface Properties *(continued)*

Statement	Interface Types	Usage Guidelines
lacp *mode*	Aggregated Ethernet interfaces	“Configuring Aggregated Ethernet LACP” on page 597
line-encoding (ami | b8zs)	T1 interfaces	“Configuring T1 Line Encoding” on page 534
line-protocol *protocol*	Serial interfaces (EIA-530, V.35, and X.21)	“Configuring the Serial Line Protocol” on page 251
line-rate *line-rate*	ATM interfaces on J-series Services Routers	“Configuring SHDSL Operating Mode on an ATM Physical Interface” on page 350
linear-red-profile *profile-name*	ATM2 interfaces	“Configuring ATM2 IQ VC Tunnel CoS Components” on page 325
linear-red-profiles *profile-name*	ATM2 interfaces	“Configuring ATM2 IQ VC Tunnel CoS Components” on page 325
link-layer-overhead *percent*	AS PIC link services IQ interfaces (lsq)	*JUNOS Services Interfaces Configuration Guide*
link-mode *mode*	Management Ethernet (fxp0) and Fast Ethernet interfaces	“Configuring the Link Characteristics” on page 91
link-speed *speed*	Aggregated Ethernet and aggregated SONET/SDH interfaces	“Configuring Aggregated Ethernet Link Speed” on page 604 and “Configuring Aggregated SONET/SDH Link Speed” on page 837
lmi (interfaces) *lmi-options*	Interfaces with Frame Relay encapsulation	“Configuring Tunable Keepalives for Frame Relay LMI” on page 364 and *JUNOS Services Interfaces Configuration Guide*
lmi-type (ansi | itu)	Link services interfaces and interfaces with Frame Relay encapsulation	“Configuring Frame Relay Keepalives” on page 364
lmi (Ethernet)	OAM CFM Ethernet Local Management Interface	“Configuring Ethernet Local Management Interface” on page 654
local-name *name*	Interfaces with PPP encapsulation	“Configuring the PPP Challenge Handshake Authentication Protocol” on page 106
lockout	SONET/SDH interfaces	“Configuring APS and MSP” on page 813
log-prefix *prefix-number*	Adaptive services interfaces	*JUNOS Services Interfaces Configuration Guide*
(long-buildout | no-long-buildout)	T3 interfaces	“Configuring the T3 Line Buildout” on page 545
(loop-timing | no-loop-timing)	Channelized IQ interfaces	“Configuring the Channelized T3 Loop Timing” on page 546

Table 7: Statements for Physical Interface Properties *(continued)*

Statement	Interface Types	Usage Guidelines
loopback *mode*	DS0, E1, E3, T1, T3, Ethernet, SONET/SDH, ATM interfaces on J-series Services Routers, serial interfaces (EIA-530, V.35, and X.21), and 10-Gigabit Ethernet interfaces in WAN PHY mode	"Configuring E1 Loopback Capability" on page 517, "Configuring E3 Loopback Capability" on page 525, "Configuring Ethernet Loopback Capability" on page 563, "Configuring Serial Loopback Capability" on page 261, "Configuring Channelized IQ and IQE SONET/SDH Loop Timing" on page 806, "Configuring T1 Loopback Capability" on page 534, "Configuring T3 Loopback Capability" on page 546, "Configuring SHDSL Operating Mode on an ATM Physical Interface" on page 350, and "Configuring SONET Options for 10-Gigabit Ethernet Interfaces" on page 826
(loopback | no-loopback)	Aggregated Ethernet, Fast Ethernet, and Gigabit Ethernet interfaces	"Configuring Ethernet Loopback Capability" on page 563
loss-priority (high | low)	Gigabit Ethernet IQ interfaces	"Specifying an Output Priority Map" on page 710
low-plp-max-threshold *percent*	ATM2 interfaces	"Configuring ATM2 IQ VC Tunnel CoS Components" on page 325
low-plp-threshold *percent*	ATM2 interfaces	"Configuring ATM2 IQ VC Tunnel CoS Components" on page 325
lsq-failure-options	Link services IQ (lsq) interfaces	*JUNOS Services Interfaces Configuration Guide*
mac *mac-address*	Management Ethernet interface (fxp0)	"Configuring the MAC Address on the Management Ethernet Interface" on page 730
(mac-learn-enable | no-mac-learn-enable)	Gigabit Ethernet IQ and IQE, Tri-Rate Ethernet copper, and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform)	"Configuring MAC Address Filtering" on page 713
maximum-vcs *maximum-vcs*	ATM interfaces	"Configuring the Maximum Number of ATM1 VCs on a VP" on page 286
minimum-links *number*	Multilink, link services, and voice services interfaces	*JUNOS Services Interfaces Configuration Guide*
mip-half-function	Connectivity Fault Management	"Configuring Maintenance Intermediate Points" on page 648
mlfr-uni-nni-bundle-options *bundle-options*	Link services and voice services interfaces	*JUNOS Services Interfaces Configuration Guide*
modem-options	For USB ports (umd0) on J4350 and J6350 Services Routers	"Specifying a USB Modem Interface on J-series Routers" on page 87

Table 7: Statements for Physical Interface Properties *(continued)*

Statement	Interface Types	Usage Guidelines
mpls	10-Gigabit Ethernet interfaces in WAN PHY mode and ATM and SONET/SDH interfaces in passive monitoring mode	"Removing MPLS Labels from Incoming Packets" on page 280 and "Removing MPLS Labels from Incoming Packets" on page 828 and "Configuring SONET Options for 10-Gigabit Ethernet Interfaces" on page 826
mrru *bytes*	Link services and voice services interfaces	*JUNOS Services Interfaces Configuration Guide*
mtu *bytes*	All interfaces, except management Ethernet (fxp0), loopback, multilink, and multicast tunnel	"Configuring the Media MTU" on page 92
multiservice-options	Adaptive services, monitoring services, and collector interfaces	"Configuring Multiservice Physical Interface Properties" on page 132
n391 *number*	Link services and voice services interfaces	*JUNOS Services Interfaces Configuration Guide*
n392 *number*	Link services and voice services interfaces	*JUNOS Services Interfaces Configuration Guide*
n393 *number*	Link services and voice services interfaces	*JUNOS Services Interfaces Configuration Guide*
neighbor *address*	SONET/SDH interfaces	"Configuring APS and MSP" on page 813
no-gratuitous-arp-request	Ethernet interfaces	"Configuring Gratuitous ARP" on page 565
no-keepalives	Interfaces with PPP, Frame Relay, or Cisco High-level Data Link Control (HDLC) encapsulation	"Configuring Keepalives" on page 120
no-partition	Channelized IQ interfaces	"Channelized Interfaces" on page 371
no-termination-request	link services IQ (lsq) interfaces	*JUNOS Services Interfaces Configuration Guide*
oam-liveness	ATM interfaces	"Configuring the OAM F4 Cell Flows" on page 301
oam-period (*seconds* | disable)	ATM interfaces	"Defining the ATM OAM F5 Loopback Cell Period" on page 315
oc-slice *oc-slice-range*	Channelized OC12 IQ interfaces	"Configuring Channelized OC12/STM4 Interfaces" on page 411
open-timeout *seconds*	Adaptive services interfaces	*JUNOS Services Interfaces Configuration Guide*
optics-options	Gigabit Ethernet dense wavelength-division multiplexing (DWDM) interfaces	"Configuring the 10-Gigabit Ethernet DWDM Interface Wavelength" on page 733

Table 7: Statements for Physical Interface Properties *(continued)*

Statement	Interface Types	Usage Guidelines
output-priority-map	Gigabit Ethernet IQ interfaces	"Specifying an Output Priority Map" on page 710
overflow (discard | tag)	All interfaces, except ATM, channelized E1, E1, Fast Ethernet, Gigabit Ethernet, and channelized IQ	"Configuring Receive and Transmit Leaky Bucket Properties" on page 122 and "Configuring Receive and Transmit Leaky Bucket Properties on SONET/SDH Interfaces" on page 830
paired-group *group-name*	SONET/SDH interfaces	"Configuring APS and MSP" on page 813
partition *partition-number*	Channelized IQ interfaces	"Channelized Interfaces" on page 371
passive	Interfaces with PPP encapsulation	"Configuring the PPP Challenge Handshake Authentication Protocol" on page 106
passive-monitor-mode	SONET/SDH interfaces	"Enabling Passive Monitoring on SONET/SDH Interfaces" on page 828
path-trace *trace-string*	10-Gigabit Ethernet interfaces in WAN PHY mode and SONET/SDH interfaces	"Configuring the SONET/SDH Path Trace Identifier" on page 807 and "Configuring SONET Options for 10-Gigabit Ethernet Interfaces" on page 826
(payload-scrambler | no-payload-scrambler)	E3, SONET/SDH, and T3 interfaces	"Configuring E3 and T3 Parameters on ATM Interfaces" on page 323, "Configuring E3 HDLC Payload Scrambling" on page 527, "Configuring SONET/SDH HDLC Payload Scrambling" on page 808, "Configuring T3 HDLC Payload Scrambling" on page 548, and "Examples: Configuring T3 Interfaces" on page 549
periodic *interval*	Aggregated Ethernet interfaces	"Configuring Aggregated Ethernet LACP" on page 597
per-unit-scheduler	IQ interfaces	*JUNOS Services Interfaces Configuration Guide*
pfc	Interfaces with PPP encapsulation	"Configuring the PPP Protocol Field Compression" on page 115
pic-type (atm1 | atm2)	ATM2 IQ interfaces	"Configuring the ATM PIC Type" on page 281
plp1 *cells*	ATM2 interfaces	"Configuring ATM2 IQ VC Tunnel CoS Components" on page 325
plp-to-clp	ATM2 IQ interfaces	"Enabling the PLP Setting to Be Copied to the CLP Bit" on page 334

Table 7: Statements for Physical Interface Properties *(continued)*

Statement	Interface Types	Usage Guidelines
policer *cos-policer-name*	Gigabit Ethernet and Gigabit Ethernet IQ and IQE PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform)	"Configuring Gigabit Ethernet Policers" on page 709
pop-all-labels	ATM and SONET/SDH interfaces in passive monitoring mode	"Removing MPLS Labels from Incoming Packets" on page 280 and "Removing MPLS Labels from Incoming Packets" on page 828
ppp-options	Interfaces with PPP encapsulation	"Configuring the PPP Challenge Handshake Authentication Protocol" on page 106
premium	Gigabit Ethernet IQ interfaces	"Configuring Gigabit Ethernet Policers" on page 709 and "Specifying an Output Priority Map" on page 710
primary sp-*fpc*/*pic*/*port*	Redundant interfaces for adaptive services interfaces (rsp-)	*JUNOS Services Interfaces Configuration Guide*
priority (high | low)	ATM2 IQ interfaces	"Configuring ATM2 IQ VC Tunnel CoS Components" on page 325
priority *number*	ISDN interfaces	"Configuring an ISDN Dialer Interface as a Backup Interface" on page 780
promiscuous-mode	ATM2 IQ interfaces	"Configuring ATM Cell-Relay Promiscuous Mode" on page 282
protect-circuit *group-name*	SONET/SDH interfaces	"Configuring APS and MSP" on page 813
queue-depth *cells*	ATM2 interfaces	"Configuring ATM2 IQ VC Tunnel CoS Components" on page 325
queue-length *number*	ATM1 interfaces	"Configuring the ATM1 Queue Length" on page 311
rate *percentage*	All interfaces, except ATM, channelized E1, E1, Fast Ethernet, Gigabit Ethernet, and channelized IQ	"Configuring Receive and Transmit Leaky Bucket Properties" on page 122 and "Configuring Receive and Transmit Leaky Bucket Properties on SONET/SDH Interfaces" on page 830
receive-bucket	All interfaces, except ATM, Fast Ethernet, and Gigabit Ethernet	"Configuring Receive and Transmit Leaky Bucket Properties" on page 122
red-differential-delay *milliseconds*	Link services and voice services interfaces	*JUNOS Services Interfaces Configuration Guide*
redundancy-options	Redundant interfaces for adaptive services interfaces (rsp-)	*JUNOS Services Interfaces Configuration Guide*

Table 7: Statements for Physical Interface Properties *(continued)*

Statement	Interface Types	Usage Guidelines
remote-loopback-respond	T1 interfaces	"Configuring the T1 Remote Loopback Response" on page 533
request	SONET/SDH interfaces	"Configuring APS and MSP" on page 813
required-depth *number*	ATM and SONET/SDH interfaces in passive monitoring mode	"Removing MPLS Labels from Incoming Packets" on page 280 and "Removing MPLS Labels from Incoming Packets" on page 828
revert-time *seconds*	SONET/SDH interfaces	"Configuring APS and MSP" on page 813
rfc-2615	SONET/SDH interfaces	"Configuring SONET/SDH RFC 2615 Support" on page 809
rts (assert | de-assert | normal)	Serial interfaces (EIA-530 and V.35)	"Configuring the Serial Signal Handling" on page 257
rts-polarity (negative | positive)	Serial interfaces (EIA-530 and V.35)	"Configuring Serial Signal Polarities" on page 260
rtvbr peak *rate* sustained *rate* burst *length*	ATM interfaces	"Configuring ATM2 IQ Real-Time VBR" on page 307
scheduler-maps *map-name*	ATM2 interfaces	"Configuring ATM2 IQ VC Tunnel CoS Components" on page 325
schedulers *number*	Ethernet IQ2 and IQ2-E PICs port interfaces	*JUNOS Services Interfaces Configuration Guide*
secondary sp-*fpc*/*pic*/*port*	Redundant interfaces for adaptive services interfaces (rsp-)	*JUNOS Services Interfaces Configuration Guide*
services-options	Services interfaces	*JUNOS Services Interfaces Configuration Guide*
serial-options	Serial interfaces (EIA-530, V.35, and X.21)	"Configuring Serial Interfaces" on page 249
services *priority-level*	Adaptive services interfaces	*JUNOS Services Interfaces Configuration Guide*
shdsl-options	ATM interfaces on J-series Services Routers	"Configuring SHDSL Operating Mode on an ATM Physical Interface" on page 350
size	All	"Tracing Operations of the Interface Process" on page 231
shaping	ATM interfaces	"Defining the ATM Traffic-Shaping Profile" on page 305
snext *margin*	ATM interfaces on J-series Services Routers	"Configuring SHDSL Operating Mode on an ATM Physical Interface" on page 350

Table 7: Statements for Physical Interface Properties *(continued)*

Statement	Interface Types	Usage Guidelines
snr-margin	ATM interfaces on J-series Services Routers	"Configuring SHDSL Operating Mode on an ATM Physical Interface" on page 350
sonet-options	SONET/SDH interfaces	"Configuring SONET/SDH Physical Interface Properties" on page 798
source-address-filter *mac-address*	Aggregated Ethernet, Fast Ethernet, Tri-Rate Ethernet copper, and Gigabit Ethernet interfaces	"Enabling Ethernet MAC Address Filtering" on page 561
(source-filtering | no-source-filtering)	Aggregated Ethernet, Fast Ethernet, Tri-Rate Ethernet copper, Gigabit Ethernet, Gigabit Ethernet IQ and IQE, and Gigabit Ethernet interfaces with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform)	"Enabling Ethernet MAC Address Filtering" on page 561
speed (10m | 100m | 1g | oc3 | oc12 | oc48)	Management Ethernet interface (fxp0), Tri-Rate Ethernet copper interfaces, and 12-port and 48-port Fast Ethernet interfaces SONET/SDH PICs with SFP	"Configuring the Interface Speed" on page 116 and "SONET/SDH Interface" on page 118
spid1spid2	ISDN interfaces	"Configuring ISDN Physical Interface Properties" on page 775 and "Configuring an ISDN Dialer Interface as a Backup Interface" on page 780
stacked-vlan-tagging	Gigabit Ethernet IQ interfaces	"Configuring the Management Ethernet Interface" on page 729
start-end-flag (filler | shared)	DS0, E1, E3, T1, and T3 interfaces	"Configuring E1 Start and End Flags" on page 518, "Configuring the E3 Start and End Flags" on page 527, "Configuring T1 Start and End Flags" on page 536, and "Configuring T3 Start and End Flags" on page 549
switching-mode (bidirectional | unidirectional)	Unchannelized OC3, OC12, and OC48 SONET/SDH interfaces on T-series platforms	"Configuring Switching Between the Working and Protect Circuits" on page 820
syslog	Adaptive services interfaces	*JUNOS Services Interfaces Configuration Guide*
(syslog | no-syslog)	Adaptive services, monitoring services, and collector interfaces	"Configuring Multiservice Physical Interface Properties" on page 132
t1-options	T1 interfaces	"Configuring T1 Interfaces" on page 529
t3-options	T3 interfaces	"Configuring T3 Interfaces" on page 539

Table 7: Statements for Physical Interface Properties *(continued)*

Statement	Interface Types	Usage Guidelines
t310	ISDN interfaces	"Configuring ISDN Physical Interface Properties" on page 775
t391 *seconds*	Link services and voice services interfaces	*JUNOS Services Interfaces Configuration Guide*
t392 *number*	Link services and voice services interfaces	*JUNOS Services Interfaces Configuration Guide*
tag-protocol-id (first-call | power-up)	ISDN interfaces	"Configuring ISDN Physical Interface Properties" on page 775
threshold *bytes*	All interfaces, except ATM, channelized E1, E1, Fast Ethernet, Gigabit Ethernet, and channelized IQ	"Configuring Receive and Transmit Leaky Bucket Properties" on page 122 and "Configuring Receive and Transmit Leaky Bucket Properties on SONET/SDH Interfaces" on page 830
timeslots *time-slot-range*	Channelized T1 IQ and channelized E1 IQ interfaces	"Channelized Interfaces" on page 371
tm (ignore | normal | require)	Serial interfaces (EIA-530)	"Configuring the Serial Signal Handling" on page 257
tm-polarity (negative | positive)	Serial interfaces (EIA-530)	"Configuring Serial Signal Polarities" on page 260
traceoptions	All	"Tracing Operations of an Individual Router Interface" on page 131 and "Tracing Operations of the Interface Process" on page 231
transmit-bucket	All interfaces, except ATM, Fast Ethernet, Tri-Rate Ethernet copper, and Gigabit Ethernet	"Configuring Receive and Transmit Leaky Bucket Properties" on page 122
transmit-clock invert	Serial interfaces (EIA-530, V.35, and X.21)	"Configuring the Serial Clocking Mode" on page 255
transmit-weight (cells *number* | percent *number*)	ATM2 IQ interfaces	"Configuring ATM2 IQ VC Tunnel CoS Components" on page 325
(traps | no-traps)	All	"Enabling or Disabling SNMP Notifications on Physical Interfaces" on page 132
trigger *defect* ignore | *defect* hold-time up *milliseconds* down *milliseconds*;	10-Gigabit Ethernet interfaces in WAN PHY mode and ATM over SONET/SDH and SONET/SDH interfaces	"Configuring SONET/SDH Defect Triggers to Be Ignored" on page 809 and "Configuring SONET Options for 10-Gigabit Ethernet Interfaces" on page 826
(unframed | no-unframed)	E3 IQ interfaces	"Configuring E3 IQ and IQE Unframed Mode" on page 528

Table 7: Statements for Physical Interface Properties *(continued)*

Statement	Interface Types	Usage Guidelines
unidirectional	10-Gigabit Ethernet interfaces on: ■ MX960 4–Port 10–Gigabit Ethernet DPC ■ T-series 10–Gigabit Ethernet IQ2 PIC ■ T-series 10–Gigabit Ethernet IQ2E PIC	"Enabling Unidirectional Traffic Flow on Physical Interfaces" on page 132
vbr peak *rate* sustained *rate* burst *length*	ATM interfaces	"Defining the ATM Traffic-Shaping Profile" on page 305
vc-cos-mode (alternate | strict)	ATM2 interfaces	"Configuring ATM2 IQ VC Tunnel CoS Components" on page 325
vlan-tagging	Fast Ethernet, Tri-Rate Ethernet copper, and Gigabit Ethernet interfaces	"Configuring 802.1Q VLANs" on page 569
vlan-vci-tagging	Fast Ethernet, Tri-Rate Ethernet copper, Gigabit Ethernet, 10-Gigabit Ethernet, and aggregated Ethernet interfaces	"Configuring ATM-to-Ethernet Interworking" on page 219
vpi *vpi-identifier*	ATM interfaces	"Configuring ATM Cell-Relay Promiscuous Mode" on page 282 and "Configuring the Maximum Number of ATM1 VCs on a VP" on page 286
vtmapping	Channelized STM1 interfaces	"Configuring Virtual Tributary Mapping of Channelized STM1 Interfaces" on page 456
wavelength *nm*	Gigabit Ethernet dense wavelength-division multiplexing (DWDM) interfaces	"Configuring the 10-Gigabit Ethernet DWDM Interface Wavelength" on page 733
working-circuit *group-name*	SONET/SDH interfaces	"Configuring APS and MSP" on page 813
yellow-differential-delay *milliseconds*	Link services and voice services interfaces	*JUNOS Services Interfaces Configuration Guide*
(z0-increment | no-z0-increment)	SONET/SDH interfaces	"Configuring an Incrementing STM ID" on page 804

Specifying an Aggregated Interface

The M-series, MX-series, and T-series routing platforms support aggregated interfaces.

You specify aggregated interfaces by assigning a number for the aggregated interface. For aggregated Ethernet interfaces, configure aex as in the following example:

```
[edit interfaces]
ae0 {
   ...
```

```
}
```

For aggregated SONET/SDH interfaces, configure as*x* as in the following example:

```
[edit interfaces]
as0 {
   ...
}
```

The maximum number of aggregated Ethernet interfaces is 128, and the assigned number can be from 0 through 127. The maximum number of aggregated Ethernet interfaces (LAG bundles) on all MX-series routers is 480, and the assigned number can be from 0 through 479. The maximum number of aggregated SONET interfaces is 16, and the assigned number can be from 0 through 15. You should not mix SONET and SDH modes on the same aggregated interface.

NOTE: SONET/SDH aggregation is proprietary to the JUNOS software and might not work with other software.

If you are configuring VLANs for aggregated Ethernet interfaces, you must include the vlan-tagging statement at the [edit interfaces ae*x*] hierarchy level to complete the association.

For more information, see "Configuring Aggregated Ethernet Interfaces" on page 593 and "Configuring Aggregated SONET/SDH Interfaces" on page 835.

Specifying a USB Modem Interface on J-series Routers

The J-series Services Routers contain two USB ports controlled by a single USB controller. One USB port can support USB devices, while the other one can act as a USB modem.

The USB modem provides a dial-in remote management interface, and supports dialer interface features by sharing the same dial pool as a dialer interface. The dial pool allows the logical dialer interface (dl*n*) and the physical interface (umd0) to be bound together dynamically on a per-call basis.

The following dialer interface features are supported by the USB modem interface:

- Encapsulation PPP
- CoS
- NAT
- Interface statistics
- Packet capture
- GRE tunnel
- Stateful firewall
- Traffic sampling

To configure a USB modem interface, include the following statements at the [edit interfaces] hierarchy level:

```
[edit interfaces]
umd0 {
    dialer-options {
        pool pool-name <priority priority>;
    }
    modem-options {
        dialin (console | routable);
        init-command-string initialization-command-string;
    }
}
```

The pool name specified at the [edit interfaces umd0 dialer-options pool] hierarchy level must be the same as the pool name specified at the [edit interfaces dl*n* unit *logical-unit-number* dialer-options pool] hierarchy level.

Configure the USB modem to operate as a dial-in WAN backup interface by including the dialin statement and specifying the routable option. If the USB modem is to be used as a dial-in console, specify the console option in the dialin statement.

When the Services Router applies the modem AT commands configured in the init-command-string statement or the default sequence of initialization commands to the modem, it compares them to the initialization commands already configured on the modem and makes the following changes:

- If the commands are the same, the router overrides the existing modem values that do not match. For example, if the initialization commands on the modem include S0 = 0 and the router's init-command-string configuration includes S0 = 2, the Services Router applies S0 = 2.
- If the initialization commands on the modem do not include a command in the router's init-command-string statement configuration, the router adds it. For example, if the init-command-string statement includes the command L2, but the modem commands do not include it, the router adds L2 to the initialization commands configured on the modem.

Include the following statements at the [edit interfaces dl*n*] hierarchy level to support a minimum configuration for a dialer interface connected to a USB modem:

```
[edit interfaces dln]
encapsulation ppp;
unit logical-unit-number;
dialer-options {
    dial-string dial-string-numbers;
    pool pool-name <priority priority>;
}
ppp-options {
    chap;
    access-profile name;
    local-name name;
    passive;
}
family inet {
```

```
        mtu bytes;
        address address {
            destination address;
        }
    }
```

For more information about configuring dial-in, see “Configuring Dial-In and Callback” on page 786.

Specifying OC768-over-OC192 Mode

The T-series routing platforms support OC768-over-OC192 mode on the 4-port OC192c PIC. In OC768-over-OC192 mode, four OC192 links are aggregated into one OC768 link with one logical interface. This single interface achieves data rates of approximately 40 Gbps. OC768 optics are expensive, and most long-distance networks currently use fiber optics and regenerators that cannot carry OC768 SONET. When you create an OC768 pipe as a large data pipe running over existing infrastructures, you transfer network traffic without link bonding or load sharing over parallel links. Load sharing is automatically accomplished in the JUNOS software using a proprietary method, and does not need to be manually configured.

The following limitations apply to OC768-over-OC192 mode:

- The maximum difference in delay between all links in the bundle is 8 µ (microseconds), equivalent to approximately 1.5 km maximum difference in length between the longest and shortest fiber pairs.
- If a single link in the bundle fails, the whole bundle fails. If link redundancy is required, implement an aggregated SONET/SDH bundle instead.
- Only routers that contain 4-port OC192 PICs can operate in OC768-over-OC192 mode.

To configure the 4-port OC192 PIC to operate in OC768-over-OC192 mode on a TX Matrix platform, include the aggregate-ports statement at the [edit chassis lcc *lcc-number* fpc *slot-number* pic *pic-number*] hierarchy level:

```
[edit chassis]
lcc lcc-number {
    fpc slot-number {
        pic pic-number {
            aggregate-ports;
        }
    }
}
...
```

To configure the 4-port OC192 PIC to operate in OC768-over-OC192 mode on a T640 routing node, include the aggregate-ports statement at the [edit chassis fpc *slot-number* pic *pic-number*] hierarchy level:

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

```
        aggregate-ports;
      }
    }
    ...
```

When you configure the 4-port OC192 PIC for OC768-over-OC192 mode, only port 0 (the first port) needs be configured as the OC768 port.

To display logical and physical interface information, use the operational mode command show interfaces so-*fpc/pic/port* extensive. When this command is used for the 4-port OC192 PIC configured for OC768-over-OC192 mode, only port 0 (so-*fpc/pic*/0) is displayed. This port is displayed as OC768.

Adding an Interface Description to the Configuration

You can include a text description of each physical interface in the configuration file. Any descriptive text you include is displayed in the output of the show interfaces commands, and is also exposed in the ifAlias Management Information Base (MIB) object. It has no impact on the interface's configuration. To add a text description, include the description statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
description text;
```

The description can be a single line of text. If the text contains spaces, enclose it in quotation marks.

For information about describing logical units, see "Adding a Logical Unit Description to the Configuration" on page 148.

Example: Adding an Interface Description to the Configuration

Add a description to a Fast Ethernet interface:

```
[edit interfaces]
user@host#
set fe-0/0/1 description "Backbone connection to PHL01"
[edit interfaces]
user@host#
show
fe-0/0/1 {
   description "Backbone connection to PHL01";
   unit 0 {
      family inet {
         address 192.168.0.1/30;
      }
   }
}
```

To display the description from the router CLI, use the show interfaces command:

```
user@host>
show interfaces fe-0/0/1
```

```
Physical interface: fe-0/0/1, Enabled, Physical link is Up
  Interface index: 129, SNMP ifIndex: 23
  Description: Backbone connection to PHL01
  ...
```

To display the interface description from the interfaces MIB, use the snmpwalk command from a server. To isolate information for a specific interface, search for the interface index shown in the SNMP ifIndex field of the show interfaces command output. The ifAlias object is in ifXTable.

```
user-server>snmpwalk host-fxp0.mylab public ifXTable | grep -e '\.23'
 snmpwalk host-fxp0.mylab public ifXTable | grep -e '\.23'
ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifName.23 = fe-0/0/1
ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifInMulticastPkts.23 = Counter32: 0
ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifInBroadcastPkts.23 = Counter32: 0
ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifOutMulticastPkts.23 = Counter32: 0
ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifOutBroadcastPkts.23 = Counter32: 0
ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifHCInOctets.23 = Counter64: 0
ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifHCInUcastPkts.23 = Counter64: 0
ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifHCInMulticastPkts.23 = Counter64: 0
ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifHCInBroadcastPkts.23 = Counter64: 0
ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifHCOutOctets.23 = Counter64: 42
ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifHCOutUcastPkts.23 = Counter64: 0
ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifHCOutMulticastPkts.23 = Counter64: 0
ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifHCOutBroadcastPkts.23 = Counter64: 0
ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifLinkUpDownTrapEnable.23 = enabled(1)
ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifHighSpeed.23 = Gauge32: 100
ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifPromiscuousMode.23 = false(2)
ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifConnectorPresent.23 = true(1)
ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifAlias.23 = Backbone connection to PHL01
ifMIB.ifMIBObjects.ifXTable.ifXEntry.ifCounterDiscontinuityTime.23 = Timeticks:
(0) 0:00:00.00
```

Configuring the Link Characteristics

By default, the routing platform's management Ethernet interface, fxp0, autonegotiates whether to operate in full-duplex or half-duplex mode. Fast Ethernet and J-series Services Router Gigabit Ethernet interfaces can operate in either full-duplex or half-duplex mode, and all other interfaces can operate only in full-duplex mode. For Gigabit Ethernet, the link partner must also be set to full duplex.

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

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

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

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

Configuring the Media MTU

The default media MTU size used on a physical interface depends on the encapsulation used on that interface. In some cases, the default IP Protocol MTU depends on whether the protocol used is IP version 4 (IPv4) or International Organization for Standardization (ISO). Table 8 on page 92 through Table 14 on page 96 list the media and protocol MTU sizes by interface type, and Table 17 on page 98 lists the encapsulation overhead by encapsulation type.

Table 8: Media MTU Sizes by Interface Type for M5, M7i with CFEB, M10, M10i with CFEB, M20, and M40 Routers

Interface Type	Default Media MTU (Bytes)	Maximum MTU (Bytes)	Default IP Protocol MTU (Bytes)
Adaptive Services (MTU size not configurable)	9192	N/A	N/A
ATM	4482	9192	4470
E1/T1	1504	9192	1500
E3/T3	4474	9192	4470
Fast Ethernet	1514	9192 (4-port) 1532 (8-port) 1532 (12-port)	1500 (IPv4)1497 (ISO)
Gigabit Ethernet	1514	9192	1500 (IPv4)1497 (ISO)
Serial	1504	9192	1500 (IPv4)1497 (ISO)
SONET/SDH	4474	9192	4470

Table 9: Media MTU Sizes by Interface Type for M40e Routers

Interface Type	Default Media MTU (Bytes)	Maximum MTU (Bytes)	Default IP Protocol MTU (Bytes)
Adaptive Services (MTU size not configurable)	9192	N/A	N/A
ATM	4482	9192	4470

Table 9: Media MTU Sizes by Interface Type for M40e Routers *(continued)*

Interface Type	Default Media MTU (Bytes)	Maximum MTU (Bytes)	Default IP Protocol MTU (Bytes)
E1/T1	1504	4500	1500
E3/T3	4474	4500 9192 (4-port)	4470
E3/DS3 IQ	4474	9192	4470
Fast Ethernet	1514	4500	1500 (IPv4)1497 (ISO)
Gigabit Ethernet	1514	9192 (1- or 2-port) 9192 (4-port)	1500 (IPv4)1497 (ISO)
Serial	1504	9192	1500 (IPv4)1497 (ISO)
SONET/SDH	4474	4500 (1-port nonconcatenated) 9192 (4-port OC3) 9192 (4-port OC3c) 4500 (1-port OC12) 4500 (4-port OC12) 4500 (4-port OC12c) 4500 (1-port OC48) 9192 (2-port OC3) 9192 (2-port OC3c) 9192 (1-port OC12c) 9192 (1-port OC48c) 4500 (1-port OC192) 9192 (1-port OC192c)	4470

Table 10: Media MTU Sizes by Interface Type for M160 Routers

Interface Type	Default Media MTU (Bytes)	Maximum MTU (Bytes)	Default IP Protocol MTU (Bytes)
Adaptive Services (MTU size not configurable)	9192	N/A	N/A

Table 10: Media MTU Sizes by Interface Type for M160 Routers *(continued)*

Interface Type	Default Media MTU (Bytes)	Maximum MTU (Bytes)	Default IP Protocol MTU (Bytes)
ATM	4482	9192	4470
E1/T1	1504	4500	1500
E3/T3	4474	4500	4470
E3/DS3 IQ	4474	9192	4470
Fast Ethernet	1514	4500	1500 (IPv4)1497 (ISO)
Gigabit Ethernet	1514	9192 (1- or 2-port) 4500 (4-port)	1500 (IPv4)1497 (ISO)
Serial	1504	9192	1500 (IPv4)1497 (ISO)
SONET/SDH	4474	4500 (1-port nonconcatenated) 9192 (1- or 2-port) 4500 (4-port)	4470

Table 11: Media MTU Sizes by Interface Type for M7i with CFEB-E, M10i with CFEB-E, M320 and M120 Platforms

Interface Type	Default Media MTU (Bytes)	Maximum MTU (Bytes)	Default IP Protocol MTU (Bytes)
ATM2 IQ	4482	9192	4470
Channelized DS3 IQ	4471	4500	4470
Channelized E1 IQ	1504	4500	1500
Channelized OC12 IQ	4474	9192	4470
Channelized STM1 IQ	4474	9192	4470
DS3	4471	4500	4470
E1	1504	4500	1500
E3 IQ	4471	4500	4470
Fast Ethernet	1514	9192 (4-port) 1532 (8-, 12- and 48-port)	1500 (IPv4)1497 (ISO)
Gigabit Ethernet	1514	9192	1500 (IPv4)1497 (ISO)

Table 11: Media MTU Sizes by Interface Type for M7i with CFEB-E, M10i with CFEB-E, M320 and M120 Platforms *(continued)*

Interface Type	Default Media MTU (Bytes)	Maximum MTU (Bytes)	Default IP Protocol MTU (Bytes)
SONET/SDH	4474	9192	4470
T1	1504	4500	1500

Table 12: Media MTU Sizes by Interface Type for T320 Platforms

Interface Type	Default Media MTU (Bytes)	Maximum MTU (Bytes)	Default IP Protocol MTU (Bytes)
ATM	4482	9192	4470
ATM2 IQ	4482	9192	4470
Channelized OC12 IQ	4474	9192	4470
Channelized STM1 IQ	4474	9192	4470
DS3	4471	4500	4470
Fast Ethernet	1514	4500 (4-port) 1532 (12- and 48-port)	1500 (IPv4)1497 (ISO)
Gigabit Ethernet	1514	9192	1500 (IPv4)1497 (ISO)
SONET/SDH	4474	9192	4470

Table 13: Media MTU Sizes by Interface Type for T640 Platforms

Interface Type	Default Media MTU (Bytes)	Maximum MTU (Bytes)	Default IP Protocol MTU (Bytes)
ATM2 IQ	4482	9192	4470
48-port Fast Ethernet	1514	1532	1500 (IPv4)1497 (ISO)
Gigabit Ethernet	1514	9192	1500 (IPv4)1497 (ISO)
SONET/SDH	4474	9192	4470

Table 14: Media MTU Sizes by Interface Type for J2300 Platforms

Interface Type	Default Media MTU (Bytes)	Maximum MTU (Bytes)	Default IP Protocol MTU (Bytes)
Fast Ethernet (10/100)	1514	9192	1500
G.SHDSL	4482	9150	4470
ISDN BRI	1504	4092	1500
Serial	1504	9150	1500
T1 or E1	1504	9150	1500

Table 15: Media MTU Sizes by Interface Type for J4300 and J6300 Platforms

Interface Type	Default Media MTU (Bytes)	Maximum MTU (Bytes)	Default IP Protocol MTU (Bytes)
ADSL2+ PIM	4482	9150	4470
Dual-Port Fast Ethernet (10/100) PIM	1514	9192	1500
Dual-Port Serial PIM	1504	9150	1500
Dual-Port T1 or E1 PIM	1504	9150	1500
Dual-Port Channelized T1/E1 PIM (channelized to DS0s)	1504	4500	1500
Dual-Port Channelized T1/E1 PIM (clear channel T1 or E1)	1504	9150	1500
Fast Ethernet (10/100) built-in interface	1514	9192	1500
G.SHDSL PIM	4482	9150	4470
4-Port ISDN BRI PIM	1504	4092	1500
T3 (DS3) or E3 PIM	4474	9192	4470

Table 16: Media MTU Sizes by Interface Type for J4350 and J6350 Platforms

Interface Type	Default Media MTU (Bytes)	Maximum MTU (Bytes)	Default IP Protocol MTU (Bytes)
4-Port ISDN BRI PIM	1504	4092	1500
ADSL2+ PIM	4482	9150	4470

Table 16: Media MTU Sizes by Interface Type for J4350 and J6350 Platforms *(continued)*

Interface Type	Default Media MTU (Bytes)	Maximum MTU (Bytes)	Default IP Protocol MTU (Bytes)
Dual-Port Fast Ethernet (10/100) PIM	1514	9192	1500
Dual-Port Serial PIM	1504	9150	1500
Dual-Port T1 or E1 PIM	1504	9150	1500
Dual-Port Channelized T1/E1 PIM (channelized to DS0s)	1504	4500	1500
Dual-Port Channelized T1/E1 PIM (clear channel T1 or E1)	1504	9150	1500
4-Port Fast Ethernet (10/100) ePIM	1518	1518	1500
Gigabit Ethernet (10/100/1000) built-in interface	1514	9018	1500
Gigabit Ethernet (10/100/1000) Enhanced Physical Interface Module (ePIM)	1514	9018	1500
Gigabit Ethernet (10/100/1000) SFP ePIM	1514	9018	1500
G.SHDSL PIM	4482	9150	4470
T3 (DS3) or E3 PIM	4474	9192	4470

NOTE: On Gigabit Ethernet ePIMs in J4350 and J6350 Services Routers, you can configure a maximum transmission unit (MTU) size of only 9018 bytes even though the CLI indicates that you can configure an MTU of up to 9192 bytes. If you configure an MTU greater than 9018 bytes, the router does not accept the configuration and generates a system log error message similar to the following:

```
/kernel: ge-0/0/0: Illegal media change. MTU invalid: 9192. Max MTU supported on
 this PIC: 9018
```

On 4-port Fast Ethernet ePIMs in J4350 and J6350 Services Routers, you can configure a maximum transmission unit (MTU) size of only 1518 bytes even though the CLI indicates that you can configure an MTU of up to 9192 bytes. If you configure an MTU greater than 1518 bytes, the router does not accept the configuration and generates a system log error message similar to the following:

```
/kernel: fe-3/0/1: Illegal media change. MTU invalid: 9192. Max MTU supported on
 this PIC: 1518
```

Table 17: Encapsulation Overhead by Encapsulation Type

Interface Encapsulation	Encapsulation Overhead (Bytes)
802.1Q/Ethernet 802.3	21
802.1Q/Ethernet Subnetwork Access Protocol (SNAP)	26
802.1Q/Ethernet version 2	18
ATM Cell Relay	4
ATM permanent virtual connection (PVC)	12
Cisco HDLC	4
Ethernet 802.3	17
Ethernet circuit cross-connect (CCC) and virtual private LAN service (VPLS)	4
Ethernet over ATM	32
Ethernet SNAP	22
Ethernet translational cross-connect (TCC)	18
Ethernet version 2	14
Extended virtual local area network (VLAN) CCC and VPLS	4
Extended VLAN TCC	22
Frame Relay	4
PPP	4

Table 17: Encapsulation Overhead by Encapsulation Type *(continued)*

Interface Encapsulation	Encapsulation Overhead (Bytes)
VLAN CCC	4
VLAN VPLS	4
VLAN TCC	22

The default media MTU is calculated as follows:

Default media MTU = Default IP MTU + encapsulation overhead

When you are configuring point-to-point connections, the MTU sizes on both sides of the connections must be the same. Also, when you are configuring point-to-multipoint connections, all interfaces in the subnet must use the same MTU size.

NOTE: The actual frames transmitted also contain cyclic redundancy check (CRC) bits, which are not part of the media MTU. For example, the media MTU for a Gigabit Ethernet Version 2 interface is specified as 1514 bytes, but the largest possible frame size is actually 1518 bytes; you need to consider the extra bits in calculations of MTUs for interoperability.

The physical MTU for Ethernet interfaces does not include the 4-byte frame check sequence (FCS) field of the Ethernet frame.

A SONET/SDH interface operating in concatenated mode has a “c” added to the rate descriptor. For example, a concatenated OC48 interface is referred to as OC48c.

If you do not configure an MPLS MTU, the JUNOS software derives the MPLS MTU from the physical interface MTU. From this value, the software subtracts the encapsulation-specific overhead and space for the maximum number of labels that might be pushed in the Packet Forwarding Engine. Currently, the software provides for three labels of four bytes each, for a total of 12 bytes.

In other words, the formula used to determine the MPLS MTU is the following:

MPLS MTU = physical interface MTU – encapsulation overhead – 12

If you configure an MTU value by including the mtu statement at the [edit interfaces *interface-name* unit *logical-unit-number* family mpls] hierarchy level, the configured value is used.

For information about configuring the encapsulation on an interface, see “Configuring Interface Encapsulation on Physical Interfaces” on page 100.

To modify the default media MTU size for a physical interface, include the mtu statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
mtu bytes;
```

If you change the size of the media MTU, you must ensure that the size is equal to or greater than the sum of the protocol MTU and the encapsulation overhead.

NOTE: Changing the media MTU or protocol MTU causes an interface to be deleted and added again.

You configure the protocol MTU by including the mtu statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family *family*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

Because tunnel services interfaces are considered logical interfaces, you cannot configure the MTU setting for the physical interface. This means you cannot include the mtu statement at the [edit interfaces *interface-name*] hierarchy level for the following interface types: generic routing encapsulation (gr-), IP-IP (ip-), loopback (lo-), link services (ls-), multilink services (ml-), and multicast (pe-, pd-). You can, however, configure the protocol MTU on tunnel interfaces, as described in "Setting the Protocol MTU" on page 181.

Configuring Interface Encapsulation on Physical Interfaces

Point-to-Point Protocol (PPP) encapsulation is the default encapsulation type for physical interfaces. You need not configure encapsulation for any physical interfaces that support PPP encapsulation. If you do not configure encapsulation, PPP is used by default. For physical interfaces that do not support PPP encapsulation, you must configure an encapsulation to use for packets transmitted on the interface.

You can optionally configure an encapsulation on a logical interface, which is the encapsulation used within certain packet types. For more information about logical interface encapsulation, see "Configuring the Encapsulation on a Logical Interface" on page 151.

This section contains the following topics:

Configuring the Encapsulation on a Physical Interface

By default, PPP is the encapsulation type for physical interfaces. To configure the encapsulation on a physical interface, include the encapsulation statement at the [edit interfaces *interface-name*] hierarchy level:

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

```
encapsulation (atm-ccc-cell-relay | atm-pvc | cisco-hdlc | cisco-hdlc-ccc | cisco-hdlc-tcc
    | ethernet-ccc | ethernet-over-atm | ethernet-tcc | ethernet-vpls |
    extended-frame-relay-ccc | extended-frame-relay-ether-type-tcc |
    extended-frame-relay-tcc | extended-vlan-ccc | extended-vlan-tcc | extended-vlan-vpls
    | flexible-ethernet-services | flexible-frame-relay | frame-relay | frame-relay-ccc |
    frame-relay-ether-type | frame-relay-ether-type-tcc | frame-relay-port-ccc | frame-relay-tcc
    | multilink-frame-relay-uni-nni | ppp | ppp-ccc | ppp-tcc | vlan-ccc | vlan-vpls);
```

The physical interface encapsulation can be one of the following:

- ATM CCC cell relay—Connects two remote virtual circuits or ATM physical interfaces with a label-switched path (LSP). Traffic on the circuit is ATM cells.

  You can configure an ATM1 Physical Interface Card (PIC) to use cell-relay accumulation mode (CAM). In this mode, the incoming cells (1 to 8 cells) are packaged into a single packet and forwarded to the LSP. Cell-relay accumulation mode is not supported on ATM2 PICs. You configure CAM as shown in the following example:

  ```
  [edit chassis]
  fpc 1 {
      pic 0 {
          atm-cell-relay-accumulation;
      }
  }
  ```

  For more information, see the *JUNOS System Basics Configuration Guide*.

- ATM PVC—Defined in RFC 2684, *Multiprotocol Encapsulation over ATM Adaptation Layer 5*. When you configure physical ATM interfaces with ATM PVC encapsulation, an RFC 2684-compliant ATM Adaptation Layer 5 (AAL5) tunnel is set up to route the ATM cells over a Multiprotocol Label Switching (MPLS) path that is typically established between two MPLS-capable routing platforms using the Label Distribution Protocol (LDP).

- Cisco HDLC—E1, E3, SONET/SDH, T1, and T3 interfaces can use Cisco HDLC encapsulation. Two related versions are supported:

  - CCC version (cisco-hdlc-ccc)—The logical interface does not require an encapsulation statement. When you use this encapsulation type, you can configure the ccc family only.

  - TCC version (cisco-hdlc-tcc)—Similar to CCC and has the same configuration restrictions, but used for circuits with different media on either side of the connection.

- Ethernet over ATM—As defined in RFC 1483, *Multiprotocol Encapsulation over ATM Adaptation Layer 5*, this encapsulation type allows ATM interfaces to connect to devices that support only bridged-mode protocol data units (BPDUs). The JUNOS software does not completely support bridging, but accepts BPDU packets as a default gateway. If you use the router as an edge device, then the router acts as a default gateway. It accepts Ethernet logical link control (LLC)/SNAP frames with IP or Address Resolution Protocol (ARP) in the payload, and drops the rest. For packets destined to the Ethernet local area network (LAN), a route lookup is done using the destination IP address. If the route lookup yields a full address match, the packet is encapsulated with an LLC/SNAP and media access control (MAC) header, and the packet is forwarded to the ATM interface.

- Ethernet cross-connect—Ethernet interfaces without VLAN tagging can use Ethernet CCC encapsulation. Two related versions are supported:
  - CCC version (ethernet-ccc)—Ethernet interfaces with standard Tag Protocol ID (TPID) tagging can use Ethernet CCC encapsulation. When you use this encapsulation type, you can configure the ccc family only.
  - TCC version (ethernet-tcc)—Similar to CCC, but used for circuits with different media on either side of the connection.

    For 8-port, 12-port, and 48-port Fast Ethernet PICs, TCC is not supported.
- VLAN CCC (vlan-ccc)—Ethernet interfaces with VLAN tagging enabled can use VLAN CCC encapsulation. VLAN CCC encapsulation supports TPID 0x8100 only. When you use this encapsulation type, you can configure the ccc family only.
- Extended VLAN cross-connect—Gigabit Ethernet interfaces with VLAN 802.1Q tagging enabled can use extended VLAN cross-connect encapsulation. (Ethernet interfaces with standard TPID tagging can use VLAN CCC encapsulation.) Two related versions of extended VLAN cross-connect are supported:
  - CCC version (extended-vlan-ccc)—Extended VLAN CCC encapsulation supports TPIDs 0x8100, 0x9100, and 0x9901. When you use this encapsulation type, you can configure the ccc family only.
  - TCC version (extended-vlan-tcc)—Similar to CCC, but used for circuits with different media on either side of the connection.

    For 8-port, 12-port, and 48-port Fast Ethernet PICs, extended VLAN CCC is not supported. For 4-port Gigabit Ethernet PICs, extended VLAN CCC and extended VLAN TCC are not supported.
- Ethernet VPLS (ethernet-vpls)—Ethernet interfaces with VPLS enabled can use Ethernet VPLS encapsulation. For more information about VPLS, see the *JUNOS VPNs Configuration Guide* and the *JUNOS Feature Guide*.
- Ethernet VLAN VPLS (vlan-vpls)—Ethernet interfaces with VLAN tagging and VPLS enabled can use Ethernet VLAN VPLS encapsulation. For more information about VPLS, see the *JUNOS VPNs Configuration Guide* and the *JUNOS Feature Guide*.
- Extended VLAN VPLS (extended-vlan-vpls)—Ethernet interfaces with VLAN 802.1Q tagging and VPLS enabled can use Ethernet Extended VLAN VPLS encapsulation. (Ethernet interfaces with standard TPID tagging can use Ethernet VLAN VPLS encapsulation.) Extended Ethernet VLAN VPLS encapsulation supports TPIDs 0x8100, 0x9100, and 0x9901. For more information about VPLS, see the *JUNOS VPNs Configuration Guide* and the *JUNOS Feature Guide*.
- Flexible Ethernet services (flexible-ethernet-services)—Gigabit Ethernet and Gigabit Ethernet IQ and IQE PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform) can use flexible Ethernet services encapsulation. Aggregated Ethernet bundles cannot use this encapsulation type. You use this encapsulation type when you want to configure multiple per-unit Ethernet encapsulations. This encapsulation type allows you to configure any combination of route, TCC, CCC, Layer 2 virtual private networks (VPNs),

and VPLS encapsulations on a single physical port. If you configure flexible Ethernet services encapsulation on the physical interface, VLAN IDs from 1 through 511 are no longer reserved for normal VLANs.

- Flexible Frame Relay (flexible-frame-relay)—IQ and IQE interfaces can use flexible Frame Relay encapsulation. You use flexible Frame Relay encapsulation when you want to configure multiple per-unit Frame Relay encapsulations. This encapsulation type allows you to configure any combination of TCC, CCC, and standard Frame Relay encapsulations on a single physical port. Also, each logical interface can have any data-link connection identifier (DLCI) value from 1 through 1022.
- Frame Relay (frame-relay)—Defined in RFC 1490, *Multiprotocol Interconnect over Frame Relay*. E1, E3, link services, SONET/SDH, T1, T3, and voice services interfaces can use Frame Relay encapsulation. Five related versions are supported:
  - CCC version (frame-relay-ccc)—The same as standard Frame Relay for DLCIs 0 through 511. DLCIs 512 through 1022 are dedicated to CCC. The logical interface must also have frame-relay-ccc encapsulation. When you use this encapsulation type, you can configure the ccc family only.
  - TCC version (frame-relay-tcc)—Similar to Frame Relay CCC and has the same configuration restrictions, but used for circuits with different media on either side of the connection.
  - Extended CCC version (extended-frame-relay-ccc)—This encapsulation type allows you to dedicate DLCIs 1 through 1022 to CCC. The logical interface must have frame-relay-ccc encapsulation. When you use this encapsulation type, you can configure the ccc family only.
  - Extended TCC version (extended-frame-relay-tcc)—Similar to extended Frame Relay CCC, this encapsulation type allows you to dedicate DLCIs 1 through 1022 to TCC, which is used for circuits with different media on either side of the connection.
  - Port CCC version (frame-relay-port-ccc)—Defined in the IETF document *Frame Relay Encapsulation over Pseudo-Wires* (expired December 2002). This encapsulation type allows you to transparently carry all the DLCIs between two customer edge (CE) routers without explicitly configuring each DLCI on the two provider edge (PE) routers with Frame Relay transport. The connection between the two CE routers can be either user-to-network interface (UNI) or network-to-network interface (NNI); this is completely transparent to the PE routers. The logical interface does not require an encapsulation statement. When you use this encapsulation type, you can configure the ccc family only.
- Frame Relay Ether Type (frame-relay-ether-type)—Physical interfaces can use Frame Relay ether type encapsulation for compatibility with Cisco Frame Relay. IETF frame relay encapsulation identifies the payload format using NLPID and SNAP formats. Cisco-compatible Frame Relay encapsulation uses the Ethernet type to identify the type of payload. Two related versions are supported:
  - TCC version (frame-relay-ether-type-tcc)—Cisco-compatible Frame Relay for DLCIs 0 through 511. DLCIs 512 through 1022 are dedicated to TCC. This numbering restriction does not apply to IQ interfaces. This encapsulation is used for circuits with different media on either side of the connection.

- Extended TCC version (extended-frame-relay-ether-type-tcc)—This encapsulation allows you to dedicate Cisco-compatible Frame Relay TCC for DLCIs 1 through 1022. This encapsulation is used for circuits with different media on either side of the connection.

- Multilink Frame Relay (MLFR) UNI and NNI (multilink-frame-relay-uni-nni)—Link services and voice services interfaces functioning as FRF.16 bundles can use multilink Frame Relay UNI NNI encapsulation. This encapsulation is also used on link services and voice services interfaces' constituent T1, E1, or *N*xDS0 interfaces.
- PPP—Defined in RFC 1661, *The Point-to-Point Protocol (PPP) for the Transmission of Multiprotocol Datagrams over Point-to-Point Links*. PPP is the default encapsulation type for physical interfaces. E1, E3, SONET/SDH, T1, and T3 interfaces can use PPP encapsulation. Two related versions are supported:
  - Circuit cross-connect (CCC) version (ppp-ccc)—The logical interface does not require an encapsulation statement. When you use this encapsulation type, you can configure the ccc family only.
  - Translational cross-connect (TCC) version (ppp-tcc)—Similar to CCC and has the same configuration restrictions, but used for circuits with different media on either side of the connection.

NOTE: When the encapsulation type is set to Cisco-compatible Frame Relay encapsulation, ensure that the LMI type is set to ANSI or Q933-A.

Encapsulation Capabilities

When you configure a point-to-point encapsulation (such as PPP or Cisco HDLC) on a physical interface, the physical interface can have only one logical interface (that is, only one unit statement) associated with it. When you configure a multipoint encapsulation (such as Frame Relay), the physical interface can have multiple logical units, and the units can be either point-to-point or multipoint.

Ethernet CCC encapsulation for Ethernet interfaces with standard TPID tagging requires that the physical interface have only a single logical interface. Ethernet interfaces in VLAN mode can have multiple logical interfaces.

For Ethernet interfaces in VLAN mode, VLAN IDs are applicable as follows:

- VLAN ID 0 is reserved for tagging the priority of frames.
- For encapsulation type vlan-ccc, VLAN IDs 1 through 511 are reserved for normal VLANs. VLAN IDs 512 and above are reserved for VLAN CCCs.
- For encapsulation type vlan-vpls, VLAN IDs 1 through 511 are reserved for normal VLANs, and VLAN IDs 512 through 4094 are reserved for VPLS VLANs. For 4-port Fast Ethernet interfaces, you can use VLAN IDs 512 through 1024 for VPLS VLANs.
- For Gigabit Ethernet interfaces and Gigabit Ethernet IQ and IQE PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform), you can configure flexible Ethernet services encapsulation

on the physical interface. For interfaces with flexible-ethernet-services encapsulation, all VLAN IDs are valid. VLAN IDs from 1 through 511 are not reserved.

- For encapsulation types extended-vlan-ccc and extended-vlan-vpls, all VLAN IDs are valid.

The upper limits for configurable VLAN IDs vary by interface type. For more information, see “Configuring 802.1Q VLANs” on page 569.

When you configure a TCC encapsulation, some modifications are needed to handle VPN connections over unlike Layer 2 and Layer 2.5 links and terminate the Layer 2 and Layer 2.5 protocol locally.

The routing platform performs the following media-specific changes:

- PPP TCC—Both Link Control Protocol (LCP) and Network Control Protocol (NCP) are terminated on the routing platform. Internet Protocol Control Protocol (IPCP) IP address negotiation is not supported. The JUNOS software strips all PPP encapsulation data from incoming frames before forwarding them. For output, the next hop is changed to PPP encapsulation.
- Cisco HDLC TCC—Keepalive processing is terminated on the routing platform. The JUNOS software strips all Cisco HDLC encapsulation data from incoming frames before forwarding them. For output, the next hop is changed to Cisco HDLC encapsulation.
- Frame Relay TCC—All Local Management Interface (LMI) processing is terminated on the routing platform. The JUNOS software strips all Frame Relay encapsulation data from incoming frames before forwarding them. For output, the next hop is changed to Frame Relay encapsulation.
- ATM—Operation, Administration, and Maintenance (OAM) and Interim Local Management Interface (ILMI) processing is terminated at the routing platform. Cell relay is not supported. The JUNOS software strips all ATM encapsulation data from incoming frames before forwarding them. For output, the next hop is changed to ATM encapsulation.

Example: Configuring the Encapsulation on a Physical Interface

Configure PPP encapsulation on a SONET/SDH interface. The second and third family statements allow Intermediate System-to-Intermediate System (IS-IS) and MPLS to run on the interface.

```
[edit interfaces]
so-7/0/0 {
  encapsulation ppp;
  unit 0 {
    point-to-point;
    family inet {
      address 192.168.1.113/32 {
        destination 192.168.1.114;
      }
    }
    family iso;
```

```
        family mpls;
    }
}
```

Configuring the PPP Challenge Handshake Authentication Protocol

For interfaces with PPP encapsulation, you can configure interfaces to support the PPP Challenge Handshake Authentication Protocol (CHAP), as defined in RFC 1994, *PPP Challenge Handshake Authentication Protocol (CHAP)*. When you enable CHAP on an interface, the interface can authenticate its peer and can be authenticated by its peer.

By default, PPP CHAP is disabled. If CHAP is not explicitly enabled, the interface makes no CHAP challenges and denies all incoming CHAP challenges. To enable CHAP, you must create an access profile, and you must configure the interfaces to use CHAP.

To configure a CHAP access profile, include the profile statement and specify a profile name at the [edit access] hierarchy level:

```
[edit access]
profile profile-name {
    client name chap-secret data;
}
```

For more information about configuring access profiles, see the *JUNOS System Basics Configuration Guide*.

When you configure an interface to use CHAP, you must assign an access profile to the interface. When an interface receives CHAP challenges and responses, the access profile in the packet is used to look up the shared secret, as defined in RFC 1994.

If no matching access profile is found for the CHAP challenge that was received by the interface, the optionally configured default CHAP secret is used. The default CHAP secret is useful if the CHAP name of the peer is unknown, or if the CHAP name changes during PPP link negotiation.

To configure PPP CHAP on an interface with PPP encapsulation, include the chap statement at the [edit interfaces *interface-name* ppp-options] hierarchy level:

```
[edit interfaces interface-name ppp-options]
chap {
    access-profile name;
    default-chap-secret name;
    local-name name;
    passive;
}
```

On each interface with PPP encapsulation, you can configure the following PPP CHAP properties:

- Assigning an Access Profile to an Interface on page 107
- Configuring a Default CHAP Secret on page 107

When you configure PPP over ATM or Multilink PPP over ATM encapsulation, you can enable CHAP on the logical interface. For more information, see "Configuring PPP over ATM2 Encapsulation" on page 320.

Assigning an Access Profile to an Interface

To assign an access profile to an interface, include the access-profile statement at the [edit interfaces *interface-name* ppp-options chap] hierarchy level:

```
[edit interfaces interface-name ppp-options chap]
access-profile name;
```

You must include the access-profile statement when you configure the CHAP authentication method. If an interface receives a CHAP challenge or response from a peer that is not in the applied access profile, the link is immediately dropped unless a default CHAP secret has been configured. For information about configuring the default CHAP secret, see "Configuring a Default CHAP Secret" on page 107.

Configuring a Default CHAP Secret

To configure a default CHAP secret for an interface, include the default-chap-secret statement at the [edit interfaces *interface-name* ppp-options chap] hierarchy level:

```
[edit interfaces interface-name ppp-options chap]
default-chap-secret name;
```

The default CHAP secret is used when no matching CHAP access profile exists, or if the CHAP name changes during PPP link negotiation.

Configuring the Local Name

By default, when CHAP is enabled on an interface, the interface uses the routing platform's system hostname as the name sent in CHAP challenge and response packets.

To configure the name the interface uses in CHAP challenge and response packets, include the local-name statement at the [edit interfaces *interface-name* ppp-options chap] hierarchy level:

```
[edit interfaces interface-name ppp-options chap]
local-name name;
```

The local name is any string from 1 to 250 characters in length, starting with an alphanumeric or underscore character, and including only the following characters:

```
a-z A-Z 0-9 % @ # / \ . _ -
```

Configuring Passive Mode

By default, when CHAP is enabled on an interface, the interface always challenges its peer and responds to challenges from its peer.

You can configure the interface not to challenge its peer, and only respond when challenged. To configure the interface not to challenge its peer, include the passive statement at the [edit interfaces *interface-name* ppp-options chap] hierarchy level:

```
[edit interfaces interface-name ppp-options chap]
passive;
```

Example: Configuring the PPP Challenge Handshake Authentication Protocol

Configure CHAP:

```
[edit access]
profile pe-A-ppp-clients;
client cpe-1 chap-secret "$1$dQYsZ$B5ojUeUjDsUo.yKwcCZ0";
          # SECRET-DATA
client cpe-2 chap-secret "$1$kdAsfaDAfkdjDsASxfafdKdFKJ";
          # SECRET-DATA
[edit interfaces so-1/2/0]
encapsulation ppp;
ppp-options {
  chap {
    access-profile pe-A-ppp-clients;
    default-chap-secret "$9$mPafafhdsaiufhyrv1Rxd";
    local-name "pe-A-so-1/1/1";
  }
}
[edit interfaces so-1/1/2]
encapsulation ppp;
ppp-options {
  chap {
    access-profile pe-A-ppp-clients;
    default-chap-secret "$9$mPafafhdsaiufhyrv1Rxd";
    local-name “pe-A-so-1/1/2";
  }
}
```

Configuring the PPP Password Authentication Protocol

For interfaces with PPP encapsulation, you can configure interfaces to support the Password Authentication Protocol (PAP), as defined in RFC 1334, *PAP Authentication Protocols*. If authentication is configured, the PPP link negotiates using CHAP or PAP protocol for authentication during the Link Control Protocol (LCP) negotiation phase. PAP is only performed after the link establishment phase (LCP up) portion of the authentication phase.

During authentication, the PPP link sends a PAP authentication-request packet to the peer with an ID and password. The authentication-request packet is sent every

2 seconds, similar to the CHAP challenge, until a response is received (acknowledgment packet, nonacknowledgment packet). If an acknowledgment packet is received, the PPP link transitions to the next state, the network phase. If a nonacknowledgment packet is received, an LCP terminate request is sent, and the PPP link goes back to the link establishment phase. If no response is received, and an optional retry counter is set to true, a new request acknowledgment packet is resent. If the retry counter expires, the PPP link transitions to the LCP negotiate phrase.

You can configure the PPP link with PAP in passive mode. By default, when PAP is enabled on an interface, the interface always sends authenticate-request packets to the peer, and requires that the peer acknowledge the authenticate-request packets. In passive mode, the router with the PPP link configured for PAP authenticates any incoming connections, but will not require the peer to authenticate its connection.

Both CHAP and PAP authentication can be configured on a PPP interface. If both are configured, CHAP is negotiated first. If CHAP authentication fails, PAP authentication is negotiated.

To enable PAP, you must create an access profile, and you must configure the interfaces to use PAP.

To configure a PAP access profile, include the profile statement and specify a profile name at the [edit access] hierarchy level:

```
[edit access]
profile profile-name {
    client name;
    pap-password password;
}
```

For more information about configuring access profiles, see the *JUNOS System Basics Configuration Guide*.

When you configure an interface to use PAP, you must assign an access profile to the interface. When an interface receives PAP authentication requests, the access profile in the packet is used to look up the password.

If no matching access profile is found for the PAP authentication request that was received by the interface, the optionally configured default PAP password is used. For information about configuring the default PAP password, see “Configuring PPP PAP Authentication” on page 155.

To configure PPP PAP on a physical interface with PPP encapsulation, include the pap statement at the [edit interfaces *interface-name* ppp-options] hierarchy level:

```
[edit interfaces interface-name ppp-options]
pap {
    access-profile name;
    local-name name;
    local-password password;
    passive;
}
```

To configure PPP PAP on a logical interface with PPP encapsulation, include the pap statement with options:

```
pap {
    default-pap-password password;
    local-name name;
    local-password password;
    passive;
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

For more information about configuring PAP for logical interfaces, see "Configuring PPP PAP Authentication" on page 155. For information about configuring tracing operations for PPP, see "Tracing Operations of the pppd Process" on page 113.

On each physical interface with PPP encapsulation, you can perform one of the following tasks:

Configuring the Local Name

By default, when PAP is enabled on an interface, the interface uses the routing platform's system hostname as the name sent in PAP request and response packets.

To configure the name the interface uses in PAP request and response packets, include the local-name statement at the [edit interfaces *interface-name* ppp-options pap] hierarchy level:

```
[edit interfaces interface-name ppp-options pap]
local-name name;
```

Configuring the Local Password

You need to configure the password to be used for authentication. To configure the host password for sending PAP requests, include the local-password statement at the [edit interfaces *interface-name* ppp-options pap] hierarchy level:

```
local-password password;
```

Configuring Passive Mode

By default, when PAP is enabled on an interface, the interface always sends authenticate-request packets to the peer, and requires that the peer acknowledge the authenticate-request packets. However, some peer routers may not support bidirectional authentication. In these cases, you can instead configure PAP to operate in passive mode. In passive mode, the router with the PPP link configured for PAP authenticates any incoming connections, but will not require the peer to authenticate its connection.

To configure the interface to authenticate with PAP in passive mode, include the passive statement at the [edit interfaces *interface-name* ppp-options pap] hierarchy level:

```
[edit interfaces interface-name ppp-options pap]
passive;
```

Example: Configuring PAP Authentication Protocol

Configure a PAP access profile, the physical and logical interfaces, and tracing operations for PPP.

For PAP authentication, a username and password for the peer is configured in the access profile, along with a PAP password. Each user can have either a PAP password or a CHAP secret.

```
[edit access]
profile userlist1;
client {
   papuser {
      pap-password "#%@^***"; # SECRET-DATA;
   }
   chapuser {
      chap-secret "#%@^***"; # SECRET-DATA;
   }
}
```

To configure the same name for the PAP password and the CHAP secret, configure the client with two different access profiles:

```
[edit access]
profile chap-profile;
client {
   sjcrouter {
      chap-secret "#%@^***"; # SECRET-DATA;
   }
   boston {
      chap-secret "#%@^***"; # SECRET-DATA;
   }
}
profile pap-profile;
client {
   sjcrouter {
```

```
        pap-password "#%@^***"; # SECRET-DATA;
    }
    boston {
        pap-password "#%@^***"; # SECRET-DATA;
    }
}
```

Configure the physical interface, including the access profile name to be used for PPP authentication:

```
[edit interfaces so-0/0/0]
ppp-options {
    pap {
        access-profile “pap-profile”;
        local-name "rtrnum1";
        local-password "XXXXXXX"; #SECRET-DATA
        passive;
    }
}
```

Configure the logical interface, including the default PAP password to be used, should the access profile not be located during authentication:

```
[edit interfaces so-0/0/0]
encapsulation frame-relay;
unit 0 {
    dlci 100;
    encapsulation frame-relay-ppp;
    ppp-options {
        pap {
            local-name "rtrnum1";
            local-password "XXXXXXX"; #SECRET-DATA
            default-pap-password "XXXXX"; #SECRET-DATA
            passive;
        }
    }
}
```

Include the pap statement to trace PPP protocol operations:

```
[edit protocols]
ppp {
    traceoptions {
        flag {
            pap;
        }
    }
}
```

Monitoring a PPP Session

You can monitor PPP packet exchanges. When monitoring is enabled, packets exchanged during a session are logged by default to /var/log/pppd, or to the file specified in the traceoptions statement.

To configure PPP packet monitoring, include the monitor-session statement at the [edit protocols ppp] hierarchy level:

```
[edit protocols ppp]
monitor-session (interface-name | all);
```

When monitoring is configured, the operational mode commands show ppp summary and show ppp interface display a Monitored flag in the Session flags column or line.

Tracing Operations of the pppd Process

To trace the operations of the routing platform's pppd process, include the traceoptions statement at the [edit protocols ppp] hierarchy level:

```
[edit protocols ppp]
traceoptions {
  file filename <files number> <match regular-expression> <size size> <world-readable |
    no-world-readable>;
  flag flag;
  level severity-level;
  no-remote-trace;
}
```

To specify more than one tracing operation, include multiple flag statements.

You can specify the following flags in the traceoptions statement:

- access—Access code
- address-pool—Address pool code
- all—All areas of code
- auth—Authentication code
- chap—Challenge Handshake Authentication Protocol (CHAP) code
- config—Configuration code
- ifdb—Interface database code
- lcp—LCP state machine code
- memory—Memory management code
- message—Message processing code
- ncp—NCP state machine code
- pap—Password Authentication Protocol (PAP) code
- ppp—PPP protocol processing code
- radius—RADIUS processing code
- rtsock—Routing socket code
- session—Session management code
- signal—Signal handling code

- timer—Timer code
- ui—User interface code

For general information about tracing, see the tracing and logging information in the *JUNOS System Basics Configuration Guide*.

Configuring PPP Address and Control Field Compression

For interfaces with PPP, PPP CCC, or PPP TCC encapsulation, you can configure compression of the Data Link Layer address and control fields, as defined in RFC 1661, *The Point-to-Point Protocol (PPP)*. By default, the address and control fields are not compressed. This means PPP-encapsulated packets are transmitted with two 1-byte fields (0xff and 0x03). If you configure address and control field compression (ACFC) and ACFC is successfully negotiated with the local router's peer, the local router transmits packets without these 2 bytes. ACFC allows you to conserve bandwidth by transmitting less data.

On M320, M120, and T-series routing platforms, ACFC is not supported for any ISO family protocols. Do not include the acfc statement at the [edit interfaces *interface-name* ppp-options compression] hierarchy level when you include the family iso statement at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level.

NOTE: The address and control fields cannot be compressed in Link Control Protocol (LCP) packets.

The PPP session restarts when you configure or modify compression options.

To configure ACFC, include the compression statement at the [edit interfaces *interface-name* ppp-options] hierarchy level, and specify acfc:

```
[edit interfaces interface-name ppp-options]
compression acfc;
```

This configuration causes the local router to try to negotiate ACFC with its peer. If ACFC is successfully negotiated, the local router sends packets with compressed address and control fields. When you include the compression acfc statement in the configuration, the PPP session restarts, and the local router sends the ACFC option in the LCP Configure-Request packet. The ACFC option informs the local router's peer that the local router can receive packets with compression. If the peer indicates that it, too, can receive packets with compression, then ACFC is negotiated. If ACFC is successfully negotiated, the local router can receive packets with or without the address and control bytes included.

To monitor the configuration, issue the show interfaces *interface-name* command. Configured options are displayed in the link flags field for the physical interface. Successfully negotiated options are displayed in the flags field for the logical interface. In this example, both ACFC and PFC are configured, but neither compression feature has been successfully negotiated.

```
user@router# run show interfaces so-0/1/1
Physical interface: so-0/1/1, Enabled, Physical link is Up
 Interface index: 133, SNMP ifIndex: 27
 Link-level type: PPP, MTU: 4474, Clocking: Internal, SONET mode, Speed: OC3,
Loopback: None, FCS: 16
  Payload scrambler: Enabled
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps 16384
  Link flags     : No-Keepalives ACFC PFC
  LCP state: Opened
  NCP state: inet: Opened, inet6: Not-configured, iso: Not-configured, mpls:
Not-configured
  CHAP state: Not-configured
  CoS queues     : 4 supported
  Last flapped   : 2004-12-29 10:49:32 PST (00:18:35 ago)
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)
  SONET alarms   : None
  SONET defects  : None
  Logical interface so-0/1/1.0 (Index 68) (SNMP ifIndex 169)
    Flags: Point-To-Point SNMP-Traps ACFC Encapsulation: PPP
    Protocol inet, MTU: 4470
      Flags: None
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 3.3.3/24, Local: 3.3.3.2, Broadcast: 3.3.3.255
```

Configuring the PPP Protocol Field Compression

For interfaces with PPP, PPP CCC, or PPP TCC encapsulation, you can configure protocol field compression. By default, the protocol field is not compressed. This means PPP-encapsulated packets are transmitted with a two-byte protocol field. For example, IPv4 packets are transmitted with the protocol field set to 0x0021, and MPLS packets are transmitted with the protocol field set to 0x0281.

For all protocols with identifiers in the range 0x0000 through 0x00ff, you can configure the router to compress the protocol field to one byte, as defined in RFC 1661, *The Point-to-Point Protocol (PPP)*. Protocol field compression (PFC) allows you to conserve bandwidth by transmitting less data.

NOTE: The protocol field cannot be compressed in Link Control Protocol (LCP) packets.

The PPP session restarts when you configure or modify compression options.

To configure PFC, include the compression statement at the [edit interfaces *interface-name* ppp-options] hierarchy level, and specify pfc:

```
[edit interfaces interface-name ppp-options]
compression pfc;
```

This configuration causes the local router to try to negotiate PFC with its peer. If PFC is successfully negotiated, the local router sends packets with compressed protocol fields. When you include the compression pfc statement in the configuration, the PPP session restarts, and the local router sends the PFC option in the LCP

Configure-Request packet. The PFC option informs the local router's peer that the local router can receive packets with compression. If the peer indicates that it, too, can receive packets with compression, then PFC is negotiated. If PFC is successfully negotiated, the local router can receive packets with either 2-byte (uncompressed) or 1-byte (compressed) protocol fields.

To monitor the configuration, issue the show interfaces *interface-name* command. Configured options are displayed in the link flags field for the physical interface. Successfully negotiated options are displayed in the flags field for the logical interface. In this example, both ACFC and PFC are configured, but neither compression feature has been successfully negotiated.

```
user@router# run show interfaces so-0/1/1
Physical interface: so-0/1/1, Enabled, Physical link is Up
  Interface index: 133, SNMP ifIndex: 27
  Link-level type: PPP, MTU: 4474, Clocking: Internal, SONET mode, Speed: OC3,
Loopback: None, FCS: 16,
  Payload scrambler: Enabled
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps 16384
  Link flags     : No-Keepalives ACFC PFC
  LCP state: Opened
  NCP state: inet: Opened, inet6: Not-configured, iso: Not-configured, mpls:
Not-configured
  CHAP state: Not-configured
  CoS queues     : 4 supported
  Last flapped   : 2004-12-29 10:49:32 PST (00:18:35 ago)
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)
  SONET alarms   : None
  SONET defects  : None
  Logical interface so-0/1/1.0 (Index 68) (SNMP ifIndex 169)
    Flags: Point-To-Point SNMP-Traps ACFC Encapsulation: PPP
    Protocol inet, MTU: 4470
      Flags: None
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 3.3.3/24, Local: 3.3.3.2, Broadcast: 3.3.3.255
```

Configuring the Interface Speed

You can configure the interface speed on the following interfaces:

- Management Ethernet Interface on M-series and T-series Routing Platforms on page 116
- Gigabit Ethernet Interfaces on J-series Services Routers on page 117
- Fast Ethernet Interface on page 117
- Tri-Rate Ethernet Copper Interface on page 118
- SONET/SDH Interface on page 118

Management Ethernet Interface on M-series and T-series Routing Platforms

By default, the M-series and T-series routing platforms management Ethernet interface, fxp0, autonegotiates whether to operate at 10 megabits per second (Mbps) or

100 Mbps. All other interfaces automatically choose the correct speed based on the PIC type and whether the PIC is configured to operate in multiplexed mode (using the no-concatenate statement in the [edit chassis] configuration hierarchy, as described in the *JUNOS System Basics Configuration Guide*).

To configure the management Ethernet interface to operate at 10 Mbps or 100 Mbps, include the speed statement at the [edit interfaces fxp0] hierarchy level:

```
[edit interfaces fxp0]
speed (10m | 100m);
```

For information about configuring the link mode, see "Configuring the Link Characteristics on Ethernet Interfaces" on page 564.

NOTE: The fxp0 interface does not support CoS.

Gigabit Ethernet Interfaces on J-series Services Routers

By default, Gigabit Ethernet interfaces (both built-in and PIMs) for J-series Services Routers autonegotiate whether to operate at 10 megabits per second (Mbps), 100 Mbps, or 1000 Mbps.

To configure a J-series Gigabit Ethernet interface to operate at 10 Mbps, 100 Mbps, or 1000 Mbps, include the speed statement at the [edit interfaces ge-*pim*/0/*port*] hierarchy level:

```
[edit interfaces ge-pim/0/port]
speed (10m | 100m | 1g);
```

For information about configuring the link mode, see "Configuring the Link Characteristics on Ethernet Interfaces" on page 564.

Fast Ethernet Interface

By default, both of the built-in Fast Ethernet ports on the M7i router FIC autonegotiate whether to operate at 10 Mbps or 100 Mbps. All other interfaces automatically choose the correct speed based on the PIC type and whether the PIC is configured to operate in multiplexed mode (using the no-concatenate statement at the [edit chassis] hierarchy level, as described in the *JUNOS System Basics Configuration Guide*).

If the link partner does not support autonegotiation, configure either Fast Ethernet port manually to match its link partner's speed and link mode. When the link mode is configured, autonegotiation is disabled.

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

To configure a Fast Ethernet port on the FIC to operate at 10 Mbps or 100 Mbps, include the speed statement at the [edit interfaces fe-*fpc/pic/port*] hierarchy level:

```
[edit interfaces fe-fpc/pic/port]
speed (10m | 100m);
```

For information about configuring the link mode, see "Configuring the Link Characteristics on Ethernet Interfaces" on page 564.

Tri-Rate Ethernet Copper Interface

By default, the Tri-Rate Ethernet copper interfaces on MX-series routers operate at 1 Gbps. Tri-Rate Ethernet copper interfaces can also be configured to operate at 10 Mbps, 100 Mbps, or 1 Gbps.

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

NOTE: Half-duplex mode is not supported on Tri-Rate Ethernet copper interfaces.

To configure a Tri-Rate Ethernet copper interface to operate at 10 Mbps, 100 Mbps, or 1 Gbps, include the speed statement at the [edit interfaces ge-*fpc/pic/port*] hierarchy level:

```
[edit interfaces ge-fpc/pic/port]
speed (10m | 100m | 1g);
```

For information about configuring the link mode, see "Configuring the Link Characteristics on Ethernet Interfaces" on page 564.

SONET/SDH Interface

You can configure the speed of SONET/SDH interfaces on next-generation SONET/SDH Type 1 and Type 2 PICs with SFP. The speed you select is dependent upon whether the PIC is in concatenated or nonconcatenated mode. In concatenated mode, the bandwidth of the interface is in a single channel. In nonconcatenated mode, the PIC operates in channelized (multiplexed) mode.

Table 18 on page 118 shows the mode combinations for the next-generation SONET/SDH Type 1 PICs with SFP.

Table 18: Type 1 PIC Mode Combinations

PIC	Mode	Speed Configuration	Default Mode
2-port OC3	2xOC3 concatenated	*fpc/pic/*0 speed oc3	concatenated
4-port OC3	1xOC12 concatenated	*fpc/pic/*0 speed oc12	—

Table 18: Type 1 PIC Mode Combinations *(continued)*

PIC	Mode	Speed Configuration	Default Mode
	1xOC12 nonconcatenated	*fpc/pic/*0:0 speed oc3	nonconcatenated
	4xOC3 concatenated	*fpc/pic/port* speed oc3	concatenated
1-port OC12	1xOC12 concatenated	*fpc/pic/*0 speed oc12	concatenated
	1xOC12 nonconcatenated	*fpc/pic/*0:0 speed oc3	nonconcatenated
	1xOC3 concatenated	*fpc/pic/*0 speed oc3	—

Table 19 on page 119 shows the mode combinations for the next-generation SONET/SDH Type 2 PICs with SFP.

Table 19: Type 2 PIC Mode Combinations

PIC	Mode	Speed Configuration	Default Mode
1-port OC48, IQ and IQE	1xOC48 concatenated	*fpc/pic/*0 speed oc48	concatenated
	1xOC48 nonconcatenated	*fpc/pic/*0:0 speed oc12	nonconcatenated
	1xOC12 concatenated	*fpc/pic/*0 speed oc12	—
	1xOC12 nonconcatenated	*fpc/pic/*0 0 speed oc3	—
	1xOC3 concatenated	*fpc/pic/*0 speed oc3	—
4-port OC12, IQ and IQE	1xOC48 concatenated	*fpc/pic/*0 speed oc48	—
	1xOC48 nonconcatenated	*fpc/pic/*0:0 speed oc12	nonconcatenated
	1xOC12 nonconcatenated	*fpc/pic/*0 speed oc3	—
	4xOC12 concatenated	*fpc/pic/port* speed oc3|oc12	concatenated
4-port OC3, IQ and IQE	1xOC12 concatenated	*fpc/pic/*0 speed oc12	—
	1xOC12 nonconcatenated	*fpc/pic/*0:0 speed oc3	nonconcatenated
	4xOC3 concatenated	*fpc/pic/port* speed oc3	concatenated

By default, SONET/SDH PICs operate in concatenated mode. To specify interface speed in concatenated mode, include the speed statement with options at the [edit interfaces so-*fpc/pic/port*] hierarchy level:

```
[edit interfaces so-fpc/pic/port]
speed (oc3 | oc12 | oc48);
```

For example, each port of the 4-port OC12 PIC can be configured to be in OC3 or OC12 speed independently when this PIC is in 4xOC12 concatenated mode.

To specify interface speed in nonconcatenated mode, include the speed statement at the [edit interfaces so-*fpc/pic/port.channel*] hierarchy level:

```
[edit interfaces so-fpc/pic/port.channel]
speed (oc3 | oc12);
```

To configure the PIC to operate in channelized (multiplexed) mode, include the no-concatenate statement at the [edit chassis fpc *slot-number* pic *pic-number*] hierarchy level.

For more information about using the no-concatenate statement, see the *JUNOS System Basics Configuration Guide*.

Configuring Keepalives

By default, physical interfaces configured with Cisco HDLC or PPP encapsulation send keepalive packets at 10-second intervals. The Frame Relay term for keepalives is LMI packets; the JUNOS software supports both ANSI T1.617 Annex D LMIs and ITU Q933 Annex A LMIs. On ATM networks, OAM cells perform the same function. You configure OAM cells at the logical interface level; for more information, see “Defining the ATM OAM F5 Loopback Cell Period” on page 315.

To disable the sending of keepalives on a physical interface, include the no-keepalives statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
no-keepalives;
```

To disable the sending of keepalives on a physical interface configured with Cisco HDLC encapsulation for a translational cross-connection, include the no-keepalives statement at the [edit interfaces *interface-name* encapsulation cisco-hdlc-tcc] hierarchy level:

```
[edit interfaces interface-name]
encapsulation cisco-hdlc-tcc {
    no-keepalives;
}
```

For more information about translation cross-connections, see “Configuring Circuit and Translational Cross-Connects” on page 213.

When you configure PPP over ATM or Multilink PPP over ATM encapsulation, you can enable or disable keepalives on the logical interface. For more information, see “Configuring PPP over ATM2 Encapsulation” on page 320.

To explicitly enable the sending of keepalives on a physical interface, include the keepalives statement at the [edit interfaces *interface-name*] hierarchy level:

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

To change one or more of the default keepalive values, include the appropriate option at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
keepalives <interval seconds> <down-count number> <up-count number>;
```

On interfaces configured with Cisco HDLC or PPP encapsulation, you can include the following three keepalive statements; note that Frame Relay encapsulation is not affected by these statements:

- interval *seconds*—The time in seconds between successive keepalive requests. The range is from 1 second through 32767 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 from 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 from 1 through 255, with a default of 1.

WARNING: If interface keepalives are configured on an interface that does not support the keepalives configuration statement (for example, 10-Gigabit Ethernet), the link layer may go down when the PIC is restarted. Avoid configuring the keepalives on interfaces that do not support the keepalives configuration statement.

For information about Frame Relay keepalive settings, see "Configuring Frame Relay Keepalives" on page 364.

Configuring the Clock Source

For both the router and interfaces, the clock source can be the router's internal Stratum 3 clock, which resides on the System Control Board (SCB), the System and Switch Board (SSB), the Forwarding Engine Board (FEB), or the Miscellaneous Control Subsystem (MCS) (depending on the router model), or an external clock that is received on the interface. By default, the 19.44-MHz Stratum 3 reference clock generates the clock signal for all serial PICs (SONET/SDH) and Plesiochronous Digital Hierarchy (PDH) PICs. PDH PICs include DS3, E3, T1, and E1 PICs.

For example, interface A can transmit on interface A's received clock (external, loop timing) or the Stratum 3 clock (internal, line timing or normal timing). Interface A cannot use a clock from any other source. For interfaces such as SONET/SDH that can use different clock sources, you can configure the source of the transmit clock on each interface.

To set the clock source, include the clocking statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
clocking (external | internal);
```

For information about clocking on channelized interfaces, see "Clock Sources on Channelized Interfaces" on page 376. Also see "Configuring Channelized IQ and IQE SONET/SDH Loop Timing" on page 806 and "Configuring the Channelized T3 Loop Timing" on page 546. For information about configuring an external synchronization interface that can be used to synchronize the internal Stratum 3 clock to an external source on the M320 and M120 routing platforms, see "Configuring an External Synchronization Interface" on page 60.

Configuring the Router as a DCE

By default, when you configure an interface with Frame Relay encapsulation, the routing platform is assumed to be data terminal equipment (DTE). That is, the routing platform is assumed to be at a terminal point on the network. To configure the routing platform to be data circuit-terminating equipment (DCE), include the dce statement at the [edit interfaces *interface-name*] hierarchy level:

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

When you configure the routing platform to be a DCE, keepalives are disabled by default.

For back-to-back Frame Relay connections, either disable the sending of keepalives on both sides of the connection, or configure one side of the connection as a DTE (the default JUNOS configuration) and the other as a DCE.

Configuring Receive and Transmit Leaky Bucket Properties

Congestion control is particularly difficult in high-speed networks with high volumes of traffic. When congestion occurs in such a network, it is usually too late to react. You can avoid congestion by regulating the flow of packets into your network. Smoother flows prevent bursts of packets from arriving at (or being transmitted from) the same interface and causing congestion.

For all interface types except ATM, channelized E1, E1, Fast Ethernet, Gigabit Ethernet, and channelized IQ, you can configure leaky bucket properties, which allow you to limit the amount of traffic received on and transmitted by a particular interface. You effectively specify what percentage of the interface's total capacity can be used to receive or transmit packets. You might want to set leaky bucket properties to limit the traffic flow from a link that is known to transmit high volumes of traffic.

NOTE: Instead of configuring leaky bucket properties, you can limit traffic flow by configuring policers. Policers work on all interfaces. For more information, see "Applying Policers" on page 185 and the *JUNOS Policy Framework Configuration Guide*.

The leaky bucket is used at the host-network interface to allow packets into the network at a constant rate. Packets might be generated in a bursty manner, but after they pass through the leaky bucket, they enter the network evenly spaced. In some cases, you might want to allow short bursts of packets to enter the network without smoothing them out. By controlling the number of packets that can accumulate in the bucket, the threshold property controls burstiness. The maximum number of packets entering the network in *t* time units is threshold + rate * *t*.

By default, leaky buckets are disabled, and the interface can receive and transmit packets at the maximum line rate.

To configure leaky bucket properties, include one or both of the receive-bucket and transmit-bucket statements at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
receive-bucket {
   overflow (discard | tag);
   rate percentage;
   threshold bytes;
}
transmit-bucket {
   overflow discard;
   rate percentage;
   threshold bytes;
}
```

In the rate statement, specify the percentage of the interface line rate that is available to receive or transmit packets. The percentage can be a value from 0 (none of the interface line rate is available) to 100 (the maximum interface line rate is available). For example, when you set the line rate to 33, the interface receives or transmits at one-third of the maximum line rate.

In the threshold statement, specify the bucket threshold, which controls the burstiness of the leaky bucket mechanism. The larger the value, the more bursty the traffic, which means that over a very short time the interface can receive or transmit close to line rate, but the average over a longer time is at the configured bucket rate. The threshold can be a value from 0 through 65,535 bytes. For ease of entry, you can enter *number* either as a complete decimal number or as a decimal number followed by the abbreviation k (1,000). For example, the entry threshold 2k corresponds to a threshold of 2,000 bytes.

In the overflow statement, specify how to handle packets that exceed the threshold:

- tag (receive bucket only)—Tag, count, and process received packets that exceed the threshold.
- discard—Discard received packets that exceed the threshold. No counting is done.

Configuring Accounting for the Physical Interface

Juniper Networks routing platforms can collect various kinds of data about traffic passing through the routing platform. You can set up one or more *accounting profiles* that specify some common characteristics of this data, including the following:

- The fields used in the accounting records
- The number of files that the routing platform retains before discarding, and the number of bytes per file
- The polling period that the system uses to record the data

You configure the profiles and define a unique name for each profile using statements at the [edit accounting-options] hierarchy level. There are two types of accounting profiles: interface profiles and filter profiles. You configure interface profiles by including the interface-profile statement at the [edit accounting-options] hierarchy level. You configure filter profiles by including the filter-profile statement at the [edit accounting-options] hierarchy level. For more information, see the *JUNOS Network Management Configuration Guide*.

You apply filter profiles by including the accounting-profile statement at the [edit firewall filter *filter-name*] and [edit firewall family *family* filter *filter-name*] hierarchy levels. For more information, see the *JUNOS Policy Framework Configuration Guide*.

Applying an Accounting Profile to the Physical Interface

To enable accounting on an interface, include the accounting-profile statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
accounting-profile name;
```

You can also reference profiles by logical unit; for more information, see "Configuring Accounting for the Logical Interface" on page 149.

Example: Applying an Accounting Profile to the Physical Interface

Configure an accounting profile for an interface and apply it to a physical interface:

```
[edit]
accounting-options {
   file if_stats {
      size 4m files 10 transfer-interval 15;
      archive-sites {
         "ftp://login:password@host/path";
      }
   }
   interface-profile if_profile {
      interval 15;
      file if_stats {
         fields {
```

```
                input-bytes;
                output-bytes;
                input-packets;
                output-packets;
                input-errors;
                output-errors;
            }
        }
    }
}
[edit interfaces ge-1/0/1]
accounting-profile if_profile;
```

Interface Diagnostics

You can use two diagnostic tools to test the physical layer connections of interfaces: Loopback testing and bit error rate test (BERT) testing. Loopback testing enables you to verify the connectivity of a circuit. BERT testing enables you to identify poor signal quality on a circuit. This section contains the following topics:

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 the problem is on one of the segments between the local router and the remote routing platform'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.

There are several types of loopback testing supported by the JUNOS software, as follows:

- DCE local—Loops packets back on the local DCE.
- DCE remote—Loops packets back on the remote DCE.

- Local—Useful for troubleshooting physical PIC errors. A local loopback loops packets, including both data and timing information, back on the local routing platform's PIC. When you configure a local loopback, the interface transmits packets to the channel services unit (CSU) built into the interface. These packets are transmitted onto the circuit toward the far-end device. The PIC receives back its own transmission and ignores any data sent from the physical circuit and the CSU. 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 routing platform'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 routing platform'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 20 on page 126 shows the loopback modes supported on the various interface types.

Table 20: Loopback Modes by Interface Type

Interface	Loopback Modes	Usage Guidelines
Aggregated Ethernet, Fast Ethernet, Gigabit Ethernet	Local	"Configuring Ethernet Loopback Capability" on page 563
E1 and E3	Local and remote	"Configuring E1 Loopback Capability" on page 517 and "Configuring E3 Loopback Capability" on page 525
*N*xDS0	Payload	"Configuring NxDS0 IQ and IQE Interfaces" on page 486, "Configuring T1 and NxDS0 Interfaces" on page 444, "Configuring NxDS0 Interfaces" on page 419, "Configuring an NxDS0 IQ Interface" on page 452, and "Configuring an NxDS0 IQ Interface" on page 465
Serial (V.35 and X.21)	Local and remote	"Configuring Serial Loopback Capability" on page 261
Serial (EIA-530)	DCE local, DCE remote, local, and remote	"Configuring Serial Loopback Capability" on page 261
SONET/SDH	Local and remote	"Configuring Channelized IQ and IQE SONET/SDH Loop Timing" on page 806

Table 20: Loopback Modes by Interface Type *(continued)*

Interface	Loopback Modes	Usage Guidelines
T1 and T3	Local, payload, and remote	"Configuring T1 Loopback Capability" on page 534 and "Configuring T3 Loopback Capability" on page 546 See also "Configuring the T1 Remote Loopback Response" on page 533

To configure loopback testing, include the loopback statement:

```
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]

Interface Diagnostics

BERT allows you to troubleshoot problems by checking the quality of links. You can configure any of the following interfaces to execute a BERT when the interface receives a request to run this test: E1, E3, T1, T3; the channelized DS3, OC3, OC12, and STM1 interfaces; and the channelized DS3 IQ, E1 IQ, and OC12 IQ interfaces.

A BERT test requires a line loop to be in place on either the transmission devices or the far-end router. The local router generates a known bit pattern and sends it out the transmit path. The received pattern is then verified against the sent pattern. The higher the bit error rate of the received pattern, the worse the noise is on the physical circuit. As you move the position of the line loop increasingly downstream toward the far-end router, you can isolate the troubled portion of the link.

To configure BERT, you must configure the duration of the test, the bit pattern to send on the transmit path, and the error rate to monitor when the inbound pattern is received.

To configure the duration of the test, the pattern to send in the bit stream, and the error rate to include in the bit stream, include the bert-period, bert-algorithm, and bert-error-rate statements, respectively, at the [edit interfaces *interface-name* *interface-type*-options] hierarchy level:

```
[edit interfaces interface-name interface-type-options]
bert-algorithm algorithm;
bert-error-rate rate;
bert-period seconds;
```

By default, the BERT period is 10 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.

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).

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 4-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 IQE PICs support only the following algorithms:

```
all-ones-repeating   Repeating one bits
all-zeros-repeating  Repeating zero bits
alternating-double-ones-zeros  Alternating pairs of ones and zeros
alternating-ones-zeros  Alternating ones and zeros
pseudo-2e9-o153      Pattern is 2^9  -1 (per 0.153 (511 type) standard)
pseudo-2e11-o152    Pattern is 2^11 -1 (per 0.152 and 0.153 (2047 type) standards)
pseudo-2e15-o151     Pattern is 2^15 -1 (per 0.151 standard)
pseudo-2e20-o151     Pattern is 2^20 -1 (per 0.151 standard)
pseudo-2e20-o153     Pattern is 2^20 -1 (per 0.153 standard)
pseudo-2e23-o151     Pattern is 2^23 -1 (per 0.151 standard)
repeating-1-in-4     1 bit in 4 is set
repeating-1-in-8     1 bit in 8 is set
repeating-3-in-24    3 bits in 24 are set
```

When you issue the help command from the CLI, all BERT algorithm options are displayed, regardless of the PIC type, and no commit check is available. Unsupported patterns for a PIC type can be viewed in system log messages.

Table 21 on page 129 shows the BERT capabilities for various interface types.

Table 21: BERT Capabilities by Interface Type

Interface	T1 BERT	T3 BERT	Comments
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	N/A	Yes (channel 0–11)	■ Single channel at a time ■ Limited algorithms ■ No bit count
Channelized STM1	Yes (channel 0–62)	N/A	■ 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” on page 380.

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 wish 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 *JUNOS System Basics and Services Command Reference*.

NOTE: To exchange BERT patterns between a local routing platform and a remote routing platform, include the loopback remote statement in the interface configuration at the remote end of the link. From the local routing platform, issue the test interface command.

Example: Configuring Bit Error Rate Testing

Configure a BERT test on a T3 interface. In this example, the run duration lasts for 120 seconds. The configured error rate is 0, which corresponds to a bit error rate of 10^{-0} (1 error per bit). The configured bit pattern of all-ones-repeating means that every bit the interface sends is a set to a value of 1.

```
[edit interfaces]
t3-1/2/0 {
    t3-options {
        bert algorithm all-ones-repeating;
        bert-error-rate 0;
        bert-period 120;
```

```
    }
}
```

Tracing Operations of an Individual Router Interface

To trace the operations of individual routing platform interfaces, include the traceoptions statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
traceoptions {
    flag flag <disable>;
}
```

You can specify the following interface tracing flags:

- all—Trace all interface operations.
- event—Trace all interface events.
- ipc—Trace all interface interprocess communication (IPC) messages.
- media—Trace all interface media changes.

The interfaces traceoptions statement does not support a trace file. The logging is done by the kernel, so the tracing information is placed in the system syslog files.

For more information about trace operations, see "Tracing Operations of the Interface Process" on page 231.

Damping Interface Transitions

By default, when an interface changes from being up to being down, or from down to up, this transition is advertised immediately to the hardware and the JUNOS software. In some situations—for example, when an interface is connected to an add-drop multiplexer (ADM) or wavelength-division multiplexer (WDM), or to protect against SONET/SDH framer holes—you might want to damp interface transitions. This means not advertising the interface's transition until a certain period of time has passed, called the *hold-time*. When you have damped interface transitions and the interface goes from up to down, the interface is not advertised to the rest of the system as being down until it has remained down for the hold-time period. Similarly when an interface goes from down to up, it is not advertised as being up until it has remained up for the hold-time period.

To damp interface transitions, include the hold-time statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
hold-time up milliseconds down milliseconds;
```

The time can be a value from 0 through 4,294,967,295 milliseconds. The default value is 0, which means that interface transitions are not damped. The JUNOS software advertises the transition within 100 milliseconds of the time value you specify.

For most Ethernet interfaces, hold timers are implemented using a 1-second polling algorithm. For 1-port, 2-port, and 4-port Gigabit Ethernet interfaces with small form-factor pluggable transceivers (SFPs), hold timers are interrupt-driven.

NOTE: The hold-time option is not available for controller interfaces.

Configuring Multiservice Physical Interface Properties

The adaptive services (AS), collector, monitoring services, and monitoring services II interfaces are multiservice interfaces specifically designed to enable IP services. To configure multiservice physical interface properties on the collector, monitoring services, and AS interfaces, include the multiservice-options statement:

```
multiservice-options {
    (core-dump | no-core-dump);
    (syslog | no-syslog);
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces cp-*fpc/pic/port*]
- [edit interfaces mo-*fpc/pic/port*]
- [edit interfaces sp-*fpc/pic/port*]

For more information about the services interfaces, see the *JUNOS Services Interfaces Configuration Guide*.

Enabling or Disabling SNMP Notifications on Physical Interfaces

By default, Simple Network Management Protocol (SNMP) notifications are sent when the state of an interface or a connection changes. To explicitly enable these notifications on the physical interface, include the traps statement at the [edit interfaces *interface-name*] hierarchy level. To disable these notifications on the physical interface, include the no-traps statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
(traps | no-traps);
```

NOTE: Gigabit Ethernet interfaces on J-series Services Routers do not support SNMP.

Enabling Unidirectional Traffic Flow on Physical Interfaces

By default, physical interfaces are bidirectional; that is, they both transmit and receive traffic. You can configure unidirectional link mode on a 10-Gigabit Ethernet interface that creates two new physical interfaces that are unidirectional. The new transmit-only and receive-only interfaces operate independently, but both are subordinate to the original parent interface.

The unidirectional interfaces enable the configuration of a unidirectional link topology. Unidirectional links are useful for applications such as broadband video services where almost all traffic flow is in one direction, from the provider to the user. Unidirectional link mode conserves bandwidth by enabling it to be differentially dedicated to transmit and receive interfaces. In addition, unidirectional link mode conserves ports for such applications because the transmit-only and receive-only interfaces act independently. Each can be connected to different routers, for example, reducing the total number of ports required.

To enable unidirectional link mode on a physical interface, include the unidirectional statement at the [edit interfaces *interface-name*] hierarchy level:

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

NOTE: Unidirectional link mode is currently supported on only the following hardware:

- 4–Port 10–Gigabit Ethernet DPC on the MX960 platform
- 10–Gigabit Ethernet IQ2 PIC and 10–Gigabit Ethernet IQ2E PIC on the T-series routing platform

The transmit-only interface is always operationally up. The operational status of the receive-only interface depends only on local faults; it is independent of remote faults and of the status of the transmit-only interface.

On the parent interface, you can configure attributes common to both interfaces, such as clocking, framing, gigether-options, and sonet-options. On each of the unidirectional interfaces, you can configure encapsulation, MAC address, MTU size, and logical interfaces.

Unidirectional interfaces support IP and IPv6. Packet forwarding takes place by means of static routes and static ARP entries. which you can configure independently on both unidirectional interfaces.

Only transmit statistics are reported on the transmit-only interface (and shown as zero on the receive-only interface). Only receive statistics are reported on the receive-only interface (and shown as zero on the transmit-only interface). Both transmit and receive statistics are reported on the parent interface.

Disabling a Physical Interface

You can disable a physical interface, marking it as being down, without removing the interface configuration statements from the configuration. To do this, include the disable statement at the [edit interfaces *interface-name*] hierarchy level:

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

Example: Disabling a Physical Interface

Disable a physical interface:

```
[edit interfaces]
so-1/1/0 {
   mtu 8000;
   clocking internal;
   encapsulation ppp;
   sonet-options {
      fcs 16;
   }
   unit 0 {
      family inet {
         address 172.16.0.0/12 {
            destination 172.16.0.4;
         }
      }
   }
}
[edit interfaces]
user@host# set so-1/1/0 disable
[edit interfaces]
user@host# show so-1/1/0
so-1/1/0 {
   disable;# Interface is marked as disabled
   mtu 8000;
   clocking internal;
   encapsulation ppp;
   sonet-options {
      fcs 16;
   }
   unit 0 {
      family inet {
         address 172.16.0.0 {
            destination 172.16.0.3;
         }
      }
   }
}
```

Chapter 4

Configuring Logical Interface Properties

For a physical interface device to function, you must configure at least one logical interface on that device. For each logical interface, you must specify the protocol family that the interface supports. You can also configure other logical interface properties. These vary by Physical Interface Card (PIC) and encapsulation type, but include the IP address of the interface, and whether the interface supports multicast traffic, data-link connection identifiers (DLCIs), virtual channel identifiers (VCIs) and virtual path identifiers (VPIs), and traffic shaping.

This chapter describes the configuration of logical interface properties:

Logical Interfaces Configuration Statements

To configure logical interface properties, include the following statements:

```
unit logical-unit-number {
    accept-source-mac {
        mac-address mac-address {
            policer {
                input cos-policer-name;
                output cos-policer-name;
            }
        }
    }
    accounting-profile name;
    allow-any-vci;
    atm-scheduler-map (map-name | default);
    backup-options {
        interface interface-name;
    }
    bandwidth rate;
    cell-bundle-size cells;
    clear-dont-fragment-bit;
    compression {
        rtp {
            f-max-period number;
            queues [ queue-numbers ];
            port {
                minimum port-number;
                maximum port-number;
            }
        }
    }
    compression-device interface-name;
    copy-tos-to-outer-ip-header;
    demux-destination family;
    demux-source family;
    demux-options {
        underlying-interface interface-name;
    }
    description text;
    dial-options {
        l2tp-interface-id name;
        (dedicated | shared);
    }
    dialer-options {
        activation-delay seconds;
        callback;
        callback-wait-period time;
        deactivation-delay seconds;
        dial-string [ dial-string-numbers ];
        idle-timeout seconds;
        incoming-map {
            caller (caller-id| accept-all);
            initial-route-check seconds;
            load-interval seconds;
            load-threshold number;
            pool pool-name;
            redial-delay time;
            watch-list {
                [ routes ];
```

```
        }
    }
}
disable;
disable-mlppp-inner-ppp-pfc;
dlci dlci-identifier;
drop-timeout milliseconds;
dynamic-call-admission-control {
    activation-priority priority;
    bearer-bandwidth-limit kilobits-per-second;
}
encapsulation type;
epd-threshold plp1 cells;
filter filter-name;
fragment-threshold bytes;
inner-vlan-id-range start start-id end end-id;
input-vlan-map {
    inner-tag-protocol-id;
    inner-vlan-id;
    (pop | pop-pop | pop-swap | push | push-push | swap |swap-push | swap-swap);
    tag-protocol-id tpid;
    vlan-id number;
}
interleave-fragments;
inverse-arp;
link-layer-overhead percent;
layer2-policer {
    input-policer policer-name;
    input-three-color policer-name;
    output-policer policer-name;
    output-three-color policer-name;
}
minimum-links number;
mrru bytes;
multicast-dlci dlci-identifier;
multicast-vci vpi-identifier.vci-identifier;
multilink-max-classes number;
multipoint;
oam-liveness {
    up-count cells;
    down-count cells;
}
oam-period (seconds | disable);
output-vlan-map {
    inner-tag-protocol-id;
    inner-vlan-id;
    (pop | pop-pop | pop-swap | push | push-push | swap |swap-push | swap-swap);
    tag-protocol-id tpid;
    vlan-id number;
}
passive-monitor-mode;
peer-unit unit-number;
plp-to-clp;
point-to-point;
ppp-options {
    chap {
```

```
    access-profile name;
    default-chap-secret name;
    local-name name;
    passive;
}
compression {
    acfc;
    pfc;
}
dynamic-profile profile-name;
lcp-restart-timer milliseconds;
loopback-clear-timer seconds;
ncp-restart-timer milliseconds;
pap {
    default-pap-password password;
    local-name name;
    local-password password;
    passive;
}
pppoe-options {
    access-concentrator name;
    auto-reconnect seconds;
    (client | server);
    service-name name;
    underlying-interface interface-name;
}
proxy-arp;
service-domain (inside | outside);
shaping {
    (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained
        rate burst length);
    queue-length number;
}
short-sequence;
transmit-weight number;
(traps | no-traps);
trunk-bandwidth rate;
trunk-id number;
tunnel {
    backup-destination address;
    destination address;
    key number;
    routing-instance {
        destination routing-instance-name;
    }
    source source-address;
    ttl number;
}
vci vpi-identifier.vci-identifier;
vci-range start start-vci end end-vci;
vpi vpi-identifier;
vlan-id number;
vlan-id-range number-number;
vlan-tags inner tpid.vlan-id outer tpid.vlan-id;
family family {
```

```
        [ family-statements ];
    }
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name*]
- [edit logical-systems *logical-system-name* interfaces *interface-name*]

For information about interface-specific logical properties, see "Logical Interfaces Statements List" on page 139.

Logical Interfaces Statements List

Table 22 on page 139 lists statements that you can use to configure logical interfaces.

Table 22: Statements for Logical Interface Properties

Statement	Interface Types	Usage Guidelines
access-profile *name*	ATM2 IQ interfaces	"Configuring PPP PAP Authentication" on page 155
accept-source-mac	Gigabit Ethernet intelligent queuing (IQ) interfaces	"Configuring MAC Address Filtering" on page 713
accounting-profile *name*	All	"Configuring Accounting for the Logical Interface" on page 149
ack-delay-time *time*	Ethernet interfaces configured for DLSw	"Configuring LLC2 Options" on page 171
ack-max *count*	Ethernet interfaces configured for DLSw	"Configuring LLC2 Options" on page 171
activation-delay *seconds*	ISDN interfaces	"Configuring ISDN Interfaces" on page 773
activation-priority *priority*	Fast Ethernet and Gigabit Ethernet interfaces, ISDN BRI interfaces, and serial interfaces with PPP or Frame Relay encapsulation on J4350 and J6350 Services Routers supporting voice over IP with the TGM550 media gateway module	"Configuring Dynamic Call Admission Control" on page 157
adaptive-shapers *adaptive-shaper-name*	Frame Relay interfaces on J-series Services Routers	*JUNOS Class of Service Configuration Guide*
allow-any-vci	Asynchronous Transfer Mode (ATM) interfaces	"Configuring ATM Interface Encapsulation" on page 316
atm-scheduler-map (*map-name* | default)	ATM2 IQ interfaces	"Configuring ATM2 IQ VC Tunnel CoS Components" on page 325
backup-destination *address*	Encryption interfaces	*JUNOS Class of Service Configuration Guide*

Table 22: Statements for Logical Interface Properties *(continued)*

Statement	Interface Types	Usage Guidelines
backup-options	J-series Services Routers ISDN interfaces	"Configuring an ISDN Dialer Interface as a Backup Interface" on page 780
bandwidth *rate*	All interfaces, except multilink and aggregated	"Configuring the Interface Bandwidth" on page 150
bearer-bandwidth-limit *kilobits-per-second*	Fast Ethernet and Gigabit Ethernet interfaces, ISDN BRI interfaces, and serial interfaces with PPP or Frame Relay encapsulation on J4350 and J6350 Services Routers supporting voice over IP with the TGM550 media gateway module	"Configuring Dynamic Call Admission Control" on page 157
cbr *rate*	ATM interfaces	"Defining the ATM Traffic-Shaping Profile" on page 305
cell-bundle-size *cells*	ATM2 IQ interfaces	"Configuring the Layer 2 Circuit Cell-Relay Cell Maximum" on page 299
clear-dont-fragment-bit	Adaptive services interfaces	*JUNOS Services Interfaces Configuration Guide*
compression	AS PIC or MultiServices PIC link services IQ interfaces (lsq) and voice services interfaces	*JUNOS Services Interfaces Configuration Guide*
compression-device *interface-name*	J-series Services Routers E1 and T1 interfaces.	*JUNOS Services Interfaces Configuration Guide*
copy-tos-to-outer-ip-header	GRE tunnel interfaces	*JUNOS Class of Service Configuration Guide*
deactivation-delay *seconds*	ISDN interfaces	"Configuring ISDN Interfaces" on page 773
demux-destination *family*	IP demux interfaces	"Configuring an IP Demux Underlying Interface" on page 240
demux-options *family*	IP demux interfaces	"Specifying the Demux Underlying Interface" on page 241
demux-source *family*	IP demux interfaces	"Configuring an IP Demux Underlying Interface" on page 240
description *text*	All	"Adding a Logical Unit Description to the Configuration" on page 148
destination (*address* | *routing-instance-name*)	Encryption generic routing encapsulation (GRE) tunnel, and IP tunnel interfaces	*JUNOS Services Interfaces Configuration Guide*
dialer-options	Adaptive services interfaces on M7i routing platforms J-series Services Routers ISDN interfaces	*JUNOS Services Interfaces Configuration Guide* "Configuring ISDN Physical Interface Properties" on page 775

Table 22: Statements for Logical Interface Properties *(continued)*

Statement	Interface Types	Usage Guidelines
disable	All	"Disabling a Logical Interface" on page 159
disable-mlppp-inner-ppp-pfc	MLPPP interfaces	*JUNOS Services Interfaces Configuration Guide*
dlci *dlci-identifier*	Point-to-point interfaces with Frame Relay encapsulation	"Configuring Frame Relay DLCIs" on page 366
drop-timeout *milliseconds*	Multilink interfaces	*JUNOS Services Interfaces Configuration Guide*
dynamic-call-admission-control	Fast Ethernet and Gigabit Ethernet interfaces, ISDN BRI interfaces, and serial interfaces with PPP or Frame Relay encapsulation on J4350 and J6350 Services Routers supporting voice over IP with the TGM550 media gateway module	"Configuring Dynamic Call Admission Control" on page 157
dynamic-profile *profile-name*	1-Gigabit Ethernet and 10-Gigabit Ethernet interfaces configured with PPP over Ethernet on M120 and M320 routers	*JUNOS Subscriber Access Configuration Guide*
encapsulation *type*	All interfaces, except aggregated SONET/SDH and loopback	"Configuring the Encapsulation on a Logical Interface" on page 151
epd-threshold *cells*	ATM2 IQ interfaces	"Configuring the ATM2 IQ EPD Threshold" on page 312
f-max-period *number*	AS PIC or MultiServices link services IQ interfaces (lsq-) and voice services interfaces	*JUNOS Services Interfaces Configuration Guide*
family	All	"Configuring the Protocol Family" on page 164
fragment-threshold *bytes*	Multilink interfaces	*JUNOS Services Interfaces Configuration Guide*
frame-relay *map-name* | default)	Frame Relay Interfaces on J-series Services Routers	*JUNOS Services Interfaces Configuration Guide* and *JUNOS Class of Service Configuration Guide*
idle-time *time*	Ethernet interfaces configured for DLSw	"Configuring LLC2 Options" on page 171
idle-timeout	ISDN interfaces	"Configuring Bandwidth on Demand" on page 783
initial-route-check *seconds*	ISDN interfaces	"Configuring ISDN Logical Interface Properties" on page 777
inner-tag-protocol-id	Gigabit Ethernet IQ interfaces	"Configuring 802.1Q VLANs" on page 569
inner-vlan-id	Gigabit Ethernet IQ interfaces	"Configuring 802.1Q VLANs" on page 569

Table 22: Statements for Logical Interface Properties *(continued)*

Statement	Interface Types	Usage Guidelines
inner-vlan-id-range	Gigabit Ethernet, 10-Gigabit Ethernet, and aggregated Ethernet IQ interfaces	"Configuring ATM-to-Ethernet Interworking" on page 219
input	AS PIC or MultiServices link services	*JUNOS Services Interfaces Configuration Guide*
input-policer *policer-name*	For 1-Gigabit Ethernet and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces on M-series and T-series routing platforms	*JUNOS Services Interfaces Configuration Guide* and "Applying a Policer" on page 716
input-three-color *policer-name*	For 1-Gigabit Ethernet and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces on M-series and T-series routing platforms	*JUNOS Class of Service Configuration Guide* and "Applying a Policer" on page 716
input-vlan-map	Gigabit Ethernet IQ interfaces	"Configuring the Management Ethernet Interface" on page 729
interleave-fragments	Link services interfaces	*JUNOS Services Interfaces Configuration Guide*
inverse-arp	Interfaces with ATM and Frame Relay encapsulation	"Configuring Inverse ATM1 or ATM2 ARP" on page 304 and "Configuring Inverse Frame Relay ARP" on page 365
key *number*	GRE tunnel interfaces on Adaptive Services PICs	*JUNOS Services Interfaces Configuration Guide*
layer2-policer	1-Gigabit Ethernet and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces	"Applying a Policer" on page 716
lcp-restart-timer	Interfaces with PPP encapsulation	"Configuring the PPP Restart Timers" on page 153
l2tp-interface-id *name*	Adaptive services interfaces	*JUNOS Services Interfaces Configuration Guide*
link-layer-overhead *percent*	AS PIC or MultiServices link services IQ interfaces (lsq)	*JUNOS Services Interfaces Configuration Guide*
llc2	Ethernet interfaces configured for DLSw on J-series Services Routers	"Configuring LLC2 Options" on page 171
load-threshold *number*	ISDN interfaces	"Configuring Bandwidth on Demand" on page 783
local-name *name*	ATM2 IQ interfaces	"Configuring PPP CHAP Authentication" on page 155 and "Configuring PPP PAP Authentication" on page 155
local-window *count*	Ethernet interfaces configured for DLSw	"Configuring LLC2 Options" on page 171
loss-priority-maps	Frame Relay interfaces on J-series Services Routers	*JUNOS Services Interfaces Configuration Guide* and *JUNOS Class of Service Configuration Guide*

Table 22: Statements for Logical Interface Properties *(continued)*

Statement	Interface Types	Usage Guidelines
mac-address *mac-address*	Gigabit Ethernet interfaces and Gigabit Ethernet IQ and IQE interfaces with small form-factor pluggable transceivers (SFPs) (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform)	"Configuring MAC Address Filtering" on page 713
max-retry *count*	Ethernet interfaces configured for DLSw	"Configuring LLC2 Options" on page 171
minimum-links *number*	Multilink interfaces	*JUNOS Services Interfaces Configuration Guide*
mrru *bytes*	Multilink interfaces	*JUNOS Services Interfaces Configuration Guide*
multicast-dlci *dlci-identifier*	Point-to-multipoint Frame Relay interfaces	"Configuring a Multicast-Capable Frame Relay Connection" on page 367
multicast-vci *vpi-identifiervci-identifier*	Point-to-multipoint ATM1 and ATM2 IQ interfaces	"Configuring the ATM OAM F5 Loopback Cell Threshold" on page 316
multilink-max-classes *number*	AS PIC or MultiServices link services IQ interfaces (lsq-)	*JUNOS Services Interfaces Configuration Guide*
multipoint	All	"Configuring a Multipoint Connection" on page 149
ncp-restart-timer	Interfaces with PPP encapsulation	"Configuring the PPP Restart Timers" on page 153
oam-liveness	ATM1 and ATM2 IQ interfaces	"Configuring the ATM OAM F5 Loopback Cell Threshold" on page 316
oam-period (disable | *seconds*)	ATM1 and ATM2 IQ interfaces	"Defining the ATM OAM F5 Loopback Cell Period" on page 315
output	All	*JUNOS Services Interfaces Configuration Guide*
output-policer *policer-name*	For 1-Gigabit Ethernet and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces on M-series and T-series routing platforms	*JUNOS Class of Service Configuration Guide* and "Applying a Policer" on page 716
output-three-color *policer-name*	For 1-Gigabit Ethernet and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces on M-series and T-series routing platforms	*JUNOS Class of Service Configuration Guide* and "Applying a Policer" on page 716
output-vlan-map	Gigabit Ethernet IQ interfaces	"Configuring the Management Ethernet Interface" on page 729
passive	ATM2 IQ interfaces	"Configuring PPP CHAP Authentication" on page 155 and "Configuring PPP PAP Authentication" on page 155

Table 22: Statements for Logical Interface Properties *(continued)*

Statement	Interface Types	Usage Guidelines
passive-monitor-mode	SONET/SDH interfaces	"Enabling Passive Monitoring on SONET/SDH Interfaces" on page 828
p-bit-timeout *time*	Ethernet interfaces configured for DLSw	"Configuring LLC2 Options" on page 171
peer-unit *unit-number*	Logical tunnel interfaces	*JUNOS Services Interfaces Configuration Guide*
pfc	Interfaces with PPP, PPP CCC, or PPP TCC encapsulation	"Configuring the PPP Protocol Field Compression" on page 115
plp1 *cells*	ATM2 IQ interfaces	"Configuring the ATM2 IQ EPD Threshold" on page 312
plp-to-clp	ATM2 IQ interfaces	"Enabling the PLP Setting to Be Copied to the CLP Bit" on page 334
point-to-point	All	"Configuring a Point-to-Point Connection" on page 148
policer	Gigabit Ethernet and Gigabit Ethernet IQ and IQE PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform)	"Configuring MAC Address Filtering" on page 713
pop	Gigabit Ethernet IQ interfaces	"Removing a VLAN Tag" on page 615
pop-pop	Gigabit Ethernet IQ interfaces	"Removing the Outer and Inner VLAN Tags" on page 615
pop-swap	Gigabit Ethernet IQ interfaces	"Removing the Outer VLAN Tag and Rewriting the Inner VLAN Tag" on page 616
port	AS PIC or MultiServices or MultiServices link services IQ interfaces (lsq) and voice services interfaces	*JUNOS Services Interfaces Configuration Guide*
ppp-options	Interfaces with PPP, PPP CCC, or PPP TCC encapsulation	"Configuring PPP CHAP Authentication" on page 155 and "Configuring PPP PAP Authentication" on page 155
proxy-arp	Ethernet interfaces	"Configuring Unrestricted Proxy ARP" on page 637
push	Gigabit Ethernet IQ interfaces	"Stacking a VLAN Tag" on page 614
push-push	Gigabit Ethernet IQ interfaces	"Stacking Two VLAN Tags" on page 617
queue-length *number*	ATM1 interfaces	"Configuring the ATM1 Queue Length" on page 311

Table 22: Statements for Logical Interface Properties *(continued)*

Statement	Interface Types	Usage Guidelines
queues [*queue-numbers*]	AS PIC or MultiServices link services IQ interfaces (lsq) and voice services interfaces	*JUNOS Services Interfaces Configuration Guide*
routing-instance	GRE tunnel and IP tunnel interfaces	*JUNOS Services Interfaces Configuration Guide*
rtp	AS PIC or MultiServices link services IQ interfaces (lsq) and voice services interfaces	*JUNOS Services Interfaces Configuration Guide*
rtvbr peak *rate* sustained *rate* burst *length*	ATM2 interfaces	"Configuring ATM2 IQ Real-Time VBR" on page 307
service-domain (inside | outside)	Adaptive services interfaces	*JUNOS Services Interfaces Configuration Guide*
shaping	ATM1 and ATM2 IQ interfaces	"Defining the ATM Traffic-Shaping Profile" on page 305
short-sequence	Multilink interfaces	*JUNOS Services Interfaces Configuration Guide*
source *source-address*	Encryption, GRE tunnel, and IP tunnel interfaces	*JUNOS Services Interfaces Configuration Guide*
swap	Gigabit Ethernet IQ interfaces	"Configuring Frames with Particular TPIDs to Be Processed as Tagged Frames" on page 610
swap-push	Gigabit Ethernet IQ interfaces	"Rewriting a VLAN Tag and Adding a New Tag" on page 621
swap-swap	Gigabit Ethernet IQ interfaces	"Rewriting the Inner and Outer VLAN Tags" on page 621
t1-time *time*	Ethernet interfaces configured for DLSw	"Configuring LLC2 Options" on page 171
t2-time *time*	Ethernet interfaces configured for DLSw	"Configuring LLC2 Options" on page 171
tag-protocol-id *tpid*	Gigabit Ethernet and Gigabit Ethernet IQ and IQE PICs with SFPs (except the 10-port Gigabit Ethernet PIC, Aggregated Ethernet with Gigabit Ethernet IQ interfaces, and the built-in Gigabit Ethernet port on the M7i platform)	"Rewriting the VLAN Tag on Tagged Frames" on page 617
transmit-weight *number*	ATM2 IQ interfaces	"Configuring the ATM2 IQ Transmission Weight" on page 315
trej-time *time*	Ethernet interfaces configured for DLSw	"Configuring LLC2 Options" on page 171

Table 22: Statements for Logical Interface Properties *(continued)*

Statement	Interface Types	Usage Guidelines
(traps | no-traps)	All	"Enabling or Disabling SNMP Notifications on Logical Interfaces" on page 151
trunk-bandwidth *rate*	ATM2 IQ interfaces	"Configuring Layer 2 Circuit Trunk Mode Scheduling" on page 295
trunk-id *number*	ATM2 IQ interfaces	"Configuring Layer 2 Circuit Transport Mode" on page 286
ttl *number*	GRE tunnel and IP tunnel interfaces	*JUNOS Services Interfaces Configuration Guide*
tunnel	Encryption, GRE tunnel, and IP tunnel interfaces	*JUNOS Services Interfaces Configuration Guide*
underlying-interface	IP demux interfaces	"Specifying the Demux Underlying Interface" on page 241
vbr peak *rate* sustained *rate* burst *length*	ATM interfaces	"Defining the ATM Traffic-Shaping Profile" on page 305
vci *vpi-identifiervci-identifier*	ATM1 and ATM2 IQ point-to-point interfaces	"Configuring a Point-to-Point ATM1 or ATM2 IQ Connection" on page 303
vci-range	ATM2 IQ interfaces	"Configuring ATM-to-Ethernet Interworking" on page 219
vpi *vpi-identifier*	ATM1 and ATM2 IQ point-to-point interfaces	"Configuring a Point-to-Point ATM1 or ATM2 IQ Connection" on page 303
vlan-id *number*	Fast Ethernet, Gigabit Ethernet, and Gigabit Ethernet IQ interfaces and aggregated Ethernet using Gigabit Ethernet IQ interfaces	"Binding VLAN IDs to Logical Interfaces" on page 574 and "Rewriting the VLAN Tag on Tagged Frames" on page 617
vlan-tags inner *tpidvlan-id* outer *tpidvlan-id*	Gigabit Ethernet IQ interfaces	"Configuring Dual VLAN Tags" on page 611
watch-list	ISDN interfaces	"Configuring Dialer Watch" on page 789

Specifying the Logical Interface Number

Each logical interface must have a logical unit number. The logical unit number corresponds to the logical unit part of the interface name. For more information, see "Interface Naming" on page 49.

Point-to-Point Protocol (PPP), Cisco High-level Data Link Control (HDLC), and Ethernet circuit cross-connect (CCC) encapsulations support only a single logical interface, whose logical unit number must be 0. Frame Relay and ATM encapsulations support multiple logical interfaces, so you can configure one or more logical unit numbers.

You specify the logical unit number by including the unit statement:

```
unit logical-unit-number {
    ...
}
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name*]
- [edit logical-systems *logical-system-name* interfaces *interface-name*]

The logical unit number can be from 0 through 16,384.

Configuring Logical System Interface Properties

With JUNOS software, you can partition a single physical routing platform into multiple logical devices that perform independent routing tasks. Because logical systems perform a subset of the tasks once handled by the physical routing platform, logical systems offer an effective way to maximize the use of a single router platform.

You can include the following logical system statements:

```
[edit logical-systems logical-system-name]
interfaces interface-name {
    unit logical-unit-number {
        logical-interface-statements;
    }
}
policy-options {
    policy-options-statements;
}
protocols {
    protocols-statements;
}
routing-instances {
    routing-instances-statements;
}
routing-options {
    routing-options-statements;
}
```

For an overview of logical systems, see the *JUNOS Feature Guide*. For detailed information about logical system configuration, see the *JUNOS Routing Protocols Configuration Guide*. For information about configuring peer relationships between logical systems, see *JUNOS Services Interfaces Configuration Guide*.

To configure interface properties of a logical system, you must include the following statements at the [edit logical-systems *logical-system-name*] hierarchy level:

```
[edit logical-systems logical-system-name]
interfaces interface-name {
    unit logical-unit-number {
        logical-interface-statements;
```

```
    }
}
```

Example: Configuring Logical System Interface Properties

Configure a logical system's interface properties:

```
[edit interfaces t3-0/0/1]
description " Physical interface to be partitioned into multiple logical systems";
[edit logical-systems 1-on-t3-0/0/1]
interfaces t3-0/0/1 {
    unit 1 {
        family inet {
            address 10.0.0.1/32 {
                destination 10.0.0.2;
            }
        }
    }
}
```

Adding a Logical Unit Description to the Configuration

You can include a text description of each logical unit in the configuration file. Any descriptive text you include is displayed in the output of the show interfaces commands, and is also exposed in the ifAlias Management Information Base (MIB) object. It has no impact on the interface's configuration. To add a text description, include the description statement:

```
description text;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

The description can be a single line of text. If the text contains spaces, enclose it in quotation marks.

For information about describing physical interfaces, see "Adding an Interface Description to the Configuration" on page 90.

Configuring a Point-to-Point Connection

By default, all interfaces are assumed to be point-to-point connections. You must ensure that the maximum transmission unit (MTU) sizes on both sides of the connection are the same.

For all interfaces except aggregated Ethernet, Fast Ethernet, and Gigabit Ethernet, you can explicitly configure an interface to be a point-to-point connection by including the point-to-point statement:

```
point-to-point;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Configuring a Multipoint Connection

By default, all interfaces are assumed to be point-to-point connections. To configure an interface to be a multipoint connection, include the multipoint statement:

```
multipoint;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Configuring Accounting for the Logical Interface

Juniper Networks routing platforms can collect various kinds of data about traffic passing through the routing platform. You can set up one or more *accounting profiles* that specify some common characteristics of this data, including the following:

- The fields used in the accounting records
- The number of files that the routing platform retains before discarding, and the number of bytes per file
- The period that the system uses to record the data

You configure the profiles and define a unique name for each profile using statements at the [edit accounting-options] hierarchy level. There are two types of accounting profiles: interface profiles and filter profiles. You configure interface profiles by including the interface-profile statement at the [edit accounting-options] hierarchy level. You configure filter profiles by including the filter-profile statement at the [edit accounting-options] hierarchy level. For more information, see the *JUNOS Network Management Configuration Guide*.

You apply filter profiles by including the accounting-profile statement at the [edit firewall filter *filter-name*] and [edit firewall family *family* filter *filter-name*] hierarchy levels. For more information, see the *JUNOS Policy Framework Configuration Guide*.

Applying an Accounting Profile to the Logical Interface

To enable accounting on a logical interface, include the accounting-profile statement:

```
accounting-profile name;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]

You can also reference profiles for the physical interface; for more information, see “Configuring Accounting for the Physical Interface” on page 124.

Example: Applying an Accounting Profile to the Logical Interface

Configure an accounting profile for an interface and apply it to a logical interface:

```
[edit]
accounting-options {
    file if_stats {
        size 4m files 10 transfer-interval 15;
        archive-sites {
            "ftp://login:password@host/path";
        }
    }
    interface-profile if_profile {
        interval 15;
        file if_stats {
            fields {
                input-bytes;
                output-bytes;
                input-packets;
                output-packets;
                input-errors;
                output-errors;
            }
        }
    }
}
[edit interfaces ge-1/0/1 unit 1]
accounting-profile if_profile;
```

To reference profiles by physical interface, see “Applying an Accounting Profile to the Physical Interface” on page 124. For information about configuring a firewall filter accounting profile, see the *JUNOS Policy Framework Configuration Guide*.

Configuring the Interface Bandwidth

By default, the JUNOS software uses the physical interface’s speed for the MIB-II object, ifSpeed. You can configure the logical unit to populate the ifSpeed variable by configuring a bandwidth value for the logical interface. The bandwidth statement sets an informational-only parameter; you cannot adjust the actual bandwidth of an interface with this statement.

To configure the bandwidth value for a logical interface, include the bandwidth statement:

```
bandwidth rate;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

rate is the peak rate, in bps or cps. You can specify a value in bits per second either as a complete decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000). You can also specify a value in cells per second by entering a decimal number followed by the abbreviation c; values expressed in cells per second are converted to bits per second using the formula 1 cps = 384 bps. The value can be any positive integer. The bandwidth statement is valid for all logical interfaces, except multilink and aggregated interfaces.

Enabling or Disabling SNMP Notifications on Logical Interfaces

By default, Simple Network Management Protocol (SNMP) notifications are sent when the state of an interface or a connection changes. To explicitly enable these notifications on the logical interface, include the traps statement; to disable these notifications on the logical interface, include the no-traps statement:

```
(traps | no-traps);
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

NOTE: Gigabit Ethernet interfaces on J-series Services Routers do not support SNMP.

Configuring Interface Encapsulation on Logical Interfaces

PPP encapsulation is the default encapsulation type for physical interfaces. You need not configure encapsulation for any physical interfaces that support PPP encapsulation. If you do not configure encapsulation, PPP is used by default. For physical interfaces that do not support PPP encapsulation, you must configure an encapsulation to use for packets transmitted on the interface. For more information about physical interface encapsulation, see “Configuring the Encapsulation on a Physical Interface” on page 100.

You can optionally configure an encapsulation on a logical interface, which is the encapsulation used within certain packet types.

Configuring the Encapsulation on a Logical Interface

Generally, you configure an interface’s encapsulation at the [edit interfaces *interface-name*] hierarchy level. However, for some encapsulation types, such as

Frame Relay, ATM, and Ethernet virtual local area network (VLAN) encapsulations, you can also configure the encapsulation type that is used inside the Frame Relay, ATM, or VLAN circuit itself. To do this, include the encapsulation statement:

```
encapsulation (atm-ccc-cell-relay | atm-ccc-vc-mux | atm-tcc-vc-mux | atm-cisco-nlpid |
    atm-mlppp-llc | atm-nlpid | atm-ppp-llc | atm-ppp-vc-mux | atm-snap | atm-tcc-snap |
    atm-vc-mux | ether-over-atm-llc | ether-vpls-over-atm-llc | ethernet |
    frame-relay-ether-type | frame-relay-ether-type-tcc | frame-relay-ccc | frame-relay-tcc
    | multilink-frame-relay-end-to-end | multilink-ppp | vlan-ccc | vlan-tcc | vlan-vpls);
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Some of the ATM encapsulations are defined in RFC 2684, *Multiprotocol Encapsulation over ATM Adaptation Layer 5*.

The following restrictions apply to logical interface encapsulation:

- With the atm-nlpid, atm-cisco-nlpid, and atm-vc-mux encapsulations, you can configure the inet family only.
- With the CCC circuit encapsulations, you cannot configure a family on the logical interface.
- A logical interface cannot have frame-relay-ccc encapsulation unless the physical device also has frame-relay-ccc encapsulation.
- A logical interface cannot have frame-relay-tcc encapsulation unless the physical device also has frame-relay-tcc encapsulation. In addition, you must assign this logical interface a DLCI from 512 through 1022 and configure it as point-to-point.
- A logical interface cannot have frame-relay-ether-type or frame-relay-ether-type-tcc encapsulation unless the physical interface has flexible-frame-relay encapsulation and is on an IQ or IQE PIC.
- For frame-relay-ether-type-tcc encapsulation, you must assign this logical interface a DLCI from 512 through 1022.
- For interfaces that carry IP version 6 (IPv6) traffic, you cannot configure ether-over-atm-llc encapsulation.
- When you use ether-over-atm-llc encapsulation, you cannot configure multipoint interfaces.
- A logical interface cannot have vlan-ccc or vlan-vpls encapsulation unless the physical device also has vlan-ccc or vlan-vpls encapsulation, respectively. In addition, you must assign this logical interface a VLAN ID from 512 through 1023; if the VLAN ID is 511 or lower, it is subject to the normal destination filter lookups in addition to source address filtering. For more information, see “Configuring VLAN Encapsulation” on page 579.
- You can create an ATM cell-relay circuit by configuring an entire ATM physical device or an individual virtual circuit (VC). When you configure an entire device, only cell-relay encapsulation is allowed on the logical interfaces. For more information, see “Configuring an ATM1 Cell-Relay Circuit” on page 318.

For more information about ATM encapsulations, see "Configuring ATM Interface Encapsulation" on page 316.

For more information about Frame Relay encapsulations, see "Configuring Frame Relay Interface Encapsulation" on page 358.

For more information about multilink encapsulations, see the *JUNOS Services Interfaces Configuration Guide*.

Configuring the PPP Restart Timers

You can configure a restart timer for the Link Control Protocol (LCP) and Network Control Protocol (NCP) components of a PPP session. You can configure the LCP restart timer on interfaces with PPP, PPP TCC, PPP over Ethernet, PPP over ATM, and PPP over Frame Relay encapsulations. You can configure the NCP restart timer on interfaces with PPP and PPP TCC encapsulations and on multilink PPP bundle interfaces.

To configure the restart timer for the NCP component of a PPP session, include the ncp-restart-timer statement, and specify the number of milliseconds.

To configure the restart timer for the LCP component of a PPP session, include the lcp-restart-timer statement, and specify the number of milliseconds:

lcp-restart-timer *milliseconds*;
ncp-restart-timer *milliseconds*;

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* ppp-options]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* ppp-options]

To monitor the configuration, issue the show interfaces *interface-name* command. Configured options are displayed in the PPP parameters field for the physical interface.

```
user@host> run show interfaces t1-0/0/0:1:1.0 detail
   Logical interface t1-0/0/0:1:1.0 (Index 67) (SNMP ifIndex 40)
   (Generation 156)
     Flags: Hardware-Down Device-Down Point-To-Point SNMP-Traps 0x4000
     Encapsulation: PPP
     PPP parameters:
       LCP restart timer: 2000 msec
       NCP restart timer: 2000 msec
     Protocol inet, MTU: 1500, Generation: 163, Route table: 0
       Flags: Protocol-Down
       Addresses, Flags: Dest-route-down Is-Preferred Is-Primary
         Destination: 1.1.1/24, Local: 1.1.1.2, Broadcast: 1.1.1.255,
```

Configuring the PPP Clear Loop Detected Timer

When a Point-to-Point Protocol (PPP) session detects a loop, the loop detected flag is set. If the flag is not cleared by the protocol after the loopback is cleared, the clear loop detected timer clears the flag after the specified time has elapsed.

To configure the clear loop detected timer for the LCP component of a PPP session, include the loopback-clear-timer statement, and specify the number of seconds.

```
loopback-clear-timer seconds;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* ppp-options]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* ppp-options]

To monitor the configuration, issue the show interfaces *interface-name* extensive command.

Configuring Dynamic Profiles for PPP

A dynamic profile acts as a template that enables you to create, update, or remove a configuration that includes attributes for client access (for example, interface or protocol) or service (for example, IGMP). Using these profiles you can consolidate all of the common attributes of a client (and eventually a group of clients) and apply the attributes simultaneously.

After they are created, the profiles reside in a profile library on the router. You can then use the dynamic-profile statement to attach profiles to interfaces.

```
dynamic-profile profile-name;
```

To assign a dynamic profile to a PPP interface, you can include the dynamic-profile statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* ppp-options]

To monitor the configuration, issue the show interfaces *interface-name* command.

For information about dynamic profiles, see Dynamic Profiles Overview in the *JUNOS Subscriber Access Configuration Guide*.

For information about creating dynamic profiles, see Configuring a Basic Dynamic Profile in the *JUNOS Subscriber Access Configuration Guide*.

For information about assigning a dynamic profile to a PPP interface, see Attaching Dynamic Profiles to PPP Subscriber Interfaces in the *JUNOS Subscriber Access Configuration Guide*.

NOTE: Dynamic profiles for PPP subscribers are supported only on PPPoE interfaces for this release.

Configuring PPP CHAP Authentication

For interfaces with PPP encapsulation, you can configure interfaces to support the PPP Challenge Handshake Authentication Protocol (CHAP), as defined in RFC 1994, *PPP Challenge Handshake Authentication Protocol (CHAP)*. When you enable CHAP on an interface, the interface can authenticate its peer and can be authenticated by its peer.

For information about configuring CHAP on logical interfaces, see the *JUNOS System Basics Configuration Guide*.

For information about configuring CHAP on physical interfaces, see "Configuring the PPP Challenge Handshake Authentication Protocol" on page 106

Configuring PPP PAP Authentication

The Password Authentication Protocol (PAP) provides a simple method for the peer to establish its identity using a 2-way handshake. This is done only upon initial link establishment.

After the link is established, an ID and password pair is repeatedly sent by the peer to the authenticator until authentication is acknowledged or the connection is terminated.

To configure PAP, you must create an access profile, configure tracing operations, and configure the logical and physical interfaces.

To configure PAP on a logical interface with PPP encapsulation, include the pap statement with options:

```
pap {
  default-pap-password password;
  local-name name;
  local-password password;
  passive;
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

For more information about configuring PAP for physical interfaces, see "Configuring the PPP Password Authentication Protocol" on page 108. For information about configuring tracing operations for the PPP protocol, see "Tracing Operations of the pppd Process" on page 113.

On each logical interface with PPP encapsulation, you can perform the following tasks:

- Configuring a Default PAP Password on page 156
- Configuring the Local Name on page 156
- Configuring the Local Password on page 156
- Configuring Passive Mode on page 157

Configuring a Default PAP Password

The default PAP password is used when no matching PAP access profile exists, or if the PAP access profile name changes during PPP link negotiation.

To configure a default PAP password for an interface, include the default-pap-password statement:

```
default-pap-password password;
```

You can include the statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* ppp-options pap]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* ppp-options pap]

Configuring the Local Name

By default, when PAP is enabled on an interface, the interface uses the routing platform's system hostname as the name sent in PAP request and response packets.

To configure the name the interface uses in PAP request and response packets, include the local-name statement:

```
local-name name;
```

You can include the statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* ppp-options pap]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* ppp-options pap]

Configuring the Local Password

You need to configure the password to be used for authentication.

To configure the host password for sending PAP requests, include the local-password statement:

```
local-password password;
```

You can include the statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* ppp-options pap]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* ppp-options pap]

Configuring Passive Mode

By default, when PAP is enabled on an interface, the interface always sends authenticate-request packets to the peer, and requires that the peer acknowledge the authenticate-request packets. However, some peer routers may not support bidirectional authentication. In these cases, you can configure PAP to operate in passive mode. In passive mode, the router with the PPP link configured for PAP authenticates any incoming connections, but will not require the peer to authenticate its connection.

To configure the interface to authenticate with PAP in passive mode, include the passive statement:

```
passive;
```

You can include the statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* ppp-options pap]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* ppp-options pap]

Configuring Dynamic Call Admission Control

Dynamic call admission control (CAC) provides enhanced control over WAN bandwidth. You can configure dynamic CAC on J4350 and J6350 Services Routers supporting voice over IP through the TGM550 media gateway module. It can be used with the following interfaces:

- Fast Ethernet and Gigabit Ethernet interfaces
- ISDN BRI interfaces
- Serial interfaces with PPP or Frame Relay encapsulation

When dynamic CAC is configured on an interface responsible for providing call bandwidth, the TGM550 informs the Media Gateway Controller (MGC) of the bandwidth limit available for voice packets on the interface and requests the MGC to block new calls when the bandwidth is exhausted.

Dynamic CAC is useful when a primary link becomes unavailable and a backup link with less bandwidth takes its place. Without dynamic CAC, the MGC cannot detect the switchover to the backup link or the resulting changes in network topology and available bandwidth. The MGC would continue to admit calls at the bandwidth of the primary link, causing network congestion and possible jitter, delay, and loss of calls.

To configure dynamic CAC for a logical interface, include the dynamic-call-admission-control statement, with options:

```
dynamic-call-admission-control {
    activation-priority priority;
    bearer-bandwidth-limit kilobits-per-second;
}
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

bearer-bandwidth-limit *kilobits-per-second* is the dynamic CAC bearer bandwidth limit (BBL)—the maximum bandwidth available for voice traffic on the interface. The TGM550 reports the BBL to the MGC. When the call bandwidth exceeds the BBL, the MGC blocks new calls and alerts the user with a busy tone. The BBL range is from 0 through 9999. The default BBL is -1, which indicates that dynamic CAC is not configured on an interface.

activation-priority *priority* specifies the order in which interfaces are used for providing call bandwidth. The interface with the highest activation priority value is used as the primary link for providing call bandwidth. If the primary link becomes unavailable, the TGM550 switches to the next active interface with the highest activation priority value, and so on. The activation priority value range is from 0 through 255. The default is 50.

NOTE: Dynamic CAC works in conjunction with the Avaya Communication Manager (CM) Call Admission Control: Bandwidth Limitation (CAC-BL) feature. If you configure dynamic CAC on WAN interfaces, you must also configure CAC-BL on Avaya CM. For more information about configuring CAC-BL, see the *Administrator Guide for Avaya Communication Manager*.

Example: Configuring Dynamic CAC

Configure dynamic CAC on a logical interface:

```
[edit]
interfaces {
    t1-4/0/0 {
        unit 0 {
            dynamic-call-admission-control {
                bearer-bandwidth-limit 900 kbps;
                activation-priority 75;
            }
        }
    }
}
```

Disabling a Logical Interface

You can unconfigure a logical interface, effectively disabling that interface, without removing the logical interface configuration statements from the configuration. When an interface is disabled, a route (pointing to the reject target) with the IP address of the interface and a 32–bit subnet mask is installed in the routing table. To do this, include the disable statement:

```
disable;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Chapter 5

Configuring Protocol Family and Interface Address Properties

This chapter describes the configuration of the interface protocol and address properties:

Protocol Family Configuration and Interface Address Statements

For each logical interface, you must configure one or more protocol families. You can also configure interface address properties. To do this, include the following statements:

```
family family {
    accounting {
        destination-class-usage;
        source-class-usage {
            direction;
        }
    }
    address address {
        destination address;
```

```
}
bundle interface-name;
filter {
    dialer filter-name;
    input filter-name;
    output filter-name;
    group filter-group-number;
}
interface-mode (access | trunk);
ipsec-sa sa-name;
keep-address-and-control;
llc2 {
    ack-delay-time time;
    ack-max count;
    idle-time time;
    local-window count;
    max-retry count;
    p-bit-timeout time;
    redundancy-group group-number {
        advertise-interval seconds;
        map {
            local-mac mac-address request mac-address;
        }
        preempt hold-time seconds;
        no-preempt;
        priority priority;
        track {
            dlsw {
                peer ip-address priority-cost priority;
                destination mac-address priority-cost priority;
            }
            interface interface-name priority-cost priority;
        }
    }
    t1-time time;
    t2-time time;
    trej-time time;
}
mtu bytes;
multicast-only;
negotiate-address;
no-redirects:
policer {
    arp policer-template-name;
    input policer-template-name;
    output policer-template-name;
}
primary;
protocols [inet iso mpls];
proxy inet-address address;
receive-options-packets;
receive-ttl-exceeded;
remote (inet-address address | mac-address address);
rpf-check <fail-filter filter-name>;
sampling {
    direction;
```

```
}
service {
    input {
        service-set service-set-name <service-filter filter-name>;
        post-service-filter filter-name;
    }
    output {
        service-set service-set-name <service-filter filter-name>;
    }
}
(translate-discard-eligible | no-translate-discard-eligible);
(translate-fecn-and-becn | no-translate-fecn-and-becn);
vlan-id number;
vlan-id-list [number number-number];
unnumbered-address interface-name destination address destination-profile
    profile-name;
address address {
    arp ip-address (mac | multicast-mac) mac-address <publish>;
    broadcast address;
    destination address;
    destination-profile name;
    eui-64;
    multipoint-destination address dlci dlci-identifier;
    multipoint-destination address {
        epd-threshold cells;
        inverse-arp;
        oam-liveness {
            up-count cells;
            down-count cells;
        }
        oam-period (disable | seconds);
        shaping {
            (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained
                rate burst length);
            queue-length number;
        }
        vci vpi-identifier.vci-identifier;
    }
    primary;
    preferred;
    (vrrp-group | vrrp-inet6-group) group-number {
        (accept-data | no-accept-data);
        advertise-interval seconds;
        authentication-type authentication;
        authentication-key key;
        fast-interval milliseconds;
        (preempt | no-preempt) {
            hold-time seconds;
        }
        priority-number number;
        track {
            priority-cost seconds;
            priority-hold-time interface-name {
                interface priority;
                bandwidth-threshold bits-per-second {
                    priority;
```

```
                }
            }
            route ip-address/mask routing-instance instance-name priority-cost cost;
        }
        virtual-address [ addresses ];
    }
  }
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

For information about interface-specific protocol and address properties, see "Configuring T1 and NxDS0 Interfaces" on page 444.

Configuring the Protocol Family

For each logical interface, you can configure one or more of the following protocols that run on the interface:

- any—Protocol-independent family used for Layer 2 packet filtering. This option is not supported on J-series Services Routers.
- bridge—(M-series and T-series routing platforms only) Configure only when the physical interface is configured with ethernet-bridge type encapsulation or when the logical interface is configured with vlan-bridge type encapsulation. You can optionally configure this protocol family for the logical interface on which you configure VPLS.
- ccc—Circuit cross-connect (CCC). You can configure this protocol family for the logical interface of CCC physical interfaces. When you use this encapsulation type, you can configure the ccc family only.
- inet—IP. You must configure this protocol family for the logical interface to support IP protocol traffic, including Open Shortest Path First (OSPF), Border Gateway Protocol (BGP), Internet Control Message Protocol (ICMP), and Internet Protocol Control Protocol (IPCP).
- inet6—IP version 6 (IPv6). You must configure this protocol family for the logical interface to support IPv6 protocol traffic, including Routing Information Protocol for IPv6 (RIPng), Intermediate System-to-Intermediate System (IS-IS), BGP, and Virtual Router Redundancy Protocol for IPv6 (VRRP). For more information about IPv6, see "IPv6 Overview" on page 166.
- iso—International Organization for Standardization (ISO). You must configure this protocol family for the logical interface to support IS-IS traffic.
- mlfr-uni-nni—Multilink Frame Relay (MLFR) FRF.16 user-to-network network-to-network (UNI NNI). You must configure this protocol or mlfr-end-to-end for the logical interface to support link services and voice services bundling.

- mlfr-end-to-end—Multilink Frame Relay end-to-end. You must configure this protocol or multilink Point-to-Point Protocol (MLPPP) for the logical interface to support multilink bundling.
- mlppp—MLPPP. You must configure this protocol (or mlfr-end-to-end) for the logical interface to support multilink bundling.
- mpls—Multiprotocol Label Switching (MPLS). You must configure this protocol family for the logical interface to participate in an MPLS path.
- tcc—Translational cross-connect (TCC). You can configure this protocol family for the logical interface of TCC physical interfaces.
- tnp—Trivial Network Protocol. This protocol is used to communicate between the Routing Engine and the routing platform's packet forwarding components. The JUNOS software automatically configures this protocol family on the routing platform's internal interfaces only, as discussed in "Displaying the Internal Ethernet Interface" on page 235.
- vpls—M-series and T-series routing platforms support Virtual Private LAN service (VPLS). You can optionally configure this protocol family for the logical interface on which you configure VPLS. VPLS provides an Ethernet-based point-to-multipoint Layer 2 VPN to connect customer edge (CE) routing platforms across an MPLS backbone. When you configure a VPLS encapsulation type, the family vpls statement is assumed by default.

  MX-series routers support dynamic profiles for VPLS pseudowires, VLAN identifier translation, and automatic bridge domain configuration.

  For more information about VPLS, see the *JUNOS VPNs Configuration Guide* and the *JUNOS Feature Guide*.

To configure the logical interface's protocol family, include the family statement, specifying the selected family. To configure more than one protocol family on a logical interface, include multiple family statements. Following is the minimum configuration:

```
family family {
    mtu size;
    multicast-only;
    no-redirects;
    primary;
    address address {
        destination address;
        broadcast address;
        preferred;
        primary;
    }
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

IPv6 Overview

IP version 4 (IPv4) has been widely deployed and used to network the Internet today. With the rapid growth of the Internet, enhancements to IPv4 are needed to support the influx of new subscribers, Internet-enabled devices, and applications. IPv6 is designed to enable the global expansion of the Internet.

IPv6 builds upon the functionality of IPv4, providing improvements to addressing, configuration and maintenance, and security.

IPv6 is defined in the following documents:

- RFC 2373, *IP Version 6 Addressing Architecture*
- RFC 2460, *Internet Protocol, Version 6 (IPv6)*

IPv4-to-IPv6 Transition

Implementing IPv6 requires a transition mechanism to allow interoperability between IPv6 nodes (both routing platforms and hosts) and IPv4 nodes. The transition mechanism is the key factor in the successful deployment of IPv6. Because millions of IPv4 nodes already exist, upgrading every node to IPv6 at the same time is not feasible.

As a result, transition from IPv4 to IPv6 happens gradually, allowing nodes to be upgraded independently and without disruption to other nodes. While a gradual upgrade occurs, compatibility between IPv6 and IPv4 nodes becomes a requirement. Otherwise, an IPv6 node would not be able to communicate with an IPv4 node.

Transition mechanisms allow IPv6 and IPv4 nodes to coexist together in the same network, and make gradual upgrading possible. The transition mechanism supported by the JUNOS software is tunneling. Tunnels allow IPv6 packets to be encapsulated into IPv4 headers and sent across an IPv4 infrastructure. For more information about configuring tunnels to support IPv4-to-IPv6 transition, see the *JUNOS Services Interfaces Configuration Guide*.

VRRP Properties

The Virtual Router Redundancy Protocol (VRRP) provides a much faster switchover to a backup router when the default router fails. Using VRRP, a backup router can take over a failed default router within a few seconds. This is done with minimum amount of VRRP traffic and without any interactions with the hosts.

For more information on VRRP properties, see the *JUNOS High Availability Configuration Guide*.

Configuring the Interface Address

You assign an address to an interface by specifying the address when configuring the protocol family. For the inet family, configure the interface's IP address. For the iso family, configure one or more addresses for the loopback interface. For the ccc, tcc, mpls, tnp, and vpls families, you never configure an address.

To assign an address to an interface, include the address statement:

```
address address {
    broadcast address;
    destination address;
    destination-profile name;
    eui-64;
    preferred;
    primary;
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family *family*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

In the address statement, specify the network address of the interface.

For each address, you can optionally configure one or more of the following:

- Broadcast address for the interface's subnet—Specify this in the broadcast statement; this applies only to Ethernet interfaces, such as the management interface fxp0, the Fast Ethernet interface, and the Gigabit Ethernet interface.
- Address of the remote side of the connection (for point-to-point interfaces only)—Specify this in the destination statement.
- Assign PPP properties to the remote end—Specify this in the destination-profile statement. You define the profile at the [edit access group-profile *name* ppp] hierarchy level (for point-to-point interfaces only). For more information, see "Configuring IPCP Options" on page 168.
- Whether the routing platform automatically generates the host number portion of interface addresses—The eui-64 statement applies only to interfaces that carry IPv6 traffic, where the prefix length of the address is 64 bits or less, and the low-order 64 bits of the address are zero. This option does not apply to the loopback interface (lo0) because IPv6 addresses configured on the loopback interface must have a 128-bit prefix length.
- Whether this address is the preferred address—Each subnet on an interface has a preferred local address. If you configure more than one address on the same subnet, the preferred local address is chosen by default as the source address when you originate packets to destinations on the subnet. For more information about preferred addresses, see "Configuring Default, Primary, and Preferred Addresses and Interfaces" on page 183.

  By default, the preferred address is the lowest numbered address on the subnet. To override the default and explicitly configure the preferred address, include the preferred statement when configuring the address.

- Whether this address is the primary address—Each interface has a primary local address. If an interface has more than one address, the primary local address is used by default as the source address when you originate packets out the interface where the destination gives no hint about the subnet (for example, some ping commands). For more information about primary addresses, see "Configuring Default, Primary, and Preferred Addresses and Interfaces" on page 183.

By default, the primary address on an interface is the lowest numbered non-127 preferred address on the interface. To override the default and explicitly configure the preferred address, include the primary statement when configuring the address.

Configuring the Interface IPv6 Address

You represent IPv6 addresses in hexadecimal notation using a colon-separated list of 16-bit values.

You assign a 128-bit IPv6 address to an interface by including the address statement:

```
address aaaa:bbbb:...:zzzz/nn;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family inet]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet]

The double colon (::) represents all bits set to 0, as shown in the following example:

```
interfaces fe-0/0/1 {
   unit 0 {
      family inet6 {
         address fec0:1:1:1::2/64;
      }
   }
}
```

NOTE: You must manually configure the router advertisement and advertise the default prefix for autoconfiguration to work on a specific interface.

Configuring IPCP Options

For interfaces with PPP encapsulation, you can configure IPCP to negotiate IP address assignments and to pass network-related information such as Windows Name Service (WINS) and Domain Name System (DNS) servers, as defined in RFC 1877, *PPP Internet Protocol Control Protocol Extensions for Name Server Addresses*.

NOTE: The JUNOS software does not request name servers from the remote end; the software does, however, send name servers to the remote end if requested.

On the logical interface, the following PPP encapsulation types are supported:

- atm-mlppp-llc
- atm-ppp-llc
- atm-ppp-vc-mux
- multilink-ppp

When you enable a PPP interface, you can configure an IP address, enable the interface to negotiate an IP address assignment from the remote end, or allow the interface to be unnumbered. You can also assign a destination profile to the remote end. The destination profile includes PPP properties, such as primary and secondary DNS and NetBIOS Name Servers (NBNSs). These options are described in the following sections:

Configuring an IP Address for an Interface

You can configure an IP address for the interface by including the address statement in the configuration. For more information, see “Configuring the Interface Address” on page 166.

If you include the address statement in the configuration, you cannot include the negotiate-address or unnumbered-address statement in the configuration.

When you include the address statement in the interface configuration, you can assign PPP properties to the remote end, as shown in “Assigning a Destination Profile to the Remote End” on page 170.

Negotiating an IP Address Assignment from the Remote End

To enable the interface to obtain an IP address from the remote end, include the negotiate-address statement at the [edit interfaces *interface-name* unit *logical-unit-number* family inet] hierarchy level:

```
negotiate-address;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family inet]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet]

If you include the negotiate-address statement in the configuration, you cannot include the address or unnumbered-address statement in the configuration.

Configuring an Interface to Be Unnumbered

To configure an interface to be unnumbered, include the unnumbered-address and destination statements in the configuration:

```
unnumbered-address interface-name destination address;
```

The unnumbered-address statement enables the local address to be derived from the specified interface. The interface name must include a logical unit number and must have a configured address (see "Configuring the Interface Address" on page 166). Specify the IP address of the remote interface with the destination statement.

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family inet]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet]

If you include the unnumbered-address statement in the configuration, you cannot include the address or negotiate-address statement in the interface configuration.

When you include the unnumbered-address statement in the interface configuration, you can assign PPP properties to the remote end, as shown in "Assigning a Destination Profile to the Remote End" on page 170.

Assigning a Destination Profile to the Remote End

When you include the address or unnumbered-address statement in the interface configuration, you can assign PPP properties to the remote end. To do this, include the destination-profile statement:

```
destination-profile name;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address*]
- [edit interfaces *interface-name* unit *logical-unit-number* family inet unnumbered-address *interface-name*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet unnumbered-address *interface-name*]

The profile name is a PPP group profile. You define the profile by including the following statements at the [edit access group-profile *name* ppp] hierarchy level:

```
[edit access group-profile name ppp]
framed-pool pool-id;
interface-id interface-id;
primary-dns primary-dns;
```

```
primary-wins primary-win-server;
secondary-dns secondary-dns;
secondary-wins secondary-wins;
```

For more information about PPP group profiles, see the *JUNOS System Basics Configuration Guide*.

Configuring LLC2 Options

Logical link control 2 (LLC2) options can be configured for data link switching (DLSw) protocol support on J-series Services Routers. DLSw allows you to tunnel System Network Architecture (SNA) and NetBIOS traffic over an IP network.

DLSw enables SNA clients to communicate to SNA applications on a mainframe through an IP network. After a connection is established, a DLSw circuit can be created for transporting SNA traffic.

The IP network between an SNA client and an SNA application becomes transparent with DLSw. DLSw transports any SNA traffic. DLSw has an LLC session on one SNA device and recreates it (almost identically) on the other SNA device, making the devices operate as if they were directly connected. DLSw is configured on peer IP routers and transports everything between the peers using Switch-to-Switch Protocol (SSP).

For information about configuring DLSw, see the *JUNOS Services Interfaces Configuration Guide* and the *J-series Services Router Advanced WAN Access Configuration Guide*

For more information, see the following sections:

- Configuring LLC2 Properties on page 171
- Configuring DLSw Ethernet Redundancy Using LLC2 Properties on page 172
- Example: Configuring LLC Options on an Interface on page 174
- Example: Configuring DLSw Ethernet Redundancy on page 174

Configuring LLC2 Properties

For basic DLSw configuration, include the llc2 statement at the [edit interfaces *interface-name* unit *logical-unit-number* family] hierarchy level. All other LLC2 statements that follow are optional and should be used only if recommended by support or a services professional to solve specific problems or for specific network designs.

To configure logical link control properties, include the llc2 statement:

```
llc2 {
    ack-delay-time time;
    ack-max count;
    idle-time time;
    local-window count;
    max-retry count;
    p-bit-timeout time;
    t1-time time;
```

```
    t2-time time;
    trej-time time;
}
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family]

You can configure the following LLC options:

- ack-delay-time—The maximum time allowed for incoming Information-frames (I-frames) to remain unacknowledged. Specify the number of milliseconds from 1 through 60000. The default value is 100 milliseconds.
- ack-max—The maximum number of I-frames received before acknowledgment is sent. Specify the number of I-frames from 1 through 127. The default value is three I-frames.
- idle-time—The number of seconds that a TCP connection between DLSw peers will stay up without any circuit using the connection. Specify the number of seconds from 1 through 60000. The default value is 10 seconds.
- local-window—The maximum number of I-frames to send before waiting for acknowledgment. Specify the number of I-frames from 1 through 127. The default value is 7 I-frames.
- max-retry—The number of retries the router should attempt when waiting for a response. Specify the number of I-frames from 1 through 127. The default value is 10 I-frames.
- p-bit-timeout—The length of time the router waits for response to a poll bit. Specify the number of milliseconds from 1 through 60000. The default value is 3000 milliseconds.
- t1-time—The length of time the router waits for an acknowledgment of transmitted frames. Specify the number of milliseconds from 1 through 60000. The default value is 1000 milliseconds.
- t2-time—The length of time the router withholds the I-frame response. Specify the number of milliseconds from 1 through 60000. The default value is 100 milliseconds.
- trej-time—Q.391-specific timer for T310, in seconds. Specify the number of milliseconds from 1 through 60000. The default value is 3000 milliseconds.

Configuring DLSw Ethernet Redundancy Using LLC2 Properties

DLSw is a means of tunneling SNA and NetBIOS traffic over IP networks. To achieve fault tolerance and load sharing, you can configure Ethernet redundancy and deploy multiple DLSw routers on the same LAN segment. These redundant routers provide alternate paths to the destinations and avoid a single point of failure.

When you configure DLSw Ethernet redundancy on a LAN segment, a master router is selected from a group of DLSw neighbors. The master router establishes the circuits.

To configure DLSw Ethernet redundancy, include the redundancy-group statement and define redundancy group options:

```
llc2 {
    redundancy-group group-number {
        advertise-interval seconds;
        map {
            local-mac mac-address remote-mac mac-address;
            preempt hold-time seconds;
                no-preempt;
                priority priority;
                track {
                    dlsw {
                        destination mac-address priority-cost priority;
                        peer ip-address priority-cost priority;
                    }
                    interface interface-name priority-cost priority;
                }
            }
        }
    }
}
```

You can include these statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family]

You can configure the following redundancy options:

- redundancy-group *group-number*—The group to which this router belongs. Specify the group number, in the range from 0 through 255.
- advertise-interval—The advertisement interval of DLSw peers on the network. All routers in the redundancy group must use the same advertisement interval. Specify the number of seconds, from 1 through 255. The default is 1 second.
- map—Map a local peer MAC address to a remote peer MAC address.
    - local-mac—The local MAC address to be mapped to a remote destination MAC address.
    - *mac-address*—The MAC address. Specify the MAC address as six hexadecimal bytes in one of the following formats: *nn*:*nn*:*nn*:*nn*:*nn*:*nn* or *nnnn* .*nnnn*.*nnnn*. For example, 0011.2233.4455 or 00:11:22:33:44:55.
    - remote-mac—The remote destination MAC address to be mapped to a local MAC address.
- preempt hold-time *seconds*— Configure the time to wait before a higher-priority backup router preempts the master router. Specify the number of seconds, from 0 through 3600. DLSw preemption is 0 by default.
- no-preempt—Prohibit the preemption of the master router.

- priority *priority*—The router's priority for becoming the master router. The router with the highest priority within the redundancy group becomes the master. A larger value indicates a higher priority for being elected. Specify the priority from 1 through 255. The default is 100 (for backup routers).
- track—Enable the following tracking options for the remote peer and the destination peer:
  - dlsw—DLSw protocol.
    - destination *mac-address* priority-cost *priority*—The local MAC address and the priority. Specify the MAC address as six hexadecimal bytes in one of the following formats: *nn*:*nn*:*nn*:*nn*:*nn*:*nn* or *nnnn* .*nnnn*.*nnnn*. For example, 0011.2233.4455 or 00:11:22:33:44:55. The priority cost is the value subtracted from the priority value when remote peer connectivity is lost. Specify a value from 1 through 254.
    - peer *ip-address* priority-cost *priority*—The IP address of the remote peer. The priority cost is the value subtracted from the priority value when remote peer connectivity is lost. Specify a value from 1 through 254.
  - interface *interface-name*—The interface name. Include the logical portion of the name, which corresponds to the logical unit number.

Example: Configuring LLC Options on an Interface

Configure LLC options on an unnumbered interface:

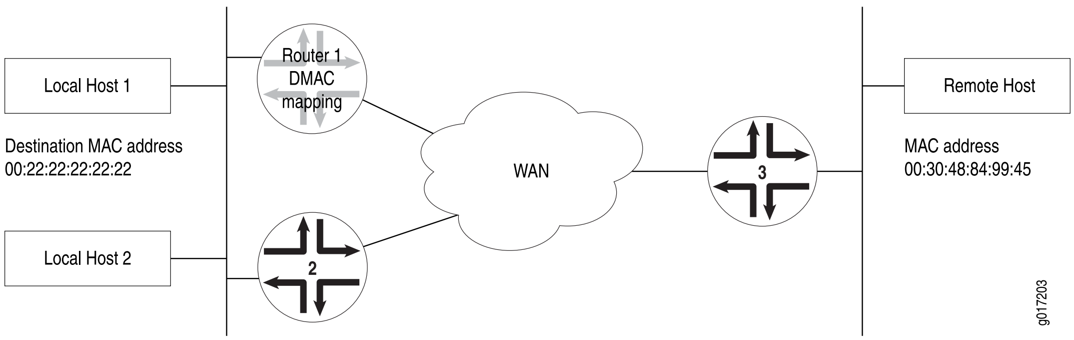
```
[edit]
interfaces {
   fe-0/0/0 {
      unit 0 {
         family inet;
         address 10.10.10.2/24;
      }
      family llc2 {
         ack-delay-time 3000;
         ack-max 10;
         idle-time 102;
         local-window 15;
         max-retry 20;
         p-bit-timeout 100;
         t1-time 101;
         t2-time 101;
         max-retry 5;
         trej-time 4000;
      }
   }
}
```

Example: Configuring DLSw Ethernet Redundancy

In Figure 6 on page 175, the local hosts share the same destination MAC address of 00:00:5E:00:01:01 and send DLSw traffic to the remote host with a MAC address of

00:02:00:00:00:01. Router 1 and Router 2 are configured for DLSw redundancy and map the local destination MAC address to the remote MAC address. Router 1 is also the designated master. If Router 1 becomes unavailable, Router 2, the backup router, takes over as the master router.

Figure 6: DLSw Ethernet Redundancy Topology



To configure DLSw Ethernet redundancy, do the following:

Configuration on Router 1

Configure the redundancy group, redundancy group options, and the priority cost of each redundancy group option:

```
[edit]
interfaces {
   fe-0/0/0 {
      unit 0 {
         family llc2 {
            redundancy-group 1 {
               advertise-interval 1;
               map {
                  local-mac 00:00:5e:00:01:01 remote-mac 00:02:00:00:00:01;
                  preempt hold-time 20;
                     priority 200;
                     track {
                        dlsw {
                           destination 00:02:00:00:00:01 priority-cost 50;
                           peer 10.10.10.10 priority-cost 25;
                        }
                        interface e1-0/0/2.0 priority-cost 40;
                     }
                  }
               }
            }
         }
      }
   }
}
```

Configuration on Router 2

Configure the redundancy group, redundancy group options, and the priority cost of each redundancy group option:

```
[edit]
interfaces {
   fe-0/0/1 {
```

```
        unit 0 {
          family llc2 {
            redundancy-group 1 {
              map {
                local-mac 00:00:5e:00:01:01 remote-mac 00:02:00:00:00:01;
                priority-cost 190;
                  track {
                    dlsw {
                      destination 00:02:00:00:00:01 priority-cost 50;
                      peer 10.10.10.10 priority-cost 25;
                    }
                    interface e1-0/0/2.0 priority-cost 40;
                  }
                }
              }
            }
          }
        }
      }
    }
```

Configuring an Unnumbered Interface

When you need to conserve IP addresses, you can configure unnumbered interfaces. Setting up an unnumbered interface enables IP processing on the interface without assigning an explicit IP address to the interface. The statements you use to configure an unnumbered interface depend on the type of interface you are configuring: a point-to-point interface or an Ethernet interface:

- Configuring an Unnumbered Point-to-Point Interface on page 176
- Configuring an Unnumbered Ethernet or Demux Interface on page 177

Configuring an Unnumbered Point-to-Point Interface

To configure a point-to-point interface to be unnumbered, configure the protocol family, but do not include the address statement:

family *family*;

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

NOTE: For interfaces with PPP encapsulation, you can configure an unnumbered interface by including the unnumbered-interface statement in the configuration. For more information, see "Configuring IPCP Options" on page 168.

When configuring unnumbered interfaces, you must ensure that a source address is configured on some interface in the routing platform. This address is the default address. We recommend that you do this by assigning an address to the loopback interface (lo0), as described in "Configuring the Loopback Interface" on page 245. If you configure an address (other than a martian) on the lo0 interface, that address is always the default address, which is preferable because the loopback interface is independent of any physical interfaces and therefore is always accessible.

Example: Configuring an Unnumbered Point-to-Point Interface

Configure an unnumbered point-to-point interface:

```
[edit]
interfaces {
    so-6/1/0 {
        unit 0 {
            family inet;
            family iso;
        }
    }
}
```

Configuring an Unnumbered Ethernet or Demux Interface

To configure an Ethernet or demultiplexing interface to be unnumbered, include the unnumbered-address statement in the configuration:

unnumbered-address *interface-name*;

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family inet]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet]

The unnumbered-address statement currently supports configuration of unnumbered Ethernet or unnumbered demux interfaces only for the IPv4 address family.

The interface that you configure to be unnumbered "borrows" an assigned IPv4 address from another interface, and is therefore referred to as the borrower interface. The interface from which the IP address is borrowed is referred to as the donor interface. In the unnumbered-address statement, *interface-name* specifies the donor interface. For an Ethernet unnumbered interface, the donor interface can be an Ethernet, ATM, SONET, or loopback interface that has a logical unit number and configured IP address and is not itself an unnumbered interface. For an IP demultiplexing unnumbered interface, the donor interface can be an Ethernet or loopback interface that has a logical unit number and configured IP address and is not itself an unnumbered interface. In addition, for either Ethernet or demux, the donor interface and the borrower interface must be members of the same routing instance and the same logical system.

When you configure an unnumbered Ethernet or demux interface, the IP address of the donor interface becomes the source address in packets generated by the unnumbered interface.

You can configure a host route that points to an unnumbered Ethernet or demux interface. For information about host routes, see the *JUNOS MPLS Applications Configuration Guide*.

For more information, see the following sections:

- Configuring a Preferred Source Address for Unnumbered Ethernet or Demux Interfaces on page 178
- Configuring Static Routes on Unnumbered Ethernet Interfaces on page 179
- Restrictions for Configuring Unnumbered Ethernet Interfaces on page 179
- Example: Configuring an Unnumbered Ethernet Interface on page 180
- Example: Configuring the Preferred Source Address for an Unnumbered Ethernet Interface on page 180
- Example: Configuring an Unnumbered Ethernet Interface as the Next Hop for a Static Route on page 181

Configuring a Preferred Source Address for Unnumbered Ethernet or Demux Interfaces

When a loopback interface with multiple secondary IPv4 addresses is configured as the donor interface for an unnumbered Ethernet or demux interface, you can optionally specify any one of the loopback interface's secondary addresses as the preferred source address for the unnumbered Ethernet or demux interface. This feature enables you to use an IP address other than the primary IP address on some of the unnumbered Ethernet or demux interfaces in your network.

To configure a secondary address on a loopback donor interface as the preferred source address for an unnumbered Ethernet or demux interface, include the preferred-source-address option in the unnumbered-address statement:

```
unnumbered-address interface-name <preferred-source-address address>;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family inet]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet]

The following considerations apply when you configure a preferred source address on an unnumbered Ethernet or demux interface:

- The unnumbered-address statement currently supports the configuration of a preferred source address only for the IPv4 address family. Configuration of a preferred source address for families other than IPv4 is not currently supported.
- If you do not specify the preferred source address, the router uses the default primary IP address of the donor interface.

- You cannot delete an address on a donor loopback interface while it is being used as the preferred source address for an unnumbered Ethernet or demux interface.
- The router uses the preferred source address, if configured for an unnumbered Ethernet or demux interface, in ARP requests and replies. ARP requests must match the preferred source address.

For a configuration example that illustrates this feature, see "Example: Configuring the Preferred Source Address for an Unnumbered Ethernet Interface" on page 180.

To display the preferred source address for an unnumbered Ethernet or demux interface, use the show interfaces operational mode command. For information about using this command, see the *JUNOS Interfaces Command Reference*.

Configuring Static Routes on Unnumbered Ethernet Interfaces

You can configure static routes on an unnumbered Ethernet interface. To do so, you use the qualified-next-hop statement to specify the unnumbered Ethernet interface as the next-hop interface for a configured static route. This feature enables you to specify independent preferences and metrics for static routes on a next-hop basis.

For a configuration example that illustrates this feature, see "Example: Configuring an Unnumbered Ethernet Interface as the Next Hop for a Static Route" on page 181.

For information about how to specify an independent preference for a static route, see the *JUNOS Routing Protocols Configuration Guide*.

Restrictions for Configuring Unnumbered Ethernet Interfaces

The following restrictions apply when you configure unnumbered Ethernet interfaces:

- The unnumbered-address statement currently supports the configuration of unnumbered Ethernet interfaces only for the IPv4 address family. Unnumbered Ethernet configuration for families other than IPv4 is not supported.
- You cannot assign an IP address to an Ethernet interface that is already configured as an unnumbered interface.
- The donor interface for an unnumbered Ethernet interface must have one or more configured IP addresses.
- The donor interface for an unnumbered Ethernet interfaced cannot be configured as unnumbered.
- An unnumbered Ethernet interface does not support configuration of the following address statement options: arp, broadcast, primary, preferred, and vrrp-group. For information about these options, see "Configuring the Interface Address" on page 166.
- Running IGMP and PIM are supported only on unnumbered Ethernet interfaces that directly face the host and have no downstream PIM neighbors. IGMP and PIM are not supported on unnumbered Ethernet interfaces that act as upstream interfaces in a PIM topology.
- Running OSPF and IS-IS on unnumbered Ethernet interfaces is not supported.

- You cannot configure this feature on the TX Matrix platform.
- The configuration of unnumbered Ethernet interfaces is not supported when graceful Routing Engine switchover (GRES) is enabled on the router.

Example: Configuring an Unnumbered Ethernet Interface

In this example, ge-1/0/0 is the unnumbered interface and ge-0/0/0 is the donor interface from which ge-1/0/0 "borrows" an IP address.

```
interfaces {
  ge-0/0/0 {
    unit 0 {
      family inet {
        address 4.4.4.1/24;
      }
    }
  }
  ge-1/0/0 {
    unit 0 {
      family inet {
        unnumbered-address ge-0/0/0.0;
      }
    }
  }
}
```

Example: Configuring the Preferred Source Address for an Unnumbered Ethernet Interface

In this example, loopback interface lo0 is the donor interface from which unnumbered Ethernet interface ge-4/0/0 "borrows" an IP address. The example also configures one of the loopback interface's secondary addresses, 3.3.3.1, as the preferred source address for the unnumbered Ethernet interface.

```
interfaces {
  lo0 {
    unit 0 {
      family inet {
        address 2.2.2.1/32;
        address 3.3.3.1/32;
      }
    }
  }
}
interfaces {
  ge-4/0/0 {
    unit 0 {
      family inet {
        unnumbered-address lo0.0 preferred-source-address 3.3.3.1;
      }
    }
  }
}
```

Example: Configuring an Unnumbered Ethernet Interface as the Next Hop for a Static Route

In this example, ge-0/0/0 is the unnumbered interface and a loopback interface, lo0, is the donor interface from which ge-0/0/0 “borrows” an IP address. The example also configures a static route to 7.7.7.1/32 with a next hop through unnumbered interface ge-0/0/0.0.

```
interfaces {
   lo0 {
      unit 0 {
         family inet {
            address 5.5.5.1/32;
            address 6.6.6.1/32;
         }
      }
   }
}
interfaces
   ge-0/0/0 {
      unit 0 {
         family inet {
            unnumbered-address lo0.0;
         }
      }
   }
}
routing-options {
   static {
      route 7.7.7.1/32 {
         qualified next-hop ge-0/0/0.0;
      }
   }
}
```

Setting the Protocol MTU

When you initially configure an interface, the protocol maximum transmission unit (MTU) is calculated automatically. If you subsequently change the media MTU, the protocol MTU on existing address families automatically changes.

For a list of default protocol MTU values, see “Configuring the Media MTU” on page 92.

To modify the MTU for a particular protocol family, include the mtu statement:

```
mtu bytes;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family *family*]

- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

If you increase the size of the protocol MTU, you must ensure that the size of the media MTU is equal to or greater than the sum of the protocol MTU and the encapsulation overhead. For a lift of encapsulation overhead values, see Table 17 on page 98. If you reduce the media MTU size, but there are already one or more address families configured and active on the interface, you must also reduce the protocol MTU size. (You configure the media MTU by including the mtu statement at the [edit interfaces *interface-name*] hierarchy level, as discussed in "Configuring the Media MTU" on page 92.)

NOTE: Changing the media MTU or protocol MTU causes an interface to be deleted and added again.

The maximum number of data-link connection identifiers (DLCIs) is determined by the MTU on the interface. If you have keepalives enabled, the maximum number of DLCIs is 1000, with the MTU set to 5012.

The actual frames transmitted also contain cyclic redundancy check (CRC) bits, which are not part of the MTU. For example, the default protocol MTU for a Gigabit Ethernet interface is 1500 bytes, but the largest possible frame size is actually 1504 bytes; you need to consider the extra bits in calculations of MTUs for interoperability.

Disabling the Removal of Address and Control Bytes

For Point-to-Point Protocol (PPP) CCC-encapsulated interfaces, the address and control bytes are removed by default before the packet is encapsulated into a tunnel.

You can disable the removal of address and control bytes. To do this, include the keep-address-and-control statement:

```
keep-address-and-control;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family ccc]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family ccc]

Disabling the Transmission of Redirect Messages on an Interface

By default, the interface sends protocol redirect messages. To disable the sending of these messages on an interface, include the no-redirects statement:

```
no-redirects;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family *family*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

To disable the sending of protocol redirect messages for the entire routing platform, include the no-redirects statement at the [edit system] hierarchy level.

Configuring Default, Primary, and Preferred Addresses and Interfaces

The routing platform has a default address and a primary interface, and interfaces have primary and preferred addresses.

The *default address* of the routing platform is used as the source address on unnumbered interfaces. The routing protocol process tries to pick the default address as the routing platform ID, which is used by protocols, including OSPF and internal BGP (IBGP).

The *primary interface* for the routing platform is the interface that packets go out when no interface name is specified and when the destination address does not imply a particular outgoing interface.

An interface's *primary address* is used by default as the local address for broadcast and multicast packets sourced locally and sent out the interface. An interface's *preferred address* is the default local address used for packets sourced by the local routing platform to destinations on the subnet.

The default address of the routing platform is chosen using the following sequence:

1. The primary address on the loopback interface lo0 that is not 127.0.0.1 is used.
2. The primary address on the primary interface is used.

To configure these addresses and interfaces, you can do the following:

- Configuring the Primary Interface for the Routing Platform on page 183
- Configuring the Primary Address for an Interface on page 184
- Configuring the Preferred Address for an Interface on page 184

Configuring the Primary Interface for the Routing Platform

The *primary interface* for the routing platform has the following characteristics:

- It is the interface that packets go out when you type a command such as ping 255.255.255.255—that is, a command that does not include an interface name (there is no interface *type*-0/0/0.0 qualifier) and where the destination address does not imply any particular outgoing interface.
- It is the interface on which multicast applications running locally on the routing platform, such as Session Announcement Protocol (SAP), do group joins by default.

- It is the interface from which the default local address is derived for packets sourced out an unnumbered interface if there are no non-127 addresses configured on the loopback interface, lo0.

By default, the multicast-capable interface with the lowest-index address is chosen as the primary interface. If there is no such interface, the point-to-point interface with the lowest index address is chosen. Otherwise, any interface with an address could be picked. In practice, this means that, on the routing platform, the fxp0 interface is picked by default.

To configure a different interface to be the primary interface, include the primary statement:

```
primary;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family *family*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

Configuring the Primary Address for an Interface

The *primary address* on an interface is the address that is used by default as the local address for broadcast and multicast packets sourced locally and sent out the interface. For example, the local address in the packets sent by a ping interface so-0/0/0.0 255.255.255.255 command is the primary address on interface so-0/0/0.0. The primary address flag also can be useful for selecting the local address used for packets sent out unnumbered interfaces when multiple non-127 addresses are configured on the loopback interface, lo0. By default, the primary address on an interface is selected as the numerically lowest local address configured on the interface.

To set a different primary address, include the primary statement:

```
primary;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family *family* address *address*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family* address *address*]

Configuring the Preferred Address for an Interface

The *preferred address* on an interface is the default local address used for packets sourced by the local routing platform to destinations on the subnet. By default, the numerically lowest local address is chosen. For example, if the addresses 172.16.1.1/12, 172.16.1.2/12, and 172.16.1.3/12 are configured on the same interface, the preferred address on the subnet (by default, 172.16.1.1) would be used as a local address when you issue a ping 172.16.1.5 command.

To set a different preferred address for the subnet, include the preferred statement:

```
preferred;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family *family* address *address*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family* address *address*]

Applying Policers

Policers allow you to perform simple traffic policing on specific interfaces or Layer 2 virtual private networks (VPNs) without configuring a firewall filter. To apply policers, include the policer statement:

```
policer {
    arp policer-template-name;
    input policer-template-name;
    output policer-template-name;
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family *family*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

In the family statement, the protocol family can be ccc, inet, inet6, mpls, tcc, or vpls.

In the arp statement, list the name of one policer template to be evaluated when Address Resolution Protocol (ARP) packets are received on the interface. By default, an ARP policer is installed that is shared among all the Ethernet interfaces on which you have configured the family inet statement. If you want more stringent or lenient policing of ARP packets, you can configure an interface-specific policer and apply it to the interface. You configure an ARP policer just as you would configure any other policer, at the [edit firewall policer] hierarchy level. If you apply this policer to an interface, the default ARP packet policer is overridden. If you delete this policer, the default policer takes effect again.

In the input statement, list the name of one policer template to be evaluated when packets are received on the interface.

In the output statement, list the name of one policer template to be evaluated when packets are transmitted on the interface.

NOTE: To use policing on a CCC or TCC interface, you must configure the CCC or TCC protocol family.

You can configure a different policer on each protocol family on an interface, with one input policer and one output policer for each family. When you apply policers, you can configure the family ccc, inet, inet6, mpls, tcc, or vpls only, and one ARP policer for the family inet protocol only. Each time a policer is referenced, a separate copy of the policer is installed on the packet forwarding components for that interface.

If you apply both policers and firewall filters to an interface, input policers are evaluated before input firewall filters, and output policers are evaluated after output firewall filters.

If you apply the policer to the interface lo0, it is applied to packets received or transmitted by the Routing Engine.

On M-series platforms (except the M320 and M120 routers), if you apply a firewall filter or policer to multiple interfaces, the filter or policer acts on the sum of traffic entering or exiting those interfaces. On T-series, M120, and M320 platforms, the filter or policer acts on the sum of traffic, if the interfaces are on the same FPC.

For more information about policers, see the *JUNOS Policy Framework Configuration Guide*.

Applying Aggregate Policers

By default, if you apply a policer to multiple protocol families on the same logical interface, the policer restricts traffic for each protocol family individually. For example, a policer with a 50 Mbps bandwidth limit applied to both IPv4 and IPv6 traffic would allow the interface to accept 50 Mbps of IPv4 traffic and 50 Mbps of IPv6 traffic. If you apply an aggregate policer, the policer would allow the interface to receive only 50 Mbps of IPv4 and IPv6 traffic combined.

To configure an aggregate policer, include the logical-interface-policer statement at the [edit firewall policer *policer-template-name*] hierarchy level:

```
[edit firewall policer policer-template-name]
logical-interface-policer;
```

For the policer to be treated as an aggregate, you must apply it to multiple protocol families on a single logical interface by including the policer statement:

```
policer {
  arp policer-template-name;
  input policer-template-name;
  output policer-template-name;
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family *family*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

In the family statement, the protocol family can be ccc, inet, inet6, mpls, tcc, or vpls.

The protocol families on which you do not apply the policer are not affected by the policer. For example, if you configure a single logical interface to accept MPLS, IPv4, and IPv6 traffic and you apply the logical interface policer policer1 to only the IPv4 and IPv6 protocol families, MPLS traffic is not subject to the constraints of policer1.

If you apply policer1 to a different logical interface, there are two instances of the policer. This means the JUNOS software polices traffic on separate logical interfaces separately, not as an aggregate, even if the same logical-interface policer is applied to multiple logical interfaces on the same physical interface port.

NOTE: Logical interface policers are not supported for filter policers. In other words, you cannot include the logical-interface-policer statement at the [edit firewall filter *name* term *name* then policer] hierarchy level.

Example: Applying Aggregate Policers

Configure two logical interface policers: aggregate_police1 and aggregate_police2. Apply aggregate_police1 to IPv4 and IPv6 traffic received on logical interface fe-0/0/0.0. Apply aggregate_police2 to CCC and MPLS traffic received on logical interface fe-0/0/0.0. This configuration causes the software to create only one instance of aggregate_police1 and one instance of aggregate_police2.

Apply aggregate_police1 to IPv4 and IPv6 traffic received on another logical interface fe-0/0/0.1. This configuration causes the software to create a new instance of aggregate_police1, one that applies to unit 0 and another that applies to unit 1.

```
[edit firewall]
policer aggregate_police1 {
    logical-interface-policer;
    if-exceeding {
        bandwidth-limit 100m;
        burst-size-limit 500k;
    }
    then {
        discard;
    }
}
policer aggregate_police2 {
    logical-interface-policer;
    if-exceeding {
        bandwidth-limit 10m;
        burst-size-limit 200k;
    }
    then {
        discard;
    }
}
[edit interfaces fe-0/0/0]
unit 0 {
    family inet {
        policer {
            input aggregate_police1;
```

```
            }
        }
        family inet6 {
            policer {
                input aggregate_police1;
            }
        }
        family ccc {
            policer {
                input aggregate_police2;
            }
        }
        family mpls {
            policer {
                input aggregate_police2;
            }
        }
    }
    unit 1 {
        family inet {
            policer {
                input aggregate_police1;
            }
        }
        family inet6 {
            policer {
                input aggregate_police1;
            }
        }
    }
```

Applying Hierarchical Policers on Enhanced Intelligent Queuing PICs

M40e, M120, and M320 edge routers and T-series core routers with Enhanced Intelligent Queuing (IQE) PICs support hierarchical policers in the ingress direction and allow you to apply a hierarchical policer for the premium and aggregate (premium plus normal) traffic levels to an interface. Hierarchical policers provide cross-functionality between the configured physical interface and the packet forwarding engine (PFE).

Before you begin, there are some general restrictions that apply to hierarchical policers:

- Only one type of policer can be configured for a logical or physical interface. For example, a hierarchical policer and a regular policer in the same direction for the same logical interface is not allowed.
- The chaining of the policers - that is, applying policers to both a port and the logical interfaces of that port - is not allowed.
- There is a limit of 64 policers per interface in case there is no BA classification, providing a single policer per DLCI.
- Only one kind of policer can be applied on a physical or logical interface.
- The policer should be independent of BA classification. Without BA classification, all traffic on an interface will be treated either as EF or non-EF, based on the

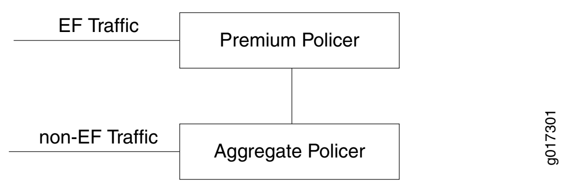
configuration. With BA classification, an interface can support up to 64 policers. Again, the interface here may be a physical interface or logical interface (i.e. DLCI).

- With BA classification, the miscellaneous traffic (i.e. the traffic *not* matching with any of the BA classification DSCP/EXP bits) will be policed as non-EF traffic. No separate policers will be installed for this traffic.

Hierarchical Policer Overview

Hierarchical policing uses two token buckets, one for aggregate (non-EF) traffic and one for premium (EF) traffic. Which traffic is EF and which is non-EF is determined by the class-of-service configuration. Logically, hierarchical policing is achieved by chaining two policers.

Figure 7: Hierarchical Policer



In the example in Figure 7 on page 189, EF traffic is policed by "Premium Policer" and non EF traffic is policed by "Aggregate Policer". What that means is, for EF traffic the out-of-spec action will be the one that is configured for "Premium Policer", but the in-spec EF traffic will still consume the tokens from the "Aggregate Policer".

But EF traffic will never be submitted to the out-of-spec action of the "Aggregate Policer". Also, if the out-of-spec action of the "Premium Policer" is not set to "Discard", those out-of-spec packets will not consume the tokens from the "Aggregate Policer". "Aggregate Policer" only polices the non-EF traffic. As you can see, the "Aggregate Policer" token bucket can go negative, if all the tokens are consumed by the non-EF traffic and then you get bursts of EF traffic. But that will be for a very short time, and over a period of time it will average out. Let's take an example:

- *Premium Policer:* Bandwidth 2 Mbps, OOS Action: Discard
- *Aggregate Policer:* Bandwidth 10 Mbps, OOS Action: Discard

In the above case, EF traffic is guaranteed 2 Mbps and the non-EF traffic will get from 8 Mbps to 10 Mbps, depending on the input rate of the EF traffic.

Hierarchical Policing Characteristics

Hierarchical Token Buckets

- Ingress traffic is first classified into EF and non-EF traffic prior to applying a policer:
  - Classification is performed by Q-tree look-up
- Channel Number selects a Shared Token Bucket Policer:

  - Dual token bucker policer is divided into (2) single bucket policers:
    - Policer1 - EF traffic
    - Policer2 - non-EF traffic
- Shared-token bucket is used to police the traffic as follows:
  - Policer1 is set to EF rate (e.g., 2 Mbps)
  - Policer2 is set to aggregate interface policed rate (e.g., 10 Mbps).
  - EF traffic gets applied to Policer1
    - If traffic is in-spec it is allowed to pass and decrement from both Policer1 and Policer2
    - If traffic is out-of-spec it can be discarded or marked with a new FC or loss priority. Policer2 will not do anything with out-of-spec EF traffic.
  - Non-EF traffic gets applied only to Policer2
    - If traffic is in-spec it is allowed to pass through and decremented Policer2
    - If traffic is out-of-spec it is discarded or marked with a new FC or set with a new drop priority
- Rate-limit the port speed to a desired rate at Layer 2
- Rate-limit the EF traffic
- Rate-limit the non-EF traffic
- Policing drops counted per color

Configuring Hierarchical Policers

To configure a hierarchical policer, apply the policing-priority statement to the proper forwarding class and configure a hierarchical policer for the aggregate and premium level. For more information on Class of Service configuration, see *Class of Service*.

NOTE: Hierarchical policers can only be configured on SONET physical interfaces hosted on an IQE PIC. Only aggregate and premium levels are supported.

CoS configuration of forwarding-class stanza for hierarchical policers

```
[edit class-of-service forwarding-classes]
class fc1 queue-num 0 priority high policing-priority premium
class fc2 queue-num 1 priority low policing-priority normal
class fc3 queue-num 2 priority low policing-priority normal
class fc4 queue-num 3 priority low policing-priority normal
```

For detailed information on Class of Service configuration and statements, see Class of Service.

Firewall configuration for hierarchical policers

```
[edit firewall hierarchical-policer foo]
aggregate {
  if-exceeding {
```

```
            bandwidth-limit 70m;
            burst-size-limit 1500;
        }
        then {
        discard;
    }
    premium {
        if-exceeding {
            bandwidth-limit 50m;
            burst-size-limit 1500;
        }
        then {
            discard;
        }
    }
```

You can apply the hierarchical policer as follows:

[edit interfaces so-0/1/0 unit 0 layer-2-policer]
input-hierarchical-policer foo

You also have the option to apply the policer at the physical port level as follows:

[edit interfaces so-0/1/0 layer-2-policer]
input-hierarchical-policer foo

Configuring a Single-Rate Two-Color Policer

You can configure a single-rate two-color policer as follows:

Firewall configuration for two-color policer

```
[edit firewall policer foo]
    if-exceeding {
        bandwidth-limit 50m;
        burst-size-limit 1500;
    }
    then {
        discard;
    }
```

You can apply the policer as follows:

[edit interfaces so-0/1/0 unit 0 layer-2-policer]
input-policer foo

You also have the option to apply the policer at the physical port level as follows:

[edit interfaces so-0/1/0 layer-2-policer]
input-policer foo

Configuring a Single-Rate Tri-Color Policer

This section describes single-rate color-blind and color-aware policers.

Configuring a Single-Rate Color-Blind Policer

You can configure a single-rate color-blind policer as follows:

Firewall configuration for a single-rate color-blind policer

```
[edit firewall three-color-policer foo]
single-rate {
   color-blind;
   committed-information-rate 50m;
   committed-burst-size 1500;
   excess-burst-size 1500;
}
```

You can apply the single-rate color-blind policer as follows:

```
[edit interfaces so-0/1/0 unit 0 layer-2-policer]
input-three-color foo
```

You also have the option to apply the policer at the physical port level as follows:

```
[edit interfaces so-0/1/0 layer-2-policer]
input-three-color foo
```

Configuring a Single-Rate Color-Aware Policer

You can configure a single-rate color-aware policer as follows:

Firewall configuration for a single-rate color-aware policer

```
[edit firewall three-color-policer bar]
single-rate {
   color-aware;
   committed-information-rate 50m;
   committed-burst-size 1500;
   excess-burst-size 1500;
}
```

You can apply the single-rate color-aware policer as follows:

```
[edit interfaces so-0/1/0 unit 0 layer-2-policer]
input-three-color foo
```

You also have the option to apply the policer at the physical port level as follows:

```
[edit interfaces so-0/1/0 layer-2-policer]
input-three-color bar
```

Configuring a Two-Rate Tri-Color Marker Policer

Ingress policing is implemented using a two-rate tri-color marker (trTCM). This is done with a dual token bucket (DTB) that maintains two rates, committed, and a peak. Egress static policing also uses a token bucket.

The token buckets perform the following Ingress Policing functions:

- (1K) trTCM - Dual Token Bucket (Red, Yellow, and Green marking)
- Policing s based on L2 packet size

  - After +/- Byte Adjust Offset
- Marking is Color Aware and Color Blind
  - Color Aware needs to have the Color set by Q-tree look-up based on
    - ToS
    - EXP
- Programmable Marking Actions
  - Color (Red, Yellow, Green)
  - Drop based on color and congestion profile
- Policer is selected based on the arriving Channel Number
  - Channel number LUT produces Policer index and Queue index
  - Multiple channels can share the same policer (LUT produces same policer index)
- Support ingress policing and trTCM at the following levels:
  - Queue
  - Logical Interface (aka ifl/DLCI)
  - Physical Interface (aka ifd)
  - Physical Port (aka controller ifd)
  - Any combinations of logical interface, physical interface and port
- Support percentage of interface speed and bits per second

Rate limits may be applied to selected queues on ingress and on predefined queues at egress. The token bucket operates in color aware and color blind modes (specified by RFC 2698).

Color Blind

```
[edit firewall three-color-policer foo]
two-rate {
   color-blind;
   committed-information-rate 50m;
   committed-burst-size 1500;
   peak-information-rate 100m;
   peak-burst-size 3k;
}
```

You can apply the three-color two-rate color-blind policer as follows:

```
[edit interfaces so-0/1/0 unit 0 layer-2-policer]
input-three-color foo
```

You also have the option to apply the policer at the physical port level as follows:

```
[edit interfaces so-0/1/0 layer-2-policer]
input-three-color foo
```

Color Aware

```
[edit firewall three-color-policer bar]
```

```
two-rate {
    color-aware;
    committed-information-rate 50m;
    committed-burst-size 1500;
    peak-information-rate 100m;
    peak-burst-size 3k;
}
```

You can apply the three-color two-rate color-aware policer as follows:

```
[edit interfaces so-0/1/0 unit 0 layer-2-policer]
input-three-color bar
```

You also have the option to apply the policer at the physical port level as follows:

```
[edit interfaces so-0/1/0 layer-2-policer]
input-three-color bar
```

Applying a Filter to an Interface

To apply firewall filters to an interface, include the filter statement:

```
filter {
    group filter-group-number;
    input filter-name;
    input-list [ filter-names ];
    output filter-name;
    output-list [ filter-names ];
}
```

To apply a single filter, include the input statement:

```
filter {
    input filter-name;
}
```

To apply a list of filters to evaluate packets received on an interface, include the input-list statement.

```
filter {
    input-list [ filter-names ];
}
```

Up to 16 filter names can be included in an input list.

To apply a list of filters to evaluate packets transmitted on an interface, include the output-list statement.

```
filter {
    output-list [ filter-names ];
}
```

When you apply filters using the input-list statement or the output-list statement, a new filter is created with the name <*interface-name*>.<*unit-direction*>. This filter is exclusively interface-specific.

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family *family*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

In the family statement, the protocol family can be ccc, inet, inet6, mpls, or vpls.

In the group statement, specify the interface group number to associate with the filter.

In the input statement, list the name of one firewall filter to be evaluated when packets are received on the interface.

In the input-list statement, list the names of filters to evaluate when packets are received on the interface. You can include up to 16 filter names.

In the output statement, list the name of one firewall filter to be evaluated when packets are transmitted on the interface.

NOTE: Output filters do not work for broadcast and multicast traffic, including VPLS traffic, as shown in “Example: Applying a Filter to an Interface” on page 197.

NOTE: On an MX-series router, you cannot apply as an output filter, a firewall filter configured at the [edit firewall filter family ccc] hierarchy level. Firewall filters configured for the family ccc statement can be applied only as input filters.

In the output-list statement, list the names of filters to evaluate when packets are transmitted on the interface. You can include up to 16 filter names.

You can use the same filter one or more times. On M-series platforms (except the M320 and M120 routers), if you apply a firewall filter or policer to multiple interfaces, the filter or policer acts on the sum of traffic entering or exiting those interfaces.

On T-series, M120, and M320 platforms, interfaces are distributed among multiple packet forwarding components. Therefore, on these platforms, if you apply a firewall filter or policer to multiple interfaces, the filter or policer acts on the traffic stream entering or exiting each interface, regardless of the sum of traffic on the multiple interfaces.

If you apply the filter to the interface lo0, it is applied to packets received or transmitted by the Routing Engine. You cannot apply MPLS filters to the management interface (fxp0) or the loopback interface (lo0).

For more information about firewall filters, see the *JUNOS Policy Framework Configuration Guide*. For more information about MPLS filters, see the *JUNOS MPLS Applications Configuration Guide*.

See also the following sections:

- Defining Interface Groups in Firewall Filters on page 196
- Filter-Based Forwarding on the Output Interface on page 196
- Example: Applying a Filter to an Interface on page 197

Defining Interface Groups in Firewall Filters

When applying a firewall filter, you can define an interface to be part of an *interface group*. Packets received on that interface are tagged as being part of the group. You can then match these packets using the interface-group match statement, as described in the *JUNOS Policy Framework Configuration Guide*.

To define the interface to be part of an interface group, include the group statement:

```
group filter-group-number;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family *family* filter]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family* filter]

Filter-Based Forwarding on the Output Interface

If port-mirrored packets are to be distributed to multiple monitoring or collection interfaces, based on patterns in packet headers, it is helpful to configure a filter-based forwarding (FBF) filter on the port-mirroring egress interface.

When an FBF filter is installed as an output filter, a packet that is forwarded to the filter has already undergone at least one route lookup. After the packet is classified at the egress interface by the FBF filter, it is redirected to another routing table for additional route lookup. To avoid packet looping inside the Packet Forwarding Engine, the route lookup in the latter routing table (designated by an FBF routing instance) must result in a different next hop from any next hop specified in a table that has already been applied to the packet.

If an input interface is configured for FBF, the source lookup is disabled for those packets headings to a different routing instance, since the routing table is not set up to handle the source lookup.

For more information about FBF configuration, see the *JUNOS Routing Protocols Configuration Guide*. For more information about port mirroring, see the *JUNOS Services Interfaces Configuration Guide*.

Example: Applying a Filter to an Interface

Input Filter for VPLS Traffic

For M-series and T-series routing platforms only, apply an input filter to VPLS traffic. Output filters do not work for broadcast and multicast traffic, including VPLS traffic.

```
[edit interfaces]
fe-2/2/3 {
    vlan-tagging;
    encapsulation vlan-vpls;
    unit 601 {
        encapsulation vlan-vpls;
        vlan-id 601;
        family vpls {
            filter {
                input filter1;  # Works for multicast destination MAC address
                output filter1;  # Does not work for multicast destination MAC address
            }
        }
    }
}
[edit firewall]
family vpls {
    filter filter1 {
        term 1 {
            from {
                destination-mac-address {
                    01:00:0c:cc:cc:cd/48;
                }
            }
            then {
                discard;
            }
        }
        term 2 {
            then {
                accept;
            }
        }
    }
}
```

Filter-Based Forwarding at the Output Interface

The following example illustrates the configuration of filter-based forwarding at the output interface. In this example, the packet flow follows this path:

1. A packet arrives at interface fe-1/2/0.0 with source and destination addresses 10.50.200.1 and 10.50.100.1 respectively.
2. The route lookup in routing table inet.0 points to the egress interface so-0/0/3.0.
3. The output filter installed at so-0/0/3.0 redirects the packet to routing table fbf.inet.0.
4. The packet matches the entry 10.50.100.0/25 in the fbf.inet.0 table, and finally leaves the router from interface so-2/0/0.0.

```
[edit interfaces]
so-0/0/3 {
    unit 0 {
        family inet {
            filter {
                output fbf;
            }
            address 10.50.10.2/25;
        }
    }
}
fe-1/2/0 {
    unit 0 {
        family inet {
            address 10.50.50.2/25;
        }
    }
}
so-2/0/0 {
    unit 0 {
        family inet {
            address 10.50.20.2/25;
        }
    }
}
[edit firewall]
filter fbf {
    term 0 {
        from {
            source-address {
                10.50.200.0/25;
            }
        }
        then routing-instance fbf;
    }
    term d {
        then count d;
    }
}
[edit routing-instances]
fbf {
    instance-type forwarding;
    routing-options {
        static {
            route 10.50.100.0/25 next-hop so-2/0/0.0;
        }
    }
}
[edit routing-options]
interface-routes {
    rib-group inet fbf-group;
}
static {
    route 10.50.100.0/25 next-hop 10.50.10.1;
}
rib-groups {
```

```
        fbf-group {
            import-rib [inet.0 fbf.inet.0];
        }
    }
```

Configuring Unicast RPF

For interfaces that carry IPv4 or IPv6 traffic, you can reduce the impact of denial of service (DoS) attacks by configuring unicast reverse path forwarding (RPF). Unicast RPF helps determine the source of attacks and rejects packets from unexpected source addresses on interfaces where unicast RPF is enabled.

NOTE: If you want to configure unicast RPF, your routing platform must be equipped with the Internet Processor II application-specific integrated circuit (ASIC).

If you enable unicast RPF on live traffic, some packets are dropped while the packet forwarding components are updating.

For transit packets exiting the router through the tunnel, forwarding path features, such as RPF, forwarding table filtering, source class usage, and destination class usage are not supported on the interfaces you configure as the output interface for tunnel traffic. For firewall filtering, you must allow the output tunnel packets through the firewall filter applied to input traffic on the interface that is the next-hop interface towards the tunnel destination.

The following sections describe unicast RPF in detail:

Configuring Unicast RPF Strict Mode

In strict mode, unicast RPF checks whether the incoming packet has a source address that matches a prefix in the routing table, and whether the interface expects to receive a packet with this source address prefix.

If the incoming packet fails the unicast RPF check, the packet is not accepted on the interface. When a packet is not accepted on an interface, unicast RPF counts the packet and sends it to an optional fail filter. If the fail filter is not configured, the default action is to silently discard the packet.

The optional fail filter allows you to apply a filter to packets that fail the unicast RPF check. You can define the fail filter to perform any filter operation, including accepting, rejecting, logging, sampling, or policing.

When unicast RPF is enabled on an interface, Bootstrap Protocol (BOOTP) packets and Dynamic Host Configuration Protocol (DHCP) packets are not accepted on the interface. To allow the interface to accept BOOTP packets and DHCP packets, you must apply a fail filter that accepts all packets with a source address of 0.0.0.0 and a destination address of 255.255.255.255. For a configuration example, see "Example: Configuring Unicast RPF" on page 203.

For more information about unicast RPF, see the *JUNOS Routing Protocols Configuration Guide*. For more information about defining fail filters, see the *JUNOS Policy Framework Configuration Guide*.

To configure unicast RPF, include the rpf-check statement:

```
rpf-check <fail-filter filter-name>;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family (inet | inet6)]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family (inet | inet6)]

Using unicast RPF can have several consequences when implemented with traffic filters:

- RPF fail filters are evaluated after input filters and before output filters.
- If you configure a filter counter for packets dropped by an input filter, and you want to know the total number of packets dropped, you must also configure a filter counter for packets dropped by the RPF check.
- To count packets that fail the RPF check and are accepted by the RPF fail filter, you must configure a filter counter.
- If an input filter forwards packets anywhere other than the inet.0 or inet6.0 routing tables, the unicast RPF check is not performed.
- If an input filter forwards packets anywhere other than the routing instance the input interface is configured for, the unicast RPF check is not performed.

Configuring Unicast RPF Loose Mode

By default, unicast RPF uses strict mode. Unicast RPF loose mode is similar to unicast RPF strict mode and has the same configuration restrictions. The only check in loose mode is whether the packet has a source address with a corresponding prefix in the routing table; loose mode does not check whether the interface expects to receive a packet with a specific source address prefix. If a corresponding prefix is not found, unicast RPF loose mode does not accept the packet. As in strict mode, loose mode counts the failed packet and optionally forwards it to a fail filter, which either accepts, rejects, logs, samples, or polices the packet.

To configure unicast RPF loose mode, include the mode:

```
mode loose;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family (inet | inet6) rpf-check <fail-filter *filter-name*>]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family (inet | inet6) rpf-check <fail-filter *filter-name*>]

Unicast RPF and Default Routes

When the active route cannot be chosen from the routes in a routing table, the routing platform chooses a default route. A default route is equivalent to an IP address of 0.0.0.0/0. If you configure a default route, and you configure unicast RPF on an interface that the default route uses, unicast RPF behaves differently than it does otherwise. For information about configuring default routes, see the *JUNOS Routing Protocols Configuration Guide*.

To determine whether the default route uses an interface, enter the show route command:

user@host> **show route *address***

address is the next-hop address of the configured default route. The default route uses the interfaces shown in the output of the show route command.

The following sections describe how unicast RPF behaves when a default route uses an interface and when a default route does not use an interface:

- Unicast RPF Behavior with a Default Route on page 201
- Unicast RPF Behavior Without a Default Route on page 202

Unicast RPF Behavior with a Default Route

If you configure a default route that uses an interface configured with unicast RPF, unicast RPF behaves as follows:

- Loose mode—All packets are automatically accepted. For this reason, we recommend that you not configure unicast RPF loose mode on interfaces that the default route uses.
- Strict mode—The packet is accepted when either of the following is true:
  - The source address of the packet matches any of the routes (either default or learned) that can be originated from the interface. Note that routes can have multiple destinations associated with them; therefore, if one of the destinations matches the incoming interface of the packet, the packet is accepted.
  - The source address of the packet does not match any of the routes.

The packet is not accepted when either of the following is true:

- The source address of the packet does not match a prefix in the routing table.
    - The interface does not expect to receive a packet with this source address prefix.

Unicast RPF Behavior Without a Default Route

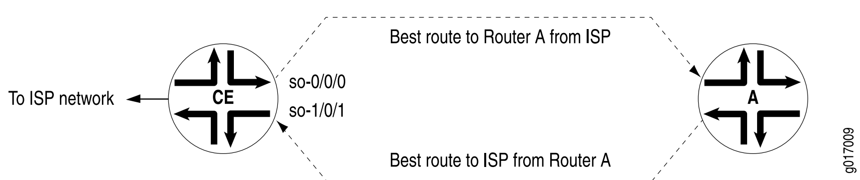
If you do not configure a default route, or if the default route does not use an interface configured with unicast RPF, unicast RPF behaves as described in “Configuring Unicast RPF Strict Mode” on page 199 and “Configuring Unicast RPF Loose Mode” on page 200. To summarize, unicast RPF without a default route behaves as follows:

- Strict mode—The packet is not accepted when either of the following is true:
    - The packet has a source address that does not match a prefix in the routing table.
    - The interface does not expect to receive a packet with this source address prefix.
- Loose mode—The packet is not accepted when the packet has a source address that does not match a prefix in the routing table.

Unicast RPF with Routing Asymmetry

In general, we recommend that you not enable unicast RPF on interfaces that are internal to the network because internal interfaces are likely to have *routing asymmetry*. Routing asymmetry means that a packet’s outgoing and return paths are different. Routers in the core of the network are more likely to have asymmetric reverse paths than routing platforms at the customer or provider edge. Figure 8 on page 202 shows unicast RPF in an environment with routing asymmetry.

Figure 8: Unicast RPF with Routing Asymmetry



In Figure 8 on page 202, if you enable unicast RPF on interface so-0/0/0, traffic destined for Router A is not rejected. If you enable unicast RPF on interface so-1/0/1, traffic from Router A is rejected.

If you need to enable unicast RPF in an asymmetric routing environment, you can use fail filters to allow the routing platform to accept incoming packets that are known to be arriving by specific paths. For an example of a fail filter that accepts packets with a specific source and destination address, see “Example: Configuring Unicast RPF” on page 203.

Configuring Unicast RPF on a VPN

You can configure unicast RPF on a VPN interface by enabling unicast RPF on the interface and including the interface statement at the [edit routing-instances *routing-instance-name*] hierarchy level.

You can configure unicast RPF only on the interfaces you specify in the routing instance. This means the following:

- For Layer 3 VPNs, unicast RPF is supported on the CE router interface.
- Unicast RPF is not supported on core-facing interfaces.
- For virtual-router routing instances, unicast RPF is supported on all interfaces you specify in the routing instance.
- If an input filter forwards packets anywhere other than the routing instance the input interface is configured for, the unicast RPF check is not performed.

For unicast RPF configuration guidelines, see "Configuring Unicast RPF" on page 199. For more information about VPNs and virtual-router routing instances, see the *JUNOS VPNs Configuration Guide*. For more information about FBF, see the *JUNOS Routing Protocols Configuration Guide*.

Example: Configuring Unicast RPF on a VPN

Configure unicast RPF on a Layer 3 VPN interface:

```
[edit interfaces]
so-0/0/0 {
   unit 0 {
      family inet {
         rpf-check;
      }
   }
}
[edit routing-instance]
VPN-A {
   interface so-0/0/0.0;
}
```

Example: Configuring Unicast RPF

Configure unicast RPF strict mode, and apply a fail filter that allows the interface to accept BOOTP packets and DHCP packets. The filter accepts all packets with a source address of 0.0.0.0 and a destination address of 255.255.255.255.

```
[edit firewall]
filter rpf-special-case-dhcp-bootp {
   term allow-dhcp-bootp {
      from {
         source-address {
            0.0.0.0/32;
```

```
                }
                address {
                    255.255.255.255/32;
                }
            }
            then {
                count rpf-dhcp-bootp-traffic;
                accept;
            }
        }
        term default {
            then {
                log;
                reject;
            }
        }
    }
    [edit]
    interfaces {
        so-0/0/0 {
            unit 0 {
                family inet {
                    rpf-check fail-filter rpf-special-case-dhcp-bootp;
                }
            }
        }
    }
```

Enabling Source Class and Destination Class Usage

For interfaces that carry IPv4, IPv6, or MPLS traffic, you can maintain packet counts based on the entry and exit points for traffic passing through your network. Entry and exit points are identified by source and destination prefixes grouped into disjoint sets defined as *source classes* and *destination classes*. You can define classes based on a variety of parameters, such as routing neighbors, autonomous systems, and route filters.

Source class usage (SCU) counts packets sent to customers by performing lookup on the IP source address. SCU makes it possible to track traffic originating from specific prefixes on the provider core and destined for specific prefixes on the customer edge. You must enable SCU accounting on both the inbound and outbound physical interfaces, and the route for the source of the packet must be in located in the forwarding table.

NOTE: SCU and DCU accounting do not work with directly connected interface routes. Source class usage does not count packets coming from sources with direct routes in the forwarding table because of software architecture limitations.

Destination class usage (DCU) counts packets from customers by performing lookup of the IP destination address. DCU makes it possible to track traffic originating from the customer edge and destined for specific prefixes on the provider core router.

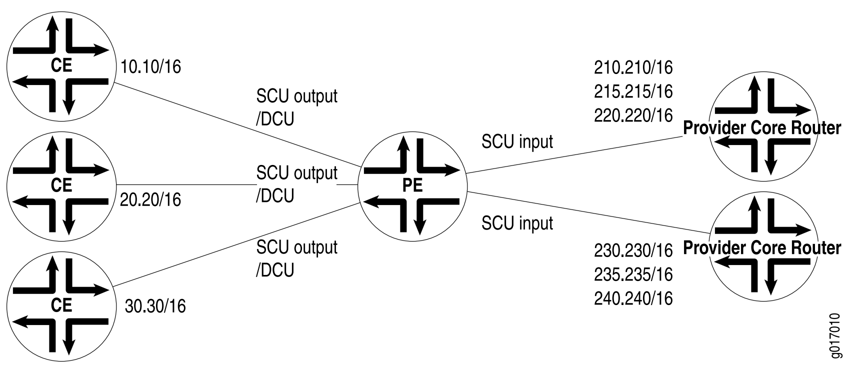
NOTE: SCU and DCU accounting are supported on the J-series routing platform only for IPv4 and IPv6 traffic.

NOTE: We recommend that you stop the network traffic on an interface before you modify the DCU or SCU configuration for that interface. Modifying the DCU or SCU configuration without stopping the traffic might corrupt the DCU or SCU statistics. Before you restart the traffic after modifying the configuration, enter the clear interfaces statistics command.

Figure 9 on page 205 illustrates an Internet service provider (ISP) network. In this topology, you can use DCU to count packets customers send to specific prefixes. For example, you can have three counters, one per customer, that count the packets destined for prefix 210.210/16 and 220.220/16.

You can use SCU to count packets the provider sends from specific prefixes. For example, you can count the packets sent from prefix 210.210/16 and 215.215/16 and transmitted on a specific output interface.

Figure 9: Prefix Accounting with Source and Destination Classes



You can configure up to 126 source classes and 126 destination classes. For each interface on which you enable destination class usage and source class usage, the JUNOS software maintains an interface-specific counter for each corresponding class up to the 126 class limit.

NOTE: To configure source class and destination class usage, your routing platform must be equipped with the Internet Processor II ASIC.

For transit packets exiting the router through the tunnel, forwarding path features, such as RPF, forwarding table filtering, source class usage, and destination class usage are not supported on the interfaces you configure as the output interface for tunnel traffic. For firewall filtering, you must allow the output tunnel packets through the firewall filter applied to input traffic on the interface that is the next-hop interface towards the tunnel destination.

NOTE:

Performing DCU accounting when an output service is enabled produces inconsistent behavior in the following configuration:

- both scu-input and dcu are configured on the packet input interface
- scu-output is configured on the packet output interface
- interface-services is enabled on the output interface

For an incoming packet with source and destination prefixes matching the SCU and DCU classes respectively configured in the router, both SCU and DCU counters will be incremented. This behavior is not harmful or negative. However, it is inconsistent with non-serviced packets, in that only the SCU count will be incremented (because SCU class ID will override DCU class ID in this case).

To enable packet counting on an interface, include the accounting statement:

```
accounting {
   destination-class-usage;
   source-class-usage {
      direction;
   }
}
```

direction can be one of the following:

- input—Configure at least one expected ingress point.
- output—Configure at least one expected egress point.
- input output—On a single interface, configure at least one expected ingress point and one expected egress point.

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family (inet | inet6 | mpls)]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family (inet | inet6 | mpls)]

For SCU to work, you must configure at least one input interface and at least one output interface. An incoming packet is counted only once, and SCU takes priority over DCU. This means that when a packet arrives on an interface on which you include the source-class-usage input and destination-class-usage statements in the configuration, and when the source and destination both match accounting prefixes, the JUNOS software associates the packet with the source class only. To ensure the outgoing packet is counted, include the source-class-usage output statements in the configuration of the outgoing interface.

On T-series, M120, and M320 routing platforms, the source class and destination classes are not carried across the platform fabric. The implications of this are as follows:

- On T-series, M120, and M320 platforms, SCU and DCU accounting is performed before the packet enters the fabric.
- On T-series, M120, and M320 routing platforms, DCU is performed before output filters are evaluated. On other M-series platforms, DCU is performed after output filters are evaluated.
- If an output filter drops traffic on T-series, M120, and M320 routing platforms, the dropped packets are included in DCU statistics. If an output filter drops traffic on other M-series platforms, the dropped packets are excluded from DCU statistics.
- On T-series, M120, and M320 platforms, the destination-class and source-class statements are not supported at the [edit firewall family *family-name* > filter *filter-name* term *term-name* from] hierarchy level. On other M-series platforms, these statements are supported.

Once you enable accounting on an interface, the JUNOS software maintains packet counters for that interface, with separate counters for inet, inet6, and mpls protocol families. You must then configure the source class and destination class attributes in policy action statements, which must be included in forwarding-table export policies.

For a complete discussion about source and destination class accounting profiles, see the *JUNOS Network Management Configuration Guide*. For more information about MPLS, see the *JUNOS MPLS Applications Configuration Guide*.

Examples: Enabling Source Class and Destination Class Usage

Configure DCU and SCU output on one interface:

```
[edit]
interfaces {
    so-6/1/0 {
        unit 0 {
            family inet {
                accounting {
                    destination-class-usage;
                    source-class-usage {
                        output;
                    }
                }
            }
        }
    }
}
```

Complete SCU Configuration

Source routers A and B use loopback addresses as the prefixes to be monitored. Most of the configuration tasks and actual monitoring occur on transit Router SCU.

The loopback address on Router A contains the origin of the prefix that is to be assigned to source class A on Router SCU. However, no SCU processing happens on this router. Therefore, configure Router A for basic Open Shortest Path First (OSPF) routing and include your loopback interface and interface so-0/0/2 in the OSPF process.

Router A

```
[edit]
interfaces {
   so-0/0/2 {
      unit 0 {
         family inet {
            address 10.255.50.2/24;
         }
      }
   }
   lo0 {
      unit 0 {
         family inet {
            address 10.255.192.10/32;
         }
      }
   }
}
protocols {
   ospf {
      area 0.0.0.0 {
         interface so-0/0/2.0;
         interface lo0.0;
      }
   }
}
```

Router SCU Router SCU handles the bulk of the activity in this example. On Router SCU, enable source class usage on the inbound and outbound interfaces at the [edit interfaces *interface-name* unit *unit-number* family inet accounting] hierarchy level. Make sure you specify the expected traffic: input, output, or, in this case, both.

Next, configure a route filter policy statement that matches the prefixes of the loopback addresses from routers A and B. Include statements in the policy that classify packets from Router A in one group named scu-class-a and packets from Router B in a second class named scu-class-b. Notice the efficient use of a single policy containing multiple terms.

Last, apply the policy to the forwarding table.

```
[edit]
interfaces {
   so-0/0/1 {
      unit 0 {
         family inet {
            accounting {
               source-class-usage {
                  input;
                  output;
               }
            }
            address 10.255.50.1/24;
```

```
            }
        }
    }
    so-0/0/3 {
        unit 0 {
            family inet {
                accounting {
                    source-class-usage {
                        input;
                        output;
                    }
                }
                address 10.255.10.3/24;
            }
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 10.255.6.111/32;
            }
        }
    }
}
protocols {
    ospf {
        area 0.0.0.0 {
            interface so-0/0/1.0;
            interface so-0/0/3.0;
        }
    }
}
routing-options {
    forwarding-table {
        export scu-policy;
    }
}
policy-options {
    policy-statement scu-policy {
        term 0 {
            from {
                route-filter 10.255.192.0/24 orlonger;
            }
            then source-class scu-class-a;
        }
        term 1 {
            from {
                route-filter 10.255.165.0/24 orlonger;
            }
            then source-class scu-class-b;
        }
    }
}
```

Router B

Just as Router A provides a source prefix, Router B's loopback address matches the prefix assigned to scu-class-b on Router SCU. Again, no SCU processing happens on this router, so configure Router B for basic OSPF routing and include your loopback interface and interface so-0/0/4 in the OSPF process.

```
interfaces {
  so-0/0/4 {
    unit 0 {
      family inet {
        address 10.255.10.4/24;
      }
    }
  }
  lo0 {
    unit 0 {
      family inet {
        address 10.255.165.226/32;
      }
    }
  }
}
protocols {
  ospf {
    area 0.0.0.0 {
      interface so-0/0/4.0;
      interface lo0.0;
    }
  }
}
```

Enabling Packet Counting for Layer 3 VPNs

You can use SCU and DCU to count packets on Layer 3 VPNs. To enable packet counting for Layer 3 VPN implementations at the egress point of the MPLS tunnel, you must configure a virtual loopback tunnel interface (vt) on the PE router, map the virtual routing and forwarding (VRF) instance type to the virtual loopback tunnel interface, and send the traffic received from the VPN out the source class output interface, as shown in the following example:

1. Configure a virtual loopback tunnel interface on a provider edge router equipped with a tunnel PIC:

   ```
   [edit interfaces]
   vt-0/3/0 {
     unit 0 {
       family inet {
         accounting {
           source-class-usage {
             input;
           }
         }
       }
     }
   }
   ```

2. Map the VRF instance type to the virtual loopback tunnel interface.

For SCU and DCU to work, you must not include the vrf-table-label statement at the [edit routing-instances *instance-name*] hierarchy level.

```
[edit routing-instances]
VPN-A {
    instance-type vrf;
    interface at-2/1/1.0;
    interface vt-0/3/0.0;
    route-distinguisher 10.255.14.225:100;
    vrf-import import-policy-A;
    vrf-export export-policy-A;
    protocols {
        bgp {
            group to-r4 {
                local-address 10.27.253.1;
                peer-as 400;
                neighbor 10.27.253.2;
            }
        }
    }
}
```

3. Send traffic received from the VPN out the source class output interface:

```
[edit interfaces]
at-2/1/0 {
    unit 0 {
        family inet {
            accounting {
                source-class-usage {
                    output;
                }
            }
        }
    }
}
```

For more information about VPNs, see the *JUNOS VPNs Configuration Guide*. For more information about virtual loopback tunnel interfaces, see the *JUNOS Services Interfaces Configuration Guide*.

Chapter 6

Configuring Circuit and Translational Cross-Connects

This chapter describes circuit and translational cross-connects:

Circuit and Translational Cross-Connects Overview

Circuit cross-connect (CCC) and translational cross-connect (TCC) allow you to configure transparent connections between two circuits, where a circuit can be a Frame Relay data-link connection identifier (DLCI), an Asynchronous Transfer Mode (ATM) virtual circuit (VC), a Point-to-Point Protocol (PPP) interface, a Cisco High-level Data Link Control (HDLC) interface, or a Multiprotocol Label Switching (MPLS) label-switched path (LSP).

Using CCC or TCC, packets from the source circuit are delivered to the destination circuit with, at most, the Layer 2 address being changed. No other processing, such as header checksums, time-to-live (TTL) decrementing, or protocol processing, is done.

To connect interfaces of the same type, use CCC. To connect unlike interfaces, use TCC.

CCC and TCC circuits fall into three categories: logical interfaces, which include ATM VCs and Frame Relay DLCIs; physical interfaces, which include PPP and Cisco HDLC; and paths, which include LSPs. The three circuit categories provide three types of cross-connect:

- Layer 2 switching (interface-to-interface)—Cross-connects between logical interfaces provide what is essentially Layer 2 switching.

- MPLS tunneling (interface-to-LSP)—Cross-connects between interfaces and LSPs allow you to connect two distant interface circuits by creating MPLS tunnels that use LSPs as the conduit.
- LSP stitching (LSP-to-LSP)—Cross-connects between LSPs provide a way to "stitch" together two label-switched paths, including paths that fall in two different traffic engineering database (TED) areas.

The cross-connect is bidirectional, so packets received on the first interface are transmitted out the second interface, and those received on the second interface are transmitted out the first interface.

For most CCC connections that connect interfaces, the interfaces must be of the same type; that is, ATM to ATM, Frame Relay to Frame Relay, PPP to PPP, or Cisco HDLC to Cisco HDLC.

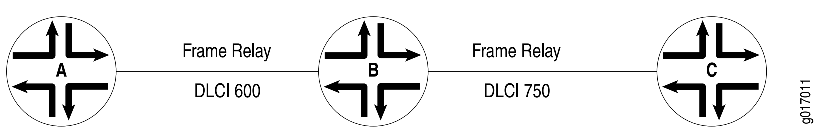
ATM-to-Ethernet interworking cross-connect circuits connect logical interfaces configured on an ATM2 and Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet IQ2 and IQ2-E physical interfaces.

For all TCC connections that connect interfaces, the interfaces can be of unlike types. Mainly, TCC is used for Layer 2.5 virtual private networks (VPNs), but it can also be used as a simple "unlike circuit" switch.

Switching cross-connects join logical interfaces to form what is essentially Layer 2 switching.

Figure 10 on page 214 illustrates a Layer 2 switching circuit cross-connect. In this topology, Router A and Router C have Frame Relay connections to Router B, which is a Juniper Networks routing platform. CCC allows you to configure Router B to act as a Frame Relay (Layer 2) switch. To do this, configure a circuit from Router A to Router C that passes through Router B, effectively configuring Router B as a Frame Relay switch with respect to these routing platforms. This configuration allows Router B to transparently switch packets (frames) between Router A and Router C without regard to the packets' contents or the Layer 3 protocols. The only processing that Router B performs is to translate DLCI 600 to 750.

Figure 10: Layer 2 Switching Circuit Cross-Connect



If the Router A–to–Router B and Router B–to–Router C circuits are PPP, for example, the Link Control Protocol and Network Control Protocol exchanges occur between Router A and Router C. These messages are handled transparently by Router B, allowing Router A and Router C to use various PPP options (such as header or address compression and authentication) that Router B might not support. Similarly, Router A and Router C exchange keepalives, providing circuit-to-circuit connectivity status.

You can configure Layer 2 switching cross-connects on PPP, Cisco HDLC, Frame Relay, Ethernet CCC, Ethernet VLAN, and ATM circuits. With CCC, only like interfaces can be connected in a single cross-connect. With TCC, unlike interfaces can be connected in a single cross-connect. In Layer 2 switching cross-connects, the exchanges take place between point-to-point links.

This chapter discusses the Layer 2 switching cross-connect configuration tasks. For information about MPLS tunneling and LSP stitching, see the *JUNOS MPLS Applications Configuration Guide*.

For information about Layer 2 and Layer 2.5 VPNs, see the *JUNOS VPNs Configuration Guide*.

To configure switching cross-connects, you must configure the following on the routing platform that is acting as the switch (Router B in Figure 10 on page 214):

Defining the Encapsulation for Switching Cross-Connects

To configure Layer 2 or Layer 2.5 switching cross-connects, configure the CCC or TCC encapsulation on the routing platform that is acting as the switch (Router B in Figure 10 on page 214).

NOTE: When you use CCC encapsulation, you can configure the ccc family only. Likewise, when you use TCC encapsulation, you can configure the tcc family only.

This section contains the following topics:

Configuring PPP or Cisco HDLC Circuits

For PPP or Cisco HDLC circuits, specify the encapsulation by including the encapsulation statement at the [edit interfaces *interface-name*] hierarchy level. This statement configures the entire physical device. For these circuits to work, you must configure a logical interface unit 0.

```
[edit interfaces interface-name]
encapsulation (ppp-ccc | cisco-hdlc-ccc | ppp-tcc | cisco-hdlc-tcc);
unit 0;
```

Configuring ATM Circuits

For ATM circuits, include the vpi statement [edit interfaces *interface-name* atm-options] hierarchy level:

```
[edit interfaces at-fpc/pic/port]
atm-options {
```

```
    vpi vpi-identifier;
}
```

On the logical interface, include the following statements:

```
point-to-point;
encapsulation (atm-ccc-cell-relay | atm-ccc-vc-mux | atm-tcc-vc-mux | atm-tcc-snap);
vci vpi-identifier.vci-identifier;
```

You can include the logical interface statements at the following hierarchy levels:

- [edit interfaces at-*fpc/pic/port* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces at-*fpc/pic/port* unit *logical-unit-number*]

For each VC, configure whether it is a circuit or a regular logical interface. The default interface type is point-to-point.

Configuring Frame Relay Circuits

For Frame Relay circuits, include the encapsulation statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
encapsulation type;
```

On the logical interface, include the following statements:

```
point-to-point;
encapsulation type;
dlci dlci-identifier;
```

You can include the logical interface statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

The encapsulation type can be one of the following:

- Flexible Frame Relay (flexible-frame-relay)—Intelligent queuing (IQ) interfaces can use flexible Frame Relay encapsulation. You use flexible Frame Relay encapsulation when you want to configure multiple per-unit Frame Relay encapsulations. This encapsulation type allows you to configure any combination of TCC, CCC, and standard Frame Relay encapsulations on a single physical port. Also, each logical interface can have any DLCI value from 1 through 1022.
- Frame Relay CCC version (frame-relay-ccc)—For E1, E3, SONET/SDH, T1, and T3 interfaces, this encapsulation type is the same as standard Frame Relay for DLCIs 0 through 511. DLCIs 512 through 1022 are dedicated to CCC. This numbering restriction does not apply to IQ interfaces. The logical interface must also have frame-relay-ccc encapsulation. When you use this encapsulation type, you can configure the ccc family only.

- Frame Relay TCC version (frame-relay-tcc)—Similar to Frame Relay CCC and has the same configuration restrictions, but used for circuits with different media on either side of the connection.
- Extended CCC version (extended-frame-relay-ccc)—This encapsulation type allows you to dedicate DLCIs 1 through 1022 to CCC. The logical interface must have frame-relay-ccc encapsulation. When you use this encapsulation type, you can configure the ccc family only.
- Extended TCC version (extended-frame-relay-tcc)—Similar to extended Frame Relay CCC, this encapsulation type allows you to dedicate DLCIs 1 through 1022 to TCC, which is used for circuits with different media on either side of the connection.
- Port CCC version (frame-relay-port-ccc)—Defined in the IETF document *Frame Relay Encapsulation over Pseudo-Wires* (expired December 2002). This encapsulation type allows you to transparently carry all the DLCIs between two customer edge (CE) routers without explicitly configuring each DLCI on the two provider edge (PE) routers with Frame Relay transport. The connection between the two CE routers can be either user-to-network interface (UNI) or network-to-network interface (NNI); this is completely transparent to the PE routers. The logical interface does not require an encapsulation statement. When you use this encapsulation type, you can configure the ccc family only.

For each DLCI, configure whether it is a circuit or a regular logical interface. The DLCI for regular interfaces must be from 1 through 511. For CCC and TCC interfaces, it must be from 512 through 1022. This restriction does not apply to IQ interfaces. The default interface type is point to point.

Configuring Ethernet CCC Circuits

You can configure Ethernet CCC encapsulation on Fast Ethernet, Gigabit Ethernet, and aggregated Ethernet interfaces.

NOTE: CCC over aggregated Ethernet requires an M-series Enhanced Flexible PIC Concentrator (FPC).

For Ethernet CCC circuits, specify the encapsulation by including the encapsulation statement at the [edit interfaces *interface-name*] hierarchy level. This statement configures the entire physical device.

```
[edit interfaces interface-name]
encapsulation ethernet-ccc;
unit logical-unit-number {
    ...
}
[edit interfaces aex]
encapsulation ethernet-ccc;
unit logical-unit-number {
    ...
}
```

Configuring Ethernet VLAN Circuits

You can configure Ethernet virtual local area network (VLAN) circuits on Fast Ethernet, Gigabit Ethernet, and aggregated Ethernet interfaces. For Ethernet VLAN circuits, specify the encapsulation by including the encapsulation statement at the [edit interfaces *interface-name*] hierarchy level. This statement configures the entire physical device. You must also enable VLAN tagging. To do this, include the following statements:

```
[edit interfaces interface-name]
vlan-tagging;
encapsulation (extended-vlan-ccc | vlan-ccc);
[edit interfaces aex]
vlan-tagging;
encapsulation vlan-ccc;
```

On the logical interface, include the following statements:

```
encapsulation vlan-ccc;
vlan-id number;
```

You can include the logical interface statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Ethernet interfaces in VLAN mode can have multiple logical interfaces. For encapsulation type vlan-ccc, VLAN IDs 1 through 511 are reserved for normal VLANs, and VLAN IDs 512 through 1023 are reserved for CCC VLANs. For encapsulation type extended-vlan-ccc, VLAN IDs 1 through 4094 are valid. VLAN ID 0 is reserved for tagging the priority of frames.

Defining the Connection for Switching Cross-Connects

To configure Layer 2 switching cross-connects, define the connection between the two circuits. You configure this on the routing platform that is acting as the switch (Router B in Figure 10 on page 214). The connection joins the interface that comes from the circuit's source to the interface that leads to the circuit's destination. When you specify the interface names, include the logical portion of the name, which corresponds to the logical unit number. The cross-connect is bidirectional, so packets received on the first interface are transmitted out the second interface, and those received on the second interface are transmitted out the first interface.

```
[edit protocols]
connections {
  remote-interface-switch connection-name {
    interface interface-name.unit-number;
  }
  lsp-switch connection-name {
    transmit-lsp lsp-number;
```

```
        receive-lsp lsp-number;
    }
}
```

Configuring MPLS for Switching Cross-Connects

For Layer 2 switching cross-connects to work, you must configure MPLS. The following is a minimal MPLS configuration:

```
[edit protocols]
mpls {
    interface (interface-name | all);
}
```

For more information, see the *JUNOS MPLS Applications Configuration Guide*.

Configuring IS-IS or MPLS Traffic for TCC Interfaces

Layer 2.5 VPNs on T-series, M120, and M320 routers support IPv4, IS-IS, and MPLS traffic types. By default, IPv4 traffic runs on T-series, M120, and M320 routers and over TCC interfaces. To configure IS-IS (ISO traffic) or MPLS traffic on Layer 2.5 VPNs, you must configure the same traffic type on both ends of the Layer 2.5 VPN.

To specify which traffic can run over a TCC interface, include the protocols statement with the appropriate value (inet, mpls, and iso) at the [edit interfaces *interface-name* unit *logical-unit-number* family tcc] hierarchy level:

```
[edit interfaces interface-name unit logical-unit-number family tcc]
protocols [ inet iso mpls ];
```

NOTE: Layer 2.5 VPNs running on M-series routers support only IPv4 traffic. IPv6 is not supported on Layer 2.5 VPNs.

When enabling ISO over a Layer 2.5 VPN that is configured on a CE Ethernet interface, you must also include the point-to-point statement at the [edit protocols isis interface *interface-name*] hierarchy level:

```
[edit protocols isis interface interface-name]
point-to-point;
```

For more information about Layer 2 VPNs, see the *JUNOS VPNs Configuration Guide*.

Configuring ATM-to-Ethernet Interworking

The ATM-to-Ethernet interworking feature is useful where ATM2 interfaces are used to terminate ATM DSLAM traffic. The ATM traffic can be forwarded with encapsulation type ccc (circuit cross-connect) to a local or remote Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet IQ2 and IQ2-E interface or label-switched path (LSP). The ATM VPI and VCI are converted to stacked VLAN inner and outer VLAN tags.

These ATM-to-Ethernet interworking circuits can be mapped to individual logical interfaces configured on an ATM2 IQ interface and Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet IQ2 and IQ2-E physical interface.

The ATM-to-Ethernet interworking cross-connect essentially provides Layer 2 switching, and statistics are reported at the logical interface level.

During conversion from ATM to Ethernet, the least significant 12 bits of the ATM cell VCI are copied to the Ethernet frame inner VLAN tag. Cells received on an ATM logical interface configured with encapsulation type vlan-vci-ccc and falling within the configured VCI range are reassembled into packets and forwarded to a designated Ethernet logical interface that is configured with encapsulation type vlan-vci-ccc.

During conversion from Ethernet to ATM, the Ethernet frame inner VLAN tags that fall within the configured range, are copied to the least significant 12 bits of the ATM cell VCI. The ATM logical interface uses its configured VPI when segmenting the Ethernet packets into cells.

ATM-to-Ethernet interworking is supported on M120, M320, and T-series routing platforms.

The following sections discuss ATM-to-Ethernet interworking:

Enabling ATM-to-Ethernet Interworking

To enable the ATM-to-Ethernet interworking cross-connect function, include the vlan-vci-tagging statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
vlan-vci-tagging;
```

Configuring the ATM-to-Ethernet Interworking Ethernet Interface

Configure the Ethernet or aggregated Ethernet physical interface by including the encapsulation statement with the vlan-vci-ccc option at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
encapsulation vlan-vci-ccc;
```

When the encapsulation type vlan-vci-ccc is configured on the physical interface, all logical interfaces configured on the Ethernet interface must also have the encapsulation type set to vlan-vci-ccc.

Configuring the ATM-to-Ethernet Interworking Ethernet Encapsulation

Configure the Ethernet logical interface by including the encapsulation statement with the vlan-vci-ccc option at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces interface-name unit logical-unit-number]
encapsulation vlan-vci-ccc;
```

The chassis configuration cannot contain the atm-l2circuit-mode statement if any logical interfaces are configured with the vlan-vci-ccc encapsulation option.

Configuring the ATM-to-Ethernet Interworking Outer VLAN Identifier

Configure the Ethernet logical interface outer VLAN ID by including the vlan-id statement specifying the outer VLAN ID at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces interface-name unit logical-unit-number]
vlan-id outer-vlan-identifier;
```

It is the administrator’s responsibility to ensure that the outer VLAN tag and VPI match and the inner VLAN tags fall within the VCI range of the VPI.

The allowable VPI range is from 0 to 255. So the outer VLAN tags must not be configured for values above 255.

Configuring the ATM-to-Ethernet Interworking Inner VLAN Identifier Range

Configure the Ethernet logical interface inner VLAN ID range by including the inner-vlan-id-range statement and specifying the starting VLAN ID and ending VLAN ID at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces interface-name unit logical-unit-number]
inner-vlan-id-range start start-id end end-id;
```

VLAN IDs 0 and 4095 are reserved by IEEE 801.1q and must not be used for the inner or outer VLAN ID.

VCIs 0 through 31 are reserved for ATM management purposes by convention. Therefore inner VLAN IDs 1 through 31 should not be used.

VLAN ID 1 might be used by Ethernet switches for certain bridge management services, so using VLAN ID 1 for the inner or outer VLAN ID is discouraged.

Configuring the ATM-to-Ethernet Interworking Physical Interface VPI

Configure the ATM physical interface VPI by including the vpi statement at the [edit interfaces *interface-name* atm-options] hierarchy level:

```
[edit interfaces interface-name atm-options]
vpi virtual-path-identifier;
```

VPI 0 is reserved, and must not be used.

ATM F4/F5 OAM is not supported for VPIs used in ATM-to-Ethernet interworking cross-connects. Any F4/F5 OAM cells received are discarded.

Only one logical interface may be declared per virtual path specified in the atm-options statement hierarchy.

It is not necessary to dedicate all the VPIs of an ATM2 interface for ATM-to-Ethernet interworking cross-connects.

Configuring the ATM-to-Ethernet Interworking ATM Logical Interface

Configure the ATM logical interface by including the encapsulation statement and specifying the encapsulation type vlan-vci-ccc at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces interface-name unit logical-unit-number]
encapsulation vlan-vci-ccc;
```

An ATM logical interface configured with the encapsulation type vlan-vci-ccc only supports the epd-threshold, shaping, traps | no-traps, disable, and description statements. No other configuration statements are supported. ATM interface CoS features are not supported by logical interfaces configured with the encapsulation type vlan-vci-ccc.

The ATM2 OC48 PIC does not support the encapsulation type vlan-vci-ccc.

The encapsulation type vlan-vci-ccc only supports the ccc protocol family. Attempts to configure any other interface protocol family are rejected.

Configuring the ATM-to-Ethernet Interworking Protocol Family

Configure the ATM logical interface protocol family by including the family statement and specifying the ccc option at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces interface-name unit logical-unit-number]
family ccc;
```

Configuring the ATM-to-Ethernet Interworking Logical Interface VPI

Configure the ATM logical interface virtual path identifier by including the vpi statement at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces interface-name unit logical-unit-number]
vpi virtual-path-identifier;
```

VPI 0 is reserved, and must not be used.

It is the administrator's responsibility to ensure the outer VLAN tag and VPI match and the inner VLAN tags fall within the VCI range of the VPI.

Once a VPI is used in an ATM-to-Ethernet interworking cross-connect, it cannot be used with any other logical interface, even if the *vpi.vci* value falls outside the VCI range for the cross-connect.

Configuring the ATM-to-Ethernet Interworking Logical Interface VCI

Configure the ATM logical interface virtual channel identifier range by including the vci-range statement and specifying the starting VCI and ending VCI at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces interface-name unit logical-unit-number]
vci-range start start-vci end end-vci;
```

Do not use VCIs 0 through 31, which are reserved for ATM management purposes by convention.

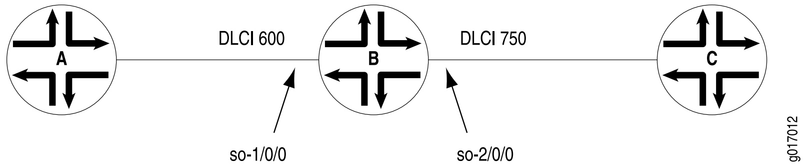
Examples: Configuring Switching Cross-Connects

This section includes the following examples:

Example: Configuring a CCC over Frame Relay Encapsulated Interface

Configure a full-duplex Layer 2 switching circuit cross-connect between Router A and Router C, using a Juniper Networks routing platform, Router B, as the virtual switch. See the topology in Figure 11 on page 224.

Figure 11: Example Topology of a Switching Circuit Cross-Connect with Frame Relay CCC Encapsulation



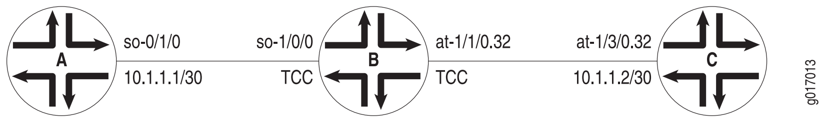

```
[edit]
interfaces {
   so-1/0/0 {
      encapsulation frame-relay-ccc;
      unit 1 {
         point-to-point;
         eui-64 frame-relay-ccc;
         dlci 600;
      }
   }
   so-2/0/0 {
      encapsulation frame-relay-ccc;
      unit 2 {
         point-to-point;
         encapsulation frame-relay-ccc;
         dlci 750;
      }
   }
}
protocols {
   connections {
      interface-switch router-a-router-c {
         interface so-1/0/0.1;
         interface so-2/0/0.2;
      }
   }
   mpls {
      interface all;
   }
}
```

Example: Configuring a TCC

Configure a full-duplex switching translational cross-connect with PPP TCC encapsulation between Router A and Router C, using a Juniper Networks routing platform, Router B, as the virtual switch. See the topology in Figure 12 on page 225.

In this topology, Router B has a PPP connection to Router A and an ATM connection to Router C.

Figure 12: Layer 2.5 Switching Translational Cross-Connect



On Router A

```
[edit]
interfaces {
   so-0/1/0 {
      description "to Router B so-1/0/0";
      encapsulation ppp;
      unit 0 {
         family inet {
            address 10.1.1.1/30;
         }
      }
   }
}
```

On Router B

```
[edit]
interfaces {
   so-1/0/0 {
      description "to Router A so-0/1/0";
      encapsulation ppp-tcc;
      unit 0 {
      }
   }
   at-1/1/0 {
      description "to Router C at-0/3/0";
      atm-options {
         vpi 0 maximum-vcs 2000;
      }
      unit 32 {
         vci 32;
         encapsulation atm-tcc-vc-mux;
      }
   }
}
[edit]
protocols {
   mpls {
      interface so-1/0/0.0;
      interface at-1/1/0.32;
   }
   connections {
      interface-switch PPP-to-ATM {
         interface so-1/0/0.0;
         interface at-1/1/0.32;
      }
   }
}
```

On Router C

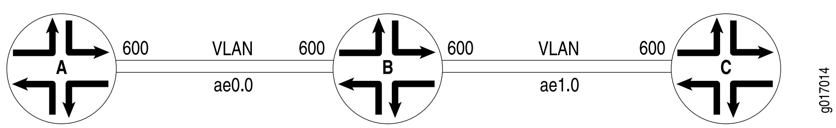
```
[edit]
interfaces {
   at-0/3/0 {
```

```
            description "to Router B at-1/1/0";
            atm-options {
               vpi 0 maximum-vcs 2000;
            }
            unit 32 {
               vci 32;
               encapsulation atm-vc-mux;
               family inet {
                  address 10.1.1.2/30;
               }
            }
         }
      }
```

Example: Configuring CCC over Aggregated Ethernet

See the topology in Figure 13 on page 226. In this topology, CE Routers A and C have aggregated Ethernet connections to PE Router B. With CCC, you specify that the circuit from Router A is connected to the circuit from Router C. Router B functions as a cross-connect switch between the two circuits. For a back-to-back connection, all VLAN IDs must be the same on Router A through Router C. You configure Router A and Router C as standard aggregated Ethernet interfaces. For more information about aggregated Ethernet, see "Configuring Aggregated Ethernet Interfaces" on page 593.

Figure 13: Interface-to-Interface Circuit Cross-Connect over Aggregated Ethernet Interfaces



On Router A

```
[edit interfaces]
ae0 {
   vlan-tagging;
   aggregated-ether-options {
      minimum-links 1;
      link-speed 1g;
   }
   unit 0 {
      vlan-id 600;
      family inet {
         address 192.168.1.1/30;
      }
   }
}
```

On Router B

```
[edit interfaces]
ae0 {
   encapsulation vlan-ccc;
   vlan-tagging;
   aggregated-ether-options {
      minimum-links 1;
      link-speed 1g;
```

```
    }
    unit 0 { # CCC switch
    encapsulation vlan-ccc;
    vlan-id 600;
    family ccc;
}
ae1 {
    encapsulation vlan-ccc;
    vlan-tagging;
    aggregated-ether-options {
        minimum-links 1;
        link-speed 100m;
    }
    unit 0 {
        encapsulation vlan-ccc;
        vlan-id 600;
        family ccc;
    }
}
[edit protocols]
mpls {
    interface all;
}
connections {
    interface-switch layer2-cross-connect {
        interface ae0.0;
        interface ae1.0;
    }
}
```

On Router C

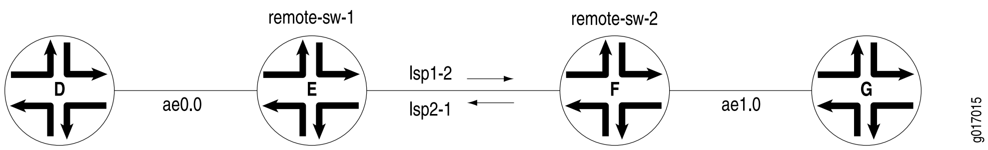
```
[edit interfaces]
ae1 {
    vlan-tagging;
    aggregated-ether-options {
        minimum-links 1;
        link-speed 1g;
    }
    unit 0 {
        vlan-id 600;
        family inet {
            address 192.168.1.2/30;
        }
    }
}
```

Example: Configuring a Remote LSP CCC over Aggregated Ethernet

See the topology in Figure 14 on page 228. In this topology, CE Router G has an aggregated Ethernet connection to PE Router F. CE Router D has an aggregated Ethernet connection to PE Router E. Router E and Router F have an MPLS LSP between them. With remote CCC, you specify that the circuit from Router D is connected to the circuit from Router G. The circuit from Router D is connected to the LSP on Router E; the circuit from Router G is connected to the LSP on Router F. In other words, ae0.0 and ae1.0 are connected using lsp1-2 and lsp2-1. You configure Router D and

Router G as standard aggregated Ethernet interfaces. For more information about aggregated Ethernet, see “Configuring Aggregated Ethernet Interfaces” on page 593.

Figure 14: Remote Interface-LSP-Interface Circuit Cross-Connect over Aggregated Ethernet Interfaces



On Router D

```
[edit interface]
ae0 {
   aggregated-ether-options {
      minimum-links 1;
      link-speed 1g;
      lacp {
         active;
         periodic fast;
      }
   }
   unit 0 {
      family inet {
         address 192.168.2.1/30;
      }
   }
}
```

On Router E

```
[edit interfaces]
ae0 {
   encapsulation ethernet-ccc;
   aggregated-ether-options {
      minimum-links 1;
      link-speed 100m;
      lacp {
         active;
         periodic fast;
      }
   }
   unit 0 {
      encapsulation vlan-ccc; # default
      family ccc; # default
   }
}
[edit protocols]
mpls {
   interface all;
}
connections {
   remote-interface-switch remote-sw-1 {
      interface ae1.0;
      receive-lsp lsp2_1;
      transmit-lsp lsp1_2;
   }
}
```

On Router F

```
[edit interfaces]
ae1 {
    encapsulation ethernet-ccc;
    aggregated-ether-options {
        minimum-links 1;
        link-speed 100m;
        lacp {
            active;
            periodic fast;
        }
    }
    unit 0 {
        encapsulation vlan-ccc; # default
        family ccc; # default
    }
}
[edit protocols]
mpls {
    interface all;
}
connections {
    remote-interface-switch remote-sw-2 {
        interface ae0.0;
        receive-lsp lsp1_2;
        transmit-lsp lsp2_1;
    }
}
```

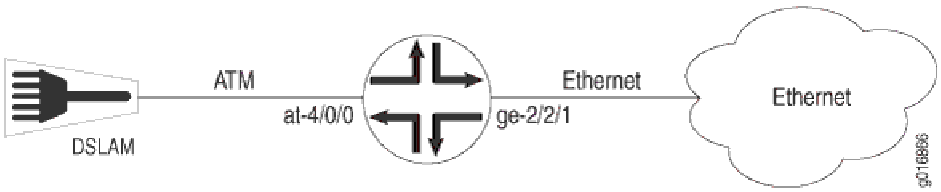
On Router G

```
[edit interface]
ae1 {
    aggregated-ether-options {
        minimum-links 1;
        link-speed 1g;
        lacp {
            active;
            periodic fast;
        }
    }
    unit 0 {
        family inet {
            address 192.168.2.2/30;
        }
    }
}
```

Example: Configuring ATM-to-Ethernet Interworking

The following example shows the configuration of the ATM and Ethernet interfaces for an ATM-to-Ethernet interworking cross connect. In the example ATM DSLAM traffic is terminated on an ATM2 interface. The ATM traffic is forwarded using encapsulation type vlan-vci-ccc to a local Ethernet IQ2 and IQ2-E interface. See the topology in Figure 15 on page 230.

Figure 15: ATM-to-Ethernet Interworking



In this example, the ATM traffic comes from the DSLAM to the router on ATM interface at-4/0/0 and is forwarded out on Ethernet interface ge-2/2/1.

```
[edit interfaces]
ge-2/2/1 {
    vlan-vci-tagging;
    encapsulation vlan-vci-ccc;
    unit 0 {
        encapsulation vlan-vci-ccc;
        vlan-id 100;
        inner-vlan-id-range start 100 end 500;
    }
}
at-4/0/0 {
    atm-options {
        vpi 100;
    }
    unit 0 {
        encapsulation vlan-vci-ccc;
        family ccc;
        vpi 100;
        vci-range start 100 end 500;
    }
}
```

Chapter 7
Tracing Interface Operations

You can trace the operations of individual routing platform interfaces and those of the interface process (dcd). For a general discussion of tracing and of the precedence of multiple tracing operations, see the *JUNOS System Basics Configuration Guide*.

For information about the operations of Virtual Router Resolution Protocol (VRRP)-enabled interfaces, see the *JUNOS High Availability Configuration Guide*.

This chapter discusses the following interface trace operation configuration tasks:

Tracing Operations of an Individual Router Interface

To trace the operations of individual routing platform interfaces, include the traceoptions statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
traceoptions {
    flag flag;
}
```

You can specify the following interface tracing flags:

- all—Trace all interface operations.
- event—Trace all interface events.
- ipc—Trace all interface interprocess communication (IPC) messages.
- media—Trace all interface media changes.

The interfaces traceoptions statement does not support a trace file. The logging is done by the kernel, so the tracing information is placed in the system syslog files.

Tracing Operations of the Interface Process

To trace the operations of the routing platform's interface process, dcd, include the traceoptions statement at the [edit interfaces] hierarchy level:

```
[edit interfaces]
```

```
traceoptions {
    file <filename> <files number> <match regular-expression> <size size>
        <world-readable | no-world-readable>;
    flag flag <disable>;
    no-remote-trace;
}
```

By default, interface process operations are placed in the file named dcd and three 1-MB files of tracing information are maintained.

You can specify the following flags in the interfaces traceoptions statement:

- change-events—Log changes that produce configuration events.
- config-states—Log the configuration state machine changes.
- kernel—Log configuration IPC messages to kernel.
- kernel-detail—Log details of configuration messages to kernel.

For general information about tracing, see the tracing and logging information in the *JUNOS System Basics Configuration Guide*.

Part 3
Configuring Special Router Interfaces

This section describes configuration of multiple unique interface types used for special purposes in the router.

Chapter 8

Displaying the Internal Ethernet Interface

This section contains the following topic:

Displaying the Internal Ethernet Interface

The internal Ethernet interface, fxp1, connects the Routing Engine with the routing platform's packet forwarding components. The JUNOS software automatically configures this interface.

NOTE: Do not modify or remove the configuration for the internal Ethernet interface that the JUNOS software automatically configures. If you do, the routing platform will stop functioning.

```
user@host> show configuration
...
interfaces {
   ...
   fxp1 {
      unit 0 {
         family tnp {
            address 1;
         }
      }
   }
}
```

Chapter 9

Configuring Discard Interfaces

On the routing platform, you can configure one physical discard interface, dsc. The discard interface allows you to identify the ingress point of a denial-of-service (DoS) attack. When your network is under attack, the target host IP address is identified, and the local policy forwards attacking packets to the discard interface. When traffic is routed out of the discard interface, the traffic is silently discarded.

You can configure the inet family protocol on the discard interface, which allows you to apply an output filter to the interface. If you apply an output filter to the interface, the action specified by the filter is executed before the traffic is discarded.

Once you configure a discard interface, you must then configure a local policy to forward attacking traffic to the discard interface. For a complete discussion about using the discard interface to protect your network against DoS attacks, see the *JUNOS Policy Framework Configuration Guide*.

To configure a discard interface, include the following statements at the [edit interfaces] hierarchy level:

```
[edit interfaces]
dsc {
    unit 0 {
        family inet {
            filter {
                output filter-name;
            }
            address address {
                destination address;
            }
        }
    }
}
```

Keep the following guidelines in mind when configuring the discard interface:

- Only the logical interface unit 0 is supported.
- The filter and address statements are optional.
- Although you can configure an input filter and a filter group, these configuration statements have no effect because traffic is not transmitted from the discard interface.

- The show interface command is not relevant for the discard interface.
- The discard interface does not support class of service (CoS).

Chapter 10

Configuring IP Demultiplexing Interfaces

This chapter contains the following topics:

Configuring an IP Demultiplexing Interface

IP demultiplexing (demux) interfaces are logical interfaces that share a common, underlying logical interface. The demux interfaces use the IP source or destination address to demultiplex received packets when the subscriber is not uniquely identified by a Layer 2 circuit.

To configure a demux interface, include the following statements at the [edit interfaces] hierarchy level:

```
[edit interfaces]
interface-name {
    unit logical-unit-number {
        ... logical-interface-configuration ...
    }
}
demux0 {
    unit logical-unit-number {
        demux-options {
            underlying-interface interface-name;
        }
        family family {
            demux-destination {
                destination-prefix;
            }
            demux-source {
                source-prefix;
            }
            mac-validate (loose | strict)
            unnumbered-address interface-name <preferred-source-address address>;
        }
```

```
    }
  }
```

Keep the following guidelines in mind when configuring the demux interface:

- Demux interfaces are supported on M120 or MX-series platforms only.
- You can configure only one demux0 interface per chassis, but you can define logical demux interfaces on top of it (for example, demux0.1, demux0.2, and so on).
- You must associate demux interfaces with an underlying logical interface.

NOTE: IP demux interfaces currently support only Gigabit Ethernet, Fast Ethernet, 10-Gigabit Ethernet, and aggregated Ethernet underlying interfaces.

- The demux underlying interface must reside on the same logical system as the demux interfaces that you configure over it.
- IP demux interfaces currently support only the Internet Protocol version 4 (IPv4) suite inet family type.
- You can configure more than one demux prefix for a given demux unit. However, you cannot configure the exact same demux prefix on two different demux units with the same underlying interface.
- You can configure overlapping demux prefixes on two different demux units with the same underlying prefix. However, under this configuration, best match rules apply (in other words, the most specific prefix wins).
- If the address in a received packet does not match any demux prefix, the packet is logically received on the underlying interface. For this reason, the underlying interface is often referred to as the “primary” interface.

Configuring an IP Demux Underlying Interface

An IP demux interface uses an underlying logical interface to receive packets.

NOTE: IP demux interfaces support only Gigabit Ethernet, Fast Ethernet, 10-Gigabit Ethernet, or aggregated Ethernet underlying interfaces.

To determine which IP demux interface to use, the destination or source prefix is matched against the destination or source address of packets that the underlying interface receives. The underlying interface family type must match the demux interface prefix type.

To configure a logical interface as an IP demux underlying interface, configure the logical demultiplexing destination or source family type. To configure, include the demux-destination (underlying interface) statement or the demux-source (underlying interface) statement:

```
interfaces {
```

```
    interface-name {
        unit logical-unit-number {
            (demux-destination family | demux-source family);
        }
    }
}
```

You can include these statements at the following hierarchy levels:

- [edit]
- [edit logical-system *logical-system-name*]
- [edit logical-system *logical-system-name* routing-instances *routing-instance-name*]

Specifying the Demux Underlying Interface

You must specify an underlying interface for the demux interfaces to use. The underlying interface must reside on the same logical system as the demux interface.

To specify the logical underlying interface, include the underlying-interface statement:

```
interfaces {
    demux0 {
        unit logical-unit-number {
            demux-options {
                underlying-interface interface-name;
            }
        }
    }
}
```

You can include these statements at the following hierarchy levels:

- [edit]
- [edit logical-systems *logical-system-name*]
- [edit logical-systems *logical-system-name* routing-instances *routing-instance-name*]

Configuring IP Demux Prefixes

You configure demux prefixes for use by the underlying interface. The demux prefixes can represent individual hosts or networks. For a given demux interface unit, you can configure either demux source or demux destination prefixes but not both. You can choose not to configure a demux source or demux destination prefix. This type of configuration results in a transmit-only interface.

To configure IP demux prefixes, include the demux-destination (demux interface) statement or the demux-source (demux interface) statement:

```
interfaces {
    demux0 {
        unit logical-unit-number {
            family family;
```

```
                demux-destination {
                    destination-prefix;
                }
            }
            family family;
                demux-source {
                    source-prefix;
                }
            }
        }
    }
}
```

You can include these statements at the following hierarchy levels:

- [edit]
- [edit logical-systems *logical-system-name*]
- [edit logical-systems *logical-system-name* routing-instances *routing-instance-name*]

Configuring MAC Address Validation on Static Demux Interfaces

MAC address validation enables the router to validate that received packets contain a trusted IP source and an Ethernet MAC source address.

MAC address validation is supported on static demux interfaces on MX-series routers only.

There are two types of MAC address validation that you can configure:

- Loose—Forwards packets when both the IP source address and the MAC source address match one of the trusted address tuples.

  Drops packets when the IP source address matches one of the trusted tuples, but the MAC address does not support the MAC address of the tuple

  Continues to forward packets when the source address of the incoming packet does not match any of the trusted IP addresses.
- Strict—Forwards packets when both the IP source address and the MAC source address match one of the trusted address tuples.

  Drops packets when the MAC address does not match the tuple's MAC source address, or when IP source address of the incoming packet does not match any of the trusted IP addresses.

To configure MAC address validation on static Ethernet interfaces, include the mac-validate (loose | strict) statement in the [edit interfaces demux0 unit *logical-unit-number* family *family*] hierarchy.

Example: Configuring a Demux Interface

Configure two VLANs, each with two IP demux interfaces. One VLAN demultiplexes based on the source address; the other VLAN demultiplexes based on the destination address.

NOTE: This example is not intended to depict any realistic deployment; it is intended to demonstrate many possible CLI variations.

```
[edit]
interfaces {
  fe-0/0/0 {
    vlan-tagging;
    unit 100 {
      vlan-id 100;
      demux-source inet; # Enable demux of inet prefixes
      family inet {
        address 10.1.1.1/24;
        filter {
          input vlan1-primary-in-filter;
          output vlan1-primary-out-filter;
        }
        mac-validate loose;
      }
    }
    unit 200 {
      vlan-id 200;
      demux-destination inet; # Enable demux of inet using destination addresses
      family inet {
        address 20.1.1.1/24;
      }
    }
    unit 300 {
      vlan-id 300;
      demux-source inet; # Enable demux of inet using source addresses
      family inet {
        address 20.1.2.1/24;
      }
    }
  }
  demux0 {
    unit 101 {
      description vlan1-sub1;
      demux-options {
        underlying-interface fe-0/0/0.100;
      }
      family inet {
        demux-source 10.1.1.0/24;
        filter {
          input vlan1-sub1-in-filter;
          output vlan1-sub1-out-filter;
```

```
                }
                mac-validate loose;
            }
        }
        unit 102 {
            description vlan1-sub2;
            demux-options {
                underlying-interface fe-0/0/0.100;
            }
            family inet {
                demux-source {
                    10.1.0.0/16;
                    10.2.1.0/24;
                }
                filter {
                    input vlan1-sub2-in-filter;
                    output vlan1-sub2-out-filter;
                    }
                mac-validate loose;
            }
        }
        unit 202 {
            description vlan2-sub2;
            demux-options {
                underlying-interface fe-0/0/0.200;
            }
            family inet {
                demux-destination 100.1.2.0/24;
            }
        }
        unit 302 {
            description vlan2-sub2;
            demux-options {
                underlying-interface fe-0/0/0.300;
            }
            family inet {
                demux-source 100.1.2.0/24;
            }
        }
    }
}
```

Chapter 11

Configuring the Loopback Interface

On the routing platform, you can configure one physical loopback interface, lo0, and one or more addresses on the interface.

Configuring the Loopback Interface

To configure the physical loopback interface, include the following statements at the [edit interfaces] hierarchy level:

```
[edit interfaces]
lo0 {
    unit 0 {
        family inet {
            address loopback-address;
            address <loopback-address2>;
            ...
        }
        family inet6 {
            address loopback-address;
        }
    }
}
```

When specifying the loopback address, do not include a destination prefix. Also, in most cases, do not specify a loopback address on any unit other than unit 0.

NOTE: For Layer 3 virtual private networks (VPNs), you can configure multiple logical units for the loopback interface. This allows you to configure a logical loopback interface for each virtual routing and forwarding (VRF) routing instance. For more information, see the *JUNOS VPNs Configuration Guide*.

For some applications, such as SSL for JUNOScript, the address for the interface lo0.0 must be 127.0.0.1.

You can configure loopback interfaces using a subnetwork address for both inet and inet6 address families. Many protocols require a subnetwork address as their source address. Configuring a subnetwork loopback address as a donor interface enables these protocols to run on unnumbered interfaces.

If you configure the loopback interface, it is automatically used for unnumbered interfaces. If you do not configure the loopback interface, the routing platform chooses the first interface to come online as the default. If you configure more than one address on the loopback interface, we recommend that you configure one to be the primary address to ensure that it is selected for use with unnumbered interfaces. By default, the primary address is used as the source address when packets originate from the interface.

For more information about unnumbered interfaces, see "Configuring an Unnumbered Interface" on page 176. For more information about primary addresses, see "Configuring the Interface Address" on page 166.

Example: Configuring the Loopback Interface

Configure two addresses on the loopback interface with host routes:

```
[edit]
user@host# edit interfaces lo0 unit 0 family inet
[edit interfaces lo0 unit 0 family inet]
user@host# set address 172.16.0.1
[edit interfaces lo0 unit 0 family inet]
user@host# set address 10.0.0.1
[edit interfaces lo0 unit 0 family inet]
user@host# top
[edit]
user@host# show
interfaces {
  lo0 {
    unit 0 {
      family inet {
        10.0.0.1;
        127.0.0.1;
        172.16.0.1;
      }
    }
  }
}
```

Configure two addresses on the loopback interface with subnetwork routes:

```
[edit]
user@host# edit interfaces lo0 unit 0 family inet
[edit interfaces lo0 unit 0 family inet]
user@host# set address 192.16.0.1/24
[edit interfaces lo0 unit 0 family inet]
user@host# set address 10.2.0.1/16
[edit interfaces lo0 unit 0 family inet]
user@host# top
[edit]
user@host# show
interfaces {
  lo0 {
    unit 0 {
      family inet {
        10.2.0.1/16;
```

```
                127.0.0.1/32;
                192.16.0.1/24;
            }
        }
    }
}
```

Configure an IP and an IPv6 address on the loopback interface with subnetwork routes:

```
[edit]
user@host# edit interfaces lo0 unit 0 family inet
[edit interfaces lo0 unit 0 family inet]
user@host# set address 192.16.0.1/24
[edit interfaces lo0 unit 0 family inet]
user@host# up
[edit interfaces lo0 unit 0 family]
user@host# edit interfaces lo0 unit 0 family inet6
[edit interfaces lo0 unit 0 family inet6]
user@host# set address 3ffe::1:200:f8ff:fe75:50df/64
[edit interfaces lo0 unit 0 family inet6]
user@host# top
[edit]
user@host# show
interfaces {
    lo0 {
        unit 0 {
            family inet {
                127.0.0.1/32;
                192.16.0.1/24;
            }
            family inet6 {
                3ffe::1:200:f8ff:fe75:50df/64;
            }
        }
    }
}
```

Chapter 12

Configuring Serial Interfaces

This chapter discusses configuration of the following serial interface properties:

Serial Interfaces Overview

Devices that communicate over a serial interface are divided into two classes: data terminal equipment (DTE) and data circuit-terminating equipment (DCE). Juniper Networks Serial Physical Interface Cards (PICs) have two ports per PIC and support full-duplex data transmission. These PICs support DTE mode only. On the Serial PIC, you can configure three types of serial interfaces:

- EIA-530—An Electronics Industries Alliance (EIA) standard for the interconnection of DTE and DCE using serial binary data interchange with control information exchanged on separate control circuits.
- V.35—An ITU-T standard describing a synchronous, physical layer protocol used for communications between a network access device and a packet network. V.35 is most commonly used in the United States and in Europe.
- X.21—An ITU-T standard for serial communications over synchronous digital lines. The X.21 protocol is used primarily in Europe and Japan.

The following standards apply to serial interfaces:

- TIA/EIA Standard 530, *High-Speed 25-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment*, defines the signals on the cable and specifies the connector at the end of the cable.
- TIA/EIA Standard 232, *Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*, describes the physical interface and protocol for serial data communication.
- ITU-T Recommendation V.35, *Data Transmission at 48 kbit/s Using 60-108 kHz Group Band Circuits*. Note that the Juniper Networks Serial PIC supports V.35 interfaces with speeds higher than 48 kilobits per second.
- ITU-T Recommendation X.21, *Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment for Synchronous Operation on Public Data Networks*.

There are no serial interface-specific logical properties. For information about general logical properties that you can configure, see “Configuring Logical Interface Properties” on page 135. On J-series Services Routers, link fragmentation and interleaving (LFI) and Multilink Point-to-Point Protocol (MLPPP) support has been extended to serial interfaces. This support on serial interfaces is the same as the existing LFI and MLPPP support on T1 and E1 interfaces.

Physical Interface Configuration Statements for Serial Interfaces

To configure serial physical interface properties, include the serial-options statement for the J-series routing platform at the [edit interfaces se-*pim*/0/*port*] hierarchy level or at the [edit interfaces se- *fpc*/*pic*/*port*] hierarchy level for M-series and T-series routing platforms:

```
[edit interfaces se-fpc/pic/port]
serial-options {
    clock-rate rate;
    clocking-mode (dce | internal | loop);
    control-polarity (negative | positive);
    cts-polarity (negative | positive);
    dcd-polarity (negative | positive);
    dce-options {
        control-signal (assert | de-assert | normal);
        cts (ignore | normal | require);
        dcd (ignore | normal | require);
        dsr (ignore | normal | require);
        dtr signal-handling-option;
        ignore-all;
        indication (ignore | normal | require);
        rts (assert | de-assert | normal);
        tm (ignore | normal | require);
    }
    dsr-polarity (negative | positive);
    dte-options {
        control-signal (assert | de-assert | normal);
        cts (ignore | normal | require);
        dcd (ignore | normal | require);
        dsr (ignore | normal | require);
        dtr signal-handling-option;
```

```
        ignore-all;
        indication (ignore | normal | require);
        rts (assert | de-assert | normal);
        tm (ignore | normal | require);
    }
    dtr-circuit (negative | positive);
    dtr-polarity (negative | positive);
    encoding (nrz | nrzi);
    idle-cycle-flag flag;
    indication-polarity (negative | positive);
    line-protocol protocol;
    loopback mode;
    rts-polarity (negative | positive);
    tm-polarity (negative | positive);
    transmit-clock invert;
}
```

Configuring the Serial Line Protocol

By default, serial interfaces use the EIA-530 line protocol. You can configure each port on the PIC independently to use one of the following line protocols:

- EIA-530
- V.35
- X.21

To configure the serial line protocol, include the line-protocol statement, specifying the eia530, v.35, or x.21 option:

```
line-protocol protocol;
```

You can include these statements at the following hierarchy levels:

- [edit interfaces se-*pim*/0/*port* serial-options]
- [edit interfaces se-*fpc*/*pic*/*port* serial-options]

For more information about serial interfaces, see the following sections:

- Serial Interface Default Settings on page 251
- Invalid Serial Interface Statements on page 253

Serial Interface Default Settings

The following sections show the default settings for serial interfaces:

- EIA-530 Interface Default Settings on page 252
- V.35 Interface Default Settings on page 252
- X.21 Interface Default Settings on page 253

EIA-530 Interface Default Settings

If you do not include the line-protocol statement or if you explicitly configure the default EIA-530 line protocol, the default settings are as follows:

```
dce-options | dte-options {
    cts normal;
    dcd normal;
    dsr normal;
    dtr normal;
    rts normal;
    tm normal;
}
clock-rate 16.384mhz;
clocking-mode loop;
cts-polarity positive;
dcd-polarity positive;
dsr-polarity positive;
dtr-circuit balanced;
dtr-polarity positive;
encoding nrz;
rts-polarity positive;
tm-polarity positive;
```

NOTE: On M-series routing platforms, you can set the DCE clocking mode for EIA-530 interfaces and commit. An error message is not displayed and the CLI is not blocked.

You can include the line-protocol statement at the following hierarchy levels:

- [edit interfaces se-*pim*/0/*port* serial-options]
- [edit interfaces se-*fpc*/*pic*/*port* serial-options]

V.35 Interface Default Settings

If you include the line-protocol v.35 statement, the default settings are as follows:

```
dce-options | dte-options {
    cts normal;
    dcd normal;
    dsr normal;
    dtr normal;
    rts normal;
}
clock-rate 16.384mhz;
clocking-mode loop;
cts-polarity positive;
dcd-polarity positive;
dsr-polarity positive;
dtr-circuit balanced;
dtr-polarity positive;
encoding nrz;
```

```
rts-polarity positive;
```

You can include the line-protocol statement at the following hierarchy levels:

- [edit interfaces se-*pim*/0/*port* serial-options]
- [edit interfaces se-*fpc*/*pic*/*port* serial-options]

X.21 Interface Default Settings

If you include the line-protocol x.21 statement, the default settings are as follows:

```
dce-options | dte-options {
    control-signal normal;
    indication normal;
}
clock-rate 16.384mhz;
clocking-mode loop;
control-polarity positive;
encoding nrz;
indication-polarity positive;
```

You can include the line-protocol statement at the following hierarchy levels:

- [edit interfaces se-*pim*/0/*port* serial-options]
- [edit interfaces se-*fpc*/*pic*/*port* serial-options]

Invalid Serial Interface Statements

The following sections show the invalid configuration statements for each type of serial interface. If you include the following statements in the configuration, an error message indicates the location of the error and the configuration is not activated.

- Invalid EIA-530 Interface Statements on page 253
- Invalid V.35 interface Statements on page 254
- Invalid X.21 Interface Statements on page 254

Invalid EIA-530 Interface Statements

If you do not include the line-protocol statement or if you explicitly configure the default EIA-530 line protocol, the following statements are invalid:

```
dce-options | dte-options {
    control-signal (assert | de-assert | normal);
    indication (ignore | normal | require);
}
control-polarity (negative | positive);
indication-polarity (negative | positive);
```

You can include the line-protocol statement at the following hierarchy levels:

- [edit interfaces se-*pim*/0/*port* serial-options]

- [edit interfaces se-*fpc/pic/port* serial-options]

Invalid V.35 interface Statements

If you include the line-protocol v.35 statement, the following statements are invalid:

```
dce-options | dte-options {
    control-signal (assert | de-assert | normal);
    indication (ignore | normal | require);
    tm (ignore | normal | require);
}
control-polarity (negative | positive);
indication-polarity (negative | positive);
loopback (dce-local | dce-remote);
tm-polarity (negative | positive);
```

You can include the line-protocol statement at the following hierarchy levels:

- [edit interfaces se-*pim*/0/*port* serial-options]
- [edit interfaces se-*fpc/pic/port* serial-options]

Invalid X.21 Interface Statements

If you include the line-protocol x.21 statement, the following statements are invalid:

```
dce-options | dte-options {
    cts (ignore | normal | require);
    dcd (ignore | normal | require);
    dsr (ignore | normal | require);
    dtr (assert | de-assert | normal);
    rts (assert | de-assert | normal);
    tm (ignore | normal | require);
}
clocking-mode (dce | internal);
cts-polarity (negative | positive);
dce-polarity (negative | positive);
dsr-polarity (negative | positive);
dtr-circuit (balanced | unbalanced);
dtr-polarity (negative | positive);
loopback (dce-local | dce-remote);
rts-polarity (negative | positive);
tm-polarity (negative | positive);
```

You can include the line-protocol statement at the following hierarchy levels:

- [edit interfaces se-*pim*/0/*port* serial-options]
- [edit interfaces se-*fpc/pic/port* serial-options]

Configuring the Serial Clocking Mode

By default, serial interfaces use loop clocking mode. For EIA-530 and V.35 interfaces, you can configure each port on the PIC independently to use loop, DCE, or internal clocking mode. For X.21 interfaces, only loop clocking mode is supported.

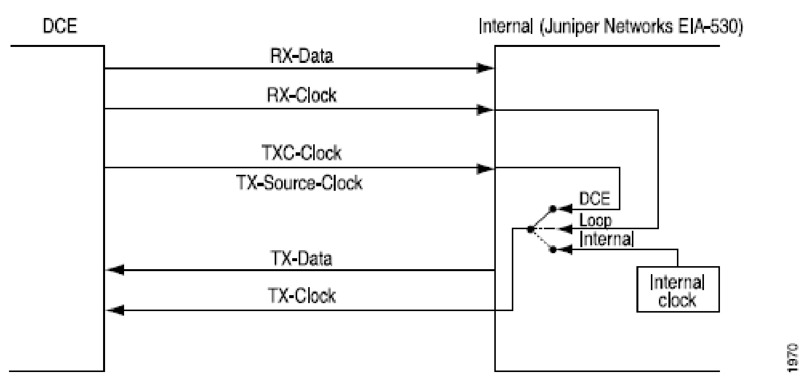
The three clocking modes work as follows:

- Loop clocking mode—Uses the DCE's RX clock to clock data from the DCE to the DTE.
- DCE clocking mode—Uses the TXC clock, which is generated by the DCE specifically to be used by the DTE as the DTE's transmit clock.
- Internal clocking mode—Also known as line timing, uses an internally generated clock. You can configure the speed of this clock by including the clock-rate statement at the [edit interfaces se-*pim*/0/*port* serial-options] or [edit interfaces se-*fpc*/*pic*/*port* dte-options] hierarchy levels. For more information about the DTE clock rate, see "Configuring the DTE Clock Rate" on page 256.

Note that DCE clocking mode and loop clocking mode use external clocks generated by the DCE.

Figure 16 on page 255 shows the clock sources of loop, DCE, and internal clocking modes.

Figure 16: Serial Interface Clocking Mode



To configure the clocking mode of a serial interface, include the clocking-mode statement:

```
clocking-mode (dce | internal | loop);
```

You can include this statement at the following hierarchy levels:

- [edit interfaces se-*pim*/0/*port* serial-options]
- [edit interfaces se-*fpc*/*pic*/*port* serial-options]

For more information about clocking on serial interfaces, see the following sections:

- Inverting the Serial Interface Transmit Clock on page 256
- Configuring the DTE Clock Rate on page 256

Inverting the Serial Interface Transmit Clock

When an externally timed clocking mode (DCE or loop) is used, long cables might introduce a phase shift of the DTE-transmitted clock and data. At high speeds, this phase shift might cause errors. Inverting the transmit clock corrects the phase shift, thereby reducing error rates.

By default, the transmit clock is not inverted. To invert the transmit clock, include the transmit-clock invert statement:

```
transmit-clock invert;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces se-*pim*/0/*port* serial-options]
- [edit interfaces se-*fpc*/*pic*/*port* serial-options]

Configuring the DTE Clock Rate

By default, the serial interface has a clock rate of 16.384 MHz. For EIA-530 and V.35 interfaces with internal clocking mode configured, you can configure the clock rate. For more information about internal clocking mode, see "Configuring the Serial Clocking Mode" on page 255.

To configure the clock rate, include the clock-rate statement:

```
clock-rate rate;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces se-*pim*/0/*port* serial-options]
- [edit interfaces se-*fpc*/*pic*/*port* serial-options]

You can configure the following interface speeds:

- 2.048 MHz
- 2.341 MHz
- 2.731 MHz
- 3.277 MHz
- 4.096 MHz
- 5.461 MHz
- 8.192 MHz
- 16.384 MHz

Although the serial interface is intended for use at the default rate of 16.384 MHz, you might need to use a slower rate if any of the following conditions prevail:

- The interconnecting cable is too long for effective operation.
- The interconnecting cable is exposed to an extraneous noise source that might cause an unwanted voltage in excess of +1 volt measured differentially between the signal conductor and circuit common at the load end of the cable, with a 50-ohm resistor substituted for the generator.
- You need to minimize interference with other signals.
- You need to invert signals.

For detailed information about the relationship between signaling rate and interface cable distance, see the following standards:

- EIA-422-A, *Electrical Characteristics of Balanced Voltage Digital Interface Circuits*
- EIA-423-A, *Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits*

Configuring the Serial Idle Cycle Flag

By default, a serial interface on J-series Services Routers transmits the value 0x7E in the idle cycles. To have the interface transmit the value 0xFF (all ones) instead, include the idle-cycle-flag statement at the [edit interfaces *interface-name* serial-options] hierarchy level, specifying the ones option:

```
[edit interfaces interface-name serial-options]
idle-cycle-flag ones;
```

To explicitly configure the default value of 0x7E, include the idle-cycle-flag statement with the flags option:

```
[edit interfaces interface-name serial-options]
idle-cycle-flag flags;
```

Configuring the Serial Signal Handling

By default, normal signal handling is enabled for all signals. For each signal, the normal option applies to the normal signal handling for that signal, as defined by the following standards:

- TIA/EIA Standard 530
- ITU-T Recommendation V.35
- ITU-T Recommendation X.21

Table 23 on page 258 shows the serial interface modes that support each signal type.

Table 23: Signal Handling by Serial Interface Type

Signal	Serial Interfaces
From-DCE signals	
Clear to send (CTS)	EIA-530 and V.35
Data carrier detect (DCD)	EIA-530 and V.35
Data set ready (DSR)	EIA-530 and V.35
Indication	X.21 only
Test mode (TM)	EIA-530 only
To-DCE signals	
Control signal	X.21 only
Data transfer ready (DTR)	EIA-530 and V.35
Request to send (RTS)	EIA-530 and V.35

You configure serial interface signal characteristics by including the dce-options or dte-options statement:

```
dce-options |dte-options {
    control-signal (assert | de-assert | normal);
    cts (ignore | normal | require);
    dcd (ignore | normal | require);
    dsr (ignore | normal | require);
    dtr signal-handling-option;
    ignore-all;
    indication (ignore | normal | require);
    rts (assert | de-assert | normal);
    tm (ignore | normal | require);
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces se-*pim*/0/*port* serial-options]
- [edit interfaces se-*fpc*/*pic*/*port* serial-options]

For EIA-530 and V.35 interfaces, configure to-DCE signals by including the dtr and rts statements, specifying the assert, de-assert, or normal option:

```
dtr (assert | de-assert | normal);
rts (assert | de-assert | normal);
```

For X.21 interfaces, configure to-DCE signals by including the control-signal statement, specifying the assert, de-assert, or normal option:

```
control-signal (assert | de-assert | normal);
```

Assertion is when the positive side of a given signal is at potential high-level output voltage (Voh), while the negative side of the same signal is at potential low-level output voltage (Vol). *Deassertion* is when the positive side of a given signal is at potential Vol, while the negative side of the same signal is at potential Voh.

For the DTR signal, you can configure normal signal handling using the signal for automatic resynchronization by including the dtr statement, and specifying the auto-synchronize option:

```
dtr {
    auto-synchronize {
        duration milliseconds;
        interval seconds;
    }
}
```

The pulse duration of resynchronization can be from 1 through 1000 milliseconds. The offset interval for resynchronization can be from 1 through 31 seconds.

For EIA-530 and V.35 interfaces, configure from-DCE signals by including the cts, dcd, and dsr statements, specifying the ignore, normal, or require option:

```
cts (ignore | normal | require);
dcd (ignore | normal | require);
dsr (ignore | normal | require);
```

For X.21 interfaces, configure from-DCE signals by including the indication statement, specifying the ignore, normal, or require option:

```
indication (ignore | normal | require);
```

For EIA-530 interfaces only, you can configure from-DCE test-mode (TM) signaling by including the tm statement, specifying the ignore, normal, or require option:

```
tm (ignore | normal | require);
```

To specify that the from-DCE signal must be asserted, include the require option in the configuration. To specify that the from-DCE signal must be ignored, include the ignore option in the configuration.

NOTE: For V.35 and X.21 interfaces, you cannot include the tm statement in the configuration.

For X.21 interfaces, you cannot include the cts, dcd, dsr, dtr, and rts statements in the configuration.

For EIA-530 and V.35 interfaces, you cannot include the control-signal and indication statements in the configuration.

For a complete list of serial options statements that are not supported by each serial interface mode, see “Invalid Serial Interface Statements” on page 253.

To return to the default normal signal handling, delete the require, ignore, assert, de-assert, or auto-synchronize statement from the configuration, as shown in the following example:

```
[edit]
user@host# delete interfaces se-fpc/pic/port dte-options control-leads cts require
```

To explicitly configure normal signal handling, include the control-signal statement with the normal option:

```
control-signal normal;
```

You can configure the serial interface to ignore all control leads by including the ignore-all statement:

```
ignore-all;
```

You can include the ignore-all statement in the configuration only if you do not explicitly enable other signal handling options at the [edit interfaces se-*pim*/0/*port* serial-options dce-options] or [edit interfaces se-*fpc*/*pic*/*port* serial-options dte-options] hierarchy levels.

You can include the control-signal, cts, dcd, dsr, dtr, indication, rts, and tm statements at the following hierarchy levels:

- [edit interfaces se-*pim*/0/*port* serial-options dte-options]
- [edit interfaces se-*fpc*/*pic*/*port* serial-options dte-options]

Configuring the Serial DTR Circuit

A balanced circuit has two currents that are equal in magnitude and opposite in phase. An unbalanced circuit has one current and a ground; if a pair of terminals is unbalanced, one side is connected to electrical ground and the other carries the signal. By default, the DTR circuit is balanced.

For EIA-530 and V.35 interfaces, configure the DTR circuit by including the dtr-circuit statement:

```
dtr-circuit (balanced | unbalanced);
```

You can include the dtr-circuit statement at the following hierarchy levels:

- [edit interfaces se-*pim*/0/*port* serial-options]
- [edit interfaces se-*fpc*/*pic*/*port* serial-options]

Configuring Serial Signal Polarities

Serial interfaces use a differential protocol signaling technique. Of the two serial signals associated with a circuit, the one referred to as the A signal is denoted with a plus sign, and the one referred to as the B signal is denoted with a minus sign; for example, DTR+ and DTR–. If DTR is low, then DTR+ is negative with respect to DTR–. If DTR is high, then DTR+ is positive with respect to DTR–.

By default, all signal polarities are positive. You can reverse this polarity on a Juniper Networks serial interface. You might need to do this if signals are miswired as a result of reversed polarities.

For EIA-530 and V.35 interfaces, configure signal polarities by including the cts-polarity, dcd-polarity, dsr-polarity, dtr-polarity, rts-polarity, and tm-polarity statements:

```
cts-polarity (negative | positive);
dcd-polarity (negative | positive);
dsr-polarity (negative | positive);
dtr-polarity (negative | positive);
rts-polarity (negative | positive);
tm-polarity (negative | positive);
```

You can include these statements at the following hierarchy levels:

- [edit interfaces se-*pim*/0/*port* serial-options]
- [edit interfaces se-*fpc*/*pic*/*port* serial-options]

For X.21 interfaces, configure signal polarities by including the control-polarity and indication-polarity statements:

```
control-polarity (negative | positive);
indication-polarity (negative | positive);
```

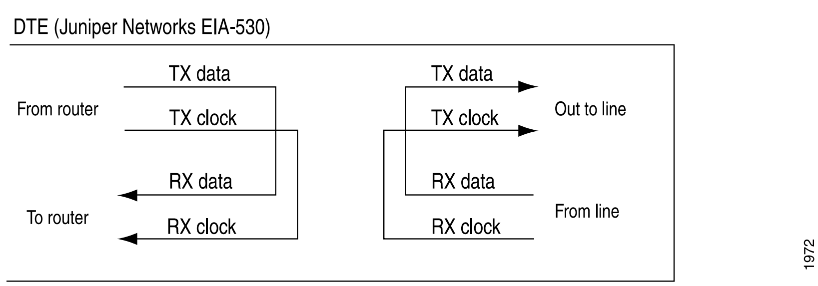
You can include these statements at the following hierarchy levels:

- [edit interfaces se-*pim*/0/*port* serial-options]
- [edit interfaces se-*fpc*/*pic*/*port* serial-options]

Configuring Serial Loopback Capability

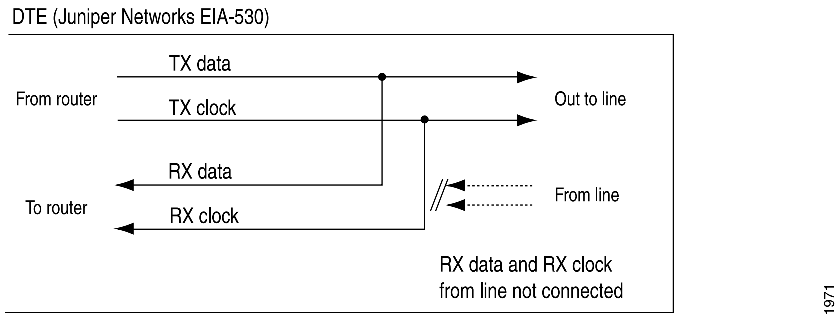
From the routing platform, remote line interface unit (LIU) loopback loops the TX (transmit) data and TX clock back to the routing platform as RX (receive) data and RX clock. From the line, LIU loopback loops the RX data and RX clock back out the line as TX data and TX clock, as shown in Figure 17 on page 261.

Figure 17: Serial Interface LIU Loopback



DCE local and DCE remote control the EIA-530 interface-specific signals for enabling local and remote loopback on the link partner DCE. Local loopback is shown in Figure 18 on page 262.

Figure 18: Serial Interface Local Loopback



For EIA-530 interfaces, you can configure DCE local, DCE remote, local, and remote (LIU) loopback capability.

For V.35, you can configure remote LIU and local loopback capability. DCE local and DCE remote loopbacks are not supported on V.35 and X.21 interfaces. Local and remote loopbacks are not supported on X.21 interfaces.

To configure the loopback capability on a serial interface, include the loopback statement, specifying the dce-local, dce-remote, local, or remote option:

```
loopback mode;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces se-*pim*/0/*port* serial-options]
- [edit interfaces se-*fpc*/*pic*/*port* serial-options]

To disable the loopback capability, remove the loopback statement from the configuration:

```
[edit]
user@host# delete interfaces se-fpc/pic/port serial-options loopback
```

You can determine whether there is an internal or external problem by checking the error counters in the output of the show interface se-*fpc*/*pic*/*port* extensive command:

```
user@host> show interfaces se-fpc/pic/port extensive
```

Example: Configuring Serial Loopback Capability

To determine the source of a problem, loop packets on the local routing platform, the local DCE, the remote DCE, and the remote line interface unit (LIU). To do this, include the no-keepalives and encapsulation cisco-hdlc statements at the [edit interfaces se-*fpc*/*pic*/*port*] hierarchy level, and the loopback local option at the [edit interfaces se-*pim*/0/*port* serial-options] or [edit interfaces se-*fpc*/*pic*/*port* serial-options] hierarchy level. With this configuration, the link stays up, so you can loop ping packets to a remote routing platform. The loopback local statement causes the interface to loop within the PIC just before the data reaches the transceiver.

```
[edit interfaces]
se-1/0/0 {
    no-keepalives;
    encapsulation cisco-hdlc;
    serial-options {
        loopback local;
    }
    unit 0 {
        family inet {
            address 10.100.100.1/24;
        }
    }
}
```

Configuring Serial Line Encoding

By default, serial interfaces use non-return to zero (NRZ) line encoding. You can configure non-return to zero inverted (NRZI) line encoding if necessary.

To have the interface use NRZI line encoding, include the encoding statement, specifying the nrzi option:

```
encoding nrzi;
```

To explicitly configure the default NRZ line encoding, include the encoding statement, specifying the nrz option:

```
encoding nrz;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces se-*pim*/0/*port* serial-options]
- [edit interfaces se-*fpc*/*pic*/*port* serial-options]

When setting the line encoding parameter, you must set the same value for paired ports. Ports 0 and 1 must share the same value.

Part 4
Configuring ATM Interfaces

This part describes the configuration of the following ATM interfaces:

Chapter 13

Configuring ATM Interfaces

This section contains the following topics:

ATM Interfaces Overview

Asynchronous Transfer Mode (ATM) is a network protocol designed to facilitate the simultaneous handling of various types of traffic streams (voice, data, and video) at very high speeds over the same physical connection. By always using 53-byte cells, ATM simplifies the design of hardware, enabling it to quickly determine the destination address of each cell. This allows simple switching of network traffic at much higher speeds than are easily accomplished using protocols with variable sizes of transfer units, such as Frame Relay and Transmission Control Protocol/Internet Protocol (TCP/IP).

Although ATM was designed to operate without the requirement of any other networking protocol, other protocols are frequently segmented and encapsulated across multiple, smaller ATM cells. This makes ATM a transport mechanism for pre-existing technologies such as Frame Relay and the TCP/IP family of protocols.

ATM relies on the concepts of virtual paths and virtual circuits. 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 virtual circuits, each represented by a virtual circuit identifier (VCI).

VPIs and VCIs are local to the routing platform, 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.

NOTE: The ATM three-bit payload type identifier (PTI) field is not supported.

With ATM2 intelligent queuing (IQ) interfaces, you can configure virtual path (VP) shaping and Operation, Administration, and Management (OAM) F4 cell flows.

ATM1 Physical and Logical Configuration Statement Hierarchies

To configure ATM1 physical interface properties, include the atm-options, e3-options, t3-options, and sonet-options statements at the [edit interfaces at-*fpc/pic/port*] hierarchy level:

ATM1 Physical Configuration Hierarchy

```
[edit interfaces at-fpc/pic/port]
atm-options {
    ilmi;
    mpls {
        pop-all-labels {
            required-depth number;
        }
    }
    pic-type atm1;
    promiscuous-mode {
        vpi vpi-identifier;
    }
    vpi vpi-identifier {
        maximum-vcs maximum-vcs;
    }
}
e3-options {
    atm-encapsulation (direct | plcp);
    buildout feet;
    framing (g.751 | g.832);
    loopback (local | remote);
    (payload-scrambler | no-payload-scrambler);
    }
encapsulation (atm-ccc-cell-relay | atm-pvc | ethernet-over-atm);
sonet-options {
    aps {
        advertise-interval milliseconds;
        authentication-key key;
        force;
        hold-time milliseconds;
        lockout;
        neighbor address;
        paired-group group-name;
        protect-circuit group-name;
        request;
        revert-time seconds;
        working-circuit group-name;
    }
    bytes {
        e1-quiet value;
        f1 value;
        f2 value;
        s1 value;
        z3 value ;
        z4 value;
    }
    loopback (local | remote);
    (payload-scrambler | no-payload-scrambler);
```

```
        rfc-2615;
        trigger {
            defect ignore {
                hold-time up milliseconds down milliseconds;
            }
        }
        (z0-increment | no-z0-increment);
    }
    t3-options {
        atm-encapsulation (direct | plcp);
        buildout feet;
        (cbit-parity | no-cbit-parity);
        loopback (local | payload | remote);
        (payload-scrambler | no-payload-scrambler);
    }
```

To configure ATM1 logical interface properties, include the following statements:

ATM1 Logical Configuration Hierarchy

```
allow-any-vci;
multicast-vci vpi-identifier.vci-identifier;
oam-liveness {
    up-count cells;
    down-count cells;
}
oam-period (disable | seconds);
shaping {
    (cbr rate | vbr peak rate sustained rate burst length);
    queue-length number;
}
vci vpi-identifier.vci-identifier;
vpi vpi-identifier;
family inet {
    address address {
        multipoint-destination address {
            inverse-arp;
            oam-liveness {
                up-count cells;
                down-count cells;
            }
            oam-period (disable | seconds);
            shaping {
                (cbr rate | vbr peak rate sustained rate burst length);
                queue-length number;
            }
            vci vpi-identifier.vci-identifier;
        }
    }
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

ATM2 IQ Physical and Logical Configuration Statement Hierarchies

To configure ATM2 IQ physical interface properties, include the atm-options and sonet-options statements at the [edit interfaces at-*fpc/pic/port*] hierarchy level:

ATM2 IQ Physical Configuration Hierarchy

```
[edit interfaces at-fpc/pic/port]
atm-options {
    cell-bundle-size cells;
    ilmi;
    linear-red-profiles profile-name{
        high-plp-max-threshold percent;
        low-plp-max-threshold percent;
        queue-depth cells high-plp-threshold percent low-plp-threshold percent;
    }
    mpls {
        pop-all-labels {
            required-depth number;
        }
    }
    pic-type atm2;
    plp-to-clp;
    promiscuous-mode {
        vpi vpi-identifier;
    }
    scheduler-maps map-name {
        forwarding-class class-name {
            epd-threshold cells plp1 cells;
            linear-red-profile profile-name;
            priority (high | low);
            transmit-weight (cells number | percent number);
        }
        vc-cos-mode (alternate | strict);
    }
    vpi vpi-identifier {
        oam-liveness {
            up-count;
            down-count;
        }
        oam-period (disable | seconds);
        shaping {
            (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained
                rate burst length);
        }
    }
}
sonet-options {
    aps {
        advertise-interval milliseconds;
        authentication-key key;
        force;
        hold-time milliseconds;
        lockout;
        neighbor address;
        paired-group group-name;
```

```
        protect-circuit group-name;
        request;
        revert-time seconds;
        working-circuit group-name;
    }
    bytes {
        e1-quiet value;
        f1 value;
        f2 value;
        s1 value;
        z3 value;
        z4 value;
    }
    loopback (local | remote);
    (payload-scrambler | no-payload-scrambler);
    rfc-2615;
    trigger {
        defect ignore {
            hold-time up milliseconds down milliseconds;
        }
    }
    (z0-increment | no-z0-increment);
}
```

To configure ATM2 IQ logical interface properties, include the following statements:

ATM2 IQ Logical Configuration Hierarchy

```
allow-any-vci;
atm-scheduler-map (map-name | default);
cell-bundle-size cells;
epd-threshold cells;
multicast-vci vpi-identifier.vci-identifier;
oam-liveness {
    up-count cells;
    down-count cells;
}
oam-period (disable | seconds);
plp-to-clp;
shaping {
    (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained rate
        burst length);
}
transmit-weight number;
trunk-id number;
vci vpi-identifier.vci-identifier;
vpi vpi-identifier;
family inet address address {
    multipoint-destination address;
    epd-threshold cells;
    inverse-arp;
    oam-liveness {
        up-count cells;
        down-count cells;
    }
    oam-period (disable | seconds);
    shaping {
```

```
            (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained
                rate burst length);
        }
        transmit-weight number;
        vci vpi-identifier.vci-identifier;
    }
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Supported Features on ATM1 and ATM2 IQ Interfaces

Table 24 on page 273 lists the supported features on ATM1 and ATM2 IQ interfaces.

Table 24: ATM1 and ATM2 IQ Supported Features

<table>
<tr><th>Item</th><th>ATM1</th><th>ATM2 IQ</th><th>Comments</th></tr>
<tr><td colspan="4">Encapsulation and Transport Modes</td></tr>
<tr><td>ATM Adaptation Layer 5 (AAL5) circuit cross-connect (CCC)</td><td>Supported</td><td>Supported</td><td>For ATM1 and ATM2 IQ Physical Interface Cards (PICs), you can configure any combination of AAL5 CCC, nonpromiscuous cell relay, and AAL5 permanent virtual connections (PVCs) on the same PIC at the same time.

See “Configuring ATM Interface Encapsulation” on page 316.</td></tr>
<tr><td>Cell-relay accumulation mode: The incoming cells (1 to 8) are packaged into a single packet and forwarded to the label-switched path (LSP).</td><td>Supported</td><td>Not supported</td><td>Cell-relay accumulation mode is per PIC, not per port. If you configure accumulation mode, the entire ATM1 PIC uses the configured mode.

See “Configuring ATM Interface Encapsulation” on page 316.</td></tr>
<tr><td>Cell-relay promiscuous port mode: All cells from 0 through 65,535 of all VPIs (0 through 255) are sent to or received from an LSP.</td><td>Supported</td><td>Supported</td><td rowspan="2">For promiscuous mode, you must configure the port with atm-ccc-cell-relay encapsulation.

For ATM2 IQ multiport PICs, you can configure one or more ports in port promiscuous mode, and the other ports with any ATM encapsulation.

For ATM2 IQ PICs, you can configure one or more logical interfaces in VPI promiscuous mode, and the other logical interfaces with any ATM encapsulation.

For ATM1 PICs, if you configure one port in port mode, all ports on the PIC operate in port mode. Likewise if you configure one logical interface in VPI mode, all logical interfaces on the PIC operate in VPI mode.

See “Configuring ATM Cell-Relay Promiscuous Mode” on page 282.</td></tr>
<tr><td>Cell-relay promiscuous VPI mode: All cells in the VCI range
0 through 65,535 of a single VPI are sent to or received from an LSP.</td><td>Supported</td><td>Supported</td></tr>
</table>

Table 24: ATM1 and ATM2 IQ Supported Features *(continued)*

Item	ATM1	ATM2 IQ	Comments
Cell-relay VP shaping	Supported	Supported	For ATM2 PICs, you can configure ATM CC cell relay promiscuous mode. VP promiscuous mode allows incoming traffic on all VCIs under the VPI to be bundled and directed to an LSP. Port promiscuous mode allows all traffic coming in on the entire VPI/VCI range to be forwarded to an LSP. In both modes, traffic shaping is not permitted. The ATM2 PIC supports traffic shaping in VP promiscuous mode and cell relay VC mode.
Cell-relay VCI mode: All cells in a VCI are sent to or received from an LSP.	Supported	Supported	For ATM1 PICs, nonpromiscuous cell-relay VCI, VPI, and port modes are supported on the same PIC with ATM AAL5 PVCs or ATM AAL5 CCC.
Cell-relay VPI mode: All cells in the VCI range (0 through *maximum-vcs*) of a single VPI are sent to or received from an LSP.	Supported	Not supported	For ATM2 IQ PICs, nonpromiscuous cell-relay VCI mode is supported on the same PIC with ATM AAL5 PVCs or ATM AAL5 CCC. See “Configuring ATM Interface Encapsulation” on page 316.
Cell-relay port mode: All cells in the VCI range (0 through *maximum-vcs*) of all VPIs (0 through 255) are sent to or received from an LSP.	Supported	Not supported	@@@amp@@@mdash;
Ethernet over ATM encapsulation:Allows ATM interfaces to connect to devices that support only bridged-mode protocol data units (PDUs).	Supported	Supported	See “Configuring ATM Interface Encapsulation” on page 316.
Layer 2 circuit cell-relay, Layer 2 circuit AAL5, and Layer 2 circuit trunk transport modes: Allow you to send ATM cells or AAL5 PDUs between ATM2 IQ interfaces across a Layer 2 circuit-enabled network. Layer 2 circuits are designed to transport Layer 2 frames between provider edge (PE) routing platforms across a Label Distribution Protocol (LDP)-signaled Multiprotocol Label Switching (MPLS) backbone.	Not supported	Supported	Transport mode is per PIC, not per port. If you configure Layer 2 circuit cell-relay, Layer 2 circuit AAL5, or Layer 2 circuit trunk transport mode, the entire ATM2 IQ PIC uses the configured transport mode. Layer 2 circuit cell-relay mode supports both VP- and port-promiscuous modes. See “Configuring Layer 2 Circuit Transport Mode” on page 286.
Layer 2 VPN cell relay and Layer 2 VPN AAL5: Allow you to carry ATM cells or AAL5 PDUs over an MPLS backbone.	Supported	Supported	See the *JUNOS VPNs Configuration Guide*.

Table 24: ATM1 and ATM2 IQ Supported Features *(continued)*

Item	ATM1	ATM2 IQ	Comments
Point-to-Point Protocol (PPP) over ATM encapsulation: Associates a PPP link with an ATM AAL5 PVC.	Not supported	Supported	For ATM2 IQ interfaces, the JUNOS software supports three PPP over ATM encapsulation types: ■ atm-ppp-llc—PPP over AAL5 logical link control (LLC). ■ atm-ppp-vc-mux—PPP over AAL5 multiplex. ■ atm-mlppp-llc—Multilink PPP over AAL5 LLC. Requires a Link Services or Voice Services PIC. See “Configuring PPP over ATM2 Encapsulation” on page 320.
Other ATM Attributes			
EPD (early packet discard) threshold: Limits the queue size in ATM cells of a particular VC or forwarding class configured over a VC when using VC tunnel class of service (CoS). When the first ATM cell of a new packet is received, the VC’s queue depth is checked against the EPD threshold. If the VC’s queue depth exceeds the EPD threshold, the first and all subsequent ATM cells in the packet are discarded.	Not supported	Supported	If you are using VC tunnel CoS, the EPD threshold configured at the logical unit level has no effect. You should configure each forwarding class for congestion management using either an individual EPD threshold (in other words, tail drop) or weighted random early detection (WRED) profile. See “Configuring the ATM2 IQ EPD Threshold” on page 312 and “Configuring ATM2 IQ VC Tunnel CoS Components” on page 325.
OAM F4 cell flows: Identify and report virtual path connection (VPC) defects and failures.	Not supported	Supported	See “Configuring the OAM F4 Cell Flows” on page 301.
OAM F5 loopback cell responses	Supported	Supported	For ATM1 interfaces, when an OAM F5 loopback request is received, the response cell is sent by the PIC. The request and response cells are not counted in the VC, logical interface, or physical interface statistics. For ATM2 IQ interfaces, when an OAM F5 loopback request is received, the response is sent by the routing engine. The OAM, VC, logical interface, and physical interface statistics are incremented. See “Defining the ATM OAM F5 Loopback Cell Period” on page 315 and “Configuring the ATM OAM F5 Loopback Cell Threshold” on page 316.
Passive monitoring mode	Supported	Supported	See “Enabling Passive Monitoring on ATM Interfaces” on page 279.
PIC type	Supported	Supported	For ATM1 interfaces, you can include the pic-type atm1 statement. For ATM2 IQ interfaces, you can include the pic-type atm2 statement. See “Configuring the ATM PIC Type” on page 281.

Table 24: ATM1 and ATM2 IQ Supported Features *(continued)*

Item	ATM1	ATM2 IQ	Comments
Ping	Supported	Supported	For ATM1 and ATM2 IQ interfaces, when you issue the ATM ping command, you must include a logical unit number in the interface name, as shown in the following example: **ping atm interface at-1/0/0.5 vci 0.123 count 3** The logical unit number is 5 on physical interface at-1/0/0. See the *JUNOS Interfaces Command Reference*.
Queue length: Limits the queue size in packets of a particular VC.	Supported	Not supported	See "Configuring the ATM1 Queue Length" on page 311.
Real-time variable bit rate (VBR): Supports VBR data traffic with average and peak traffic parameters.	Not supported	Supported	Compared to non-real-time VBR, real-time VBR data is serviced at a higher priority. Real-time VBR is suitable for carrying packetized video and audio. See "Configuring ATM2 IQ Real-Time VBR" on page 307.
Shaping rates: Peak and sustained rates of traffic.	Supported	Supported	For ATM1 OC3 interfaces, the rate can be from 33 kilobits per second (Kbps) through 135.6 megabits per second (Mbps); for ATM1 OC12 interfaces, the rate can be from 33 Kbps through 276 Mbps. For ATM2 IQ OC3 interfaces, the rate can be from 33 Kbps through 135,600,000 bits per second (bps). For ATM2 IQ OC12 interfaces, the rate can be from 33 Kbps through 271,273,396 bps (up to 50 percent of the line rate). For ATM2 IQ OC48 interfaces, the rate can be from 33 Kbps through 2,170,107,168 bits per second (bps). For ATM2 IQ DS3 and E3 interfaces, the rate can be from 33 Kbps to the maximum rate. The maximum rate varies depending on the ATM encapsulation and framing you configure: ■ For DS3 interfaces with direct ATM encapsulation, the maximum rate is 40,038,968 bps. ■ For DS3 interfaces with Physical Layer Convergence Protocol (PLCP) ATM encapsulation, the maximum rate is 36,864,000 bps. ■ For E3 interfaces with g.751 framing and direct ATM encapsulation, the maximum rate is 30,801,509 bps. ■ For E3 interfaces with g.751 framing PLCP ATM encapsulation, the maximum rate is 27,648,000 bps. ■ For E3 interfaces with g.832 framing, the maximum rate is 30,720,000 bps. See "Defining the ATM Traffic-Shaping Profile" on page 305.

Table 24: ATM1 and ATM2 IQ Supported Features *(continued)*

Item	ATM1	ATM2 IQ	Comments
VC tunnel CoS: Allows VCs to be opened as VC tunnels.	Not supported	Supported	On M-series platforms (except the M320 and M120 routers), a VC tunnel can support four CoS queues. On the M320, M120, and T-series platforms, a VC tunnel can support eight CoS queues. Within the VC tunnel, the class-based weighted fair queuing algorithm is used to schedule packet transmission from each queue. You can configure the queue admission policies, such as EPD or WRED, to control the queue size during congestion. See "Configuring ATM2 IQ VC Tunnel CoS Components" on page 325.
VCI management	Supported	Supported	For ATM1 interfaces, you must specify the maximum number of VCIs by including the maximum-vcs statement in the configuration. This restricts VCIs to the range 0 through *maximum-vcs*. See "Configuring the Maximum Number of ATM1 VCs on a VP" on page 286. For ATM2 interfaces, you must not include the maximum-vcs statement in the configuration. All ATM2 IQ interfaces support VCI numbers from 0 through 65,535. The total number of VCIs that you can open on an ATM2 IQ port depends on two factors: ■ Number of tunnels ■ Sparseness of VCI numbers (the more sparse, the fewer VCIs supported) For ATM1 and ATM2 IQ interfaces with promiscuous mode, the allowable maximum number of VCIs is 65,535.
VCI statistics	Supported	Supported	For ATM1 interfaces, multipoint VCI statistics are collected from indirect sources. For ATM2 IQ interfaces, multipoint VCI statistics are collected directly from the PIC. For ATM1 and ATM2 IQ interfaces, point-to-point VCI statistics are the same as logical interface statistics.

Configuring Communication with Directly Attached ATM Switches and Routers

For ATM1 and ATM2 IQ interfaces, you can configure communication with directly attached ATM switches and routers to enable querying of the IP addresses and switch port numbers. You query the switch or router by entering the following show command:

user@host> **show ilmi interface *interface-name***

The routing platform uses VC 0.16 to communicate with the ATM switch or router.

To configure communication between the routing platform and its directly attached ATM switches and routers, include the ilmi statement at the [edit interfaces *interface-name* atm-options] hierarchy level:

```
[edit interfaces interface-name atm-options]
ilmi;
```

Example: Configuring Communication with Directly Attached ATM Switches and Routers

Enable an interface to communicate directly with an ATM switch or router:

```
[edit interfaces]
at-0/1/0 {
    atm-options {
        vpi 0;
        ilmi;
    }
    unit 0 {
        vci 0.120;
        family inet {
            address 10.33.33.1/30;
        }
    }
}
```

Enabling ILMI for Cell Relay

The JUNOS software supports standard AAL5 and three Layer 2 circuit transport modes: Layer 2 circuit AAL5, Layer 2 circuit cell-relay, and Layer 2 circuit trunk transport mode.

Integrated local management interface (ILMI) is supported on standard AAL5 interfaces, regardless of encapsulation. To enable ILMI on interfaces with cell-relay encapsulation, you must configure an ATM2 IQ PIC to use Layer 2 circuit trunk transport mode. ILMI is not supported with cell-relay encapsulation when the ATM2 IQ PIC is configured with Layer 2 AAL5 or Layer 2 circuit cell-relay transport mode, as shown in as shown in Table 25 on page 278.

Layer 2 circuit cell-relay trunk mode is not supported on ATM OC48 PICs.

Table 25: ILMI Support by Encapsulation Type

Encapsulation Type	ILMI Support
Standard AAL5, with any encapsulation type	Yes
Layer 2 circuit AAL5 mode	No
Layer 2 circuit cell-relay mode	No
Layer 2 circuit trunk mode	Yes

For more information about Layer 2 circuit transport modes, see “Configuring Layer 2 Circuit Transport Mode” on page 286.

To configure ILMI on an interface with cell-relay encapsulation, include the following statements:

```
[edit chassis fpc slot-number pic pic-number]
atm-l2circuit-mode trunk trunk;
[edit interfaces at-fpc/pic/port]
encapsulation atm-ccc-cell-relay;
atm-options {
   ilmi;
   pic-type atm2;
}
unit logical-unit-number {
   trunk-id number;
}
```

For more information about ILMI, see “Configuring Communication with Directly Attached ATM Switches and Routers” on page 277.

Example: Enabling ILMI for Cell Relay

On an ATM2 IQ PIC with Layer 2 circuit trunk transport mode, enable ILMI on an interface with cell-relay encapsulation:

```
[edit chassis]
fpc 0 {
   pic 1 {
      atm-l2circuit-mode trunk uni;
   }
}
[edit interfaces]
at-0/0/0 {
   encapsulation atm-ccc-cell-relay;
   atm-options {
      pic-type atm2;
      ilmi;
   }
}
```

Enabling Passive Monitoring on ATM Interfaces

The Monitoring Services I and Monitoring Services II PICs are designed to enable IP services. If you have a Monitoring Services PIC and an ATM PIC installed in an M160, M40e, or T-series routing platform, you can monitor IP version 4 (IPv4) traffic from another routing platform.

On ATM interfaces, you enable packet flow monitoring by including the passive-monitor-mode statement at the [edit interfaces at-*fpc/pic/port*] hierarchy level:

```
[edit interfaces at-fpc/pic/port]
passive-monitor-mode;
```

If you include the passive-monitor-mode statement in the configuration, the ATM interface is always up, and the interface does not receive or transmit incoming control packets, such as OAM cell and ILMI.

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

```
[edit interfaces mo-fpc/pic/port unit logical-unit-number]
family inet;
```

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

```
[edit interfaces mo-fpc/pic/port unit logical-unit-number family inet]
receive-options-packets;
receive-ttl-exceeded;
```

For the monitoring services interface, you can configure multiservice physical interface properties. For more information, see "Configuring Multiservice Physical Interface Properties" on page 132 and the *JUNOS Services Interfaces Configuration Guide*.

Removing MPLS Labels from Incoming Packets

The JUNOS software can forward only IPv4 packets to a Monitoring Services PIC. IPv4 packets with MPLS labels cannot be forwarded to a Monitoring Services PIC. By default, if packets with MPLS labels are forwarded to the Monitoring Services PIC, they are discarded. To monitor packets with MPLS labels, you must remove the MPLS labels as the packets arrive on the interface.

You can remove up to two MPLS labels from an incoming packet by including the pop-all-labels statement at the [edit interfaces *interface-name* atm-options mpls] hierarchy level:

```
[edit interfaces interface-name atm-options mpls]
pop-all-labels {
   required-depth number;
}
```

By default, the pop-all-labels statement takes effect for incoming packets with one or two labels. You can specify the number of MPLS labels an incoming packet must have for the pop-all-labels statement to take effect by including the required-depth statement at the [edit interfaces *interface-name*atm-options mpls pop-all-labels] hierarchy level:

```
[edit interfaces interface-name atm-options mpls pop-all-labels]
required-depth number;
```

The required depth can be 1, 2, or [1 2]. If you include the required-depth 1 statement, the pop-all-labels statement takes effect for incoming packets with one label only. If you include the required-depth 2 statement, the pop-all-labels statement takes effect for incoming packets with two labels only. If you include the required-depth

[1 2] statement, the pop-all-labels statement takes effect for incoming packets with one or two labels. A required depth of [1 2] is equivalent to the default behavior of the pop-all-labels statement.

When you remove MPLS labels from incoming packets, note the following:

- The pop-all-labels statement has no effect on IP packets with three or more MPLS labels.
- When you enable MPLS label removal, you must configure all ports on a PIC with the same label popping mode and required depth.
- You use the pop-all-labels statement to enable passive monitoring applications, not active monitoring.
- You cannot apply MPLS filters or accounting to the MPLS labels because the labels are removed as soon as the packet arrives on the interface.
- The following ATM encapsulation types are not supported on interfaces with MPLS label removal:
  - atm-ccc-cell-relay
  - atm-ccc-vc-mux
  - atm-mlppp-llc
  - atm-tcc-snap
  - atm-tcc-vc-mux
  - ether-over-atm-llc
  - ether-vpls-over-atm-llc

Configuring the ATM PIC Type

For ATM1 and ATM2 IQ interfaces, the JUNOS software does not determine from the interface name at- *fpc/pic/port* whether your routing platform has an ATM1 or ATM2 IQ PIC installed. You can configure the PIC type as ATM1 or ATM2 IQ by including the pic-type statement at the [edit interfaces *interface-name* atm-options] hierarchy level:

```
[edit interfaces interface-name atm-options]
pic-type (atm1 | atm2);
```

The following guidelines apply to configuring the ATM PIC type:

- If you include the pic-type statement in the configuration, and you include other statements at the [edit interfaces *interface-name* atm-options] hierarchy level that do not match the configured PIC type, the configuration does not commit. For example, you cannot commit a configuration that includes the pic-type atm2 statement and the maximum-vcs statement.
- If you do not include the pic-type statement and you do include the maximum-vcs statement in the configuration, the JUNOS software assumes you are configuring an ATM1 interface, and sets the PIC type option accordingly. If you do not include

the maximum-vcs statement in the configuration, the JUNOS software assumes you are configuring an ATM2 IQ interface, and sets the PIC type option accordingly.

- If you include the promiscuous-mode statement in the configuration of an ATM2 interface, you must also include the pic-type atm2 statement.

Example: Configuring the ATM PIC Type

Configure the PIC type on an ATM1 and an ATM2 interface.

On an ATM1 Interface

```
[edit interfaces]
at-1/0/0 {
    atm-options {
        pic-type atm1;
        vpi 0 maximum-vcs 256;
        vpi 1 maximum-vcs 512;
    }
    ...
}
```

On an ATM2 IQ Interface

```
[edit interfaces]
at-1/1/0 {
    atm-options {
        pic-type atm2;
        vpi 0;
        vpi 2 {
            oam-period 6;
        }
    }
    ...
}
```

Configuring ATM Cell-Relay Promiscuous Mode

For ATM1 and ATM2 IQ interfaces with atm-ccc-cell-relay encapsulation, you can map all incoming cells from either an interface port or a virtual path (VP) to a single LSP without restricting the VCI number. Promiscuous mode allows you to map traffic from all 65,535 VCIs to a single LSP, or from all 256 VPIs to a single LSP.

To map incoming traffic from a port or VC to an LSP, include the promiscuous-mode statement at the [edit interfaces *interface-name* atm-options] hierarchy level:

```
[edit interfaces interface-name]
atm-options {
    promiscuous-mode {
        vpi vpi-identifier;
    }
}
```

You can include multiple vpi statements in the configuration.

To enable all VCIs in a VPI to open in ATM CCC cell-relay mode, you must also map the logical interface to a VPI by including the vpi statement in the logical interface configuration:

```
vpi vpi-identifier;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Also, note the following:

- For promiscuous mode, you must configure the port with atm-ccc-cell-relay encapsulation.
- For ATM1 and ATM2 IQ PICs, changing modes between promiscuous and nonpromiscuous causes all physical interfaces to be deleted and re-added.
- For ATM1 and ATM2 IQ PICs, when you configure promiscuous mode, you cannot configure VCIs.
- For ATM1 PICs, if you configure one port in port mode, all ports on the PIC operate in port mode. Likewise if you configure one logical interface in VPI mode, all logical interfaces on the PIC must operate in VPI mode.
- For ATM2 IQ PICs, you can configure one or more logical interfaces in VPI promiscuous mode, and the other logical interfaces with any ATM encapsulation.
- For ATM2 IQ PICs, when you configure promiscuous mode, you must also include the pic-type atm2 statement. For more information, see "Configuring the ATM PIC Type" on page 281.
- For ATM2 IQ multiport PICs, you can configure one or more ports in port promiscuous mode, and the other ports with any ATM encapsulation.
- For interfaces that are configured for cell-relay promiscuous virtual path identifier (VPI) mode, the show interfaces command output does not show OAM F4 cell statistics.

Examples: Configuring ATM Cell-Relay Promiscuous Mode

This section includes the following examples:

Configuring Port-Promiscuous Mode

```
[edit interfaces]
at-0/2/1 {
    encapsulation atm-ccc-cell-relay; # at the physical interface level only
    atm-options {
        pic-type atm2;
        promiscuous-mode;
    }
    unit 0 {
        allow-any-vci;
    }
}
```

Configuring VP-Promiscuous Mode

```
[edit interfaces]
at-0/2/0 {
   atm-options {
      pic-type atm2;
      promiscuous-mode {
         vpi 0;
         vpi 1;
      }
      vpi 2;
      vpi 3;
   }
   unit 0 {
      encapsulation atm-ccc-cell-relay; # at the logical interface level only
      vpi 0;
   }
   unit 1 {
      encapsulation atm-ccc-cell-relay;
      vpi 1;
   }
   unit 2 {
      encapsulation atm-snap;
      vci 2.100;
   }
   unit 3 {
      encapsulation atm-vc-mux;
      vci 3.100;
   }
}
```

To map incoming traffic from a port to an LSP, include the allow-any-vci statement at the [edit interfaces *interface-name* unit 0] hierarchy level. When you include the allow-any-vci statement, you cannot configure other logical interfaces in the same physical interface. Next, you must map unit 0 to an LSP using the CCC connection.

Mapping Incoming Traffic from a Port to an LSP

```
[edit interfaces at-1/2/0]
encapsulation atm-ccc-cell-relay;
atm-options {
   promiscuous-mode;
}
unit 0 {
   allow-any-vci;
}
```

Mapping Unit 0 to an LSP

```
protocols {
   connections {
      remote-interface-switch router-a-router-c {
         interface at-1/2/0.0;
      }
      lsp-switch router-a-router-c {
         transmit-lsp lsp1
         receive-lsp lsp2;
      }
   }
}
```

To map a VPI to an LSP, you must define the allowed VPIs. You can configure one or more logical interfaces, each mapped to a different VPI. You can then route traffic from each of these interfaces to different LSPs.

Mapping a VPI to an LSP

```
[edit interfaces at-1/1/0]
encapsulation atm-ccc-cell-relay;
atm-options {
   pic-type atm1;
   promiscuous-mode {
      vpi 10;
      vpi 20;
   }
}
unit 0 {
   encapsulation atm-ccc-cell-relay;
   vpi 10;
}
unit 1 {
   encapsulation atm-ccc-cell-relay;
   vpi 20;
}
[edit interfaces at-3/1/0]
encapsulation atm-ccc-cell-relay;
atm-options {
   pic-type atm2;
   promiscuous-mode {
      vpi 10;
      vpi 20;
   }
}
unit 0 {
   encapsulation atm-ccc-cell-relay;
   vpi 10;
}
unit 1 {
   encapsulation atm-ccc-cell-relay;
   vpi 20;
}
[edit protocols]
mpls {
   connections {
      interface-switch router-a-router-c {
         interface at-1/1/0.0;
         interface at-3/1/0.0;
      }
      interface-switch router-a-router-d {
         interface at-1/1/0.1;
         interface at-3/1/0.1;
      }
   }
}
```

Configuring the Maximum Number of ATM1 VCs on a VP

For ATM1 interfaces, you must configure the maximum number of virtual circuits (VCs) allowed on a virtual path (VP) so that sufficient memory on the ATM1 PIC can be allocated for each VC.

To configure the highest-numbered VCs on a VP, include the maximum-vcs and vpi statements at the [edit interfaces *interface-name* atm-options] hierarchy level:

```
[edit interfaces interface-name atm-options]
vpi vpi-identifier {
   maximum-vcs maximum-vcs;
}
```

The VP identifier can be a value from 0 through 255. For most interfaces, you can define a maximum of 4090 VCs per interface, and some interfaces have higher limits. Promiscuous mode removes these limits. For more information, see “Configuring ATM Cell-Relay Promiscuous Mode” on page 282.

All VPIs that you configure in the atm-options statement are stored in a single table. If you modify the VPIs—for example, by editing them in configuration mode or by issuing a load override command—all VCs on the interface are closed and then reopened, resulting in a temporary loss of connectivity for all the VCs on the interface.

You can also include some of the statements in the sonet-options statement to set SONET/SDH parameters on ATM interfaces, as described in “Configuring SONET/SDH Parameters on ATM Interfaces” on page 324.

Configuring Layer 2 Circuit Transport Mode

On ATM2 IQ interfaces only, you can configure Layer 2 circuit cell-relay, Layer 2 circuit AAL5, or Layer 2 circuit trunk transport mode.

Layer 2 circuit cell-relay and Layer 2 circuit AAL5 are defined in Internet draft draft-martini-l2circuit-encap-mpls-07.txt, *Encapsulation Methods for Transport of Layer 2 Frames Over IP and MPLS Networks* (expires December 2004).

Layer 2 circuit cell-relay and Layer 2 circuit AAL5 transport modes allow you to send ATM cells between ATM2 IQ interfaces across a Layer 2 circuit-enabled network. Layer 2 circuits are designed to transport Layer 2 frames between PE routing platforms across an LDP-signaled MPLS backbone. You use Layer 2 circuit AAL5 transport mode to send AAL5 segmentation and reassembly protocol data units (SAR-PDUs) over the Layer 2 circuit.

A trunk is a collection of ATM VPs. Layer 2 circuit trunk transport mode allows you to send ATM cells over MPLS trunking.

By default, ATM2 IQ PICs are in standard AAL5 transport mode. Standard AAL5 allows multiple applications to tunnel the protocol data units of their Layer 2 protocols over an ATM virtual circuit. Encapsulation of these Layer 2 protocol data units allows a number of these emulated virtual circuits to be carried in a single tunnel. Protocol data units are segmented at one end of the tunnel and reassembled at the other end. The ingress routing platform reassembles the protocol data units received from the incoming VC and transports each PDU as a single packet.

In contrast, Layer 2 circuit cell-relay and Layer 2 circuit AAL5 transport modes accept a stream of ATM cells, convert these to an encapsulated Layer 2 format, then tunnel them over an MPLS or IP backbone, where a similarly configured routing platform segments these packets back into a stream of ATM cells, to be forwarded to the virtual circuit configured for the far-end routing platform.

In Layer 2 circuit cell-relay transport mode, ATM cells are bundled together and transported in packet form to the far-end routing platform, where they are segmented back into individual ATM cells and forwarded to the ATM virtual circuit configured for the far-end routing platform.

The uses for the four transport modes are defined as follows:

- To tunnel IP packets over an ATM backbone, use the default standard AAL5 transport mode.
- To tunnel a stream of AAL5-encoded ATM SAR-PDUs over an MPLS or IP backbone, use Layer 2 circuit AAL5 transport mode.
- To tunnel a stream of ATM cells over an MPLS or IP backbone, use Layer 2 circuit cell-relay transport mode.
- To transport ATM cells over an MPLS core network that is implemented between other vendors' switches or routers, use Layer 2 circuit trunk transport mode.

NOTE: You can transport AAL5-encoded traffic with Layer 2 circuit cell-relay transport mode, because Layer 2 circuit cell-relay transport mode ignores the encoding of the cell data presented to the ingress interface.

When you configure AAL5 mode Layer 2 circuits, the control word carries cell loss priority (CLP) information by default.

The Layer 2 circuit trunk transport mode is not supported on the ATM2 IQ OC48c/STM16 PIC.

To configure Layer 2 circuit AAL5, Layer 2 circuit cell-relay, or Layer 2 circuit trunk mode, you must perform the following tasks:

1. Identify the interface as an ATM2 IQ interface by including the pic-type atm2 statement at the [edit interfaces at-*fpc/pic/port* atm-options] hierarchy level:

   ```
   [edit interfaces at-fpc/pic/port atm-options]
   pic-type atm2;
   ```

2. Include the atm-l2circuit-mode statement at the [edit chassis fpc *slot-number* pic *pic-number*] hierarchy level, specifying aal5, cell, or trunk:

   ```
   [edit chassis fpc slot-number pic pic-number]
   atm-l2circuit-mode (aal5 | cell | trunk trunk );
   ```

By default, the trunk mode uses user-to-network interface (UNI) mode. The trunk option can be UNI or network-to-network interface (NNI). For more information about UNI and NNI, see the *JUNOS VPNs Configuration Guide* and the *JUNOS Feature Guide*.

Transport mode is per PIC, not per port. If you do not include the atm-l2circuit-mode statement in the configuration, the ATM2 IQ PIC uses standard AAL5 transport mode. If you configure Layer 2 circuit cell-relay, Layer 2 circuit AAL5 transport mode, or Layer 2 circuit trunk mode, the entire ATM2 PIC uses the configured transport mode.

3. For Layer 2 circuit trunk mode only, you must also configure a trunk identification number by including the trunk-id statement:

   trunk-id *number*;

   You can include this statement at the following hierarchy levels:

   - [edit interfaces *interface-name* unit *logical-unit-number*]
   - [edit logical-systems*logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

   The trunk identification number can be from 0 through 31; each trunk on an interface must have a unique trunk ID. When you associate a trunk ID number with a logical interface, you are in effect specifying the interfaces that are allowed to send ATM traffic over an LSP. For UNI mode, the trunk ID range is from 0 through 7. For NNI mode, the trunk ID range is from 0 through 31. Trunk IDs on connecting trunks do not need to be the same.

   For information about proportional bandwidth sharing in trunk mode, see "Configuring Layer 2 Circuit Trunk Mode Scheduling" on page 295.

4. For Layer 2 circuit AAL5 mode, configure logical interface encapsulation by including the encapsulation statement, specifying the atm-ccc-vc-mux encapsulation type:

   encapsulation atm-ccc-vc-mux;

   You can include this statement at the following hierarchy levels:

   - [edit interfaces *interface-name* unit *logical-unit-number*]
   - [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

5. For Layer 2 circuit cell-relay and Layer 2 circuit trunk modes, configure physical interface encapsulation by including the encapsulation statement at the [edit interfaces *interface-name*] hierarchy level, specifying the atm-ccc-cell-relay encapsulation type:

   [edit interfaces *interface-name*]
   encapsulation atm-ccc-cell-relay;

For more information about Layer 2 circuits, see the *JUNOS VPNs Configuration Guide* and the *JUNOS Routing Protocols Configuration Guide*. For a comprehensive example, see the *JUNOS Feature Guide*.

Examples: Configuring IQ Layer 2 Circuit Transport Mode

This section includes the following configuration examples:

Configure Layer 2 circuit AAL5 transport mode and cell-relay transport mode.

Configuring Layer 2 Circuit AAL5 Transport Mode

```
[edit chassis]
fpc 0 {
    pic 1 {
        atm-l2circuit-mode aal5;
    }
}
[edit interfaces]
at-0/1/0 {
    atm-options {
        pic-type atm2;
        vpi 0;
    }
    unit 0 {
        encapsulation atm-ccc-vc-mux;
        point-to-point;
        vci 0.32;
    }
}
```

Configuring Layer 2 Circuit Cell-Relay Transport Mode

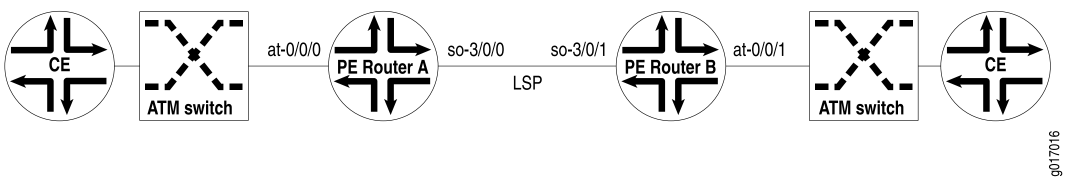
```
[edit chassis]
fpc 0 {
    pic 1 {
        atm-l2circuit-mode cell;
    }
}
[edit interfaces]
at-0/1/0 {
    encapsulation atm-ccc-cell-relay;
    atm-options {
        pic-type atm2;
        vpi 0;
    }
    unit 0 {
        encapsulation atm-ccc-cell-relay;
        point-to-point;
        vci 0.32;
    }
}
```

Configuring Layer 2 Circuit Trunk Transport Mode

In Figure 19 on page 290, Router A is a local PE routing platform. Router B is a remote PE router. Both Juniper Networks routing platforms have Layer 2 circuit cell-relay capability. You configure an ATM physical interface on Router A in Layer 2 circuit trunk mode and specify trunks that are allowed to send traffic over the LSP. As a cell is received on this interface, it is classified using the CoS bits in the cell header, and encapsulated as a labeled packet. It is then queued on one of the outgoing queues according to its classification and sent over the LSP to Router B. At Router B, the packet label is removed and the raw cell is put on one of the queues of the ATM interface and forwarded to the second ATM switch. To carry the CoS information and CLP of the cell over the network, the CoS and CLP bits are copied into the EXP bits of the MPLS label. This CoS information is used to select the output queues. Using EPD profiles, the CLP is used to determine whether the cell should be dropped.

For more information about ATM CoS capability, see "Configuring ATM2 IQ VC Tunnel CoS Components" on page 325.

Figure 19: Layer 2 Circuit Trunk Topology



On Router A

```
[edit chassis]
fpc 0 {
   pic 1 {
      atm-l2circuit-mode trunk uni;
   }
}
[edit interfaces]
at-0/0/0 {
   encapsulation atm-ccc-cell-relay;
   atm-options {
      pic-type atm2;
      ilmi;
   }
   unit 0 {
      trunk-id 0;
      epd-threshold 10240;
   }
   unit 1 {
      trunk-id 1;
      epd-threshold 10240;
   }
   unit 2 {
      trunk-id 2;
      epd-threshold 10240;
   }
   unit 3 {
      trunk-id 3;
      epd-threshold 10240;
   }
   unit 4 {
```

```
            trunk-id 4;
            epd-threshold 10240;
        }
        unit 5 {
            trunk-id 5;
            epd-threshold 10240;
        }
        unit 6 {
            trunk-id 6;
            epd-threshold 10240;
        }
        unit 7 {
            trunk-id 7;
            epd-threshold 10240;
        }
    }
    so-3/0/0 {
        mtu 9192;
        unit 0 {
            family inet {
                address 10.0.1.1/24;
            }
            family mpls;
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 172.16.0.1/32;
                address 10.255.245.1/32;
            }
        }
    }
    [edit protocols]
    rsvp {
        interface all;
    }
    mpls {
        interface all;
    }
    ldp {
        interface all;
    }
    ospf {
        traffic-engineering;
        reference-bandwidth 4g;
        area 0.0.0.0 {
            interface all;
            interface fxp0.0 {
                disable;
            }
        }
    }
    l2circuit {
        neighbor 10.255.245.2 {
            interface at-0/1/0.0 {
```

```
        virtual-circuit-id 100;
      }
      interface at-0/1/0.1 {
        virtual-circuit-id 101;
      }
      interface at-0/1/0.2 {
        virtual-circuit-id 102;
      }
      interface at-0/1/0.3 {
        virtual-circuit-id 103;
      }
      interface at-0/1/0.4 {
        virtual-circuit-id 104;
      }
      interface at-0/1/0.5 {
        virtual-circuit-id 105;
      }
      interface at-0/1/0.6 {
        virtual-circuit-id 106;
      }
      interface at-0/1/0.7 {
        virtual-circuit-id 107;
      }
    }
  }
```

On Router B

```
[edit chassis]
fpc 0 {
  pic 1 {
    atm-l2circuit-mode trunk uni;
  }
}
[edit interfaces]
at-0/0/1 {
  encapsulation atm-ccc-cell-relay;
  atm-options {
    pic-type atm2;
  }
  unit 0 {
    trunk-id 0;
    epd-threshold 10240;
  }
  unit 1 {
    trunk-id 1;
    epd-threshold 10240;
  }
  unit 2 {
    trunk-id 2;
    epd-threshold 10240;
  }
  unit 3 {
    trunk-id 3;
    epd-threshold 10240;
  }
  unit 4 {
```

```
            trunk-id 4;
            epd-threshold 10240;
        }
        unit 5 {
            trunk-id 5;
            epd-threshold 10240;
        }
        unit 6 {
            trunk-id 6;
            epd-threshold 10240;
        }
        unit 7 {
            trunk-id 7;
            epd-threshold 10240;
        }
    }
    so-3/0/1 {
        mtu 9192;
        unit 0 {
            family inet {
                address 10.0.1.2/24;
            }
            family mpls;
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 172.16.0.1/32;
                address 10.255.245.2/32;
            }
        }
    }
    [edit protocols]
    rsvp {
        interface all;
    }
    mpls {
        interface all;
    }
    ldp {
        interface all;
    }
    ospf {
        traffic-engineering;
        reference-bandwidth 4g;
        area 0.0.0.0 {
            interface all;
            interface fxp0.0 {
                disable;
            }
        }
    }
    l2circuit {
        neighbor 10.255.245.1 {
            interface at-0/1/0.0 {
```

```
            virtual-circuit-id 100;
        }
        interface at-0/1/0.1 {
            virtual-circuit-id 101;
        }
        interface at-0/1/0.2 {
            virtual-circuit-id 102;
        }
        interface at-0/1/0.3 {
            virtual-circuit-id 103;
        }
        interface at-0/1/0.4 {
            virtual-circuit-id 104;
        }
        interface at-0/1/0.5 {
            virtual-circuit-id 105;
        }
        interface at-0/1/0.6 {
            virtual-circuit-id 106;
        }
        interface at-0/1/0.7 {
            virtual-circuit-id 107;
        }
    }
}
```

Configuring Layer 2 Circuit Cell-Relay Promiscuous Mode

By default, all incoming cells are mapped from a single VC to an external LSP. For ATM interfaces with Layer 2 circuit cell-relay transport mode and atm-ccc-cell-relay encapsulation, you can configure promiscuous mode. Promiscuous mode allows you to map all incoming cells from either an interface port or a 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” on page 282.

Example: Configuring Layer 2 Circuit Cell-Relay Promiscuous Mode

Configure Layer 2 circuit cell-relay VP- and port-promiscuous mode:

VP-Promiscuous Mode

```
[edit interfaces]
at-0/1/0 {
    encapsulation atm-ccc-cell-relay;
    atm-options {
        pic-type atm2;
        cell-bundle-size 4;
        promiscuous-mode {
            vpi 0;
        }
    }
    unit 0 {
        encapsulation atm-ccc-cell-relay;
        point-to-point;
```

```
        vci 0.32;
    }
}
```

Port-Promiscuous Mode

```
[edit interfaces]
at-0/1/0 {
    encapsulation atm-ccc-cell-relay;
    atm-options {
        pic-type atm2;
        promiscuous-mode;
    }
    unit 0 {
        allow-any-vci;
    }
}
```

Configuring Layer 2 Circuit Trunk Mode Scheduling

For ATM2 IQ interfaces configured to use Layer 2 circuit trunk mode, you can share a scheduler among 32 trunks on an ATM port. A weighted round robin scheduling algorithm ensures each trunk receives a proportional share of the bandwidth when all trunks are active, and redistributes bandwidth that would have otherwise been reserved by an inactive trunk, thus minimizing the latency on each trunk. For general information about Layer 2 circuit trunk mode, see "Configuring Layer 2 Circuit Transport Mode" on page 286. For general information about ATM CoS scheduling, see "Configuring ATM2 IQ VC Tunnel CoS Components" on page 325.

Each trunk is associated with a trunk bandwidth. The trunk bandwidth is the maximum bandwidth used each time a trunk is serviced. We recommend configuring trunk bandwidths so that the ratio between the minimum and maximum bandwidths does not exceed 1:500.

To minimize latency, the JUNOS software does not shape the trunks. As cells are received, they are immediately transmitted.

To configure trunk bandwidth, include the trunk-bandwidth statement:

trunk-bandwidth *rate*;

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

The trunk bandwidth can be from 1,000,000 through 542,526,792 bps. You can specify the rate in bits per second or cells per second (cps). You can specify a bits-per-second value either as a complete decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000). You can specify a cells-per-second value by entering a decimal number followed by the abbreviation c; values expressed in cells per second are converted to bits per second by means of the formula 1 cps = 384 bps.

The JUNOS software rounds off the configured value. Therefore, we recommend that you configure a minimum trunk bandwidth of 1m. From 1m, configure values in increments of 500k.

Example: Configuring Layer 2 Circuit Trunk Mode Scheduling

Configure two logical interfaces to use Layer 2 circuit trunk mode, ATM CoS scheduling, and proportional bandwidth sharing:

```
[edit interface]
at-1/1/0 {
    encapsulation atm-ccc-cell-relay;
    atm-options {
        pic-type atm2;
        ilmi;
        scheduler-maps {
            trunk-map {
                vc-cos-mode strict;
                forwarding-class cbr-class {
                    priority high;
                    transmit-weight percent 40;
                    epd-threshold 100;
                }
                forwarding-class rtvbr-class {
                    priority low;
                    transmit-weight percent 30;
                    epd-threshold 100;
                }
                forwarding-class nrtvbr-class {
                    priority low;
                    transmit-weight percent 20;
                    epd-threshold 100;
                }
                forwarding-class ubr-class {
                    priority low;
                    transmit-weight percent 10;
                    epd-threshold 100;
                }
            }
        }
    }
    unit 0 {
        encapsulation atm-ccc-cell-relay;
        trunk-id 1;
        trunk-bandwidth 10m;
        atm-scheduler-map trunk-map;
        family ccc {
            filter {
                output atm-trunk-01;
            }
        }
    }
    unit 1 {
        encapsulation atm-ccc-cell-relay;
        trunk-id 3;
```

```
        trunk-bandwidth 30m;
        atm-scheduler-map trunk-map;
    }
}
```

Configuring CoS Queues in Layer 2 Circuit Trunk Mode

On ATM2 IQ interfaces, you can configure ATM CoS scheduling for AAL5 mode and Layer 2 circuit trunk mode. For general information about ATM CoS, see "Configuring ATM2 IQ VC Tunnel CoS Components" on page 325.

When you configure CoS scheduling in Layer 2 circuit trunk mode, the trunk is defined on the logical interface, and four CoS queues are opened in the trunk. For each CoS queue, you specify a priority and a transmit weight. CoS queues are serviced using a weighted round robin (WRR) algorithm. One queue is serviced with strictly high priority and the remaining queues are serviced with the WRR.

For Layer 2 circuit trunk mode, only strict mode is supported. Alternate mode is not supported.

To configure CoS queues in Layer 2 circuit trunk mode, perform the following tasks:

1. Include the encapsulation atm-ccc-cell-relay statement at the [edit interfaces at-*fpc/pic/port*] hierarchy level:

   ```
   [edit interfaces at-fpc/pic/port]
   encapsulation atm-ccc-cell-relay;
   ```

2. Include the scheduler-maps statement at the [edit interfaces at-*fpc/pic/port* atm-options] hierarchy level:

   ```
   [edit interfaces at-fpc/pic/port atm-options]
   scheduler-maps map-name {
       forwarding-class (class-name | assured-forwarding | best-effort |
           expedited-forwarding | network-control);
       vc-cos-mode strict;
   }
   ```

3. Include the atm-scheduler-map, trunk-bandwidth, and trunk-id statements at the [edit interfaces at-*fpc/pic/port* unit *logical-unit-number*] hierarchy level:

   ```
   [edit interfaces at-fpc/pic/port unit logical-unit-number]
   atm-scheduler-map (map-name | default);
   trunk-bandwidth rate;
   trunk-id number;
   ```

For information about ATM scheduler maps, see "Configuring an ATM Scheduler Map" on page 327.

For information about trunk identification numbers, see "Configuring Layer 2 Circuit Transport Mode" on page 286. For information about trunk bandwidths, see "Configuring Layer 2 Circuit Trunk Mode Scheduling" on page 295.

Strict mode CoS queue priority works as follows:

- Scheduling—One queue has strictly high priority and is always serviced before the remaining queues are serviced by a weighted round robin. This means the packets in a high priority queue are sent first until the queue is empty. Then low priority queues send packets until their weight quota becomes zero or negative.
- Latency—Each trunk is associated with a trunk bandwidth. The trunk bandwidth is the maximum bandwidth used each time a trunk is serviced. In the scheduling process, each trunk is serviced in a WRR. The maximum latency for any trunk to begin transmitting is equal to the sum of the weights of all previously queued trunks. Trunks without data do not affect output scheduling. As long as all the trunks have data, the exact weight proportions are maintained. If a trunk runs out of data during its turn, it is no longer included in the WRR. When the trunk gets more data, the trunk is placed at the end of the queue. For more information, see “Configuring Layer 2 Circuit Trunk Mode Scheduling” on page 295.

Within a single trunk, the maximum latency of a high priority queue is the time it takes to transmit one ATM cell. The latency of a low priority queue is the sum of high priority queue burst time and the transmission time of the remaining low priority queues’ weight.

- Bandwidth distribution—Trunks are serviced in a WRR based on the trunk bandwidth.

Within a single trunk, the high priority queue consumes the bandwidth first regardless of its weight. The remaining bandwidth is distributed to the low priority queues in proportion to their weights.

Consider the following example:

- You configure a trunk with weights of 10 percent, 20 percent, 30 percent, and 40 percent for queues 0, 1, 2, and 3, respectively.
- You configure queue 0 to be a high priority queue.
- Queue 0 does not have cells to transmit.

In this scenario, queues 1, 2 and 3 receive 2/9, 3/9, and 4/9 of the bandwidth, respectively.

NOTE: Constant bit rate (CBR) traffic always enters the strictly high priority queue.

For more information about strict and alternate modes, see “Configuring VC CoS Mode” on page 334.

For general information about Layer 2 circuit trunk mode, see “Configuring Layer 2 Circuit Transport Mode” on page 286.

For interfaces configured in trunk mode, you can also configure dual EPD thresholds depending on packet loss priorities (PLPs). For more information, see “Configuring Two EPD Thresholds per Queue” on page 314.

Example: Configuring CoS Queues in Layer 2 Circuit Trunk Mode

Configure a scheduler map and trunk bandwidth:

```
[edit interfaces]
at-6/1/0 {
    encapsulation atm-ccc-cell-relay;
    atm-options {
        pic-type atm2;
        scheduler-maps {
            cos0 {
                vc-cos-mode strict;
                forwarding-class cbr-class {
                    priority high;
                    transmit-weight percent 10;
                }
                forwarding-class rtvbr-class {
                    priority low;
                    transmit-weight percent 20;
                }
                forwarding-class nrtvbr-class {
                    priority low;
                    transmit-weight percent 30;
                }
                forwarding-class ubr-class {
                    priority low;
                    transmit-weight percent 40;
                }
            }
        }
    }
    unit 0 {
        trunk-id 0;
        trunk-bandwidth 10m;
        atm-scheduler-map cos0;
    }
}
```

Configuring the Layer 2 Circuit Cell-Relay Cell Maximum

By default, each frame contains one cell. For ATM interfaces with Layer 2 circuit cell-relay transport mode configured, you can configure the maximum number of ATM cells per frame on the physical or logical interface. To set the maximum number of cells per frame, include the cell-bundle-size statement:

```
cell-bundle-size cells;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* atm-options]
- [edit interfaces *interface-name* unit *logical-unit-number*]

- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

The cell bundle size can be from 1 through 176.

After 125 microseconds, cell bundling times out. This means that after 125 microseconds if the frame does not contain the configured value, the frame is transmitted anyway.

If you include the cell-bundle-size statement at the [edit interfaces *interface-name* atm-options] hierarchy level, then the configured value becomes the default for all the logical interface units configured for that physical interface. If you include the cell-bundle-size statement for a logical interface, the logical interface configuration overrides the value configured at the physical interface level.

The transmit rates you configure on the routing platforms at each end of the connection must be the same value.

Class-Based Cell Bundling

For Layer 2 circuit trunk mode only, cell bundling is enhanced by a set of CoS and traffic shaping rules, as follows:

- CBR and real-time variable bit rate (RTVBR) cells are not bundled. They are always sent as single-cell packets.
- Cells with the same CLP bits are bundled together. This means all the cells in a bundle contain the same CLP value.
- Cells with the same CoS bits are bundled together. This means all the cells in a bundle belong to the same class of service.
- As alluded to in the previous rules, several triggers cause early packet transmission, meaning that the packet is transmitted before the number of cells received is equal to the value configured with the cell-bundle-size statement. These triggers are as follows:
  - The next cell is of type CBR or RTVBR.
  - The next cell has a different CLP bit.
  - The next cell has different CoS bits.
  - The 125-microsecond timer expires.

CoS-based cell bundling optimizes the release of a bundle by sending out the cell that triggers early packet transmission as a single-cell packet. This means that when a cell triggers early packet transmission, that cell is not bundled. Consequently, certain input data patterns might cause primarily single-cell packets to be transmitted. For example, say the output interface receives a steady pattern of two cells from a non-RTVBR queue, followed by two cells from a UBR queue. In this case, all transmitted packets contain a single cell because the first cell triggers a transition and is transmitted by itself. The second cell is also transmitted by itself because the third cell triggers another transition, and so on. This effect might not be dramatic with a mix of traffic; it is most evident with steady traffic patterns, as generated by ATM test equipment programmed to emit regular sequences of CoS queue transitions.

Configuring the OAM F4 Cell Flows

For ATM2 IQ interfaces, the F4 flow cell is used for management of the VP level. If your routing platform is equipped with an ATM2 IQ PIC, you can configure OAM F4 cell flows to identify and report VPC defects and failures. The JUNOS software supports three types of OAM F4 cells in end-to-end F4 flows:

- Virtual Path Alarm Indication Signal (VP-AIS)
- Virtual Path Remote Defect Indication (VP-RDI)
- Virtual Path Loopback

The JUNOS software does not support segment F4 flows, VPC continuity check, or VP performance management functions.

On each VP, you can configure an interval during which to transmit loopback cells by including the oam-period statement at the [edit interfaces *interface-name* atm-options vpi *vpi-identifier*] hierarchy level:

```
[edit interfaces interface-name atm-options vpi vpi-identifier]
oam-period (disable | seconds);
```

When you add a VPI at the atm-options hierarchy, an end-to-end F4 VCI is automatically opened to send and receive OAM F4, VP-AIS, and VP-RDI cells. If you enable OAM by including the oam-period statement in the configuration, the routing platform sends and receives OAM F4 loopback cells.

If the physical ATM interface is configured with encapsulation type atm-ccc-cell-relay, then F4 VCIs are not created, and F4 OAM processing is not performed for the VPIs configured on that interface.

To modify OAM liveness values on a VP, include the oam-liveness statement at the [edit interfaces *interface-name* atm-options vpi *vpi-identifier*] hierarchy level:

```
[edit interfaces interface-name atm-options vpi vpi-identifier]
oam-liveness {
    up-count cells;
    down-count cells;
}
```

up-count is the minimum number of consecutive OAM F4 loopback cells received on a VPI before it is declared up.

down-count is the minimum number of consecutive OAM F4 loopback cells lost before a VPI is declared down.

When a VP-AIS or VP-RDI cell is received, the VPI is marked down. When a VP-AIS cell is received on a VPI, a VP-RDI is generated and transmitted on the same VPI. When an OAM F4 loopback request cell is received, the routing platform sends a loopback reply cell, even if the oam-period statement is not included in the configuration of the VPI.

When a VPI is marked down because the VPI receives VP-AIS, VP-RDI, VC-AIS, or VC-RDI cells, or because the VPI does not receive down-count consecutive OAM F4 loopback replies, all the VCIs that belong to the VPI are marked down. When a VPI is marked up, all the VCIs that belong to the VPI are marked up. The status of logical interfaces is also changed when the status of the last VCI on that interface is changed.

For a configuration example, see “Example: Configuring ATM2 IQ Interfaces” on page 338.

NOTE: For interfaces that are configured for cell-relay promiscuous virtual path identifier (VPI) mode, the show interfaces command output does not show (OAM) F4 cell statistics.

Defining Virtual Path Tunnels

For ATM2 IQ interfaces, you can configure shaping on a VPI. When you do this, the VPI is called a VP tunnel. If your routing platform is equipped with an ATM2 IQ PIC, you can configure VP tunnels and a weight for each VC. Each VC is serviced in WRR mode. When VCs have data to send, they send the number of cells equal to their weight before passing control to the next active VC. This allows proportional bandwidth sharing between multiple VCs within a rate-shaped VP tunnel. VP tunnels are not supported on point-to-multipoint interfaces.

If you change or delete VP tunnel traffic shaping, all logical interfaces on a VP are deleted and re-added.

All VPIs you configure on logical interfaces must also be configured on the physical interface, at the [edit interfaces *interface-name* atm-options] hierarchy level.

When you configure a VPI without shaping parameters, the VPI is a regular VPI; no shaping is attached. VCIs that belong to non-shaped VPIs can have VCI shaping.

For point-to-point interfaces, include the shaping statement at the [edit interfaces *interface-name* atm-options vpi *vpi-identifier*] hierarchy level:

```
[edit interfaces interface-name atm-options vpi vpi-identifier]
shaping {
   (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained rate
      burst length);
   queue-length number;
}
```

For cbr, vbr, and burst statement usage guidelines, see “Defining the ATM Traffic-Shaping Profile” on page 305. For information about ATM2 IQ shaping values, see “Specifying ATM2 IQ Shaping Values” on page 311.

Configuring a Point-to-Point ATM1 or ATM2 IQ Connection

When you use ATM encapsulation on an interface, you must map each logical interface to a VCI. You can optionally map logical interfaces to a VPI.

For ATM1 and ATM2 IQ interfaces, you can configure a VCI and a VPI on a point-to-point ATM interface by including the vci statement:

```
vci vpi-identifier.vci-identifier;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

For each VCI, configure the VCI and VPI identifiers. The default VPI identifier is 0. For ATM1 interfaces, the VCI identifier cannot exceed the highest-numbered VC configured for the interface with the vpi statement, as described in "Configuring the Maximum Number of ATM1 VCs on a VP" on page 286.

VCIs 0 through 31 are reserved for specific ATM values designated by the ATM Forum.

ATM2 IQ interfaces support only one invalid VC counter for all ports. The invalid VC counter is recorded at port 0 only.

When you are configuring point-to-point connections, the maximum transmission unit (MTU) sizes on both sides of the connections must be the same.

Configuring a Point-to-Multipoint ATM1 or ATM2 IQ Connection

An ATM interface can be a point-to-point interface or a point-to-multipoint (also called a multipoint nonbroadcast multiaccess [NBMA]) connection.

For ATM1 and ATM2 IQ interfaces, you can configure an NBMA ATM connection by including the following statements:

```
multipoint-destination address {
    epd-threshold cells;
    inverse-arp;
    oam-liveness {
        up-count cells;
        down-count cells;
    }
    oam-period (disable | seconds);
    shaping {
        (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained
            rate burst length);
        queue-length number;
    }
    vci vpi-identifier.vci-identifier;
```

```
}
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address*]

address is the interface's address. The address must include the destination prefix (for example, /24).

For each destination, include one multipoint-destination statement. *address* is the address of the remote side of the connection, and *vci-identifier* and *vpi-identifier* are the VCI and optional VPI identifiers for the connection.

When you configure point-to-multipoint connections, all interfaces in the subnet must use the same MTU size.

Configuring a Multicast-Capable ATM1 or ATM2 IQ Connection

For ATM1 and ATM2 IQ interfaces, you can configure a multicast-capable connection. By default, ATM connections assume unicast traffic. If your ATM switch performs multicast replication, you can configure the connection to support multicast traffic by including the multicast-vci statement:

```
multicast-vci vpi-identifier.vci-identifier;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

vci-identifier and *vpi-identifier* are the VCI and VPI identifiers, which define the ATM VCI over which the switch is expecting to receive multicast packets for replication.

You can configure multicast support only on point-to-multipoint ATM connections.

Configuring Inverse ATM1 or ATM2 ARP

For ATM1 and ATM2 IQ interfaces, you can configure inverse ATM Address Resolution Protocol (ARP), as described in RFC 2225, *Classical IP and ARP over ATM*. When inverse ATM ARP is enabled, the routing platform responds to received inverse ATM ARP requests by providing IP address information to the requesting ATM device.

The routing platform does not initiate inverse ATM ARP requests.

By default, inverse ATM ARP is disabled. To configure a VC to respond to inverse ATM ARP requests, include the inverse-arp statement:

```
inverse-arp;
```

For a list of hierarchy levels at which you can include this statement, see inverse-arp.

You must configure ATM LLC subnetwork attachment point (SNAP) encapsulation on the logical interface to support inverse ARP. No other ATM encapsulation types are allowed. For more information, see “Configuring ATM Interface Encapsulation” on page 316.

Defining the ATM Traffic-Shaping Profile

When you use an ATM encapsulation on ATM1 and ATM2 IQ interfaces, you can define bandwidth utilization, which consists of either a constant rate or a peak cell rate, with sustained cell rate and burst tolerance.

These values are used in the ATM generic cell-rate algorithm, which is a leaky bucket algorithm that defines the short-term burst rate for ATM cells, the maximum number of cells that can be included in a burst, and the long-term sustained ATM cell traffic rate.

If your routing platform is equipped with an ATM2 IQ PIC, each VC can have independent shaping parameters. For more information, see “Defining Virtual Path Tunnels” on page 302.

NOTE: When the DS3 or E3 port parameters are not identical on all ports of a multiport ATM DS3 or E3 PIC, the ATM PIC driver might not always use the minimum port shaping rate (of all the ports on a multiport ATM DS3 or E3 PIC) selected for cell transmission shaping. The PIC's shaping rate is always updated to conform to the last port setting updated by the PIC software driver, rather than use the minimum port (shaping) rate. There is no syslog message to inform the user of the shaping rate decision applied by the software driver.

By default, the bandwidth utilization is unlimited; that is, unspecified bit rate (UBR) is used. Also, by default, buffer usage by VCs is unregulated.

To define limits to bandwidth utilization, include the shaping statement:

```
shaping {
    (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained rate
        burst length);
    queue-length number;
}
```

For a list of hierarchy levels at which you can include this statement, see shaping.

The rtvbr statement is supported on ATM2 IQ PICs only. The queue-length statement is supported on ATM1 PICs only.

To configure VP tunnels on ATM2 IQ interfaces, include the shaping statement at the [edit interfaces *interface-name* atm-options vpi *vpi-identifier*] hierarchy level:

```
[edit interfaces interface-name atm-options vpi vpi-identifier]
shaping {
```

```
    (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained rate
      burst length);
}
```

When configuring ATM traffic shaping, you can do the following:

Configuring ATM CBR

For traffic that does not require the ability to periodically burst to a higher rate, you can specify a constant bit rate (CBR).

To specify a CBR on ATM1 and ATM2 IQ interfaces, include the cbr statement:

```
cbr rate;
```

For a list of hierarchy levels at which you can include this statement, see cbr. On J-Series Services Routers, ATM CBR shaping is not supported.

For ATM1 OC3 interfaces, the rate can be from 33 Kbps through 135.6 Mbps; for ATM1 OC12 interfaces, the rate can be from 33 Kbps through 276 Mbps.

For ATM2 IQ OC3 and OC12 interfaces, the rate can be from 33 Kbps through 542,526,792 bps.

For ATM2 IQ OC48 interfaces, the rate can be from 33 Kbps through 2,170,107,168 bps.

For ATM2 IQ DS3 and E3 interfaces, the rate can be from 33 Kbps to the maximum rate. The maximum rate varies depending on the ATM encapsulation and framing you configure, as shown in Table 26 on page 306.

Table 26: Shaping Rate Range by Interface Type

Interface Type	Maximum Rate
DS3 with direct ATM encapsulation	40,038,968 bps
DS3 with PLCP ATM encapsulation	36,864,000 bps
E3 with g.751 framing and direct ATM encapsulation	30,801,509 bps
E3 with g.751 framing PLCP ATM encapsulation	27,648,000 bps
E3 with g.832 framing	30,720,000 bps

Configuring ATM2 IQ Real-Time VBR

By default, ATM interfaces use UBR; that is, bandwidth utilization is unlimited. For ATM2 IQ interfaces only, you can configure RTVBR, which supports variable bit rate data traffic with average and peak traffic parameters. Compared to non-real-time VBR, RTVBR data is serviced at a higher priority with a relatively small sustainable cell rate (SCR) limit to minimize the delay. Real-time VBR is suitable for carrying packetized video and audio.

To configure RTVBR, include the rtvbr statement:

rtvbr peak *rate* sustained *rate* burst *length*;

For a list of hierarchy levels at which you can include this statement, see rtvbr.

When configuring RTVBR, you can define the following shaping properties:

- Peak rate—Top rate at which traffic can burst.
- Sustained rate—Normal traffic rate averaged over time.
- Burst length—Maximum number of cells that a burst of traffic can contain. It can be a value from 1 through 4000 cells.

The peak and sustained rates can be from 33 Kbps through 542,526,792 bps.

Configuring ATM VBR

By default, ATM interfaces use UBR; that is, bandwidth utilization is unlimited. For ATM1 and ATM2 IQ interfaces, you can configure non-real-time VBR, which supports variable bit rate data traffic with average and peak traffic parameters. Compared to RTVBR, non-real-time VBR is scheduled with a lower priority and with a larger SCR limit, allowing it to recover bandwidth if it falls behind. Non-real-time VBR is suitable for packet data transfers.

To define VBR on ATM1 and ATM2 IQ interfaces, include the vbr statement:

vbr peak *rate* sustained *rate* burst *length*;

For a list of hierarchy levels at which you can include this statement, see vbr.

When configuring VBR, you can define the following shaping properties:

- Peak rate—Top rate at which traffic can burst.
- Sustained rate—Normal traffic rate averaged over time.
- Burst length—Maximum number of cells that a burst of traffic can contain. It can be a value from 1 through 4000 cells.

Specifying ATM1 Shaping Values

For ATM1 interfaces, you can specify the rates in bits per second or cells per second. For OC3c interfaces, the highest rate is 135,631,698 bps (353,207.55 cps), which corresponds to 100 percent of the available line rate. For OC12c interfaces, the highest rate is 271,263,396 bps (706,415.09 cps), which corresponds to 50 percent of the available line rate. Table 27 on page 309 lists some of the other rates you can specify. If you specify a rate that is not listed, it is rounded to the nearest rate.

The exact number of values differs between OC12c and OC3c interfaces. OC12c interfaces have about four times as many value increments as OC3c interfaces.

For OC12c rates between 1/2 of the line rate and 1/128 of the line rate, there are 128 steps between each 1/*n* value. This means that there is 128 steps between the 1/2 and 1/3 line rate values, and another 128 steps between 1/3 and 1/4 and so on. For rates smaller than 1/127, there are (16,384 minus 127) or 16, 257 values. The reason for this is that fractional shaping is ignored at rates below 1/127. This results in a total of about 32,384 distinct rates for OC12c. When *n* is larger than or equal to 127, the steps are 1/*n*.

For OC3c, the starting point is full line rate, the fraction/integer breakpoint is about 1/31, and there is a maximum of 4096 scheduler slots for use after 1/31 of line rate, producing about 8032 total distinct rates. When *n* is larger than or equal to 31, the steps are 1/*n*.

For ATM1 interfaces, the following formula can be used to predict the actual shaping rate:

- OC3 shaping settings between 135,631,698 bps (OC3 ATM cell line rate) and 4,375,216 bps (1/31 of OC3 ATM cell line rate).
- OC12 shaping settings between 271,263,396 bps (half OC12 ATM cell line rate – the highest rate supported) and 4,271,864 bps (1/127 of OC12 ATM cell line rate).

actual-rate = (128 * *line-rate*) / (trunc ((128 * *line-rate*) / *desired-rate*))

line-rate is the maximum available rate on the interface (in bits per second) after factoring out the overhead for SONET/SDH and ATM (per-cell) overheads. For OC3c interfaces, the line rate is calculated as follows:

line-rate = 155,520,000 bps x (26/27) x (48/53) = 135,631,698.1 bps

For OC12c interfaces, the line rate is calculated as follows:

line-rate = 622,080,000 bps x (26/27) x (48/53) = 542,526,792.45 bps

desired-rate is the rate you enter in the vbr statement, in bits per second.

The trunc operator indicates that all digits to the right of the decimal point should be dropped.

For shaping settings smaller than 1/31 of OC3 ATM cell line rate (4,375,216 bps) and 1/127 of OC12 ATM cell line rate (4,271,864 bps), you can predict the actual shaping rate using the following formula:

```
actual-rate = ( 1 / ( trunc ( line-rate / desired-rate ) +1 ) ) * line-rate
```

For example, for OC12 interfaces, the actual rates for shaping below 4,271,864 bps are calculated as follows:

```
1 / 127 * 542,526,792.45 bps = 4,271,864 bps (11124 cells/second)
1 / 128 * 542,526,792.45 bps = 4,238,490 bps (11038 cells/second)
1 / 129 * 542,526,792.45 bps = 4,205,634 bps (10952 cells/second)
...
```

Buffers are shared among all VCs, and by default, there is no limit to the buffer size for a VC. If a VC is particularly slow, it might use all the buffer resources.

Table 27 on page 309 shows ATM1 traffic-shaping rates.

Table 27: ATM1 Traffic-Shaping Rates

Interface Type	Line Rate (bps)	Line Rate (cps)	Percentage of Total Line Rate
OC3			
	135,600,000	353,125	100.00
	134,542,320	350,370.66	99.22
	133,511,760	347,686.88	98.46
	132,494,760	345,038.44	97.71
	131,491,320	342,425.31	96.97
	130,501,440	339,847.5	96.24
	129,525,120	337,305	95.52
	128,562,360	334,797.81	94.81
	127,626,720	332,361.25	94.12
	126,691,080	329,924.69	93.43
OC12			
	271,263,396	706,415.09	50.00
	270,207,897	703,666.40	49.81
	269,160,579	700,939.01	49.61
	268,121,349	698,232.68	49.42
	267,090,113	695,547.17	49.23

Table 27: ATM1 Traffic-Shaping Rates *(continued)*

Interface Type	Line Rate (bps)	Line Rate (cps)	Percentage of Total Line Rate
	266,066,779	692,882.24	49.04
	265,051,257	690,237.65	48.85
	264,043,458	687,613.17	48.67
	263,043,293	685,008.58	48.48
	262,050,677	682,423.64	48.30

Example: Specifying ATM1 Shaping Values

Determine the actual rate in ATM1 interfaces when the desired rate is 80 percent of the maximum rate:

- OC3c:

  135,600,000 bps * 0.8 = 108,480,000 bps

  Because 108,480,000 bps is greater than 1/31 of OC3 ATM cell line rate:

  actual-rate = (128 * 135,600,000.1) / (trunc ((128 * 135,600,000.1) / 108,480,000))
  actual-rate = 17,356,800,013 / (trunc (17,356,800,013 / 108,480,000))
  actual-rate = 17,356,800,013 / 160
  actual-rate = 108,480,000 bps

- OC12c:

  271,263,396 bps * 0.8 = 217,010,716.8 bps

  Because 217,010,716.8 bps is greater than 1/127 of OC12 ATM cell line rate:

  actual-rate = (128 * 542,526,792.45) / (trunc ((128 * 542,526,792.45)/217,010,716.8))
  actual-rate = 69,443,429,434 / (trunc (69,443,429,434 / 217,010,716.8))
  actual-rate = 69,443,429,434 / 320
  actual-rate = 217,010,717 bps

Determine the actual rate in ATM1 interfaces when the desired rate is 3,000,000 bps:

- OC3c:

  Because 3,000,000 bps is smaller than 1/31 of OC3 ATM cell line rate:

  actual-rate= (1 / (trunc (line-rate / desired-rate) + 1)) * line-rate
  actual-rate = (1 / (trunc (135,631,698 / 3,000,000) + 1)) * 135,631,698
  actual-rate = (1 / (45 + 1)) * 135,631,698
  actual-rate = (1 / 46) * 135,631,698

actual-rate = 2,948,515 bps

- OC12c:

  Because 3,000,000 bps is smaller than 1/127 of OC12 ATM cell line rate:

  actual-rate = (1 / (trunc (line-rate / desired-rate) + 1)) * line-rate
  actual-rate = (1 / (trunc (542,526,792 / 3,000,000) + 1)) * 542,526,792
  actual-rate = (1 / (180 + 1)) * 542,526,792
  actual-rate = (1 / 181) * 542,526,792
  actual-rate = 2,997,386 bps

Specifying ATM2 IQ Shaping Values

For ATM2 IQ OC3c interfaces, the maximum available rate is 100 percent of line rate, or 135,600,000 bps. For ATM2 IQ OC12c interfaces, the maximum available rate is 50 percent of line rate, or 271,273,396 bps. You can specify the rates in bits per second or cells per second. Fractional shaping is accurate within 0.5 percent of the desired rate.

Configuring the ATM1 Queue Length

ATM1 PICs contain a transmit buffer pool of 16,382 buffers, which are shared by all the PVCs that you configure on the PIC. Even multiple-port ATM PICs have a single buffer pool shared by all the ports.

By default, the ATM1 PIC allows PVCs to consume all the buffers they require. If the sustained traffic rate for a PVC exceeds its shaped rate, buffers are consumed. Eventually, all buffers on the PIC are consumed, and the other PVCs are underserved. This results in head-of-line blocking.

For each PVC, you prevent this situation by configuring the queue length of the PVC. The queue length is a limit on the number of transmit packets that can be queued. Packets that exceed the limit are dropped.

To limit the queue size of a PVC, include the queue-length statement:

```
queue-length number;
```

For a list of hierarchy levels at which you can include this statement, see queue-length.

The length can be from 1 through 16,383 packets. The default is 16,383 packets. You should include the queue-length statement in the configuration of all the PVCs that you configure on an ATM1 PIC. The queue-length statement performs two functions:

- It prevents head-of-line blocking because it limits the number of packets and therefore buffers that can be consumed by each configured PVC.
- It sets the maximum lifetime that can be sustained by packets over the PVC when traffic has oversubscribed the configured shaping contract.

The total value of all the queue lengths must not exceed the total number of packets that can be held in the buffer space available on the PIC. The total number of packets the buffers can hold depends on the size of the physical interface MTU, including all encapsulation overhead. You can use the following formula to calculate the total number of packets the buffer space can hold:

16,382 / (Round Up (MTU / 480))

For example, assuming default MTU settings for all ATM1 interfaces on a PIC, the total number of packets that can be held is:

16,382 / (Round Up (4482 / 480)) = 1638 packets

Thus, you can configure up to 1638 for the combined queue length of all the PVCs on an ATM1 PIC that uses default MTU settings for all interfaces.

If you set a queue length to a very low value, small bursts in packets transiting the PVC might not be buffered.

The maximum lifetime that packets can sustain while transiting a PVC depends on the shaping rate you configure for the PVC, the setting for the queue-length statement, and the physical interface MTU. You can use the following formula to calculate the maximum lifetime that packets can sustain while transiting a PVC:

(PVC queue-length in packets x MTU) / (PVC shaping in bps / 8)

For example, if you configure a PVC on an ATM1 interface with the default MTU, a CBR shaping rate of 3,840,000 bps (10,000 cps), and a queue length of 25 packets. The maximum lifetime is:

(25 x 4482) / (3,840,000 / 8) = 233 ms

This is the worst-case lifetime assuming all packets in the queue are MTU sized, and the traffic using the PVC is oversubscribing its configured shaping contract.

In general, we recommend that you use a maximum lifetime under 500 ms.

If you add or change the queue-length setting on the VC, the logical interface associated with the VC is deleted and re-added.

Configuring the ATM2 IQ EPD Threshold

The EPD threshold is a limit on the number of transmit cells that can be queued. Cells that exceed the limit are discarded. When a beginning of packet (BOP) cell is received, the VC's queue depth is checked against the EPD threshold. If the VC's queue depth exceeds the EPD threshold, the BOP cell and all subsequent cells in the packet are discarded. This prevents a single queue from draining all the buffers on the PIC.

By default, for UBR the EPD threshold is approximately 1 percent of the available cell buffers. If shaping is enabled, the default EPD threshold is proportional to the shaping rate according to the following formula:

default epd-threshold = number of buffers * shaping rate / line rate

By default, the software estimates how much buffer space is needed for each PVC. However, you can configure the per-VC buffer space. In general, ATM PVCs need larger buffers for data traffic and smaller buffers for time-sensitive applications. Unnecessarily deep buffers might cause excessive delays on congested PVCs. Overly shallow buffers might cause premature random early detection (RED) or tail packet drops in bursty conditions.

The minimum EPD threshold value is 48 cells. If the default EPD threshold formula results in an EPD threshold of less than 48 cells, the result will be ignored, and the minimum value of 48 cells will be used.

To set the EPD threshold of a PVC, include the epd-threshold statement:

```
epd-threshold cells;
```

For a list of hierarchy levels at which you can include this statement, see epd-threshold.

The allowable range for EPD threshold varies by interface type, as shown in Table 28 on page 313.

Table 28: EPD Threshold Range by Interface Type

Interface Type	EPD Range
1-port OC48	48 through 425,984 cells
1-port and 2-port OC12	48 through 425,984 cells
2-port OC3, DS3, and E3	48 through 212,992 cells
4-port DS3 and E3	48 through 106,496 cells

You should include the epd-threshold statement in the configuration of all the PVCs that you configure on an ATM2 IQ PIC. The epd-threshold statement performs two functions:

- It prevents head-of-line blocking because it limits the number of packets and therefore buffers that can be consumed by each configured PVC.
- It sets the maximum lifetime that can be sustained by packets over the PVC when traffic has oversubscribed the configured shaping contract.

If you add or change the EPD threshold on the VC, the logical interface associated with the VC is deleted and re-added.

On ATM2 IQ DS3 and E3 interfaces, you might be able to enter an EPD threshold or shaping parameter that exceeds the maximum threshold for these interfaces. If the configuration commits, the physical interface might indicate that it is up, but the logical interface fails. As a workaround, configure shaping parameters and EPD thresholds that do not exceed the bandwidth of the interface.

For information about configuring dual EPD thresholds on interfaces configured to use Layer 2 circuit trunk mode, see "Configuring Two EPD Thresholds per Queue" on page 314.

Example: Configuring the ATM2 IQ EPD Threshold

Configure the EPD threshold for a point-to-point ATM2 interface and a point-to-multipoint ATM2 interface.

On a Point-to-Point ATM2 Interface

```
[edit interfaces at-1/0/0]
unit 0 {
  vci 0.123;
  epd-threshold 1300;
  ...
}
```

On a Point-to-Multipoint ATM2 Interface

```
[edit interfaces at-1/0/1]
unit 0 {
  multipoint;
  family inet address 10.0.12.12/24 {
    multipoint-destination 10.0.12.14 vci 0.123 epd-threshold 1300;
    ...
  }
}
```

Configuring Two EPD Thresholds per Queue

For ATM2 IQ interfaces configured to use Layer 2 circuit trunk mode, you can set two EPD thresholds that depend on the PLPs of the packets. When you set a threshold with the epd-threshold statement, it applies to packets that have a PLP of 0. When you set a threshold with the plp1 statement, it applies to packets that have a PLP of 1. If you include the plp1 statement in the configuration, you must also include the epd-threshold statement.

To configure two EPD thresholds, include the epd-threshold and plp1 statements:

epd-threshold *cells* plp1 *cells*;

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* atm-options scheduler-maps *map-name* forwarding-class *class-name*]
- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

The value you set with the epd-threshold statement (for PLP0) should be equal to or greater than the value you set with the plp1 statement. EPD threshold ranges vary by interface type. See Table 28 on page 313.

For general information about EPD thresholds, see “Configuring the ATM2 IQ EPD Threshold” on page 312.

Configuring the ATM2 IQ Transmission Weight

For ATM2 IQ interfaces configured with VPI shaping, you can control the number of cells a VCI can send each time the VCI has a turn to transmit by including the transmit-weight statement:

transmit-weight *cells*;

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

VPI traffic shaping is not supported on point-to-multipoint interfaces.

The number of cells can be from 1 through 32,000. For a configuration example, see “Example: Configuring ATM2 IQ Interfaces” on page 338.

Defining the ATM OAM F5 Loopback Cell Period

For ATM1 and ATM2 IQ interfaces with an ATM encapsulation, you can configure the OAM F5 loopback cell period on virtual circuits. This is the interval at which OAM F5 loopback cells are transmitted.

By default, no OAM F5 loopback cells are sent. To send OAM F5 loopback cells, include the oam-period statement:

oam-period (disable | *seconds*);

For a list of hierarchy levels at which you can include this statement, see oam-period.

The period can be from 1 through 900 seconds. You can also choose the disable option to disable the OAM loopback cell transmit feature.

OAM VC-AIS and VC-RDI defect indication cells are used for identifying and reporting VC defects end-to-end. When a physical link or interface failure occurs, intermediate nodes insert OAM AIS cells into all the downstream VCs affected by the failure. Upon receiving an AIS cell on a VC, the routing platform marks the logical interface down and sends an RDI cell on the same VC to notify the remote end of the error status. When an RDI cell is received on a VC, the routing platform sets the logical interface status to down. When no AIS or RDI cells are received for 3 seconds, the routing platform sets the logical interface status to up. You do not need to configure anything to enable defect indication.

Configuring the ATM OAM F5 Loopback Cell Threshold

For ATM1 and ATM2 IQ interfaces with an ATM encapsulation, you can configure the OAM F5 loopback cell threshold on VCs. This is the minimum number of consecutive OAM F5 loopback cells received before a VC is declared up, or the minimum number of consecutive OAM F5 loopback cells lost before a VC is declared down.

By default, when five consecutive OAM F5 loopback cells are received, the VC is considered to be up, and when five consecutive cells are lost, the VC is considered to be down. To modify these values, include the oam-liveness statement:

```
oam-liveness {
    up-count cells;
    down-count cells;
}
```

For a list of hierarchy levels at which you can include this statement, see oam-liveness.

The cell count can be a value from 1 through 255.

Configuring ATM Interface Encapsulation

To configure ATM encapsulation on a physical interface, include the encapsulation statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
encapsulation (atm-ccc-cell-relay | atm-pvc | ethernet-over-atm);
```

For ATM interfaces, the physical interface encapsulation can be one of the following:

- ATM cell-relay—This encapsulation connects two remote virtual circuits or ATM physical interfaces with an LSP. Traffic on the circuit is ATM cells.
- ATM PVC—ATM PVC encapsulation is defined in RFC 2684, *Multiprotocol Encapsulation over ATM Adaptation Layer 5*.
- Ethernet over ATM—As defined in RFC 1483 (the previous version of RFC 2684), this encapsulation type allows ATM interfaces to connect to devices that support only bridged-mode protocol data units (BPDUs). The JUNOS software does not completely support bridging, but accepts BPDU packets as a default gateway. If you use the router as an edge device, then the router acts as a default gateway. It accepts Ethernet LLC/SNAP frames with IP or ARP in the payload, and drops the rest. For packets destined to the Ethernet LAN, a route lookup is done using the destination IP address. If the route lookup yields a full address match, the packet is encapsulated with an LLC/SNAP and media access control (MAC) header, and the packet is forwarded to the ATM interface.

Generally, you configure an interface's encapsulation at the [edit interfaces *interface-name*] hierarchy level. However, for ATM encapsulations, you can also configure the encapsulation type that is used inside the ATM cell itself. To do this, include the encapsulation statement:

encapsulation (atm-ccc-cell-relay | atm-ccc-vc-mux | atm-cisco-nlpid | atm-mlppp-llc |
atm-nlpid | atm-ppp-llc | atm-ppp-vc-mux | atm-snap | atm-tcc-snap | atm-vc-mux |
atm-tcc-vc-mux | ether-over-atm-llc | ether-vpls-over-atm-llc);

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Table 29 on page 317 shows the logical interface encapsulation types for ATM interfaces.

Table 29: ATM Logical Interface Encapsulation Types

Encapsulation Types	Comments
ATM CCC cell relay	This encapsulation type connects two remote virtual circuits or ATM physical interfaces with an LSP. This encapsulation type carries traffic in ATM cells. When you use this encapsulation type, you can configure the ccc family only.
ATM CCC VC multiplex	This encapsulation type is for CCC circuits. When you use this encapsulation type, you can configure the ccc family only.
ATM network layer protocol identifier (NLPID)	When you use this encapsulation type, you can configure the inet family only.
ATM SNAP	
ATM SNAP encapsulation on translational cross-connect (TCC) circuits	When you use this encapsulation type, you can configure the tcc family only.
ATM VC multiplex	When you use this encapsulation type, you can configure the inet family only.
ATM VC multiplex on TCC circuits	When you use this encapsulation type, you can configure the tcc family only.
Cell-relay accumulation mode (CAM)	In this mode, the incoming 1 to 8 cells are packaged into a single packet and forwarded to the LSP. To configure CAM, include the atm-cell-relay-accumulation statement at the [edit chassis fpc *slot-number* pic *pic-number*] hierarchy level. This encapsulation type is for ATM1 interfaces only. For more information about CAM, see the *JUNOS System Basics Configuration Guide*.
Cisco ATM NLPID	When you use this encapsulation type, you can configure the inet family only.
Ethernet over ATM	This encapsulation type is for interfaces that carry IPv4 traffic. When you use this encapsulation type, you cannot configure point-to-multipoint interfaces.

Table 29: ATM Logical Interface Encapsulation Types *(continued)*

Encapsulation Types	Comments
Ethernet VPLS over ATM	This encapsulation type enables a VPLS instance to support bridging between Ethernet interfaces and ATM interfaces, as described in RFC 2684. Use this encapsulation type to support IEEE 802.1p classification binding on ATM VCs. This encapsulation type is for ATM2 IQ interfaces only. When you use this encapsulation type, you cannot configure point-to-multipoint interfaces.
Multilink PPP over AAL5 LLC	This encapsulation type is for ATM2 IQ interfaces only. When you use this encapsulation type, your routing platform must be equipped with a Link Services or Voice Services PIC.
PPP over AAL5 LLC	This encapsulation type is for ATM2 IQ interfaces only. When you use this encapsulation type, you cannot configure point-to-multipoint interfaces.
PPP over AAL5 multiplex	This encapsulation type is for ATM2 IQ interfaces only. When you use this encapsulation type, you cannot configure point-to-multipoint interfaces.

Configuring an ATM1 Cell-Relay Circuit

For ATM1 interfaces, you can create an ATM cell-relay circuit by configuring an entire ATM physical device or an individual VC. When you configure an entire device, only cell-relay encapsulation is allowed on the logical interfaces; for ATM1 PICs, you use the atm-options statement to control the number and location of VCs. The configuration of allowed VCs on both ingress and egress ATM interfaces should be the same. For most interfaces, you can define a maximum of 4090 VCs per interface. The highest-numbered VC value you can configure is 4089. Promiscuous mode removes these limits. For more information, see “Configuring ATM Cell-Relay Promiscuous Mode” on page 282.

For ATM1 interfaces, if you are dedicating the entire device to a cell-relay circuit, include the allow-any-vci statement in the configuration of unit 0:

```
allow-any-vci;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit 0]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit 0]

Once you include this statement, you cannot configure other logical interfaces in the same physical interface.

NOTE: When you use ATM CCC cell-relay encapsulation, you must configure the logical encapsulation as atm-ccc-cell-relay. You cannot mix different logical encapsulation types on an interface that you have configured with ATM CCC cell-relay physical encapsulation.

Example: Configuring an ATM1 Cell-Relay Circuit

Configure an ATM1 cell-relay circuit:

```
[edit interfaces at-1/2/0]
encapsulation atm-ccc-cell-relay;
atm-options {
   pic-type atm1;
   vpi 0 maximum-vcs 256;
}
unit 0 {
   point-to-point;
   encapsulation atm-ccc-cell-relay;
   allow-any-vci;
}
```

Configuring an Individual VC on a Logical Interface

```
[edit interfaces at-1/1/0]
encapsulation atm-ccc-cell-relay;
atm-options {
   pic-type atm1;
   vpi 0 maximum-vcs 256;
}
unit 120 {
   encapsulation atm-ccc-cell-relay;
   vci 0.120;
}
```

Configuring Nonpromiscuous Port Mode

```
[edit interfaces at-0/0/1]
encapsulation atm-ccc-cell-relay;
atm-options {
   pic-type atm1;
   vpi 0 {
      maximum-vcs 100;
   }
   vpi 1 {
      maximum-vcs 300;
   }
   vpi 4 {
      maximum-vcs 200;
   }
}
unit 0 {
   encapsulation atm-ccc-cell-relay;
   allow-any-vci;
}
```

Configuring Nonpromiscuous VPI Mode

```
[edit interfaces at-0/0/1]
encapsulation atm-ccc-cell-relay;
atm-options {
   pic-type atm1;
   vpi 0 {
      maximum-vcs 100;
   }
}
unit 0 {
   encapsulation atm-ccc-cell-relay;
   vpi 0;
}
```

Configuring Nonpromiscuous VCI Mode

```
[edit interfaces at-0/0/1]
encapsulation atm-ccc-cell-relay;
atm-options {
   pic-type atm1;
   vpi 0 {
      maximum-vcs 100;
   }
}
unit 0 {
   encapsulation atm-ccc-cell-relay;
   vci 0.50
}
```

Configuring PPP over ATM2 Encapsulation

For ATM2 IQ interfaces, you can configure PPP over AAL5 encapsulation, as described in RFC 2364, *PPP over AAL5*. PPP over ATM encapsulation associates a PPP link with an ATM AAL5 PVC.

The JUNOS software supports three PPP over ATM encapsulation types:

- atm-ppp-llc—PPP over AAL5 LLC.
- atm-ppp-vc-mux—PPP over ATM AAL5 multiplex.
- atm-mlppp-llc—Multilink PPP over ATM AAL5 LLC. For this encapsulation type, your routing platform must be equipped with a Link Services or Voice Services PIC. MLPPP over ATM encapsulation is not supported on ATM2 IQ OC48 interfaces.

To enable PPP over ATM encapsulation, include the encapsulation statement, specifying the atm-mlppp-llc, atm-ppp-llc, or atm-ppp-vc-mux encapsulation type:

```
encapsulation (atm-mlppp-llc | atm-ppp-llc | atm-ppp-vc-mux);
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

When you configure PPP over ATM encapsulation, you can enable PPP Challenge Handshake Authentication Protocol (CHAP) and keepalives on the logical interface. For more information about PPP CHAP and keepalives, see "Configuring the PPP Challenge Handshake Authentication Protocol" on page 106 and "Configuring Keepalives" on page 120.

NOTE: When you use PPP over ATM encapsulation, we recommend that you not include the oam-period statement in the configuration. Instead, we recommend that you enable keepalives to detect connection failures.

Example: Configuring PPP over ATM2 IQ Encapsulation

Configure three logical interfaces with PPP over ATM encapsulation:

```
[edit interfaces]
at-0/1/0 {
    atm-options {
        pic-type atm2;
        vpi 0;
        vpi 2;
    }
    unit 0 {
        encapsulation atm-ppp-llc;
        ppp-options {
            chap {
                access-profile pe-B-ppp-clients;
                local-name "pe-A-at-0/1/0";
            }
        }
        keepalives interval 5 up-count 6 down-count 4;
        vci 0.120;
        family inet address 192.168.13.13/30;
    }
    unit 1 {
        encapsulation atm-ppp-vc-mux;
        vci 2.120;
        keepalives interval 6 up-count 6 down-count 4;
        family inet address 192.168.14.13/30;
    }
    unit 2 {
        encapsulation atm-ppp-vc-mux;
        ppp-options {
            chap {
                passive;
                access-profile pe-A-ppp-clients;
                local-name "pe-A-at-0/1/0";
            }
        }
        keepalives interval 5 up-count 6 down-count 4;
        vci 2.121;
        family inet address 192.168.15.13/30;
    }
}
```

Configuring Multilink PPP over ATM2 IQ Encapsulation

```
[edit interfaces]
at-0/0/0 {
   atm-options {
      pic-type atm2;
      vpi 10;
   }
   unit 0 {
      encapsulation atm-mlppp-llc;
      ppp-options {
         chap {
            access-profile pe-B-ppp-clients;
            local-name " pe-A-at-0/0/0";
         }
      }
      keepalive interval 5 up-count 6 down-count 4;
      vci 10.120;
      family mlppp {
         bundle ls-0/3/0.0;
      }
   }
}
at-0/0/1 {
   atm-options {
      pic-type atm2;
      vpi 11;
   }
   unit 1 {
      encapsulation atm-mlppp-llc;
      ppp-options {
         chap {
            access-profile pe-B-ppp-clients;
            local-name " pe-A-at-0/0/0";
         }
      }
      keepalive interval 5 up-count 6 down-count 4;
      vci 11.120;
      family mlppp {
         bundle ls-0/3/0.0;
      }
   }
}
at-1/2/3 {
   atm-options {
      pic-type atm2;
      vpi 12;
   }
   unit 2 {
      encapsulation atm-mlppp-llc;
      ppp-options {
         chap {
            access-profile pe-B-ppp-clients;
            local-name " pe-A-at-0/0/0";
         }
      }
      keepalive interval 5 up-count 6 down-count 4;
      vci 12.120;
```

```
        family mlppp {
            bundle ls-0/3/0.0;
        }
    }
}
...
ls-0/3/0 {
    encapsulation multilink-ppp;
    interleave-fragments;
    keepalive;
    unit 0 {
        mrru 4500;
        short-sequence;
        fragment-threshold 16320;
        drop-timeout 2000;
        encapsulation multilink-ppp;
        interleave-fragments;
        minimum-links 8;
        family inet {
            address 10.10.0.1/32 {
                destination 10.10.0.2;
            }
        }
        family iso;
        family inet6 {
            address 8090::0:1/128 {
                destination 8090::0:2;
            }
        }
    }
    ...
}
```

Configuring E3 and T3 Parameters on ATM Interfaces

For ATM1 and ATM2 IQ interfaces, you can configure ATM E3 and T3 interfaces by including the following statements at the [edit interfaces at-*fpc/pic/port*] hierarchy level:

```
[edit interfaces at-fpc/pic/port]
e3-options {
    atm-encapsulation (direct | plcp);
    buildout feet;
    framing (g.751 | g.832);
    loopback (local | remote);
    (payload-scrambler | no-payload-scrambler);
}
t3-options {
    atm-encapsulation (direct | plcp);
    buildout feet;
    (cbit-parity | no-cbit-parity);
    loopback (local | payload | remote);
    (payload-scrambler | no-payload-scrambler);
}
```

The following options and default values differ from those described in the chapters "Configuring E3 Interfaces" on page 521 and "Configuring T3 Interfaces" on page 539:

- atm-encapsulation—PLCP is the default value. The E3 line-format option g.832 supports the direct ATM-encapsulation option only.
- buildout—The default value is 10 feet. The number of feet can be any integer value. The range is from 0 through 450 feet (about 137 meters).
- cbit-parity—The default option is to enable cbit parity.
- framing—There is no default option for E3 interfaces; T3 interfaces use the cbit-parity statement in place of the framing statement.
- loopback—By default, loopback is disabled.
- payload-scrambler—The default option is to enable payload scrambling.

In addition, the ATM E3 and T3 PICs support the clocking statement at the interface level, as do the SONET/SDH PICs. For more information about E3- and T3-specific parameters, see "Configuring E3 Interfaces" on page 521 and "Configuring T3 Interfaces" on page 539.

NOTE: You must configure all the ports on an ATM E3 or T3 PIC with the same framing and encapsulation. Otherwise, the system will set all the ports on the PIC to the slowest framing and encapsulating configuration. For ATM T3, this is PLCP. For ATM E3, this is G.751 PLCP.

Configuring SONET/SDH Parameters on ATM Interfaces

When configuring ATM1 and ATM2 IQ SONET/SDH interfaces, you can also include the following statements in the sonet-options statement to set SONET/SDH parameters on ATM interfaces:

```
[edit interfaces at-fpc/pic/port]
sonet-options {
  aps {
    advertise-interval milliseconds;
    authentication-key key;
    force;
    hold-time milliseconds;
    lockout;
    neighbor address;
    paired-group group-name;
    protect-circuit group-name;
    request;
    revert-time seconds;
    working-circuit group-name;
  }
  bytes {
    e1-quiet value;
    f1 value;
    f2 value;
    s1 value;
```

```
        z3 value;
        z4 value;
    }
    loopback (local | remote);
    (payload-scrambler | no-payload-scrambler);
    rfc-2615;
    trigger {
        defect ignore {
            hold-time up milliseconds down milliseconds;
        }
    }
    (z0-increment | no-z0-increment);
}
```

For information about configuring specific SONET/SDH statements, see "Configuring SONET/SDH Interfaces" on page 797.

Configuring ATM2 IQ VC Tunnel CoS Components

The ATM2 IQ interface allows multiple IP queues into each VC. On M-series platforms (except the M320 and M120 router), a VC tunnel can support four CoS queues. On the M320, M120, and T-series platforms for all ATM2 IQ PICs except the OC48 PIC, a VC tunnel can support eight CoS queues. Within a VC tunnel, the WRR algorithm schedules the cell transmission of each queue. You can configure the queue admission policies, such as EPD or WRED, to control the queue size during congestion.

For information about CoS components that apply generally to all interfaces, see the *JUNOS Class of Service Configuration Guide*.

To configure ATM2 IQ VC tunnel CoS components, include the following statements at the [edit interfaces at-*fpc/pic/port*] hierarchy level:

```
[edit chassis fpc slot-number pic pic-number]
max-queues-per-interface number;
[edit interfaces at-fpc/pic/port]
atm-options {
    linear-red-profiles profile-name {
        high-plp-max-threshold percent;
        low-plp-max-threshold percent;
        queue-depth cells high-plp-threshold percent low-plp-threshold percent;
    }
    plp-to-clp;
    scheduler-maps map-name {
        forwarding-class class-name {
            epd-threshold cells plp1 cells;
            linear-red-profile profile-name;
            priority (high | low);
            transmit-weight (cells number | percent number);
        }
        vc-cos-mode (alternate | strict);
    }
}
unit 0 {
    atm-scheduler-map (map-name | default);
```

```
    family family {
        address address {
            destination address;
        }
    }
    plp-to-clp;
    shaping {
        (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained
            rate burst length);
    }
    vci vpi-identifier.vci-identifier;
}
```

This section contains the following topics:

Configuring Linear RED Profiles

Linear RED profiles define CoS virtual circuit drop profiles. You can configure up to 32 linear RED profiles per port. When a packet arrives, RED checks the queue fill level. If the fill level corresponds to a nonzero drop probability, the RED algorithm determines whether to drop the arriving packet.

To configure linear RED profiles, include the linear-red-profiles statement at the [edit interfaces at-*fpc/pic/port* atm-options] hierarchy level:

```
[edit interfaces at-fpc/pic/port atm-options]
linear-red-profiles profile-name {
    high-plp-max-threshold percent;
    low-plp-max-threshold percent;
    queue-depth cells high-plp-threshold percent low-plp-threshold percent;
}
```

The queue-depth, high-plp-threshold, and low-plp-threshold statements are mandatory.

You can define the following options for each RED profile:

- high-plp-max-threshold—Define the drop profile fill-level for the high PLP CoS VC. When the fill level exceeds the defined percentage, all packets with high PLP are dropped.
- low-plp-max-threshold—Define the drop profile fill-level for the low PLP CoS VC. When the fill level exceeds the defined percentage, all packets with low PLP are dropped.

- queue-depth—Define maximum queue depth in the CoS VC drop profile. Packets are always dropped beyond the defined maximum. The range you can configure is from 1 through 64,000 cells.
- high-plp-threshold—Define CoS VC drop profile fill-level percentage when linear RED is applied to cells with high PLP. When the fill level exceeds the defined percentage, packets with high PLP are randomly dropped by RED.
- low-plp-threshold—Define CoS VC drop profile fill-level percentage when linear RED is applied to cells with low PLP. When the fill level exceeds the defined percentage, packets with low PLP are randomly dropped by RED.

Configuring an ATM Scheduler Map

To define a scheduler map, you associate it with a forwarding class. Each class is associated with a specific queue, as follows:

- best-effort—Queue 0
- expedited-forwarding—Queue 1
- assured-forwarding—Queue 2
- network-control—Queue 3

NOTE: For M320, M120, and T-series platforms only, you can configure more than four forwarding classes and queues. For more information, see "Enabling Eight Queues on ATM2 IQ Interfaces" on page 328.

When you configure an ATM scheduler map, the JUNOS software creates these CoS queues for a VC. The JUNOS software prefixes each packet delivered to the VC with the next-hop rewrite data associated with each queue.

To configure an ATM scheduler map, include the scheduler-maps statement at the [edit interfaces at-*fpc/pic/port* atm-options] hierarchy level:

```
edit interfaces at-fpc/pic/port atm-options]
scheduler-maps map-name {
   forwarding-class class-name {
      epd-threshold cells plp1 cells;
      linear-red-profile profile-name;
      priority (high | low);
      transmit-weight (cells number | percent number);
   }
}
```

You can define the following options for each forwarding class:

- **epd-threshold** or **linear-red-profile**—An EPD threshold provides a queue of cells that can be stored with tail drop. When a BOP cell is received, the VC's queue depth is checked against the EPD threshold. If the VC's queue depth exceeds the EPD threshold, the BOP cell and all subsequent cells in the packet are discarded.

A linear RED profile defines the number of cells using the queue-depth statement within the RED profile. (You configure the queue-depth statement at the [edit interfaces at-*fpc/pic/port* atm-options linear-red-profiles *profile-name*] hierarchy level.)

By default, if you include the scheduler-maps statement at the [edit interfaces at-*fpc/pic/port* atm-options] hierarchy level, the interface uses an EPD threshold that is determined by the JUNOS software based on the available bandwidth and other parameters. You can override the default EPD threshold by setting an EPD threshold or a linear RED profile.

- **priority**—By default, queue 0 is high-priority, and the remaining queues are low-priority. You can configure high or low queuing priority for each queue.
- **transmit-weight**—By default, the transmit weight is 95 percent for queue 0, and 5 percent for queue 3. You can configure the transmission weight in number of cells or percentage. Each CoS queue is serviced in WRR mode. When CoS queues have data to send, they send the number of cells equal to their weight before passing control to the next active CoS queue. This allows proportional bandwidth sharing between multiple CoS queues within a rate-shaped VC tunnel. A CoS queue can send from 1 through 32,000 cells or from 5 through 100 percent of queued traffic before passing control to the next active CoS queue within a VC tunnel.

The AAL5 protocol prohibits cells from being interleaved on a VC; therefore, a complete packet is always sent. If a CoS queue sends more cells than its assigned weight because of the packet boundary, the deficit is carried over to the next time the queue is scheduled to transmit. If the queue is empty after the cells are sent, the deficit is waived, and the queue's assigned weight is reset.

NOTE: If you include the scheduler-maps statement at the [edit interfaces at-*fpc/pic/port* atm-options] hierarchy level, the epd-threshold statement at the [edit interfaces *interface-name* unit *logical-unit-number*] or [edit interfaces *interface-name* unit *logical-unit-number* address *address* family *family* multipoint-destination *address*] hierarchy level has no effect because either the default EPD threshold, the EPD threshold setting in the forwarding class, or the linear RED profile takes effect instead.

For more information about forwarding classes, see the *JUNOS Class of Service Configuration Guide*.

Enabling Eight Queues on ATM2 IQ Interfaces

By default, ATM2 IQ PICs on T-series, M120, and M320 platforms are restricted to a maximum of four egress queues per interface. You can enable eight egress queues on ATM2 IQ interfaces by including the max-queues-per-interface statement at the [edit chassis fpc *slot-number* pic *pic-number*] hierarchy level:

```
[edit chassis fpc slot-number pic pic-number]
max-queues-per-interface number;
```

The numerical value can be 4 or 8.

If you include the max-queues-per-interface statement, all ports on the ATM2 IQ PIC use the configured mode.

When you include the max-queues-per-interface statement and commit the configuration, all physical interfaces on the ATM2 IQ PIC are deleted and re-added. Also, the PIC is taken offline and then brought back online immediately. You do not need to manually take the PIC offline and online. You should change modes between four queues and eight queues, or vice versa, only when there is no active traffic going to the ATM2 IQ PIC.

To configure up to eight queues on the ATM2 IQ interface, you must also include the statements described in "Configuring ATM2 IQ VC Tunnel CoS Components" on page 325.

For general information about configuring up to eight forwarding classes and queues on PICs other than ATM2 IQ PICs, see the *JUNOS Class of Service Configuration Guide*.

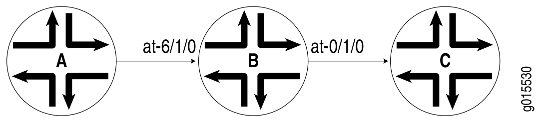
NOTE: When you are considering enabling eight queues on an ATM2 IQ interface, you should note the following:

- ATM2 IQ interfaces using Layer 2 circuit trunk transport mode support only four CoS queues.
- ATM2 IQ OC48 interfaces support only four CoS queues.
- ATM2 IQ interfaces with MLPPP encapsulation support only four CoS queues.
- You can configure only four RED profiles for the eight queues. Thus, queue 0 and queue 4 share a single RED profile, as do queue 1 and queue 5, queue 2 and queue 6, and queue 3 and queue 7. There is no restriction on EPD threshold per queue.
- The default chassis scheduler allocates resources for queue 0 through queue 3, with 25 percent of the bandwidth allocated to each queue. When you configure the chassis to use more than four queues, you must configure and apply a custom chassis scheduler to override the default. To apply a custom chassis scheduler, include the scheduler-map-chassis statement at the [edit class-of-service interfaces at-*fpc/pic/**] hierarchy level. For more information about configuring and applying a custom chassis scheduler, see the *JUNOS Class of Service Configuration Guide*.

Example: Enabling Eight Queues on T-series, M120, and M320 Platforms

In Figure 20 on page 330, Router A generates IP packets with different IP precedence settings. Router B is an M320, M120, or T-series platform with two ATM2 IQ interfaces. On Router B, interface at-6/1/0 receives traffic from Router A, while interface at-0/1/0 sends traffic to Router C. This example shows the CoS configuration for Router B.

Figure 20: Example Topology for Router with Eight Queues



On Router B:

```
[edit chassis]
fpc 0 {
   pic 1 {
      max-queues-per-interface 8;
   }
}
fpc 6 {
   pic 1 {
      max-queues-per-interface 8;
   }
}
[edit interfaces]
at-0/1/0 {
   atm-options {
      linear-red-profiles {
         red_1 queue-depth 1k high-plp-threshold 50 low-plp-threshold 80;
         red_2 queue-depth 2k high-plp-threshold 40 low-plp-threshold 70;
         red_3 queue-depth 3k high-plp-threshold 30 low-plp-threshold 60;
         red_4 queue-depth 4k high-plp-threshold 20 low-plp-threshold 50;
      }
      scheduler-maps {
         sch_red {
            vc-cos-mode strict;
            forwarding-class fc_q0 {
               priority high;
               transmit-weight percent 5;
               linear-red-profile red_1;
            }
            forwarding-class fc_q1 {
               priority low;
               transmit-weight percent 10;
               linear-red-profile red_2;
            }
            forwarding-class fc_q2 {
               priority low;
               transmit-weight percent 15;
               linear-red-profile red_3;
            }
            forwarding-class fc_q3 {
               priority low;
               transmit-weight percent 20;
               linear-red-profile red_4;
            }
            forwarding-class fc_q4 {
               priority low;
               transmit-weight percent 5;
               linear-red-profile red_1;
```

```
    }
    forwarding-class fc_q5 {
        priority low;
        transmit-weight percent 10;
        linear-red-profile red_2;
    }
    forwarding-class fc_q6 {
        priority low;
        transmit-weight percent 15;
        linear-red-profile red_3;
    }
    forwarding-class fc_q7 {
        priority low;
        transmit-weight percent 20;
        linear-red-profile red_4;
    }
}
sch_epd {
    vc-cos-mode alternate;
    forwarding-class fc_q0 {
        priority high;
        transmit-weight percent 5;
        epd-threshold 1024;
    }
    forwarding-class fc_q1 {
        priority low;
        transmit-weight percent 10;
        epd-threshold 2048;
    }
    forwarding-class fc_q2 {
        priority low;
        transmit-weight percent 15;
        epd-threshold 3072;
    }
    forwarding-class fc_q3 {
        priority low;
        transmit-weight percent 20;
        epd-threshold 4096;
    }
    forwarding-class fc_q4 {
        priority low;
        transmit-weight percent 5;
        epd-threshold 2048;
    }
    forwarding-class fc_q5 {
        priority low;
        transmit-weight percent 10;
        epd-threshold 3072;
    }
    forwarding-class fc_q6 {
        priority low;
        transmit-weight percent 15;
        epd-threshold 4096;
    }
    forwarding-class fc_q7 {
        priority low;
```

```
                transmit-weight percent 20;
                epd-threshold 5120;
            }
        }
    }
}
atm-options {
    vpi 0;
}
unit 0 {
    vci 0.100;
    shaping {
        cbr 1920000;
    }
    atm-scheduler-map sch_red;
    family inet {
        address 172.16.0.1/24;
    }
}
unit 1 {
    vci 0.101;
    shaping {
        vbr peak 1m sustained 384k burst 256;
    }
    atm-scheduler-map sch_epd;
    family inet {
        address 172.16.1.1/24;
    }
}
}
at-6/1/0 {
    atm-options {
        vpi 0;
    }
    unit 0 {
        vci 0.100;
        family inet {
            address 10.10.0.1/24;
        }
    }
    unit 1 {
        vci 0.101;
        family inet {
            address 10.10.1.1/24;
        }
    }
}
[edit class-of-service]
classifiers {
    inet-precedence inet_classifier {
        forwarding-class fc_q0 {
            loss-priority low code-points 000;
        }
        forwarding-class fc_q1 {
            loss-priority low code-points 001;
        }
```

```
        forwarding-class fc_q2 {
            loss-priority low code-points 010;
        }
        forwarding-class fc_q3 {
            loss-priority low code-points 011;
        }
        forwarding-class fc_q4 {
            loss-priority low code-points 100;
        }
        forwarding-class fc_q5 {
            loss-priority low code-points 101;
        }
        forwarding-class fc_q6 {
            loss-priority low code-points 110;
        }
        forwarding-class fc_q7 {
            loss-priority low code-points 111;
        }
    }
    forwarding-classes {
        queue 0 fc_q0;
        queue 1 fc_q1;
        queue 2 fc_q2;
        queue 3 fc_q3;
        queue 4 fc_q4;
        queue 5 fc_q5;
        queue 6 fc_q6;
        queue 7 fc_q7;
    }
    interfaces {
        at-6/1/0 {
            unit * {
                classifiers {
                    inet-precedence inet_classifier;
                }
            }
        }
    }
}
[edit routing-options]
static {
    route 10.10.20.2/32 {
        next-hop at-0/1/0.0;
        retain;
        no-readvertise;
    }
    route 10.10.1.2/32 {
        next-hop at-0/1/0.1;
        retain;
        no-readvertise;
    }
}
```

Verifying the Configuration

To see the results of this configuration, you can issue the following operational mode commands:

- show interfaces at-0/1/0 extensive

- show interfaces queue at-0/1/0
- show class-of-service forwarding-class

Configuring VC CoS Mode

VC CoS mode defines the CoS queue scheduling priority. By default, the VC CoS mode is alternate. When it is a queue's turn to transmit, the queue transmits up to its weight in cells as specified by the transmit-weight statement at the [edit interfaces at-*fpc/pic/port* atm-options scheduler-maps *map-name* forwarding-class *class-name*] hierarchy level. The number of cells transmitted can be slightly over the configured or default transmit weight, because the transmission always ends at a packet boundary.

To configure the VC CoS mode, include the vc-cos-mode statement at the [edit interfaces at-*fpc/pic/port* atm-options scheduler-maps] hierarchy level:

```
edit interfaces at-fpc/pic/port atm-options scheduler-maps]
vc-cos-mode (alternate | strict);
```

Two modes of CoS scheduling priority are supported:

- alternate—Assign high priority to one queue. The scheduling of the queues alternates between the high priority queue and the remaining queues. Every other scheduled packet is from the high priority queue.
- strict—Assign strictly high priority to one queue. A queue with strictly high priority is always scheduled before the remaining queues. The remaining queues are scheduled in round-robin fashion.

Enabling the PLP Setting to Be Copied to the CLP Bit

For a PE router with customer edge (CE)-facing, egress, ATM2 IQ interfaces configured with standard AAL5 encapsulation, you can enable the PLP setting to be copied into the CLP bit.

NOTE: This configuration setting is not applicable to Layer 2 circuit encapsulations because the control word captures and preserves CLP information. For more information about Layer 2 circuit encapsulations, see "Configuring Layer 2 Circuit Transport Mode" on page 286.

By default, at egress ATM2 IQ interfaces configured with standard AAL5 encapsulation, the PLP information is not copied to the CLP bit. This means the PLP information is not carried beyond the egress interface onto the CE router.

You can enable the PLP information to be copied into the CLP bit by including the plp-to-clp statement:

```
plp-to-clp;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* atm-options]
- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Configuring ATM CoS on the Logical Interface

To apply the ATM scheduler map to a logical interface, include the atm-scheduler-map statement:

```
atm-scheduler-map (map-name | default);
```

For ATM CoS to take effect, you must configure the VCI and VPI identifiers and traffic shaping on each VC by including the following statements:

```
vci vpi-identifier.vci-identifier;
shaping {
   (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained rate
      burst length);
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

For more information, see “Configuring a Point-to-Point ATM1 or ATM2 IQ Connection” on page 303 and “Defining the ATM Traffic-Shaping Profile” on page 305.

You can also apply a scheduler map to the chassis traffic that feeds the ATM interfaces. For more information, see the *JUNOS Class of Service Configuration Guide*.

Example: Configuring ATM2 IQ VC Tunnel CoS Components

Configure ATM2 IQ VC tunnel CoS components:

```
[edit interfaces]
at-1/2/0 {
   atm-options {
      vpi 0;
      linear-red-profiles red-profile-1 {
         queue-depth 35000 high-plp-threshold 75 low-plp-threshold 25;
      }
      scheduler-maps map-1 {
         vc-cos-mode strict;
         forwarding-class best-effort {
            priority low;
            transmit-weight percent 25;
            linear-red-profile red-profile-1;
         }
```

```
            }
        }
        unit 0 {
            vci 0.128;
            shaping {
                vbr peak 20m sustained 10m burst 20;
            }
            atm-scheduler-map map-1;
            family inet {
                address 192.168.0.100/32 {
                    destination 192.168.0.101;
                }
            }
        }
    }
```

Example: Configuring ATM1 Interfaces

The following configuration is sufficient to get an ATM1 OC3 or OC12 interface up and running. By default, ATM interfaces use ATM PVC encapsulation.

```
[edit interfaces]
at-fpc/pic/port {
    atm-options {
        vpi vpi-identifier maximum-vcs maximum-vcs-value;
        unit 0 {     # one unit per VC
        vci vpi-identifier.vci-identifier;
        family inet {
            address local-address {
                destination address;
            }
        }
    }
    unit 1 {# second VC
    ...
}
```

Complex Configuration Example

```
[edit interfaces]
at-0/0/0 {
    encapsulation atm-pvc;
    atm-options {
        vpi 0 maximum-vcs 1200;
    }
    unit 2 {
        encapsulation atm-snap;
        inverse-arp;
        vci 0.80;
        family inet {
            mtu 1500;
            address 192.168.0.3/32 {
                destination 192.168.0.1;
            }
        }
    }
    unit 3 {
```

```
        encapsulation atm-snap;
        vci 0.32;
        oam-period 60;
        family inet {
            mtu 1500;
            address 192.168.4.3/32 {
                destination 192.168.4.2;
            }
        }
    }
}
at-0/2/0 {
    encapsulation atm-pvc;
    atm-options {
        vpi 0 maximum-vcs 1200;
    }
    unit 2 {
        encapsulation atm-snap;
        inverse-arp;
        vci 0.82;
        family inet {
            mtu 1500;
            address 192.168.5.3/32 {
                destination 192.168.5.2;
            }
        }
    }
}
at-0/3/0 {
    encapsulation atm-pvc;
    atm-options {
        vpi 0 maximum-vcs 1200;
    }
    unit 140 {
        encapsulation atm-snap;
        multipoint;
        family inet {
            address 192.168.7.4/24 {
                multipoint-destination 192.168.7.5;
                vci 0.100;
                inverse-arp;
            }
        }
    }
}
at-7/3/0 {
    encapsulation atm-pvc;
    atm-options {
        vpi 0 maximum-vcs 1200;
    }
    unit 0 {
        encapsulation atm-snap;
        vci 0.32;
        family inet {
            address 192.168.12.3/32 {
                destination 192.168.12.2;
```

```
            }
        }
    }
}
```

Example: Configuring ATM2 IQ Interfaces

Configure VP tunnel-shaping and OAM F4 on an ATM2 IQ interface:

```
interfaces {
    at-5/2/0 {
        atm-options {
            vpi 0 {
                shaping {
                    vbr peak 10m sustained 6m burst 12;
                }
                oam-period 10;
                oam-liveness {
                    up-count 6;
                    down-count 5;
                }
            }
            vpi 4 {
                shaping {
                    vbr peak 7m sustained 4m burst 24;
                }
            }
            vpi 5 {
                oam-period 10;
                oam-liveness {
                    up-count 6;
                    down-count 5;
                }
            }
            vpi 6;
        }
        unit 0 {
            vci 0.128;
            transmit-weight 20;
            family inet {
                address 192.168.9.225/32 {
                    destination 192.168.9.224;
                }
            }
        }
        unit 1 {
            vci 0.129;
            transmit-weight 30;
            family inet {
                address 192.168.9.226/32 {
                    destination 192.168.9.227;
                }
            }
        }
```

```
        unit 2 {
            vci 5.123;
            shaping {
                vbr peak 60m sustained 4m burst 24;
            }
            family inet {
                address 192.168.9.227/32 {
                    destination 192.168.9.230;
                }
            }
        }
    }
}
```

Chapter 14

Configuring ATM-over-ADSL Interfaces

This chapter includes the following topics:

ATM-over-ADSL Overview

J4300 and J6300 Services Routers with asymmetrical DSL (ADSL) Annex A or Annex B PIMs can use an ATM interface to send network traffic through a point-to-point connection to a DSLAM. ATM-over-ADSL interfaces are not supported on J2300 Services Routers.

NOTE: You can configure J4300 and J6300 Services Routers with ADSL PIMs for connections through DSL only, not for direct ATM connections.

You configure the underlying ADSL as an ATM interface with an interface name of at-*pim*/0/*port*. Multiple encapsulation types are supported on both the physical and logical ATM-over-ADSL interface.

You can configure Point-to-Point Protocol over Ethernet (PPPoE) over ATM to connect through DSL lines. For PPPoE on an ATM-over-ADSL interface, you must configure encapsulation on both the physical and logical interfaces. To configure encapsulation on an ATM-over-ADSL physical interface, use Ethernet over ATM encapsulation. To configure encapsulation on an ATM-over-ADSL logical interface, use the PPPoE over AAL5 LLC encapsulation. LLC encapsulation allows a single ATM virtual connection to transport multiple protocols.

NOTE: PPPoE encapsulation is not supported on an M120 router with ATM2 PICs.

When you configure a point-to-point encapsulation such as PPP on a physical interface, the physical interface can have only one logical interface (only one unit statement) associated with it.

For more information about configuring PPPoE, see “Configuring PPPoE” on page 743.

Configuring Physical ATM Interfaces and Logical Interface Properties for ADSL

To configure physical ATM interfaces for ADSL, include the vpi 0 statement at the [edit interfaces at-*pim*/0/*port* atm-options] hierarchy level, the operating-mode statement at the [edit interfaces at-*pim*/0/*port* dsl-options] hierarchy level, and the encapsulation statement at the [edit interfaces at-*pim*/0/*port*] hierarchy level:

```
[edit interfaces at-pim/0/port]
atm-options {
   vpi 0;
   dsl-options;
   operating-mode (adsl2plus | ansi-dmt | auto | etsi | itu-annexb-ur2 | itu-annexb-non-ir2 |
      itu-dmt | itu-dmt-bis);
}
encapsulation (atm-pvc | ethernet-over-atm);
```

Configure logical interface properties by including the encapsulation statement, family statement, and vci statement:

```
unit logical-unit-number {
   encapsulation (atm-vc-mux | atm-nlpd | atm-cisco-nlpd | atm-snap | atm-ppp-vc-mux |
      atm-ppp-llc | ether-over-atm-llc | ppp-over-ether-over-atm-llc);
   family inet {
      vci vpi-identifier.vci-identifier;
   }
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Configuring the ATM-over-ADSL Virtual Path Identifier

Set the ATM virtual path identifier (VPI) to 0 (zero) by including the vpi 0 statement at the [edit interfaces at-*pim*/0/*port* atm-options] hierarchy level:

```
[edit interfaces at-pim/0/port atm-options]
vpi 0;
```

Configuring the ATM-over-ADSL Physical Interface Operating Mode

Configure the ADSL operating mode on the physical ATM interface by including the operating-mode statement at the [edit interfaces at-*pim*/0/*port* dsl-options] hierarchy level:

```
[edit interfaces at-pim/0/port dsl-options]
operating-mode mode;
```

By default, the mode is auto, which means the ADSL line autonegotiates the setting to match the setting of the DSLAM located at the central office.

Table 30 on page 343 shows the Annex A PIM and Annex B PIM operational modes for ATM-over-ADSL interfaces.

Table 30: ATM-over-ADSL Operational Modes

Encapsulation Types	Comments
Annex A PIMs	
adsl2plus	Set the ADSL line to train in the ITU G.992.5 mode.
ansi-dmt	Set the ADSL line to train in the ANSI T1.413 Issue 2 mode.
auto	Set the ADSL line to autonegotiate the setting to match the setting of the DSLAM located at the central office. The ADSL line trains in the ANSI T1.413 Issue 2 (ansi-dmt) or ITU G.992.1 (itu-dmt) mode.
itu-dmt	Set the ADSL line to train in the ITU G.992.1 mode.
itu-dmt-bis	Set the ADSL line to train in the ITU G.992.3 mode.
itu-lite	Set the ADSL line to train in the G.992.2 mode.
itu-lite-bis	Set the ADSL line to train in the G.992.4 mode.
Annex B PIMs	
adsl2plus	Set the ADSL line to train in the ITU G.992.5 mode.
auto	Set the ADSL line after autonegotiating the setting to match the setting of the DSLAM located at the central office.
etsi	Set the ADSL line to train in the ETSI TS 101 388 V1.3.1 mode.
itu-dmt	Set the ADSL line to train in the ITU G.992.1 mode.
itu-dmt-bis	Set the ADSL line to train in the ITU G.992.3 mode.

Table 30: ATM-over-ADSL Operational Modes *(continued)*

Encapsulation Types	Comments
itu-annexb-ur2	Set the ADSL line to train in the ITU G.992.1 Deutsche Telekom UR-2 mode.
itu-annexb-non-ur2	Set the ADSL line to train in the ITU G.992.1 non-UR-2 mode.
itu-dmt	Set the ADSL line to train in the ITU G.992.1 mode.

Configuring the ATM-over-ADSL Physical Interface Encapsulation Type

Configure the physical interface encapsulation type by including the encapsulation statement at the [edit interfaces at-*pim*/0/*port*] hierarchy level:

[edit interfaces at-*pim*/0/*port*]
encapsulation *type*;

Table 31 on page 344 shows the physical interface encapsulation types for ATM-over-ADSL interfaces.

Configuring the ATM-over-ADSL Logical Interface Encapsulation Type

Configure the logical interface encapsulation type by including the encapsulation statement:

[edit interfaces at-*pim*/0/*port* unit *logical-unit-number*]
encapsulation *type*;

You can include this statement at the following hierarchy levels:

[edit interfaces *interface-name* unit *logical-unit-number*]

[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Table 31 on page 344 shows the logical interface encapsulation types for ATM-over-ADSL interfaces.

Table 31: ATM-over-ADSL Encapsulation Types

Encapsulation Types	Comments
Physical Interface	
ether-over-atm	Ethernet over ATM encapsulation. Use this type of encapsulation for interfaces that carry IPv4 traffic.
atm-pvc	ATM permanent virtual circuits (PVCs).

Table 31: ATM-over-ADSL Encapsulation Types *(continued)*

Encapsulation Types	Comments
Logical Interface	
atm-vc-mux	Use ATM VC multiplex encapsulation. You can only configure the inet family when you use this type of encapsulation.
atm-nlpd	Use ATM network layer protocol ID (NLPD) encapsulation. You can only configure the inet family when you use this type of encapsulation.
atm-cisco-nlpd	Use Cisco NLPD encapsulation. You can only configure the inet family when you use this type of encapsulation.
atm-snap	Use ATM subnetwork attachment point (SNAP) encapsulation.
atm-ppp-vc-mux	Use PPP over ATM AAL5 multiplex encapsulation.
atm-ppp-llc	Use ATM PPP over AAL5 logical link control (LLC) encapsulation.
ether-over-atm-llc	Use Ethernet over LLC encapsulation for interfaces that carry IPv4 traffic. You cannot configure multipoint interfaces if you use this type of encapsulation.
ppp-over-ether-over-atm-llc	Use PPP over Ethernet over ATM LLC encapsulation. You cannot configure the interface address when you use this encapsulation type. Instead, you configure the interface address on the PPP interface.

Configuring the ATM-over-ADSL Protocol Family

Configure the protocol family type by including the family statement:

[edit interfaces at-*pim*/0/*port* unit *logical-unit-number*]
family *family*;

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Configuring the ATM-over-ADSL Virtual Channel Identifier

Configure the virtual channel identifier (VCI) type and value by including the vci statement:

```
[edit interfaces at-pim/0/port unit logical-unit-number]
vci vpi-identifier.vci-identifier;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Chapter 15

Configuring ATM-over-SHDSL Interfaces

This chapter includes the following topics:

ATM-over-SHDSL Overview

The symmetric high-speed digital subscriber line (SHDSL) Physical Interface Module (PIM) is available for J-series Services Routers. The PIM supports multi-rate, high-speed, symmetrical digital subscriber line technology for data transfer between a single customer premises equipment (CPE) subscriber and a central office (CO). Unlike ADSL, which was designed for delivering more bandwidth downstream than upstream, SHDSL is symmetrical and delivers a bandwidth of 2.3 Mbps in both directions. The SHDSL PIM has 2 ports and supports ATM-over-SHDSL mode only.

SHDSL is defined in the following specifications from the ITU and the Internet Engineering Task Force (IETF):

- ITU G.991.2, *Single-pair High-speed Digital Subscriber Line (SHDSL) Transceiver*
- ITU G.994.1, *Handshake Procedures for Digital Subscriber Line (DSL) Transceivers*
- ITU G.997.1, *Physical Layer Management for Digital Subscriber Line (DSL) Transceivers*
- RFC 3276, *Definitions of Managed Objects for High Bit-Rate DSL - 2nd generation (HDSL2) and Single-Pair High-Speed Digital Subscriber Line (SHDSL) Lines*

J-series Services Routers with SHDSL Annex A or Annex B PIMs act as a primary WAN link. They use an ATM interface to send network traffic through a point-to-point connection to a DSL-access multiplexer (DSLAM). You can configure Point-to-Point Protocol over Ethernet (PPPoE) over ATM to connect through DSL lines. For more information about configuring PPPoE, see “Configuring PPPoE” on page 743.

ATM-over-SHDSL interfaces are not supported on J2300 Services Routers.

NOTE: You can configure J-series Services Routers with SHDSL PIMs for connections through SHDSL only, not for direct ATM connections.

Configuring ATM Mode for SHDSL Overview

To configure the ATM mode for SHDSL, include the pic-mode statement at the [edit chassis fpc *fpc-number* pic 0 shdsl] hierarchy level:

```
[edit chassis]
fpc fpc-number {
   pic 0 {
      shdsl {
         pic-mode (1-port-atm | 2-port-atm);
      }
   }
}
```

For more information about configuring the ATM mode, see the *JUNOS System Basics Configuration Guide* and the *J-series Services Router Advanced WAN Access Configuration Guide*.

To configure SHDSL operating mode on the physical ATM interface and set the encapsulation, include the shdsl-options statement and the encapsulation statement at the [edit interfaces at-*pim*/0/ *port*] hierarchy level:

```
[edit interfaces at-pim/0/port]
shdsl-options {
   annex (annex-a | annex-b);
   line-rate line-rate;
   loopback (local remote);
   snr-margin {
      current margin;
      snext margin;
   }
   encapsulation (atm-pvc | ethernet-over-atm)
}
```

To configure ATM virtual path identifier (VPI) options for the interface, include the vpi statement at the [edit interfaces *interface-name* atm-options] hierarchy level:

```
[edit interfaces interface-name]
atm-options {
   vpi vpi-identifier {
      maximum-vcs maximum-vcs;
      oam-liveness {
         up-count cells;
         down-count cells;
      }
      oam-period (disable | seconds);
   }
```

```
}
```

For more information about configuring ATM VPI options, see “Configuring the Maximum Number of ATM1 VCs on a VP” on page 286.

To configure logical interface properties, include the encapsulation statement, family statement, and vci statement:

```
unit logical-unit-number {
    encapsulation type;
    family inet {
        vci vpi-identifier.vci-identifier;
    }
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Configuring ATM Mode on the PIM

The J-series Services Routers with an SHDSL PIM installed support the 2-port, two-wire mode (Annex A or Annex B). You can configure only one mode on each 2-port SHDSL PIM.

NOTE: G.SHDSL interfaces on a J-series Services Router only support 2-port, two-wire mode. This is enabled by default. The 1-port, 4-wire mode is not supported.

The two-wire mode supports autodetection of the line rate or fixed line rate and network speeds from 192 Kbps to 2.3 Kbps in 64-Kbps increments.

For information about configuring Annex A or Annex B, see “Configuring SHDSL Operating Mode on an ATM Physical Interface” on page 350.

To configure the ATM mode for SHDSL, include the pic-mode statement at the [edit chassis fpc *fpc-number* pic 0 shdsl] hierarchy level:

```
[edit chassis]
fpc fpc-number {
    pic 0 {
        shdsl {
            pic-mode 2-port-atm);
        }
    }
}
```

The default is 2-wire mode. If nothing is configured, the SHDSL interface will be configured in 2-wire mode (2-port-atm).

For more information about configuring the pic-mode statement, see the *JUNOS System Basics Configuration Guide*. For information about configuring the ATM mode, see the *J-series Services Router Basic LAN and WAN Access Configuration Guide*.

Configuring SHDSL Operating Mode on an ATM Physical Interface

To configure the SHDSL operating mode on the physical ATM interface, include the shdsl-options statement at the [edit interfaces at-*pim*/0/*port*] hierarchy level:

```
[edit interfaces at-pim/0/port]
shdsl-options {
    annex (annex-a | annex-b);
    line-rate line-rate;
    loopback (local | remote);
    snr-margin {
        current margin;
        snext margin;
    }
}
```

Configure the following SHDSL options:

- annex—The type of annex:
  - annex-a—Use for North American SHDSL network implementations.
  - annex-b—Use for European SHDSL network implementations.
- line-rate—The SHDSL line rate. The default for 2-wire mode is auto. The default for 4-wire mode is 4608 Kbps.
- loopback—A loopback connection, local or remote.
  - local—Use to troubleshoot physical PIC errors. A local loopback loops packets, including both data and timing information, back on the local routing platform's PIM.
  - remote—Use to troubleshoot 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 routing platform's PIC.
- snr-margin— The SHDSL signal-to-noise ratio (SNR) margin, current or snext. The SNR margin is the difference between the desired SNR and the actual SNR.
  - current—Current SNR is the difference between desired SNR and the actual SNR. When configured, the line trains at higher than current noise margin plus SNR threshold.
  - snext—Self-near-end crosstalk (SNEXT) SNR margin line trains the line at higher than SNEXT threshold.

Configuring Encapsulation on the ATM Physical Interface

To configure the type of encapsulation for the physical ATM interface, include the encapsulation statement at the [edit interfaces at-*pim* /0/*port*] hierarchy level:

```
[edit interfaces at-pim/0/port]
encapsulation (atm-pvc | ether-over-atm);
```

Configure one of the following:

- atm-pvc—ATM permanent virtual circuits (PVCs), used for PPP over ATM over SHDSL interfaces. This is the default encapsulation.
- ether-over-atm—Ethernet over ATM encapsulation. For interfaces that carry IPv4 traffic, use this type of encapsulation.

Configuring Logical Interface Properties

To configure logical interface properties, include the encapsulation statement, family statement, and vci statement:

```
unit logical-unit-number {
  encapsulation type;
  family inet {
    vci vpi-identifier.vci-identifier;
  }
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

To configure the logical link-layer encapsulation type, include the encapsulation statement.

ATM-over-SHDSL interfaces that use inet (IP) protocols support the following encapsulations on the logical interface:

- atm-vc-mux—Use ATM VC multiplex encapsulation. You can only configure the inet family when you use this type of encapsulation.
- atm-nlpd—Use ATM network layer protocol ID (NLPD) encapsulation. You can only configure the inet family when you use this type of encapsulation.
- atm-cisco-nlpd—Use Cisco NLPD encapsulation. You can only configure the inet family when you use this type of encapsulation.

ATM-over-SHDSL for PPP over ATM interfaces support the following encapsulations on the logical interface:

- atm-ppp-llc—Use ATM PPP over AAL5 logical link control (LLC) encapsulation.
- atm-ppp-vc-mux—Use PPP over ATM AAL5 multiplex encapsulation.

ATM-over-SHDSL interfaces also support the following encapsulations on the logical interface:

- atm-snap—Use ATM subnetwork attachment point (SNAP) encapsulation.
- atm-mlppp-llc—For ATM2 IQ interfaces only, use Multilink PPP (MLPPP) over AAL5 LLC. For this encapsulation type, your routing platform must be equipped with a Link Services or Voice Services PIC. MLPPP over ATM encapsulation is not supported on ATM2 IQ OC48 interfaces.
- ppp-over-ether-over-atm-llc—Use PPP over Ethernet over ATM LLC encapsulation. When you use this encapsulation type, you cannot configure the interface address. Instead, you configure the interface address on the PPP interface.
- family—The family protocol type.
- vci—The virtual channel identifier (VCI) type and value.
- *vci-identifier*—ATM virtual circuit identifier. Unless you configure the interface to use promiscuous mode, this value cannot exceed the largest numbered VC configured for the interface with the maximum-vcs option of the vpi statement. Specify a VCI identifier from 0 through 4089 or 0 through 65,535 with promiscuous mode. VCIs from 0 through 31 are reserved.
- *vpi-identifier*—ATM virtual path identifier. Specify a VPI from 0 through 255. The default is 0.

Example: Configuring an ATM-over-SHDSL Interface

The following example illustrates an ATM-over-SHDSL interface configuration.

Configuration for the ATM Mode on the PIM

```
[edit chassis]
fpc 6 {
    pic 0 {
        shdsl {
            pic-mode 2-port-atm;
        }
    }
}
```

Configuration for the SHDSL Operating Mode on the Physical ATM Interface

```
[edit interfaces at-6/0/0/0]
shdsl-options {
    annex annex-b;
    line-rate 192;
    loopback local;
    snr-margin {
        current 1;
        snext 2;
    }
}
```

Configuration for the Encapsulation on the Physical ATM Interface

```
[edit interfaces at-6/0/0/0]
encapsulation ethernet-over-atm;
```

Configuration for the Logical Interface

```
[edit interfaces at-6/0/0/0 unit 3]
encapsulation atm-nlpid;
family inet {
   vci 25;
}
```

Verifying an ATM-over-SHDSL Interface Configuration

To verify an ATM-over-SHDSL interface configuration, you can issue the following operational mode command:

user@host> **show interfaces at-*pim*/0/*port* extensive**

Part 5

Configuring Frame Relay Interfaces

Chapter 16
Configuring Frame Relay Interfaces

This chapter discusses configuration of the following Frame Relay properties:

Frame Relay Interfaces Overview

The Frame Relay protocol allows network designers to reduce costs by using shared facilities that are managed by a Frame Relay service provider. Users pay fixed charges for the local connections from each site in the Frame Relay network to the first point of presence (POP) in which the provider maintains a Frame Relay switch. The portion of the network between the endpoint switches is shared by all the customers of the service provider, and individual data-link connection identifiers (DLCIs) are assigned to ensure each customer receives only their own traffic.

Users contract with their providers for a specific minimum portion of the shared bandwidth Committed Information Rate (CIR) and for a maximum allowable peak rate, Burst Information Rate (BIR). Depending on the terms of the contract, traffic exceeding the CIR can be marked as eligible for discard, in the event of network congestion, or a best effort term can apply up to the BIR rate.

Frame Relay does not require private and permanently connected wide area network facilities, unlike some older WAN protocols.

Frame Relay was developed as a replacement for the older and much slower X.25 protocol. It scales to much higher data rates because it does not require explicit acknowledgment of each frame of data.

You can configure the Frame Relay protocol on SONET/SDH, E1/E3, and T1/T3 physical routing platform interfaces, and on the channelized DS3, channelized OC12, channelized T3 intelligent queuing (IQ), channelized OC12 IQ, and channelized E1 IQ interfaces.

Configuring Frame Relay Interface Encapsulation

Point-to-Point Protocol (PPP) encapsulation is the default encapsulation type for physical interfaces. You need not configure encapsulation for any physical interfaces that support PPP encapsulation. If you do not configure encapsulation, PPP is used by default. For physical interfaces that do not support PPP encapsulation, you must configure an encapsulation to use for packets transmitted on the interface. You can optionally configure an encapsulation on a logical interface, which is the encapsulation used within certain packet types.

For more information, see the following sections:

- Configuring the Frame Relay Encapsulation on a Physical Interface on page 358
- Configuring the Frame Relay Encapsulation on a Logical Interface on page 361

Configuring the Frame Relay Encapsulation on a Physical Interface

For Frame Relay interfaces, configure Frame Relay encapsulation on the physical interface. This encapsulation is defined in RFC 1490, *Multiprotocol Interconnect over Frame Relay*. SONET/SDH and T3 interfaces can use Frame Relay encapsulation.

To configure Frame Relay encapsulation on a physical interface, include the encapsulation statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
encapsulation type;
```

When you configure a multipoint encapsulation (such as Frame Relay), the physical interface can have multiple logical units, and the units can be either point-to-point or multipoint.

The encapsulation type can be one of the following:

- Flexible Frame Relay (flexible-frame-relay)—IQ interfaces can use flexible Frame Relay encapsulation. You use flexible Frame Relay encapsulation when you want to configure multiple per-unit Frame Relay encapsulations. This encapsulation type allows you to configure any combination of TCC, CCC, and standard Frame Relay encapsulations on a single physical port. Also, each logical interface can have any DLCI value from 1 through 1022.
- Frame Relay (frame-relay)—Defined in RFC 1490. E1, E3, link services, SONET/SDH, T1, T3, and voice services interfaces can use Frame Relay encapsulation. Five related versions are supported:

  - Circuit cross-connect (CCC) version (frame-relay-ccc)—The same as standard Frame Relay for DLCIs 0 through 511. DLCIs 512 through 1022 are dedicated to CCC. The logical interface must also have frame-relay-ccc encapsulation. When you use this encapsulation type, you can configure the ccc family only.
  - Translational cross-connect (TCC) version (frame-relay-tcc)—Similar to Frame Relay CCC and has the same configuration restrictions, but used for circuits with different media on either side of the connection.
  - Extended CCC version (extended-frame-relay-ccc)—This encapsulation type allows you to dedicate DLCIs 1 through 1022 to CCC. The logical interface must have frame-relay-ccc encapsulation. When you use this encapsulation type, you can configure the ccc family only.
  - Extended TCC version (extended-frame-relay-tcc)—Similar to extended Frame Relay CCC, this encapsulation type allows you to dedicate DLCIs 1 through 1022 to TCC, which is used for circuits with different media on either side of the connection.
  - Port CCC version (frame-relay-port-ccc)—Defined in the Internet Engineering Task Force (IETF) document, *Frame Relay Encapsulation over Pseudo-Wires* (expired December 2002). This encapsulation type allows you to transparently carry all the DLCIs between two customer edge (CE) routers without explicitly configuring each DLCI on the two provider edge (PE) routers with Frame Relay transport. The connection between the two CE routers can be either user-to-network interface (UNI) or network-to-network interface (NNI); this is completely transparent to the PE routers. The logical interface does not require an encapsulation statement. When you use this encapsulation type, you can configure the ccc family only.

- Frame Relay Ether Type (frame-relay-ether-type)—Physical interfaces can use Frame Relay ether type encapsulation for compatibility with Cisco Frame Relay. IETF frame relay encapsulation identifies the payload format using NLPID and SNAP formats. Cisco-compatible Frame Relay encapsulation uses the Ethernet type to identify the type of payload. Two related versions are supported:
  - TCC version (frame-relay-ether-type-tcc)—Cisco-compatible Frame Relay for DLCIs 0 through 511. DLCIs 512 through 1022 are dedicated to TCC. This numbering restriction does not apply to IQ interfaces. This encapsulation is used for circuits with different media on either side of the connection.
  - Extended TCC version (extended-frame-relay-ether-type-tcc)—This encapsulation allows you to dedicate Cisco-compatible Frame Relay TCC for DLCIs 1 through 1022. This encapsulation is used for circuits with different media on either side of the connection. Extended Frame Relay ether type TCC encapsulation is supported on the same PICs as extended Frame Relay TCC encapsulation.

NOTE: When the encapsulation type is set to Cisco-compatible Frame Relay encapsulation, ensure that the LMI type is set to ANSI or Q933-A.

Support for extended Frame Relay and flexible Frame Relay differs by PIC type, as shown in Table 32 on page 360.

Table 32: PIC Support for Enhanced Frame Relay Encapsulation Types

PIC Type	Extended Frame Relay CCC	Extended Frame Relay TCC	Flexible Frame Relay
Intelligent Queuing			
1-port Channelized CHOC12 IQ	Yes	Yes	Yes
4-port Channelized DS3 IQ	Yes	Yes	Yes
10-port Channelized E1 IQ	Yes	Yes	Yes
4-port E3 IQ	Yes	Yes	Yes
1-port Channelized STM1 IQ	Yes	Yes	Yes
SONET/SDH			
1-port OC12	Yes	Yes	No
2-port OC3	Yes	Yes	No
1-port OC48	Yes	Yes	No
1-port OC192	Yes	Yes	No
1-port STM16 SDH, SMSR	Yes	Yes	No
Others			
4-port E1	No	No	No
4-port T1	No	No	No
4-port T3	No	No	No
10-port Channelized E1	No	No	No
2-port Channelized DS3	No	No	No
1-port Channelized OC12, SMIR	No	No	No
4-port Channelized DS3	No	No	No
1-port Channelized STM1, SMIR	No	No	No
2-port Serial	No	No	No

Example: Configuring the Encapsulation on a Physical Interface

Configure Frame Relay encapsulation on a SONET/SDH interface. The second and third family statements allow Intermediate System-to-Intermediate System (IS-IS) and Multiprotocol Label Switching (MPLS) to run on the interface.

```
[edit interfaces]
so-7/0/0 {
```

```
        encapsulation frame-relay;
        unit 0 {
            point-to-point;
            family inet {
                address 192.168.1.113/32 {
                    destination 192.168.1.114;
                }
            }
            family iso;
            family mpls;
        }
    }
```

Configuring the Frame Relay Encapsulation on a Logical Interface

Generally, you configure an interface's encapsulation at the [edit interfaces *interface-name*] hierarchy level. However, for Frame Relay encapsulation, you can also configure the encapsulation type that is used inside the Frame Relay packet itself. To do this, include the encapsulation statement, specifying the frame-relay-ccc, frame-relay-ppp, frame-relay-tcc, frame-relay-ether-type, or frame-relay-ether-type-tcc option:

```
encapsulation (frame-relay-ccc | frame-relay-ppp | frame-relay-tcc | frame-relay-ether-type
    | frame-relay-ether-type-tcc);
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Configuring Frame Relay Control Bit Translation

On interfaces with Frame Relay CCC encapsulation, you can configure Frame Relay control bit translation, as defined in the IETF documents:

- Internet draft draft-martini-frame-encap-mpls-00.txt, *Frame Relay Encapsulation over Pseudo-Wires* (expired December 2002)
- Internet draft draft-martini-l2circuit-encap-mpls-07.txt, *Encapsulation Methods for Transport of Layer 2 Frames Over IP and MPLS Networks* (expired December 2004)

To support Frame Relay services over IP and MPLS backbones using Layer 2 VPNs and Layer 2 circuits, you can configure translation of the Frame Relay control bits. When you configure translation of Frame Relay control bits, the bits are mapped into the Layer 2 circuit control word and preserved across the IP or MPLS backbone.

The JUNOS software allows you to translate the following Frame Relay control bits:

- Discard eligibility (DE)—A header bit used to identify lower priority traffic that can be dropped during periods of congestion.

- Forward explicit congestion notification (FECN)—A header bit transmitted by the source routing platform requesting that the destination routing platform slow down its requests for data.
- Backward explicit congestion notification (BECN)—A header bit transmitted by the destination routing platform requesting that the source routing platform send data more slowly.

By default, translation of Frame Relay control bits is disabled. If you enable Frame Relay control bit translation, the bits are translated in both directions (CE to PE and PE to CE):

- From CE to PE—At ingress, the DE, FECN, and BECN header bits from the incoming Frame Relay header are mapped to the control word.
- From PE to CE—At egress, the DE, FECN, and BECN header bits from the control word are mapped to the outgoing Frame Relay header.

The Frame Relay control bits do not map to MPLS EXP labels, and do not affect class-of-service (CoS) behavior inside the provider network.

You enable or explicitly disable translation of Frame Relay control bits by including the translate-discard-eligible and translate-fecn-and-becn statements:

```
(translate-discard-eligible | no-translate-discard-eligible);
(translate-fecn-and-becn | no-translate-fecn-and-becn);
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family ccc]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family ccc]

If you enable or disable Frame Relay control bit translation on one CE-facing interface, you must configure the same Frame Relay control bit translation settings on the other CE-facing interface.

If you change the Frame Relay control bit translation settings, the circuit goes down and comes back up, which might result in traffic loss for a few seconds.

If you enable Frame Relay control bit translation, the number of supportable Layer 2 virtual private networks (VPNs) and Layer 2 circuits is reduced to one eighth of what the routing platform can support without Frame Relay control bit translation enabled.

For ATM2 IQ interfaces, the control word contains a field to carry ATM cell loss priority (CLP) information by default. For more information, see “Configuring Layer 2 Circuit Transport Mode” on page 286.

For more information about Layer 2 circuits, see the *JUNOS VPNs Configuration Guide* and the *JUNOS Routing Protocols Configuration Guide*. For a comprehensive example, see the *JUNOS Feature Guide*.

Configuring the Media MTU on Frame Relay Interfaces

For Frame Relay interfaces, the default media maximum transmission unit (MTU) is 4482 bytes. (For a complete list of MTU values, see “Configuring the Media MTU” on page 92.)

To modify the default media MTU size for a physical interface, include the mtu statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
mtu bytes;
```

If you change the size of the media MTU, you must ensure that the size is equal to or greater than the sum of the protocol MTU and the encapsulation overhead. You can include the mtu statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family *family*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

For more information, see “Setting the Protocol MTU with Frame Relay Encapsulation” on page 363.

Setting the Protocol MTU with Frame Relay Encapsulation

For each interface, you can configure an interface-specific MTU by including the mtu statement at the [edit interfaces interface *interface-name*] hierarchy level. If you need to modify this MTU for a particular protocol family, include the mtu statement:

```
mtu mtu;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family *family*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

For Frame Relay encapsulation, the default protocol MTU is 4470 bytes.

If you increase the size of the protocol MTU, you must ensure that the size of the media MTU is equal to or greater than the sum of the protocol MTU and the encapsulation overhead. (You configure the media MTU by including the mtu statement at the [edit interfaces *interface-name*] hierarchy level, as discussed in “Configuring the Media MTU on Frame Relay Interfaces” on page 363.)

When the family is mpls, the default protocol MTU is 1488 bytes. MPLS packets are 1500 bytes and have 4 to 12 bytes of overhead.

Configuring Frame Relay Keepalives

By default, physical interfaces configured with Cisco High-level Data Link Control (HDLC) or Point-to-Point Protocol (PPP) encapsulation send keepalive packets at 10-second intervals. The Frame Relay term for keepalives is Local Management Interface (LMI) packets; note that the JUNOS software supports both ANSI T1.617 Annex D LMIs and ITU Q933 Annex A LMIs.

To disable the sending of keepalives on a physical interface, include the no-keepalives statement at the [edit interfaces interface *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
no-keepalives;
```

For back-to-back Frame Relay connections, either disable the sending of keepalives on both sides of the connection, or configure one side of the connection as a data terminal equipment (DTE) (the default JUNOS configuration) and the other as a data circuit-terminating equipment (DCE).

If keepalives are enabled, the number of possible DLCI configurations on a multipoint or multicast connection is limited by the MTU size selected for the interface. To calculate the available DLCIs, use the formula (MTU – 12) /5. To increase the number of possible DLCIs, disable keepalives.

Configuring Tunable Keepalives for Frame Relay LMI

On interfaces configured with Frame Relay connections, you can tune the keepalive settings by using the lmi statement. A Frame Relay interface can be either DCE or DTE (the default JUNOS configuration). DTE acts as a master, requesting status from the DCE part of the link.

By default, the JUNOS software uses ANSI T1.617 Annex D LMIs. To change to ITU Q933 Annex A LMIs, include the lmi-type itu statement at the [edit interfaces *interface-name* lmi] hierarchy level:

```
[edit interfaces interface-name lmi]
lmi-type itu;
```

To configure Frame Relay keepalive parameters, include the lmi statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
lmi (interfaces) {
    lmi-type (ansi | itu);
    n391dte number;
    n392dce number;
    n392dte number;
    n393dce number;
    n393dte number;
    t391dte seconds;
    t392dce seconds;
}
```

You can include the following statements:

- n391dte—DTE full status polling interval. The DTE sends a status inquiry to the DCE at the interval specified by t391dte. n391dte specifies the frequency at which these inquiries expect a full status report; for example, a n391dte value of 10 would specify a full status report in response to every tenth inquiry. The intermediate inquiries ask for a keepalive exchange only. The range is from 1 through 255, with a default value of 6.
- n392dce—DCE error threshold. The number of errors required to bring down the link, within the event-count specified by n393dce. The range is from 1 through 10, with a default value of 3.
- n392dte—DTE error threshold. The number of errors required to bring down the link, within the event-count specified by n393dte. The range is from 1 through 10, with a default value of 3.
- n393dce—DCE monitored event-count. The range is from 1 through 10, with a default value of 4.
- n393dte—DTE monitored event-count. The range is from 1 through 10, with a default value of 4.
- t391dte—DTE keepalive timer. Period at which the DTE sends out a keepalive response request to the DCE and updates status depending on the DTE error threshold value. The range is from 5 through 30 seconds, with a default value of 10 seconds.
- t392dce—DCE keepalive timer. Period at which the DCE checks for keepalive responses from the DTE and updates status depending on the DCE error threshold value. The range is from 5 through 30 seconds, with a default value of 15 seconds.

Configuring Inverse Frame Relay ARP

Frame Relay interfaces support inverse Frame Relay ARP, as described in RFC 2390, *Inverse Address Resolution Protocol*. When inverse Frame Relay ARP is enabled, the routing platform responds to received inverse Frame Relay ARP requests by providing IP address information to the requesting routing platform on the other end of the Frame permanent virtual circuit (PVC).

The routing platform does not initiate inverse Frame Relay ARP requests.

By default, inverse Frame Relay ARP is disabled. To configure a routing platform to respond to inverse Frame Relay ARP requests, include the inverse-arp statement:

```
inverse-arp;
```

For a list of hierarchy levels at which you can include this statement, see inverse-arp.

You must configure Frame Relay encapsulation on the logical interface to support inverse ARP. For more information, see “Configuring Frame Relay Interface Encapsulation” on page 358.

Configuring the Router as a DCE with Frame Relay Encapsulation

By default, when you configure an interface with Frame Relay encapsulation, the routing platform is assumed to be DTE. That is, the routing platform is assumed to be at a terminal point on the network. To configure the routing platform to be DCE, include the dce statement at the [edit interfaces *interface-name*] hierarchy level:

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

When you configure the routing platform to be a DCE, keepalives are disabled by default.

For back-to-back Frame Relay connections, either disable the sending of keepalives on both sides of the connection, or configure one side of the connection as a DCE and the other as a DTE by removing the dce statement from the configuration (the default JUNOS configuration).

Configuring Frame Relay DLCIs

When you are using Frame Relay encapsulation on an interface, each logical interface corresponds to one or more permanent virtual circuits (PVCs) or switched virtual circuits (SVCs). For each PVC or SVC, you must configure one data-link connection identifier (DLCI).

A Frame Relay interface can be a point-to-point interface or a point-to-multipoint (also called a multipoint nonbroadcast multiaccess [NBMA]) connection.

To configure Frame Relay DLCIs, you can do the following:

Configuring a Point-to-Point Frame Relay Connection

To configure a point-to-point Frame Relay connection, include the dlci statement:

```
dlci dlci-identifier;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

The DLCI identifier is a value from 16 through 1022. Numbers 1 through 15 are reserved for future use. A point-to-point interface can have one DLCI.

NOTE: For information about Frame Relay DLCI limitations for channelized interfaces, see "Data-Link Connection Identifiers on Channelized Interfaces" on page 374.

You configure the routing platform to use DLCI sparse mode by including the sparse-dlcis statement at the [edit chassis fpc *slot-number* pic *pic-number*] hierarchy level. For more information about DLCI sparse mode, see the *JUNOS System Basics Configuration Guide*.

For more information about Frame Relay DLCIs, see "Configuring a Point-to-Point Frame Relay Connection" on page 366.

When you are configuring point-to-point connections, the MTU sizes on both sides of the connection must be the same.

Configuring a Point-to-Multipoint Frame Relay Connection

To configure a point-to-multipoint Frame Relay connection (also called a multipoint NBMA connection), include the multipoint-destination statement:

```
multipoint-destination address dlci dlci-identifier;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family *family* address *address*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family* address *address*]

For each destination, include one multipoint-destination statement. *address* is the address of the remote side of the connection, and *dlci-identifier* is the DLCI identifier for the connection.

When you are configuring point-to-multipoint connections, all interfaces in the subnet must use the same MTU size.

If keepalives are enabled, causing the interface to send LMI messages during idle times, the number of possible DLCI configurations is limited by the MTU selected for the interface. For more information, see "Configuring Frame Relay Keepalives" on page 364.

Configuring a Multicast-Capable Frame Relay Connection

By default, Frame Relay connections assume unicast traffic. If your Frame Relay switch performs multicast replication, you can configure the connection to support multicast traffic by including the multicast-dlci statement:

```
multicast-dlci dlci-identifier;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]

- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

The DLCI identifier is a value from 16 through 1022 that defines the Frame Relay DLCI over which the switch expects to receive multicast packets for replication.

You can configure multicast support only on point-to-multipoint Frame Relay connections.

If keepalives are enabled, causing the interface to send LMI messages during idle times, the number of possible DLCI configurations is limited by the MTU selected for the interface. For more information, see “Configuring Frame Relay Keepalives” on page 364.

Part 6
Configuring Channelized Interfaces

Chapter 17
Channelized Interfaces

This chapter provides a high-level overview of channelized interfaces, focusing mainly on the capabilities, properties, and structure of channelized IQ and IQE interfaces:

Channelized Interfaces Overview

Channelized interfaces enable you to configure a number of individual channels that subdivide the bandwidth of a larger interface and minimize the number of Physical Interface Cards (PICs) that an installation requires.

NOTE: Channelized intelligent queuing (IQ) and channelized enhanced intelligent queuing (IQE) interfaces require M-series Enhanced Flexible PIC Concentrators (FPCs) and MX-series Enhanced Flexible PIC Concentrators (FPCs).

Wherever JUNOS configuration guides refer to channelized interfaces and PICs without the “intelligent queuing IQ or IQE” descriptor, they are referring to the original channelized interfaces and PICs.

On M40e routers, all supported interface types support a maximum number of 784 traffic-bearing interfaces that can be created per interface port and includes ports on channelized PICs.

MX-series routers support two Type 2 Channelized IQ PICs: OC12/STM4 IQE PIC with SFP and OC48/STM16 IQE PIC with SFP. Each channelized OC12/STM4 PIC supports 4 ports, and the channelized OC48/STM16 PIC supports one port.

Channelized 4xCOC12 IQE PICs support deep-channelization of up to six OC slices (STS1) per port. For example, only six OC slices can be channelized to CT1/T1 or CE1/E1.

Channelized COC48 IQE PICs support deep-channelization of up to six OC slices (STS1) in a block of 12 contiguous OC slices. For example, only six OC slices out of OC slice 1-12 can be channelized to CT1/T1 or CE1/E1. The PIC supports deep-channelization of maximum 24 OC slices in this way.

Channelized OC48 IQE PICs do not support STS-48 clear-channel mode.

IQ and IQE PICs do not support aggregated SONET (link bonding).

For channelized IQ and IQE logical interfaces, you can configure class of service (CoS). For more information, see the *JUNOS Class of Service Configuration Guide*.

Channelized Interface Capabilities

You can configure each port of a channelized IQ PIC or channelized IQE PIC as a single interface that uses the entire available bandwidth, or partition each port into smaller data channels. In either case, you start with a channelized interface (designated by a c in the interface name, as in coc12). From the channelized interfaces, you configure data channels. Following are the channelized interface names and data-channel interface names associated with channelized IQ and IQE PICs.

Channelized Interface Names

This section lists the channelized interface names.

- coc48-*fpc/pic/port*—Channelized OC48 IQE interface. Configure on a Channelized OC48 IQE PIC.
- coc12-*fpc/pic/port*—Channelized OC12 interface. Configure on Channelized OC12 IQ or IQE PICs.

- coc3-*fpc/pic/port*:*channel*—Channelized OC3 interface. Configure on Channelized OC3 IQ or IQE, Channelized OC12 IQ or IQE PICs.
- coc1-*fpc/pic/port*:*channel*—Channelized OC1 interface. Configure on Channelized OC3 IQ or IQE, Channelized OC12 IQ or IQE, or Channelized OC48 IQE PICs.
- ct3-*fpc/pic/port*:*channel*—Channelized T3 interface. Configure on Channelized OC3 IQ or IQE, Channelized OC12 IQ or IQE, Channelized OC48 IQE, or Channelized DS3 IQ or IQE PICs.
- cstm16-*fpc/pic/port*—Channelized STM16 interface. Configure on a Channelized OC48 IQE PIC in SDH mode.
- cstm4-*fpc/pic/port*—Channelized STM4 interface. Configure on a Channelized OC12 IQ or IQE PIC in SDH mode.
- cstm1-*fpc/pic/port*—Channelized STM1 interface. Configure on a Channelized STM1 IQ or IQE PIC.
- cau4-*fpc/pic/port*:*channel*—Channelized AU-4 IQ interface. Configure on Channelized STM1 IQ or IQE, Channelized OC48 IQE, or Channelized OC12 IQE PICs.
- ct1-*fpc/pic/port*:*channel*—Channelized T1 interface. Configure on Channelized OC3 IQ or IQE, Channelized OC12 IQ or IQE, Channelized T1 IQ or IQE, Channelized OC48 IQE, or Channelized DS3 IQ or IQE PICs.
- ce1-*fpc/pic/port*:*channel*—Channelized E1 interface. Configure on Channelized E1 IQ or IQE, Channelized STM1 IQ or IQE, Channelized OC48/STM16 IQE, or Channelized OC12/STM4 IQE PICs.

Data-Channel Interface Names

This section lists the data-channel interface names.

- e1-*fpc/pic/port*:*channel*—E1 channel. Configure on Channelized E1 IQ or IQE, Channelized STM1 IQ or IQE, Channelized OC12/STM4 IQE, or Channelized OC48 IQE PICs.
- e3-*fpc/pic/port*:*channel*—E3 channel. Configure on Channelized OC3/STM1 IQE, or Channelized OC12/STM4 IQE, Channelized OC48 IQE, or Channelized/Clear channel DS3E3 IQE or E3 IQ PICs.
- ds-*fpc/pic/port*:*channel*—*N*xDS0 channel. Configure on Channelized OC3 IQ or IQE, Channelized OC12 IQ or IQE, Channelized OC48/STM16 IQE, Channelized STM1 IQ or IQE, Channelized DS3 IQ or IQE, Channelized T1 IQ, or Channelized E1 IQ or IQE PICs.
- so-*fpc/pic/port*:*channel*—SONET/SDH channel. Configure one OC3 channel on a Channelized OC3 IQ or IQE, four OC3 channels on a Channelized OC12 IQ or IQE, one OC12 channel on a Channelized OC12 IQ or IQE, four OC12 channels on Channelized OC48 IQE, or one STM1 channel on a Channelized STM1 IQ or IQE PICs.
- t1-*fpc/pic/port*:*channel*—T1 channel. Configure on Channelized T1 IQ or IQE, Channelized OC3 IQ or IQE, Channelized OC12 IQ or IQE, Channelized OC48 IQE, or Channelized DS3 IQ or IQE PICs.
- t3-*fpc/pic/port*:*channel*—T3 channel. Configure on Channelized OC3 IQ or IQE, Channelized OC12 IQ or IQE, Channelized OC48 IQE, Clear Channel DS3E3 IQE, or Channelized DS3 IQ or IQE PICs.

Data-Link Connection Identifiers on Channelized Interfaces

If you use Frame Relay encapsulation on a channelized interface, see Table 33 on page 374 for the maximum number of data-link connection identifiers (DLCIs) per channel that you can configure at each channel level for various channelized PICs.

If you use a per-unit-scheduler configuration on a channelized interface, see Table 34 on page 375 for the maximum number of data-link connection identifiers (DLCIs) per channel that you can configure at each channel level for various channelized PICs.

NOTE: The actual number of DLCIs you can configure for each channel is determined by the capabilities of your system, such as the number and types of PICs installed. If the number of DLCIs in the configuration exceeds the capabilities of your system, the routing platform might not be able to support the maximum DLCI values shown in Table 33 on page 374. To determine the capabilities of your system, please contact Juniper Networks customer support.

Table 33: Frame Relay DLCI Limitations for Channelized Interfaces

PIC Types	Number of DLCIs per Level	Range
Original Channelized PICs		
DS0 level channels	■ 3 for sparse mode	■ 1–1022 for sparse mode (0 is reserved for the Local Management Interface [LMI])
T3 and T1 level channels	■ 63 for regular mode ■ 3 for sparse mode	■ 1–63 for regular mode ■ 1–1022 for sparse mode (0 is reserved for the LMI)
Channelized IQ and IQE PICs		
DS0 level channels (Channelized DS3 IQ or IQE, Channelized STM1 IQ or IQE, Channelized E1 IQ or IQE, Channelized OC3 IQ or IQE, or Channelized OC12 IQ or IQE PICs)	■ 16	■ 1–1022 (0 is reserved for the LMI)
E1 level channels (Channelized E1 IQ or IQE PIC)	■ 64	■ 1–1022 (0 is reserved for the LMI)
E1 level channels (Channelized STM1 IQ or IQE PIC)	■ 64	■ 1–1022 (0 is reserved for the LMI)
OC3 level channels (Channelized OC3 IQ or IQE, or Channelized OC12 IQ or IQE PIC)	■ 1022	■ 1–1022 (0 is reserved for the LMI)

Table 33: Frame Relay DLCI Limitations for Channelized Interfaces *(continued)*

PIC Types	Number of DLCIs per Level	Range
OC12 level channels (Channelized OC12 IQ or IQE, Channelized OC48/STM16 IQE PICs, and (per port on) OC12 ports on 4xOC12/STM4 IQE PICs)	■ 1022	■ 1–1022 (0 is reserved for the LMI)
STM1 level channel (Channelized STM1 IQ or IQE PIC)	■ 1022	■ 1–1022 (0 is reserved for the LMI)
T1 level channels (Channelized DS3 IQ or IQE PIC)	■ 64	■ 1–1022 (0 is reserved for the LMI)
T1 level channels (Channelized OC3 IQ or IQE, or Channelized OC12 IQ or IQE PIC)	■ 64	■ 1–1022 (0 is reserved for the LMI)
T3 level channel (Channelized DS3 IQ or IQE, Channelized OC3 IQ or IQE, or Channelized OC12 IQ or IQE PIC)	■ 1022	■ 1–1022 (0 is reserved for the LMI)

Table 34: Per Unit Scheduler DLCI Limitations for Channelized Interfaces

	Number of DLCIs per Level			
	Non M40e Platforms		M40e Platform Only	
PIC Types	With Per-Unit-Scheduler	Without Per-Unit-Scheduler	With Per-Unit-Scheduler	Without Per-Unit-Scheduler
DS0 level channels	■ 64	■ 64	■ 16	■ 16
T1/E1 level channels	■ 64	■ 64	■ 64	■ 64
TS3/E3 level channels	■ 975	Protocol family combinations apply	256	256
SONET	■ 64	Protocol family combinations apply	975	Protocol family combinations apply
Protocol Family Combinations				

Table 34: Per Unit Scheduler DLCI Limitations for Channelized Interfaces *(continued)*

	Number of DLCIs per Level			
	Non M40e Platforms		M40e Platform Only	
PIC Types	With Per-Unit-Scheduler	Without Per-Unit-Scheduler	With Per-Unit-Scheduler	Without Per-Unit-Scheduler
Combining multiple protocol families per PIC changes the number of Frame Relay DLCIs as shown.		**Protocol Family Combinations**		**Number of DLCIs per PIC**
		inet		3600
		inet6		3600
		mpls		3000
		inet, inet6		2400
		inet, mpls		2000
		inet6, mpls		2000
		inet, inet6, mpls		1550

Clock Sources on Channelized Interfaces

Channelized interfaces and channelized IQ and IQE interfaces have different clocking capabilities. For channelized IQ and IQE interfaces, you can configure clocking on each interface independently by including the clocking (internal | external) statement at the [edit interfaces *interface-name*] hierarchy level.

For channelized IQ and IQE interfaces, clocking is provided as follows:

- For all channelized IQ and IQE PICs, the clocking statement is supported on all channels. To configure clocking on individual interfaces, include the clocking statement at the [edit interfaces *type-fpc/pic/port*:*channel*] hierarchy level. If you do not include the clocking statement, the individual interfaces use internal clocking by default.
- SONET/SDH-level clocking is provided at the root controller interface at the [edit interfaces *type-fpc/pic/port*] hierarchy level.
- Configure T3-level clocking by including the clocking statement at the [edit interfaces ct3-*fpc/pic/port*] hierarchy level.
- Configure T1-level clocking by including the clocking statement at the [edit interfaces t1-*fpc/pic/port*:*channel*] hierarchy level.
- Configure E1-level clocking by including the clocking statement at the [edit interfaces ce1-*fpc/pic/port*] hierarchy level.
- Configure clocking for all *N*xDS0 channels by including the clocking statement at the [edit interfaces ct1-*fpc/pic/port*:*channel*] or [edit interfaces ce1-*fpc/pic/port*] hierarchy level.

- The clocking statement is ignored if you include it at the [edit interfaces coc1-*fpc/pic/port*:*channel*] or [edit interfaces cau4-*fpc/pic/port*:*channel*] hierarchy level.
- SONET/SDH level clocking is applicable only at the controller interfaces for channelized IQ and IQE PICs. Clocking configuration is not effective at the so-*fpc/pic/port* or so-*fpc/pic/port*:*channel* for channelized IQ and IQE PICs.

For non-IQ and non-IQE channelized interfaces, clocking at each channel level is provided as follows:

- For Channelized OC12, DS3, and E1 PICs, the clocking statement is supported only for channel 0; it is ignored if included in the configuration of other channels. The clock source configured for channel 0 applies to all channels on these channelized interfaces.
- For the Channelized STM1 PIC, the clocking statement is supported on channels 0 through 62. To configure clocking on the STM1 interface, include the loop-timing statement at the [edit interfaces e1-*fpc/pic/port* :0 sonet-options] hierarchy level. To configure clocking on individual E1 interfaces, include the clocking statement at the [edit interfaces e1-*fpc/pic/port*:*channel*] hierarchy level. The channel number can be 0 through 62. If you do not include the clocking statement, the individual E1 interfaces use internal clocking by default.
- For channelized STM1 interfaces, you should configure the clock source at one side of the connection to be internal and configure the other side of the connection to be external.
- When you configure the clock source for a channelized interface—t3-*fpc/pic/port*:0, for example—you must also include the channel-group statement at the [edit chassis] hierarchy level, and specify channel group 0.

Table 35 on page 377 lists the clocking capabilities for each channelized PIC.

Table 35: Clocking Capabilities by Channelized PIC Type

PIC Type	SONET/SDH Level	DS3 Level	DS1/E1 Level
Channelized PICs			
Channelized DS3 and Multichannel DS3	Not applicable.	The loop-timing statement is supported at the [edit interfaces t1-*fpc/pic/port*:0 t3-options] or [edit interfaces *fpc/pic/port*:0:0 t3-options] hierarchy level.	The clocking statement is supported at the [edit interfaces t1-*fpc/pic/port*:0] or [edit interfaces ds-*fpc/pic/port*:0:0] hierarchy level.
Channelized E1	Not applicable.	Not applicable.	The clocking statement is supported at the [edit interfaces e1-*fpc/pic/port*:0] or [edit interfaces ds-*fpc/pic/port*:0] hierarchy level.
Channelized OC12	Not configurable.	The clocking statement is supported at the [edit interfaces t3-*fpc/pic/port*:0] hierarchy level.	Not applicable.

Table 35: Clocking Capabilities by Channelized PIC Type *(continued)*

PIC Type	SONET/SDH Level	DS3 Level	DS1/E1 Level
Channelized STM1	Not configurable.	Not applicable.	The clocking statement is supported at the [edit interfaces e1-*fpc/pic/port*:[0-62]] hierarchy level.
Channelized IQ and IQE PICs			
Channelized DS3 IQ or IQE	Not applicable.	The clocking statement is supported at the [edit interfaces ct3-*fpc/pic/port*] hierarchy level. The clocking statement is ignored if you include it at the [edit interfaces t3-*fpc/pic/port*] hierarchy level.	For T1 channels, the clocking statement is supported at the [edit interfaces t1-*fpc/pic/port*:[1-28]] hierarchy level. For *N*xDS0 channels, the clocking statement is supported at the [edit interfaces ct1-*fpc/pic/port*:[1-28]] hierarchy level.
Channelized E1 IQ	Not applicable.	Not applicable.	For E1 and *N*xDS0 channels, the clocking statement is supported at the [edit interfaces ce1-*fpc/pic/port*] hierarchy level. The clocking statement is ignored if you include it at the [edit interfaces e1-*fpc/pic/port*] hierarchy level.
Channelized OC3 IQ or IQE	The clocking statement is supported at the [edit interfaces coc3-*fpc/pic/port*] hierarchy level. The clocking statement is ignored if you include it at the [edit interfaces so-*fpc/pic/port*] hierarchy level.	The clocking statement is supported at the [edit interfaces t3-*fpc/pic/port*:[1-12]] hierarchy level. The clocking statement is ignored if you include it at the [edit interfaces coc1-*fpc/pic/port*:*channel*] hierarchy level.	The clocking statement is supported at the [edit interfaces ct1-*fpc/pic/port*:[1-12]:[1-28]] and [edit interfaces t1-*fpc/pic/port*:[1-12]:[1-28]] hierarchy levels.
Channelized OC12 IQ or IQE	The clocking statement is supported at the [edit interfaces coc12-*fpc/pic/port*] hierarchy level. The clocking statement is ignored if you include it at the [edit interfaces so-*fpc/pic/port*] hierarchy level.	The clocking statement is supported at the [edit interfaces t3-*fpc/pic/port*:[1-12]] hierarchy level. The clocking statement is ignored if you include it at the [edit interfaces coc1-*fpc/pic/port*:*channel*] hierarchy level.	The clocking statement is supported at the [edit interfaces ct1-*fpc/pic/port*:[1-12]:[1-28]] and [edit interfaces t1-*fpc/pic/port*:[1-12]:[1-28]] hierarchy levels.

Table 35: Clocking Capabilities by Channelized PIC Type *(continued)*

PIC Type	SONET/SDH Level	DS3 Level	DS1/E1 Level
Channelized OC48 IQE	The clocking statement is supported at the [edit interfaces coc48-*fpc/pic/port*] hierarchy level. The clocking statement is ignored if you include it at the [edit interfaces so-*fpc/pic/port*] hierarchy level.	The clocking statement is supported at the [edit interfaces t3-*fpc/pic/port*:[1-48]] hierarchy level. The clocking statement is ignored if you include it at the [edit interfaces coc1-*fpc/pic/port*:*channel*] hierarchy level.	The clocking statement is supported at the [edit interfaces ct1*fpc/pic/port*:[1-48]:[1-28]] and [edit interfaces t1-*fpc/pic/port*:[1-48]:[1-28]] hierarchy levels.
Channelized STM1 IQ or IQE	The clocking statement is supported at the [edit interfaces cstm1-*fpc/pic/port*] hierarchy level. The clocking statement is ignored if you include it at the [edit interfaces cau4-*fpc/pic/port*:*channel*] or [edit interfaces so-*fpc/pic/port*] hierarchy level.	Not applicable.	For E1 and *N*xDS0 channels, the clocking statement is supported at the [edit interfaces ce1-*fpc/pic/port*[1-63]] hierarchy level. The clocking statement is ignored if you include it at the [edit interfaces e1-*fpc/pic/port*] hierarchy level.
Channelized STM4 IQ or IQE	The clocking statement is supported at the [edit interfaces cstm4-*fpc/pic/port*] hierarchy level. The clocking statement is ignored if you include it at the [edit interfaces cau4-*fpc/pic/port*:*channel*] or [edit interfaces so-*fpc/pic/port*] hierarchy level.	Not applicable.	For E1 and *N*xDS0 channels, the clocking statement is supported at the [edit interfaces ce1-*fpc/pic/port*[1:4]:[1-63]] hierarchy level. The clocking statement is ignored if you include it at the [edit interfaces e1-*fpc/pic/port*] hierarchy level.
Channelized STM16 IQE	The clocking statement is supported at the [edit interfaces cstm16-*fpc/pic/port*] hierarchy level. The clocking statement is ignored if you include it at the [edit interfaces cau4-*fpc/pic/port*:*channel*] or [edit interfaces so-*fpc/pic/port*] hierarchy level.	Not applicable.	For E1 and *N*xDS0 channels, the clocking statement is supported at the [edit interfaces ce1-*fpc/pic/port*[1:16]:[1-63]] hierarchy level. The clocking statement is ignored if you include it at the [edit interfaces e1-*fpc/pic/port*] hierarchy level.

Channelized E1 and T1 PIM Properties

Channelized E1 and T1 PIMs on J-series Services Routers provide support for ISDN Primary Rate Interface (PRI) connectivity for dial-in and callback and for use as primary or backup network connections. You can configure up to 30 channelized E1 time slots (ce1-*pim*/0/*port*) or 23 channelized T1 time slots (ct1-*pim*/0/*port*) as an ISDN PRI group, with the 16th E1 time slot or the 24th T1 time slot operating as the D-channel to control the group of time slots as B-channels. These B-channels can operate unconfigured. The encapsulation type multilink-ppp, cisco-hdlc, or ppp is configured under the dialer interface.

For more information about configuring the dialer interface, see "Configuring ISDN Logical Interface Properties" on page 777.

E1 and T1 time slots unused by ISDN PRI can operate normally as DS0 interfaces. PRI B-channels run at 64 Kbps, but do not support the 56-Kbps line rate.

For more information about Channelized E1 PIMs, ISDN PRI connectivity, and the ISDN features they support, see the *J-series Services Router Basic LAN and WAN Access Configuration Guide*.

Channelized IQ and IQE Interfaces Properties

On channelized IQ and IQE interfaces, you can specify options that are globally applied to all interface types associated with channelized IQ and IQE interfaces. For example, e1-options statements that you include at the [edit interfaces ce1-*fpc*/*pic*/*port*] hierarchy level apply globally to all E1 and *N*xDS0 interfaces that you create by partitioning ce1-*fpc*/*pic*/*port*. Likewise, t3-options statements that you include at the [edit interfaces ct3-*fpc*/*pic*/*port*] hierarchy level apply globally to all T1 and *N*xDS0 interfaces that you create by partitioning ct3-*fpc*/*pic*/*port*.

You can also apply interface options at the channel level. For example, you can include t1-options statements at the [edit interfaces t1-*fpc*/*pic*/*port* <:*channel*>] hierarchy level, and ds0-options statements at the [edit interfaces ds-0/1/1<:*channel*>] hierarchy level.

Only a subset of the interface options is valid on each type of channelized IQ interface. You configure all HDLC information at the end-data channel level, not at the parent level. For example, configure HDLC information at the [edit interfaces ds-*fpc*/*pic*/*port*<:*channel*>] hierarchy level, not at the [edit interfaces ct1-*fpc*/*pic*/*port*<:*channel*>] hierarchy level.

Automatic Protection Switching (APS) is supported on channelized STM1 IQ interfaces and channelized OC12 IQ interfaces. To configure APS, include the aps statement with options at the [edit interfaces *interface-name* sonet-options] hierarchy level. For information about configuring APS, see "Configuring APS and MSP" on page 813.

In interchassis and intrachassis redundant LSQ configurations that use MLPPP and SONET APS, you can inhibit a router from sending PPP termination-request messages to the remote host if the link PIC fails. To inhibit the router from sending PPP termination-request messages to the remote host if the link PIC fails, include the no-termination-request statement at the [edit interfaces *interface-name* ppp-options] hierarchy level.

The no-termination-request statement is supported only with MLPPP and SONET APS configurations and works with PPP, PPP over Frame Relay, and MLPPP interfaces only. The supported PIC types are as follows:

- Channelized OC48/STM16 IQE PICs
- Channelized OC12/STM4 IQ and IQE PICs
- Channelized OC3 IQ and IQE PICs
- Channelized STM1 IQ and IQE PICs

Channelized IQ and IQE interfaces do not support receive buckets or transmit buckets.

For channelized IQ and IQE interfaces, there are some limitations on where you place certain statements in the configuration. When you configure clocking, bit error rate testing (BERT), C-bit parity, and loopback statements on T3, T1, or DS0 channels, you must follow these guidelines:

- For T3 IQ interfaces, you can include the loopback payload statement at the [edit interfaces ct3-*fpc/pic/port*] and [edit interfaces t3-*fpc/pic/port*:*channel*] hierarchy levels. For T1 interfaces, you can include the loopback payload statement at the [edit interfaces t1-*fpc/pic/port*:*channel*] hierarchy level; it is ignored if included at the [edit interfaces ct1-*fpc/pic/port*] hierarchy level. For *N*xDS0 interfaces, payload and remote loopback are the same. If you configure one, the other is ignored. *N*xDS0 IQ interfaces do not support local loopback.
- If you include clocking, BERT, and C-bit parity configurations at both the [edit interfaces ct3-*fpc/pic/port*<:*channel*> t3-options] and [edit interfaces t3-*fpc/pic/port*<:*channel*> t3-options] hierarchy levels, the channelized T3-level statements are valid, and the T3-level statements are ignored.
- If you include clocking, BERT, and C-bit parity configurations at both the [edit interfaces ct3-*fpc/pic/port*<:*channel*> t3-options] and [edit interfaces t1-*fpc/pic/port*<:*channel*> t1-options] hierarchy levels, the channelized T3-level statements are operational for the T3 connections and the T1-level statements are operational for the T1 connections.
- Because DS0 channels do not have clocking capability, you must configure clocking at the [edit interfaces ct1-*fpc/pic/port*<:*channel*> t1-options] or [edit interfaces ce1-*fpc/pic/port*<:*channel*> e1-options] hierarchy level for channelized *N*xDS0 IQ interfaces.
- You can set BERT at the [edit interfaces t3-*fpc/pic/port*<:*channel*> t3-options] hierarchy level or on any partitioned channel of the channelized T3 interface. There are 12 BERT patterns available for *N*xDS0 channels and 28 BERT patterns for T1, channelized T1, T3, and channelized T3 interfaces within channelized IQ interfaces.
- For channelized IQ and IQE PICs, SONET/SDH level, use the sonet-options loopback statement local and remote options at the controller interface (coc48, cstm16, coc12, cstm4, coc3, cstm1). It is ignored for path-level interfaces so-*fpc/pic/port* or so-*fpc/pic/port*:*channel*.
- For channelized interfaces that use Frame Relay encapsulation, the number of configurable DLCIs varies by channelized interface type.
- For channelized interfaces, you can configure class of service (CoS) on channels, but not at the controller level.

- For original Channelized OC12 PICs, limited CoS functionality is supported. For more information, contact Juniper Networks customer support.
- CoS is not configurable on controller interfaces.

Structure of Channelized IQ and Channelized IQE PICs

Figure 21 on page 383 through Figure 33 on page 387 show the structural organization of the channelized PICs, channelized IQ PICs, and channelized IQE PICs. Table 36 on page 388 shows the structure of all channelized PICs, including channelized PICs, channelized IQ PICs, and channelized IQE PICs.

Figure 21: Channelized OC48/STM16 IQE PIC (in SONET Mode)

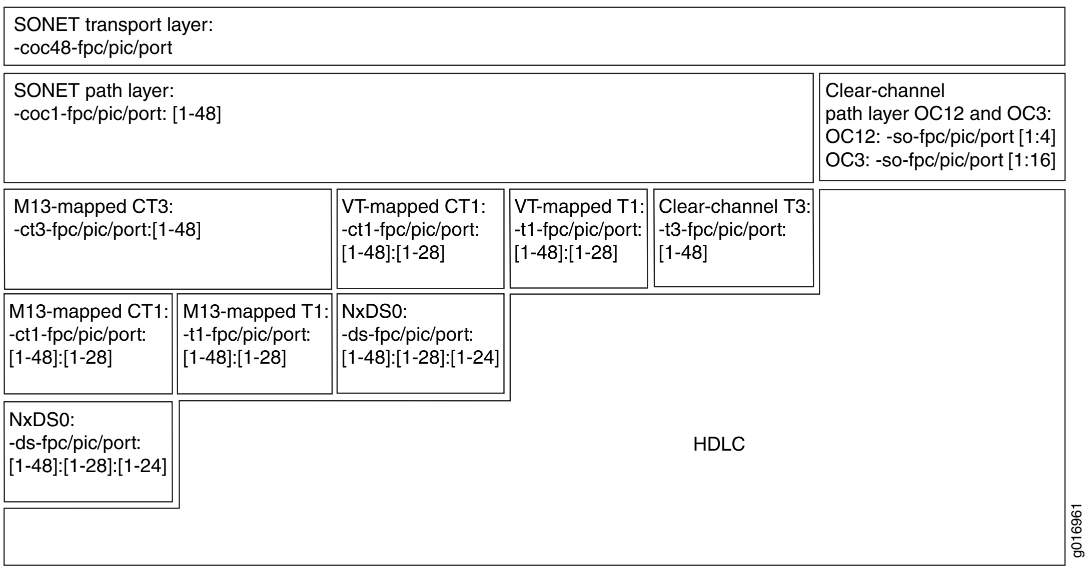


Figure 22: Channelized OC48/STM16 IQE PIC (in SDH Mode)

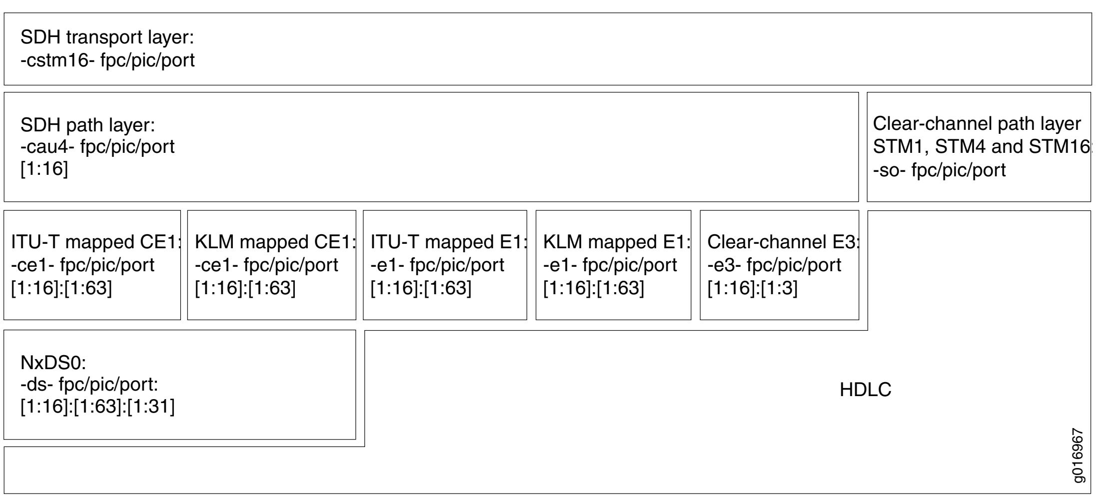


Figure 23: Channelized OC12 IQ PIC and Channelized OC12/STM4 IQE PIC (in SONET Mode)

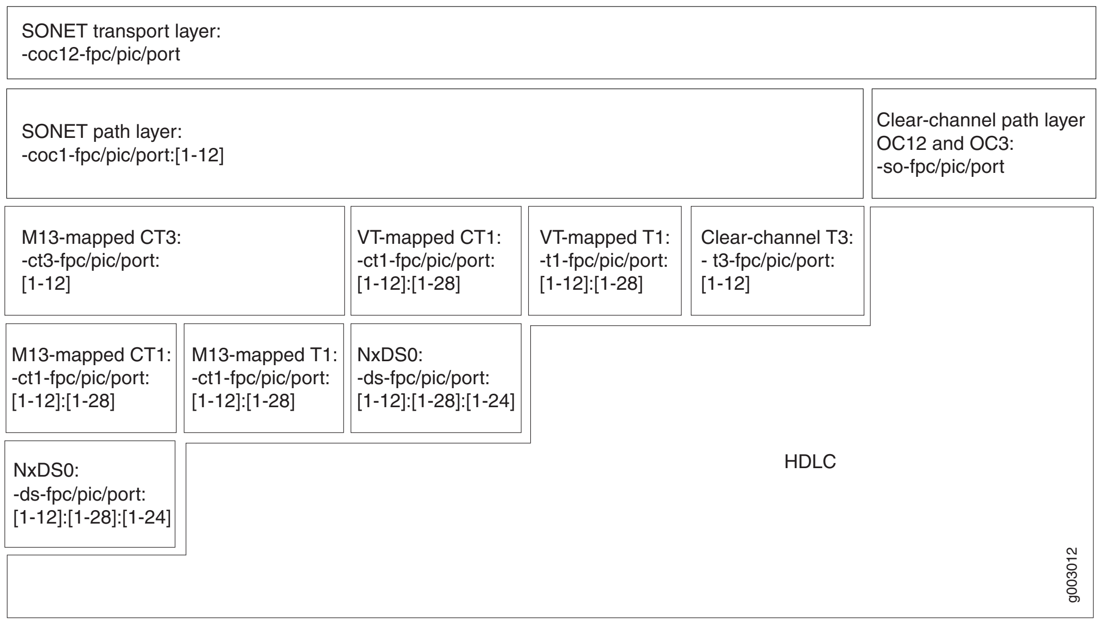


Figure 24: Channelized OC12/STM4 IQE PIC (in SDH Mode)

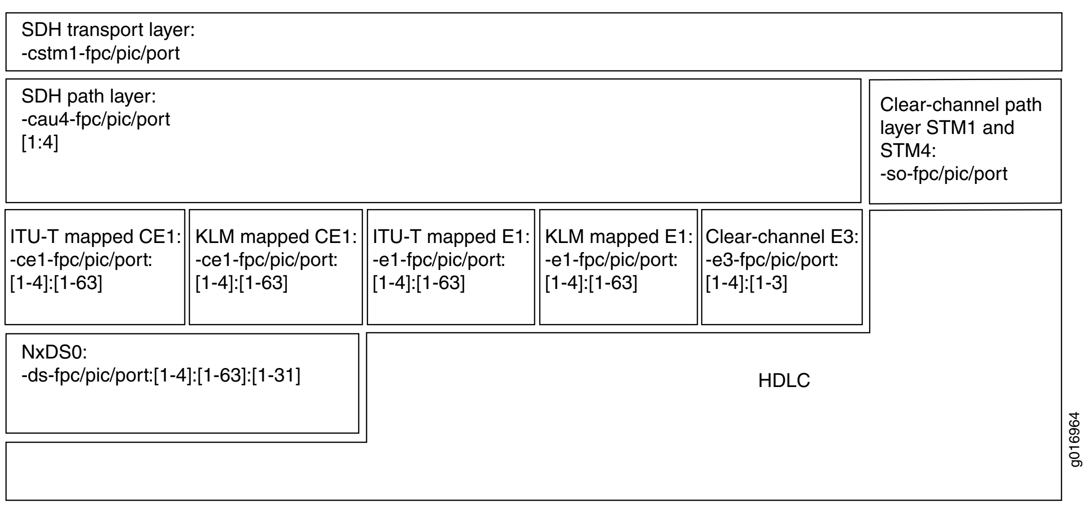


Figure 25: Channelized OC12/STM4 IQ PIC (in SDH Mode)

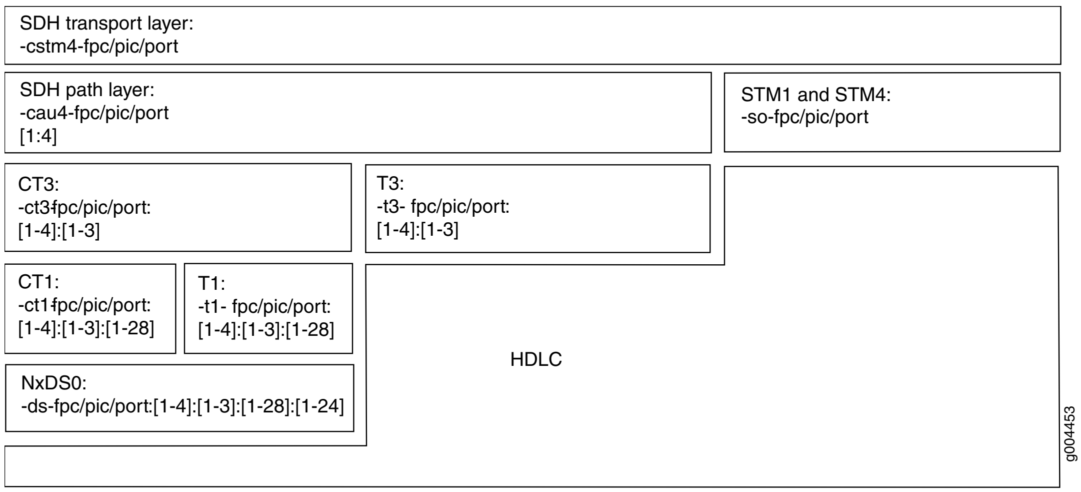


Figure 26: Channelized OC3 Ports (in SONET Mode) on Channelized OC3 IQ and Channelized OC3/STM1 IQE PICs

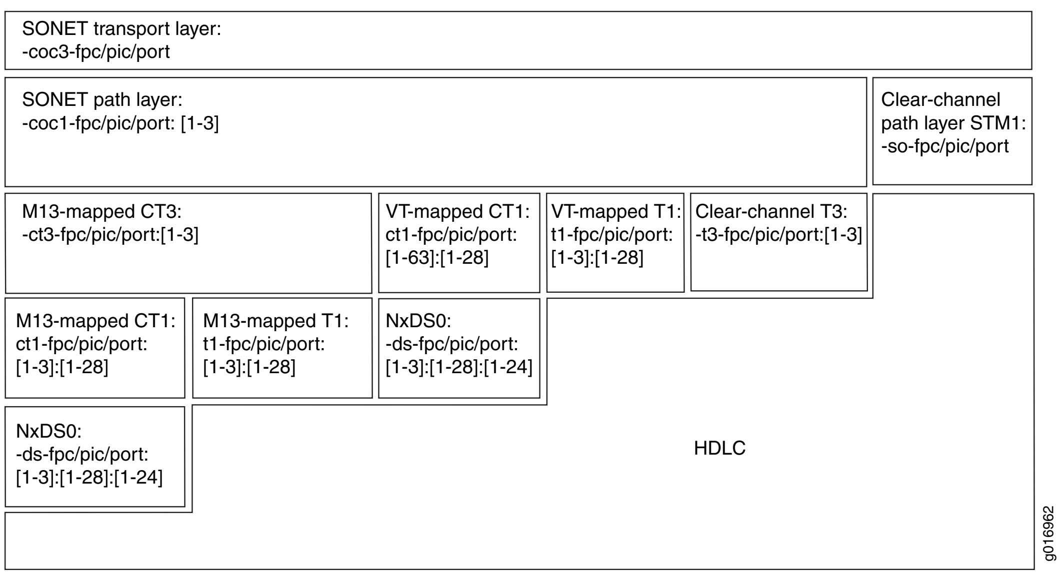


Figure 27: Channelized CSTM1 Ports (in SDH Mode) on Channelized OC3/STM1 IQE PIC

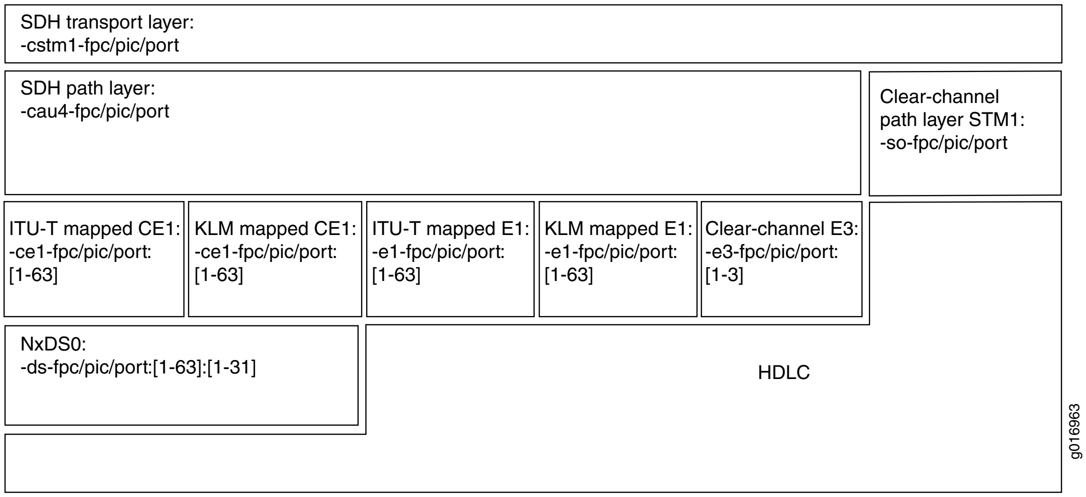


Figure 28: Channelized STM1 IQ PIC

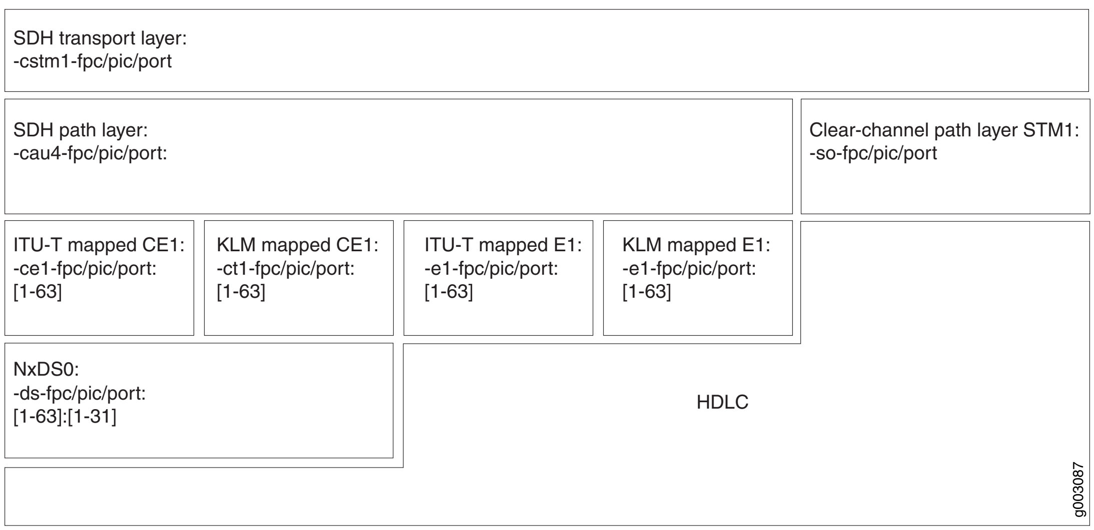


Figure 29: Channelized CDS3/E3 IQE PIC (in DS3 Mode)

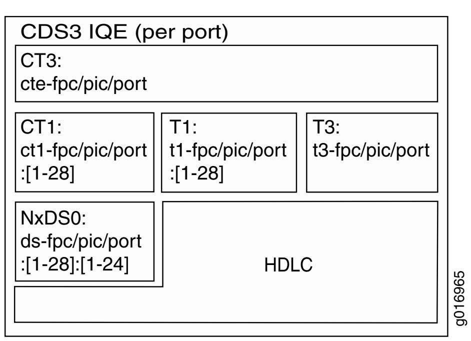


Figure 30: Channelized CDS3/E3 IQE PIC (in E3 Mode)

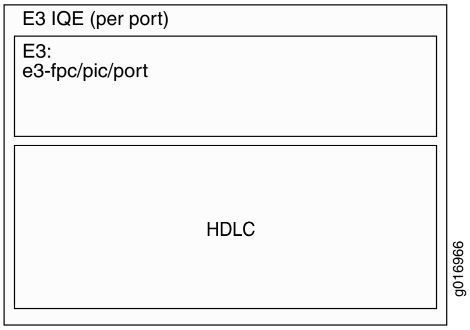


Figure 31: Channelized DS3 IQ PIC

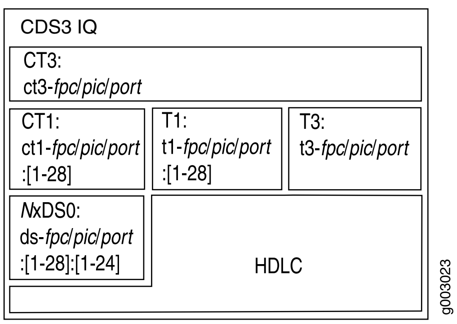


Figure 32: Channelized T1 IQ and IQE PIC

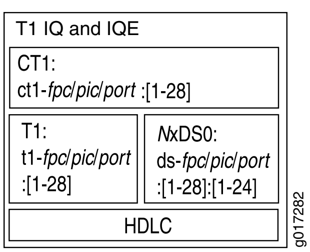


Figure 33: Channelized E1 IQ and IQE PIC

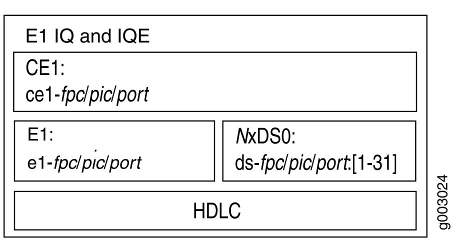


Table 36: Structural Differences: Channelized PICs, Channelized IQ PICs, and Channelized IQE PICs

PIC Type	Transport	Path	DS3	DS1/E1	E3
Channelized PICs					
Channelized OC12	t3-*fpc/pic/port* :0	t3-*fpc/pic/port* :[0-11]	t3-*fpc/pic/port* :[0-11]	Not applicable.	Not applicable.
Channelized STM1	e1-*fpc/pic/port* :0	e1-*fpc/pic/port* :0	Not applicable.	e1-*fpc/pic/port* :[0-63]	Not applicable.
Channelized T3 and Multichannel T3	Not applicable.	Not applicable.	t1-*fpc/pic/port* :0	t1-*fpc/pic/port* :[0-27]	Not applicable.
Channelized E1	Not applicable.	Not applicable.	Not applicable.	e1-*fpc/pic/port* ds-*fpc/pic/port* :0	Not applicable.
Channelized IQ PICs					
Channelized OC12/STM4 IQ (SONET Mode)	coc12-*fpc/pic/port*	coc1-*fpc/pic/port* :[1-12] so-*fpc/pic/port*	ct3-*fpc/pic/port* :[1-12] t3-*fpc/pic/port* :[1-12]	ct1-*fpc/pic/port* :[1-3]:[1-28] t1-*fpc/pic/port* :[1-3]:[1-28]	Not applicable.
Channelized OC12/STM4 IQ (SDH Mode)	cstm4-*fpc/pic/port*	cau4-*fpc/pic/port* so-*fpc/pic/port*	ct3-*fpc/pic/port* :[1-12] t3-*fpc/pic/port* :[1-12]	ct1-*fpc/pic/port* :[1-3]:[1-28] t1-*fpc/pic/port* :[1-3]:[1-28]	Not applicable.
Channelized OC3 IQ (SONET)	coc3-*fpc/pic/port*	coc1-*fpc/pic/port* :[1-3] so-*fpc/pic/port*	ct3-*fpc/pic/port* :[1-3] t3-*fpc/pic/port* :[1-3]	ct1-*fpc/pic/port* :[1-3]:[1-28] t1-*fpc/pic/port* :[1-3]:[1-28]	Not applicable.
Channelized STM1 IQ (SDH)	Not applicable.	cau4-*fpc/pic/port* so-*fpc/pic/port*	Not applicable.	ce1-*fpc/pic/port* :[1-63] e1-*fpc/pic/port* :[1-63]	Not applicable.
Channelized DS3 IQ	Not applicable.	Not applicable.	ct3-*fpc/pic/port* t3-*fpc/pic/port*	ct1-*fpc/pic/port* :[1-28] t1-*fpc/pic/port* :[1-28]	Not applicable.
Channelized E1 IQ	Not applicable.	Not applicable.	Not applicable.	ce1-*fpc/pic/port* e1-*fpc/pic/port*	Not applicable.
Channelized IQE PICs					

Table 36: Structural Differences: Channelized PICs, Channelized IQ PICs, and Channelized IQE PICs *(continued)*

PIC Type	Transport	Path	DS3	DS1/E1	E3
Channelized OC48/STM16 IQE (SONET Mode)	coc48-*fpc/pic/port*	coc1-*fpc/pic/port* :[1-48] so-*fpc/pic/port*	ct3-*fpc/pic/port* :[1-48] t3-*fpc/pic/port* :[1-48]	ct1-*fpc/pic/port* :[1-48]:[1-28] t1-*fpc/pic/port* :[1-48]:[1-28]	Not applicable.
Channelized OC48/STM16 IQE (SDH Mode)	cstm16-*fpc/pic/port*	cau4-*fpc/pic/port* :[1:16] so-*fpc/pic/port*	Not applicable.	ce1-*fpc/pic/port* :[1:16]:[1-63] e1-*fpc/pic/port* :[1:16]:[1-63]	e3-*fpc/pic/port* :[1:16]:[1:3]
Channelized OC12 IQE (SONET Mode)	coc12-*fpc/pic/port*	coc1-*fpc/pic/port* :[1-12] so-*fpc/pic/port*	ct3-*fpc/pic/port* :[1-12] t3-*fpc/pic/port* :[1-12]	ct1-*fpc/pic/port* :[1-3]:[1-28] t1-*fpc/pic/port* :[1-3]:[1-28]	Not applicable.
Channelized STM4 IQE (SDH Mode)	cstm4-*fpc/pic/port*	cau4-*fpc/pic/port* so-*fpc/pic/port*	Not applicable.	ce1-*fpc/pic/port* :[1-63] e1-*fpc/pic/port* :[1-63]	e3-*fpc/pic/port* :[1:3]
Channelized OC3 IQE (SONET)	coc3-*fpc/pic/port*	coc1-*fpc/pic/port* :[1-3] so-*fpc/pic/port*	ct3-*fpc/pic/port* :[1-3] t3-*fpc/pic/port* :[1-3]	ct1-*fpc/pic/port* :[1-3]:[1-28] t1-*fpc/pic/port* :[1-3]:[1-28]	Not applicable.
Channelized STM1 IQE	cstm1-*fpc/pic/port*	cau4-*fpc/pic/port* so-*fpc/pic/port*	Not applicable.	ce1-*fpc/pic/port* :[1-63] e1-*fpc/pic/port* :[1-63]	e3-*fpc/pic/port* :[1:3]]
Channelized DS3 IQE	Not applicable.	Not applicable.	ct3-*fpc/pic/port* t3-*fpc/pic/port*	ct1-*fpc/pic/port* :[1-28] t1-*fpc/pic/port* :[1-28]	Not applicable.
Channelized E3 IQE	Not applicable.	Not applicable.	Not applicable.	Not applicable.	e3-*fpc/pic/port* :[1:4]
Channelized T1 IQE	Not applicable.	Not applicable.	Not applicable.	ct1-*fpc/pic/port* t1-*fpc/pic/port*	Not applicable.
Channelized E1 IQE	Not applicable.	Not applicable.	Not applicable.	ce1-*fpc/pic/port* e1-*fpc/pic/port*	Not applicable.

Chapter 18

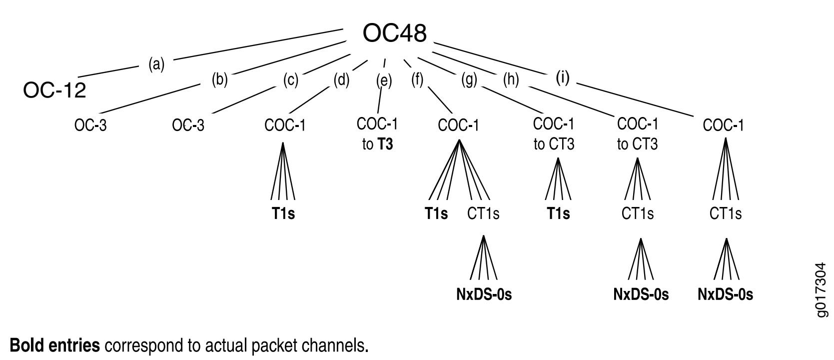
Configuring Channelized OC48/STM16 IQE Interfaces

This section contains the following topics:

Channelized OC48/STM16 IQE Interfaces Overview

Channelized enhanced intelligent queuing (IQE) interfaces allow arbitrary and dynamic channelization of serial links, allowing greater flexibility than the channelized interfaces. Figure 34 on page 391, Figure 35 on page 392, and Figure 36 on page 393 illustrate the Channelized OC48/STM16 IQE Physical Interface Cards (PICs) in several examples of many possible configurations.

Figure 34: Sample Channelization of OC48/STM16 IQE PIC (SONET Mode)



In the example in Figure 34 on page 391, a Channelized OC48/STM16 IQE PIC operating in SONET mode is partitioned into the following OC slices:

a. A clear channel OC12 interface.

b. An OC3 interface.

c. An COC3 interface.

d. A channelized COC1 partitioned into T1 interfaces.

e. A channelized COC1 partitioned into a T3 interface.

f. A channelized COC1 partitioned into CT3, partitioned into T1 interfaces, and CT1s partitioned into *N*xDS0 interfaces.

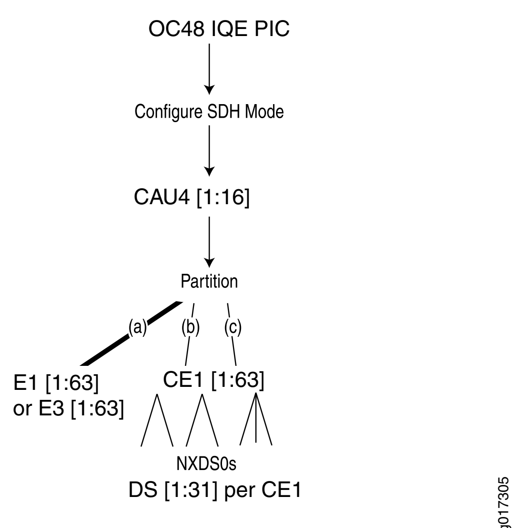
g. A channelized COC1 partitioned into CT3, partitioned into T1 interfaces.

h. A channelized COC1 partitioned into CT3, partitioned into CT1s, partitioned into *N*xDS0 interfaces.

i. A channelized COC1 partitioned into CT1s, partitioned into *N*xDS0 interfaces.

This is one of thousands of ways to configure a Channelized OC48/STM16 IQE PIC. To configure the interfaces shown in Figure 35 on page 392, see "Example: Configuring a Channelized OC48 IQE PIC as a Nonpartitioned SONET OC48 Interface" on page 405 .

Figure 35: Sample Channelization of OC48/STM16 IQE PIC (SDH Mode)



In Figure 35 on page 392, a Channelized OC48/STM16 IQE PIC operating in SDH mode results in a channelized STM16 interface, which can be nonpartitioned into one STM16 interface or up to 16 CAU4 partitions numbered from 1 through 16 partitioned into the following STM slices:

a. Up to 63 ITU-T or KML mapped E1 interfaces per CAU4, or up to 3 clear channel E3 interfaces per CAU4.

b. Up to 63 ITU-T mapped CE1 interfaces partitioned into up to 31 *N*xDS0 interfaces per CE1 interface.

c. Up to 63 KLM mapped CE1 interfaces partitioned into up to 31 *N*xDS0 interfaces per CE1 interface.

This is one of thousands of ways to configure a Channelized OC48/STM16 IQE PIC.

Figure 36: Sample Channelization of OC48/STM16 IQE PIC to E3 Channels

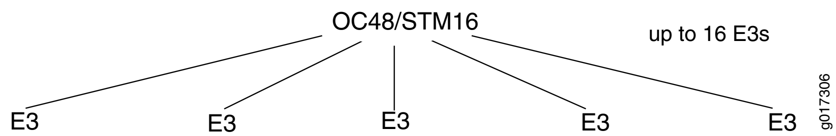


Figure 36 on page 393 shows five E3 channels configured on the Channelized OC48/STM16 IQE PIC. You can configure 11 additional E3 channels. For more information about configuring E3 channels on Channelized OC48/STM16 IQE PICs, see "Configuring E3 Interfaces" on page 403.

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring Channelized OC48/STM16 IQE Interfaces in SONET Mode

This section describes how to configure channelized OC48/STM16 IQE interfaces, discussing the following topics:

Configuring OC12 Interfaces

You can configure up to four OC12 interfaces on a 1-port Channelized OC48/STM16 IQE PIC. To configure an OC12 interface, include the partition, oc-slice, and interface-type statements at the [edit interfaces coc48-*fpc/pic/port*] hierarchy level, specifying the so interface type:

```
[edit interfaces coc48-fpc/pic/port]
partition partition-number oc-slice oc-slice-range interface-type so;
```

The partition number is the sublevel interface partition index. For SONET/SDH interfaces, the partition number does not correlate with bandwidth size. For OC12 interfaces, the partition number can be from 1 through 4.

NOTE: For channelized OC48 IQE interfaces, channel numbering begins with 1 (:1).

The OC-slice range is the range of SONET/SDH slices. For SONET/SDH interfaces, the OC-slice range specifies the bandwidth size required for the interface type you are configuring. OC12 interfaces must occupy 12 consecutive OC slices per interface, in one of the following forms:

- 1–12
- 13–24
- 25–26
- 37–48

By contrast, the T3 and OC1 interfaces each occupy one OC slice per interface and OC3 interfaces occupy three slices per interface.

The interface type is the channelized interface type or data channel you are creating. For channelized OC48 IQE interfaces, the interface type can be so.

Example: Configuring OC12 Interfaces

Configure an OC12 interface, using partition 1 and OC slices 1 through 12. This configuration creates interface so-1/1/0:1.

```
[edit interfaces coc48-1/1/0]
partition 1 oc-slice 1-12 interface-type so;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring OC3 Interfaces

To configure an OC3 interface, include the partition, oc-slice, and interface-type statements at the [edit interfaces coc48-*fpc/pic/port*] hierarchy level, specifying the so interface type:

```
[edit interfaces coc48-fpc/pic/port]
partition partition-number oc-slice oc-slice-range interface-type so;
```

The partition number is the sublevel interface partition index. For SONET/SDH interfaces, the partition number does not correlate with bandwidth size. For OC3 interfaces, the partition number can be from 1 through 16.

NOTE: For channelized OC48 IQE interfaces, channel numbering begins with 1 (:1).

The OC-slice range is the range of SONET/SDH slices. For SONET/SDH interfaces, the OC-slice range specifies the bandwidth size required for the interface type you are configuring. OC3 interfaces must occupy three consecutive OC slices per interface, in one of the following forms:

- 1–3
- 4–6
- 7–9
- 10–12
- and so on (in groups of 3), up to 48

By contrast, the T3 and OC1 interfaces each occupy one OC slice per interface.

The interface type is the channelized interface type or data channel you are creating. For channelized OC48 IQE interfaces, the interface type can be so.

Example: Configuring OC3 Interfaces

Configure an OC3 interface, using partition 1 and OC slices 4 through 6. This configuration creates interface so-1/1/0:1.

```
[edit interfaces coc48-1/1/0]
partition 1 oc-slice 4-6 interface-type so;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring T3 Interfaces

To configure a T3 interface on an OC48/STM16 IQE PIC, include the partition, oc-slice, and interface-type statements at the [edit interfaces coc48-*fpc/pic/port*] hierarchy level, specifying the coc1 interface type:

```
[edit interfaces coc48-fpc/pic/port]
partition partition-number oc-slice oc-slice-range interface-type coc1;
```

This configuration creates interface coc1-*fpc/pic/port*:*channel*.

Then, include the no-partition interface-type statement at the [edit interfaces coc1-*fpc/pic/port*:*channel*] hierarchy level, specifying the t3 interface type:

```
[edit interfaces coc1-fpc/pic/port:channel]
no-partition interface-type t3;
```

This configuration creates interface t3-*fpc/pic/port*:*channel*.

The partition number is the sublevel interface partition index and is correlated with the channel number. For channelized OC1 interfaces, the partition number can be from 1 through 48. For channelized OC48/STM16 IQE interfaces, channel numbering begins with 1 (:1).

The OC-slice range is the range of SONET/SDH slices. For SONET/SDH interfaces, the OC-slice range specifies the bandwidth size required for the interface type you are configuring. For channelized OC1 interfaces, the OC slice can be from 1 through 12. You can configure only one OC slice per channelized OC1 interface.

The interface type is the channelized interface type or clear channel you are creating. For channelized OC48 interfaces, *type* can be so or coc1.

Example: Configuring T3 Interfaces

Configure a T3 interface using partition 3 and OC slice 3. This configuration creates interface t3-1/1/0:3:

```
[edit interfaces coc48-1/1/0]
partition 3 oc-slice 3 interface-type coc1;
[edit interfaces coc1-1/1/0:3]
no-partition interface-type t3;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring T1 Interfaces

To configure T1 interfaces on a Channelized OC48 IQE PIC, perform the following tasks:

1. Partition the channelized OC48 IQE interface into channelized OC1 interfaces by including the partition, oc-slice, and interface-type statements at the [edit interfaces coc48-*fpc/pic/port*] hierarchy level, specifying the coc1 interface type:

   ```
   [edit interfaces coc48-fpc/pic/port]
   partition partition-number oc-slice oc-slice-range interface-type coc1;
   ```

2. If your network equipment uses VT mapping, partition the channelized OC1 interface into T1 interfaces by including the partition and interface-type statements at the [edit interfaces coc1-*fpc/pic/port*] hierarchy level, specifying the t1 interface type:

   ```
   [edit interfaces coc1-fpc/pic/port:channel]
   partition partition-number interface-type t1;
   ```

3. If your network equipment uses M13 or C-bit parity, convert the channelized OC1 interface into a channelized T3 interface by including the no-partition and interface-type statements at the [edit interfaces coc1- *fpc/pic/port*:*channel*] hierarchy level, specifying the ct3 interface type. Note that because the no-partition statement is included, this configuration does not create another level of channelization, as denoted by the number of colons in the resulting interface.

   ```
   [edit interfaces coc1-fpc/pic/port:channel]
   no-partition partition-number interface-type ct3;
   ```

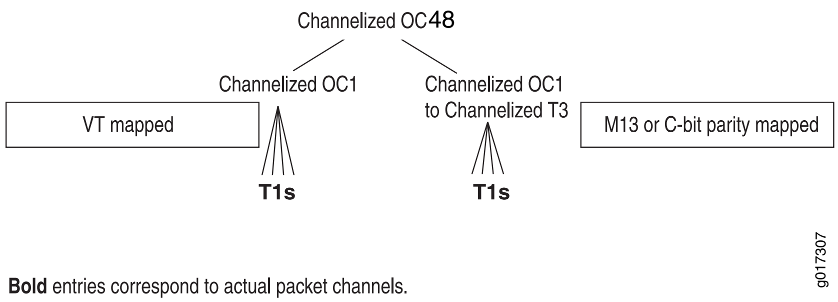
4. Partition the channelized T3 interface into T1 interfaces by including the partition and interface-type statements at the [edit interfaces ct3-*fpc/pic/port*:*channel*] hierarchy level, specifying the t1 interface type:

   ```
   [edit interfaces ct3-fpc/pic/port:channel]
   partition partition-number interface-type t1;
   ```

NOTE: Class-of-service (CoS) rules cannot be applied to an individual channel configured on channelized IQE interfaces. You can only apply CoS rules to the aggregate bit streams.

Figure 37 on page 397 shows VT-mapped and M13 or C-bit parity-mapped configurations of T1 interfaces.

Figure 37: T1 Interfaces on a Channelized OC48 PIC



Example: Configuring T1 Interfaces

Configure the following T1 interfaces:

```
t1-0/0/0:1:1
t1-0/0/0:1:2
t1-0/0/0:1:3
t1-0/0/0:1:4
t1-0/0/0:1:5
```

VT-Mapped Configuration

```
[edit interfaces coc48-0/0/0]
partition 1 oc-slice 1 interface-type coc1;

[edit interfaces coc1-0/0/0:1]
partition 1-5 interface-type t1;
```

M13 or C-bit Parity-Mapped Configuration

```
[edit interfaces coc48-0/0/0]
partition 1 oc-slice 1 interface-type coc1;

[edit interfaces coc1-0/0/0:1]
no-partition interface-type ct3;

[edit interfaces ct3-0/0/0:1]
partition 1-5 interface-type t1;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring Fractional T1 Interfaces

By default, all the time slots on a channelized T1 interface are used. To configure a fractional T1 interface on a Channelized OC48 IQE PIC, perform the following tasks:

1. Configure a T1 interface. For more information, see "Configuring T1 Interfaces" on page 396.
2. Configure the number of time slots allocated to the T1 interface by including the **timeslots** statement at the **[edit interfaces t1-*fpc/pic/port*<:*channel*> t1-options]** hierarchy level:

```
[edit interfaces t1-fpc/pic/port<:channel> t1-options]
timeslots time-slot-range;
```

For channelized T1 interfaces, the time-slot range is from 1 through 24. You can designate any combination of time slots. To configure ranges, use hyphens. To configure discontinuous time slots, use commas. Do not include spaces. For more information, see "Configuring Fractional T1 Time Slots" on page 537.

Example: Configuring Fractional T1 Interfaces

Configure a fractional T1 interface that uses time slots 1 through 5 and 10:

```
[edit interfaces coc48-0/0/0]
partition 1 oc-slice 1 interface-type coc1;
[edit interfaces coc1-0/0/0:1]
partition 1 interface-type t1;
[edit interfaces t1-0/0/0:1:1 t1-options]
timeslots 1-5,10;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring NxDS0 Interfaces

To configure *N*xDS0 interfaces on a Channelized OC48 IQE PIC, perform the following tasks:

1. Partition the channelized OC48 IQE interface into channelized OC1 interfaces by including the **partition**, **oc-slice**, and **interface-type** statements at the **[edit interfaces coc48-*fpc/pic/port*:*channel*]** hierarchy level, specifying the **coc1** interface type:

```
[edit interfaces coc48-fpc/pic/port:channel]
partition partition-number oc-slice oc-slice-range interface-type coc1;
```

2. If your network equipment uses VT mapping, partition the channelized OC1 interface into channelized T1 interfaces by including the **partition** and **interface-type** statements at the **[edit interfaces coc1-*fpc/pic/port*:*channel*]** hierarchy level, specifying the **ct1** interface type:

```
[edit interfaces coc1-fpc/pic/port:channel]
partition partition-number interface-type ct1;
```

NOTE: Class-of-service (CoS) rules cannot be applied to an individual channel configured on channelized IQE interfaces. You can only apply CoS rules to the aggregate bit streams.

If your network equipment uses M13 or C-bit parity, convert the channelized OC1 interface into a channelized T3 interface by including the no-partition and interface-type statements at the [edit interfaces coc1-*fpc/pic/port*] hierarchy level, specifying the ct3 interface type:

```
[edit interfaces coc1-fpc/pic/port:channel]
no-partition partition-number interface-type ct3;
```

NOTE: Because the no-partition statement is included, this configuration task does not create another level of channelization, as denoted by the number of colons in the resulting interface.

3. Partition the channelized T3 interface into channelized T1 interfaces by including the partition and interface-type statements at the [edit interfaces ct3-*fpc/pic/port*:*channel*] hierarchy level, specifying the ct1 interface type:

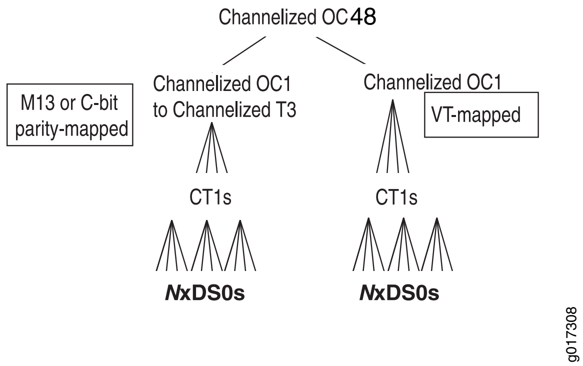
```
[edit interfaces ct3-fpc/pic/port:channel]
partition partition-number interface-type ct1;
```

4. Configure channelized *N*xDS0 interfaces on the channelized T1 interface by including the partition, timeslots, and interface-type statements at the [edit interfaces ct1-*fpc/pic/port*:*channel*] hierarchy level, specifying the ds interface type:

```
[edit interfaces ct1-fpc/pic/port:channel:channel]
partition partition-number timeslots time-slot-range interface-type ds;
```

Figure 38 on page 400 shows VT-mapped and M13 or C-bit parity-mapped configurations of *N*xDS0 interfaces.

Figure 38: Sample Channelization of OC48 IQE PIC



Bold entries correspond to actual packet channels.

Example: Configuring NxDS0 Interfaces

Configure the following two *N*xDS0 interfaces with 10 time slots and 4 time slots, respectively:

```
ds-0/0/0:1:2:1
ds-0/0/0:1:2:2
```

VT-Mapped Configuration

```
[edit interfaces coc48-0/0/0]
partition 1 oc-slice 1 interface-type coc1;

[edit interfaces coc1-0/0/0:1]
partition 2 interface-type ct1;

[edit interfaces ct1-0/0/0:1:2]
partition 1 timeslots 1-10 interface-type ds;
partition 2 timeslots 12-16 interface-type ds;
```

M13 or C-bit Parity-Mapped Configuration

```
[edit interfaces coc48-0/0/0]
partition 1 oc-slice 1 interface-type coc1;

[edit interfaces coc1-0/0/0:1]
no-partition interface-type ct3;

[edit interfaces ct3-0/0/0:1]
partition 2 interface-type ct1;

[edit interfaces ct1-0/0/0:1:2]
partition 1 timeslots 1-10 interface-type ds;
partition 2 timeslots 12-16 interface-type ds;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring Channelized OC48/STM16 IQE Interfaces (SDH Mode)

The Channelized OC48 IQE PIC configured for SDH mode creates a single channelized STM16 interface. You can configure this interface as unpartitioned using the no-partition statement at the [edit interfaces cstm16-*fpc/pic/port*] hierarchy level to create a single STM16 interface, or you can partition it into the following OC slices:

- 16 channelized AU-4 interfaces or a clear channel path layer with 1 STM16, 4 STM4, or 16 STM1 interfaces
- 16 channelized AU-4 interfaces, each partitioned to 3 clear channel E3 interfaces or 63 CE1 or E1 (ITU-T or KLM) interfaces or a combination of CE1, E1, and E3 interfaces
- 16 channelized AU-4 interfaces, each partitioned to 63 CE1 (ITU-T or KLM) interfaces each partitioned to 31 *N*xDS0 interfaces

This section describes how to configure the following channelized OC48 IQE interfaces on a Channelized OC48 IQE PIC configured in SDH mode:

Configuring a Channelized OC48/STM16 IQE PIC for SDH Mode

To configure a Channelized OC48/STM16 IQE PIC to operate in SDH mode, include the framing sdh statement at the [edit chassis fpc *fpc/pic/port*] hierarchy level:

```
[edit chassis ]
  fpc 0 {
    pic 2 {
      framing sdh;
    }
  }
}
```

This configuration creates interface cstm16-0/2/0.

For more information, see the *JUNOS System Basics Configuration Guide*.

Configuring Clear Channel STM1, STM4, and STM16 Interfaces

On a Channelized OC48/STM16 IQE PIC, you can partition the CSTM16 transport layer into 1 clear channel STM16 interface, 4 clear channel STM4 interfaces, or 16 clear channel STM1 interfaces. Combinations of STM4 and STM1 are also permitted, but you must observe the OC-slice parameters.

To configure an STM16 interface, include the no-partition and interface-type statements at the [edit interfaces cstm16-*fpc/pic/port*] hierarchy level:

```
[edit interfaces cstm16-fpc/pic/port]
partition partition-number oc-slice oc-slice-range interface-type so;
```

This configuration creates interface so-*fpc/pic/port.channel*.

To configure an STM4 interface, include the no-partition and interface-type statements at the [edit interfaces cstm16-*fpc/pic/port*] hierarchy level:

```
[edit interfaces cstm16-fpc/pic/port]
partition partition-number oc-slice oc-slice-range interface-type stm16;
```

This configuration creates interface so-*fpc/pic/port.channel*.

To configure an STM1 interface, include the no-partition and interface-type statements at the [edit interfaces cstm16-*fpc/pic/port*] hierarchy level:

```
[edit interfaces cstm16-fpc/pic/port]
partition partition-number oc-slice oc-slice-range interface-type so;
```

This configuration creates interface so-*fpc/pic/port.channel*.

Configuring Channelized AU-4 Interfaces

To configure a channelized AU-4 interface, include the partition, oc-slice, and interface-type statements at the [edit interfaces cstm4-*fpc/pic/port*:*channel*] hierarchy level, specifying the cau4 interface type:

```
[edit interfaces cstm4-fpc/pic/port]
partition partition-number oc-slice oc-slice-range interface-type cau4;
```

This configuration creates interface cau4-*fpc/pic/port*:*channel*.

The partition number is the sublevel interface partition index. For SDH interfaces, the partition number is not correlated with bandwidth size. For channelized OC48/STM16 IQE interfaces, channelized STM16 interface can have from 1 through 16 partition numbers and channel numbering begins with 1 (:1).

The OC-slice range is the range of SONET/SDH slices. For SDH interfaces, the OC-slice range specifies the bandwidth size required for the interface type you are configuring. The interface type is the channelized interface type or data channel you are creating.

Example: Configuring Channelized AU-4 Interfaces

Configure channelized AU-4 interfaces, using partitions 1 through 16:

```
[edit interfaces cstm4-0/2/0]
partition 1 oc-slice 1-16 interface-type cau4;
```

This configuration creates the interfaces cau4-0/2/0:1 through cau4-0/2/0:16.

Configuring E3 Interfaces

To configure E3 interfaces, include the partition and interface-type statements at the [edit interfaces cau4-*fpc/pic/port*] hierarchy level, specifying the e3 interface type:

```
[edit interfaces]
cau4-fpc/pic/port {
   partition partition-number interface-type e3;
}
```

This configuration creates the interfaces e3-*fpc/pic/port*:*channel*.

NOTE: Class-of-service (CoS) rules cannot be applied to an individual channel configured on channelized IQE interfaces. You can only apply CoS rules to the aggregate bit streams.

Example: Configuring E3 Interfaces

Configure E3 interfaces, using partition 1 and partition 2:

```
[edit interfaces]
cau4-0/2/0:1 {
   partition 1 interface-type e3;
}
e3-0/2/0:1:1;
```

Configuring E1 or Channelized E1 Interfaces

To configure E1 or channelized E1 interfaces, include the partition and interface-type statements at the [edit interfaces cau4-*fpc/pic/port*] hierarchy level, specifying the e1 or ce1 interface type:

```
[edit interfaces]
cau4-fpc/pic/port {
   partition partition-number interface-type e1;
}
cau4-fpc/pic/port {
   partition partition-number interface-type ce1;
}
```

This configuration creates the interfaces e1-*fpc/pic/port*:*channel* and ce1-*fpc/pic/port*:*channel*.

NOTE: Class-of-service (CoS) rules cannot be applied to an individual channel configured on channelized IQE interfaces. You can only apply CoS rules to the aggregate bit streams.

Example: Configuring E1 or Channelized E1 Interfaces

Configure E1 or channelized E1 interfaces, using partition 3 and partition 4:

```
[edit interfaces]
cau4-0/2/0:1 {
   partition 3 interface-type e1;
}
cau4-0/2/0:1 {
   partition 4 interface-type ce1;
}
```

This configuration creates interfaces e1-0/2/0:1:3 and ce1-0/2/0:1:4.

Configuring NxDS0 IQE Interfaces

Configure channelized *N*xDS0 IQE interfaces on the channelized E1 IQE interface by including the partition, timeslots, and interface-type statements at the [edit interfaces ce1-*fpc/pic/port*:*channel*] hierarchy level, specifying the ds interface type:

```
[edit interfaces ce1-fpc/pic/port:channel:channel]
partition partition-number timeslots time-slot-range interface-type ds;
```

This configuration creates the interface ds-*fpc/pic/port*:*channel.*

The time-slot range is from 1 through 31. You can designate any combination of time slots. To configure ranges, use hyphens. To configure discontinuous time slots, use commas. You can use a combination of ranges and discontinuous time slots, for example:

```
1,9-18,21
```

Example: Configuring NxDS0 IQE Interfaces

Configure channelized *N*xDS0 interfaces, using partition 4 and time slots 1 through 10:

```
[edit interfaces]
ce1-0/2/0:1:2:3 {
   partition 4 interface-type ds0 timeslots 1-10;
}
```

This configuration creates interface ds-0/2/0:1:2:3:4.

Configuring Link PIC Failover on Channelized OC48/STM16 IQE Interfaces

For Channelized OC48 IQE PICs used as linking PICs in redundant LSQ configurations, you can inhibit the router from sending PPP termination-request messages to the remote host if the link PIC fails. To do this, include the no-termination-request statement at the [edit interfaces *interface-name* ppp-options] hierarchy level:

```
no-termination-request;
```

The no-termination-request statement is supported only with MLPPP and SONET APS configurations and works with PPP, PPP over Frame Relay, and MLPPP interfaces only.

For information about interchassis and intrachassis LSQ failover, see the *JUNOS Services Interfaces Configuration Guide*.

Example: Configuring a Channelized OC48 IQE PIC as a Nonpartitioned SONET OC48 Interface

Configuring a SONET OC48 Interface

Configure a channelized OC48 IQE PIC as a single nonpartitioned SONET OC48 interface:

```
[edit interfaces]
coc48-5/0/0 {
   no-partition interface-type so; # so-5/0/0
}
```

Configuring Multiple Interface Types

Configure the following interfaces on a Channelized OC48 IQE PIC:

a. An OC3 interface

b. Another OC3 interface

c. A channelized OC1 partitioned into T1 interfaces

d. A channelized OC1 converted into a T3 interface

e. A channelized OC1 partitioned into T1 interfaces and channelized T1s, which are partitioned into *N*xDS0 interfaces

f. A channelized OC1 converted into a channelized T3, which is partitioned into T1 interfaces

g. A channelized OC1 converted into a channelized T3, which is partitioned into T1 interfaces and a channelized T1, which is partitioned into *N*xDS0 interfaces

h. A channelized OC1 partitioned into channelized T1s, which are partitioned into *N*xDS0 interfaces

Configuring the Interface Partitions

```
[edit interfaces]
coc48-1/1/0 {
   sonet-options {
      sonet-options-statements;
   }
   partition 1 oc-slice 1-3 interface-type so; # (a) so-1/1/0:1
   partition 2 oc-slice 4-6 interface-type so; # (b) so-1/1/0:2
   partition 3 oc-slice 7 interface-type coc1; # (c) coc1-1/1/0:3
   partition 4 oc-slice 8 interface-type coc1; #(d) coc1-1/1/0:4
   partition 5 oc-slice 9 interface-type coc1; # (e) coc1/1/0:5
   partition 6 oc-slice 10 interface-type coc1; # (f) coc1-1/1/0:6
   partition 7 oc-slice 11 interface-type coc1; # (g) coc1-1/1/0:7
   partition 8 oc-slice 12 interface-type coc1; # (h) coc1-1/1/0:8
}
```

(a)

```
so-1/1/0:1 {
   description “(a) OC-slice 1-3 of coc48-1/1/0. COC48 > OC3.”;
   sonet-options {
```

```
            sonet-options-statements;
        }
    }

(b)     so-1/1/0:2 {
            description "(b) OC-slice 4-6 of coc48-1/1/0. COC48 > OC3.";
            sonet-options {
                sonet-options-statements;
            }
        }

(c)     coc1-1/1/0:3 {
            description "(c) OC-slice 7 of coc48-1/1/0. COC48 to COC1 VT-mapped to T1s.";
            sonet-options {
                sonet-options-statements;
            }
            partition 1 - 10 interface-type t1; # t1-1/1/0:[1-10]
        }
        t1-1/1/0:3:1 {
            description "(c) OC-slice 7 of coc48-1/1/0. T1 interface configuration.";
            t1-options {
                t1-options-statements;
            }
        }
        ...

(d)     coc1-1/1/0:4 {
            description "(d) OC-slice 8 of coc48-1/1/0. COC48 to COC1 converted to a T3.";
            sonet-options {
                sonet-options-statements;
            }
            no-partition interface-type t3; # t3-1/1/0:4
        }
        t3-1/1/0:4 {
            description "(d) OC-slice 8 of coc48-1/1/0. T3 interface configuration.";
        }

(e)     coc1-1/1/0:5 {
            description "(e) OC-slice 9 of coc48-1/1/0. COC48 to COC1 VT-mapped to T1s.";
            sonet-options {
                sonet-options-statements;
            }
            partition 1 - 3 interface-type t1; # t1-1/1/0:5:[1-3]
            partition 4 interface-type ct1; # ct1-1/1/0:5:4
        }
        t1-1/1/0:5:1 {
            description "(e) OC-slice 9 of coc48-1/1/0. T1 interface configuration.";
            t1-options {
                t1-options-statements;
            }
        }
        ...
        ct1-1/1/0:5:4 {
            description "(e) OC-slice 9 of coc48-1/1/0. CT1 to NxDSOs.";
```

```
        t1-options {
            t1-options-statements;
        }
        partition 1 timeslots 0 - 10 interface-type ds0; # ds-1/1/0:5:4:1
        partition 2 timeslots 11- 23 interface-type ds0; # ds-1/1/0:5:4:2
        ...
    }
```

(f)

```
    coc1-1/1/0:6 {
        description "(f) OC-slice 10 of coc48-1/1/0. COC48 to COC1 converted to a CT3
            to T1s.";
        sonet-options {
            sonet-options-statements;
        }
        no-partition interface-type ct3; # ct3-1/1/0:6
    }
    ct3-1/1/0:6 {
        description "(f) COC48 to CT3 M-13 and C-bit parity-mapped to T1s.";
        sonet-options {
            sonet-options-statements;
        }
        partition 1 - 10 interface-type t1; # t1-1/1/0:6:[1-10]
    }
    t1-1/1/0:6:1 {
        description "(f) T1 interface configuration.";
        t1-options {
            t1-options-statements;
        }
    }
    ...
```

(g)

```
    coc1-1/1/0:7 {
        description "(g) OC-slice 11 of coc48-1/1/0. COC48 to COC1 converted to a CT3
            to T1s and CT1 to NxDS0s.";
        sonet-options {
            sonet-options-statements;
        }
        no-partition interface-type ct3; # ct3-1/1/0:7
    }
    ct3-1/1/0:7 {
        description "(g) COC48 to CT3 M-13 and C-bit parity-mapped to T1s and CT1.";
        sonet-options {
            sonet-options-statements;
        }
        partition 1 - 10 interface-type t1; # t1-1/1/0:7:[1-10]
        partition 2 interface-type ct1; # ct1-1/1/0:7:11
    }
    t1-1/1/0:7:1 {
        description "(g) T1 interface configuration.";
        t1-options {
            t1-options-statements;
        }
    }
    ...
    ct1-1/1/0:7:11 {
```

```
    description "(g) CT1 to NxDSOs.";
    t1-options {
        t1-options-statements;
    }
    partition 1 timeslots 0 - 10 interface-type ds0; # ds-1/1/0:7:11:1
    partition 2 timeslots 11- 23 interface-type ds0; # ds-1/1/0:7:11:2
    ...
}
```

(h)

```
coc1-1/1/0:8 {
    description "(h) OC-slice 12 of coc48-1/1/0. COC48 to COC1 VT-mapped to CT1
        to NxDS0s.";
    sonet-options {
        sonet-options-statements;
    }
    partition 1 interface-type t1; # ct1-1/1/0:8:1
}
ct1-1/1/0:8:1 {
    description "(h) CT1 to NxDSOs.";
    t1-options {
        t1-options-statements;
    }
    partition 1 timeslots 0 - 10 interface-type ds0; # ds-1/1/0:8:1:1
    partition 2 timeslots 11- 23 interface-type ds0; # ds-1/1/0:8:1:2
    ...
}
```

For a full configuration example, see the *JUNOS Feature Guide*.

Example: Configuring Channelized OC48 Interfaces with Partitioned Channels

The following configuration is sufficient to get the channelized OC48 interface up and running. The OC48 interface can be divided into up to 4 OC12 channels, up to 16 OC3 channels, or up to 48 OC1 channels and combinations are permitted; for example, 1 OC12, 4 OC3s, and 24 OC1s. There are 48 OC1 slices available on the OC48 IQE interface. An OC48 configuration uses all 48 slices, each OC12 uses 12 slices, each OC1 uses 1 slice. Permissible combinations must fit within the 48 available OC1 slices. DS1 channels can use the following encapsulation types:

- PPP, PPP CCC, and PPP TCC
- Frame Relay, Frame Relay CCC, and Frame Relay TCC
- Cisco HDLC, Cisco HDLC CCC, and Cisco HDLC TCC

The channels can also have logical interfaces.

```
[edit interfaces]
t3-fpc/pic/port:0 {
    encapsulation cisco-hdlc;
    t3-options {
        compatibility-mode larscom;
        payload-scrambler;
    }
```

```
    unit 0 {
        family inet {
            address 10.11.30.1/30;
        }
        family iso;
    }
}
t3-fpc/pic/port:1 {
    encapsulation ppp;
    t3-options {
        compatibility-mode larscom;
        payload-scrambler;
    }
    unit 0 {
        family inet {
            address 10.11.30.5/30;
        }
        family iso;
    }
}
t3-fpc/pic/port:2 {
    encapsulation frame-relay;
    t3-options {
        compatibility-mode larscom;
        payload-scrambler;
    }
    unit 0 {
        dlci 100;
        family inet {
            address 10.11.30.9/30;
        }
        family iso;
    }
    unit 1 {
        dlci 101;
        family inet {
            address 10.11.31.9/30;
        }
        family iso;
    }
}
t3-1fpc/pic/port:3 {
    encapsulation cisco-hdlc-ccc;
    t3-options {
        compatibility-mode larscom;
        payload-scrambler;
    }
    unit 0;
}
t3-fpc/pic/port:4 {
    encapsulation ppp-ccc;
    t3-options {
        compatibility-mode larscom;
        payload-scrambler;
    }
    unit 0;
```

```
}
t3-fpc/pic/port:5 {
    dce;
    encapsulation frame-relay-ccc;
    t3-options {
        compatibility-mode larscom;
        payload-scrambler;
    }
    unit 0 {
        encapsulation frame-relay-ccc;
        dlci 1000;
    }
    unit 1 {
        encapsulation frame-relay-ccc;
        dlci 1001;
    }
}
```

Chapter 19

Configuring Channelized OC12/STM4 Interfaces

This section contains the following topics:

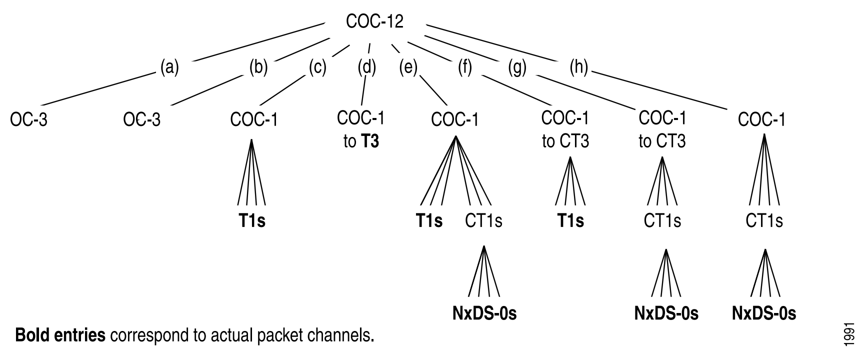
Channelized OC12/STM4 IQ and IQE Interfaces Overview

Channelized IQ and channelized IQE interfaces allow arbitrary and dynamic channelization of serial links, allowing greater flexibility than the channelized interfaces. Channelized OC12/STM4 IQ and IQE Physical Interface Cards (PICs) can be configured to operate in SONET or SDH mode. Each physical port on a multiple-port IQE PIC can be configured to operate in either SONET or SDH mode for increased granularity. The following sections describe the different modes of operation and channelization possibilities.

Channelization of OC12/STM4 IQ and Channelized OC12/STM4 IQE PICs (SONET Mode)

Channelized OC12/STM4 IQ PICs and Channelized OC12/STM4 IQE PICs can be configured to operate in SONET or SDH mode and partitioned into various partitions. Figure 39 on page 412 illustrates one possible channelization configuration for Channelized OC12/STM4 IQ and IQE PICs operating in SONET mode.

Figure 39: Sample Channelization of OC12/STM4 IQ or IQE PIC (SONET Mode)



In the example in Figure 39 on page 412, a Channelized OC12/STM4 IQ PIC operating in SONET mode is partitioned into the following OC slices:

a. An OC3 interface.

b. Another OC3 interface.

c. A channelized OC1 partitioned into T1 interfaces.

d. A channelized OC1 converted into a T3 interface.

e. A channelized OC1 partitioned into T1 interfaces and channelized T1s, which are partitioned into *N*xDS0 interfaces.

f. A channelized OC1 converted into a channelized T3, which is partitioned into T1 interfaces.

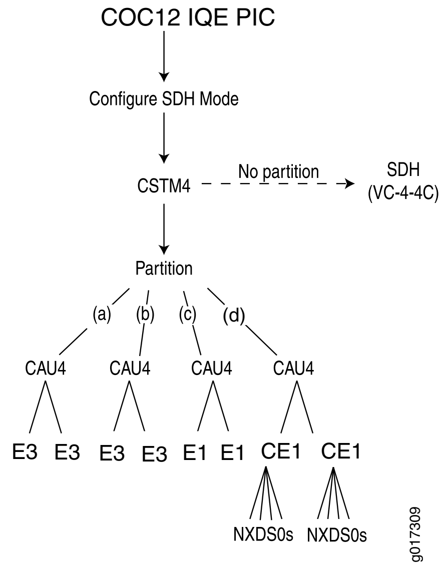
g. A channelized OC1 converted into a channelized T3, which is partitioned into T1 interfaces and a channelized T1, which is partitioned into *N*xDS0 interfaces.

h. A channelized OC1 partitioned into channelized T1s, which are partitioned into *N*xDS0 interfaces.

Channelization of OC12/STM4 IQE PIC (SDH Mode)

Channelized OC12/STM4 IQE PICs can be configured to operate in SONET or SDH mode and partitioned to various smaller partitions. Figure 40 on page 413 illustrates one possible channelization configuration for Channelized OC12/STM4 IQE PICs operating in SDH mode.

Figure 40: Sample Channelization of OC12/STM4 IQE PIC (SDH Mode)



In Figure 40 on page 413, a Channelized OC12/STM4 IQE PIC operating in SDH mode results in a channelized STM4 interface, which can be nonpartitioned into one SDH VC-4-VC interface or partitioned into the following OC slices:

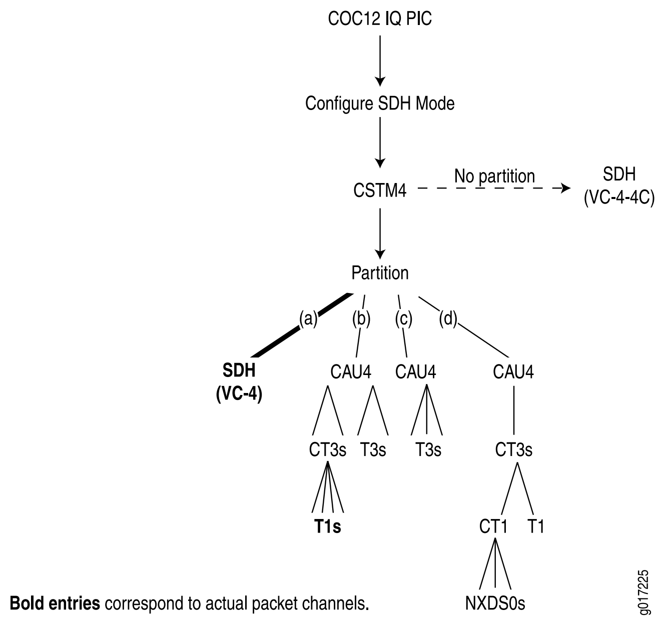
a. An SDH VC-4 interface.
b. A channelized AU-4 partitioned into E3 interfaces.
c. Another channelized AU-4 interface partitioned into E3 interfaces.
d. Another channelized AU-4 interface partitioned into E1 interfaces.
e. Another channelized AU-4 interface partitioned into CE1 interfaces partitioned into *N*xDS0 interfaces.

This is one of thousands of ways to configure a Channelized OC12/STM4 IQE PIC.

Channelization of OC12/STM4 IQ PIC (SDH Mode)

Channelized OC12/STM4 IQ PICs can be configured to operate in SONET or SDH mode and partitioned into various smaller partitions. Figure 41 on page 414 illustrates one possible channelization configuration for Channelized OC12/STM4 IQ PICs operating in SDH mode.

Figure 41: Sample Channelization of OC12/STM4 IQ PIC (SDH Mode)



In Figure 41 on page 414, a Channelized OC12/STM4 IQ PIC operating in SDH mode results in a channelized STM4 interface, which can be nonpartitioned into one SDH VC-4-VC interface or partitioned into the following OC slices:

a. An SDH VC-4 interface.
b. A channelized AU-4 partitioned into channelized T3 interfaces and T3 interfaces.
c. Another channelized AU-4 interface converted into T3 interfaces.
d. Another channelized AU-4 interface converted into a channelized T3 interface, which is partitioned further into a channelized T1 and a T1 interface. The channelized T1 interface is further partitioned into *N*xDS0 interfaces.

This is one of thousands of ways to configure a Channelized OC12/STM4 IQ PIC.

Channelization of OC12 PIC (SDH Mode)

OC12 PICs can be configured to various smaller partitions, such as T3s.

Figure 42: Sample Channelization of OC12 PIC (non !Q and !QE)

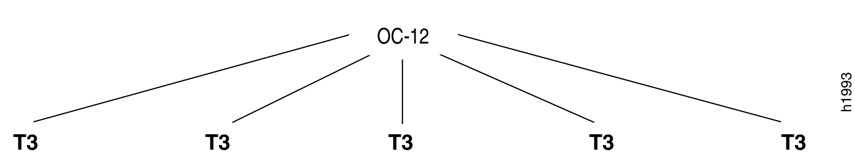


Figure 42 on page 414 shows five T3 channels configured on the Channelized OC12 PIC. You can configure seven additional T3 channels. For more information about configuring Channelized OC12 PICs, see “Configuring Channelized OC12 Interfaces” on page 432.

Configuring Channelized OC12/STM4 IQ and IQE Interfaces (SONET Mode)

This section describes how to configure channelized OC12/STM4 IQ and IQE interfaces, discussing the following topics:

Configuring an OC12/STM4 Interface

You can configure one OC12 interface on a one-port Channelized OC12/STM4 IQ or IQE PIC. On a 4-port OC12/STM4 IQ or IQE PIC, you can configure one OC12 interface per port. To configure an OC12 interface, include the no-partition and interface-type statements at the [edit interfaces coc12-*fpc/pic/port*] hierarchy level:

```
[edit interfaces coc12-fpc/pic/port]
no-partition interface-type so;
```

This configuration creates interface so-*fpc/pic/port*.

NOTE: Class-of-service (CoS) rules cannot be applied to an individual channel configured on channelized IQ and IQE interfaces. You can only apply CoS rules to the aggregate bit streams.

Configuring T3 Interfaces

To configure a T3 interface on an OC12 PIC, include the partition, oc-slice, and interface-type statements at the [edit interfaces coc12-*fpc/pic/port*] hierarchy level, specifying the coc1 interface type:

```
[edit interfaces coc12-fpc/pic/port]
partition partition-number oc-slice oc-slice-range interface-type coc1;
```

This configuration creates interface coc1-*fpc/pic/port*:*channel*.

Then, include the no-partition interface-type statement at the [edit interfaces coc1-*fpc/pic/port*:*channel*] hierarchy level, specifying the t3 interface type:

```
[edit interfaces coc1-fpc/pic/port:channel]
no-partition interface-type t3;
```

This configuration creates interface t3-*fpc/pic/port*:*channel*.

The partition number is the sublevel interface partition index and is correlated with the channel number. For channelized OC1 interfaces, the partition number can be from 1 through 12.

NOTE: For channelized OC12 interfaces, channel numbering begins with 0 (:0). For channelized OC12/STM4 IQ and IQE interfaces, channel numbering begins with 1 (:1).

The OC-slice range is the range of SONET/SDH slices. For SONET/SDH interfaces, the OC-slice range specifies the bandwidth size required for the interface type you are configuring. For channelized OC1 interfaces, the OC slice can be from 1 through 12. You can configure only one OC slice per channelized OC1 interface.

The interface type is the channelized interface type or clear channel you are creating. For channelized OC12 interfaces, *type* can be so or coc1.

Example: Configuring T3 Interfaces

Configure a T3 interface using partition 3 and OC slice 3. This configuration creates interface t3-1/1/0:3:

```
[edit interfaces coc12-1/1/0]
partition 3 oc-slice 3 interface-type coc1;
[edit interfaces coc1-1/1/0:3]
no-partition interface-type t3;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring OC3 Interfaces

To configure an OC3 interface, include the partition, oc-slice, and interface-type statements at the [edit interfaces coc12-*fpc/pic/port*] hierarchy level, specifying the so interface type:

```
[edit interfaces coc12-fpc/pic/port]
partition partition-number oc-slice oc-slice-range interface-type so;
```

The partition number is the sublevel interface partition index. For SONET/SDH interfaces, the partition number does not correlate with bandwidth size. For OC3 interfaces, the partition number can be from 1 through 4.

NOTE: For channelized OC12 interfaces, channel numbering begins with 0 (:0). For channelized OC12 IQ and IQE interfaces, channel numbering begins with 1 (:1).

The OC-slice range is the range of SONET/SDH slices. For SONET/SDH interfaces, the OC-slice range specifies the bandwidth size required for the interface type you are configuring. OC3 interfaces must occupy three consecutive OC slices per interface, in one of the following forms:

- 1–3
- 4–6
- 7–9
- 10–12

By contrast, the T3 and OC1 IQ interfaces each occupy one OC slice per interface.

The interface type is the channelized interface type or data channel you are creating. For channelized OC12 interfaces, the interface type can be coc1 or so.

Example: Configuring OC3 Interfaces

Configure an OC3 interface, using partition 1 and OC slices 4 through 6. This configuration creates interface so-1/1/0:1:

```
[edit interfaces coc12-1/1/0]
partition 1 oc-slice 4-6 interface-type so;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring T1 Interfaces

To configure T1 interfaces on a Channelized OC12 IQ or IQE PIC, perform the following tasks:

1. Partition the channelized OC12 interface into channelized OC1 interfaces by including the partition, oc-slice, and interface-type statements at the [edit interfaces coc12-*fpc/pic/port*] hierarchy level, specifying the coc1 interface type:

   ```
   [edit interfaces coc12-fpc/pic/port]
   partition partition-number oc-slice oc-slice-range interface-type coc1;
   ```

2. If your network equipment uses VT mapping, partition the channelized OC1 interface into T1 interfaces by including the partition and interface-type statements at the [edit interfaces coc1-*fpc/pic/port*] hierarchy level, specifying the t1 interface type:

   ```
   [edit interfaces coc1-fpc/pic/port]
   partition partition-number interface-type t1;
   ```

3. If your network equipment uses M13 or C-bit parity, convert the channelized OC1 interface into a channelized T3 interface by including the no-partition and interface-type statements at the [edit interfaces coc1- *fpc/pic/port*:*channel*] hierarchy level, specifying the ct3 interface type. Note that because the no-partition statement is included, this configuration does not create another level of channelization, as denoted by the number of colons in the resulting interface.

   ```
   [edit interfaces coc1-fpc/pic/port]
   no-partition partition-number interface-type ct3;
   ```

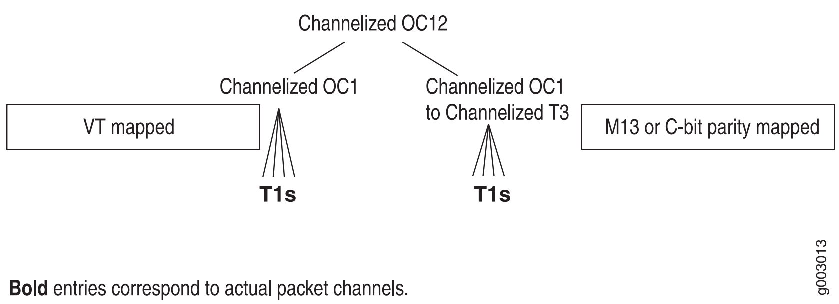
4. Partition the channelized T3 interface into T1 interfaces by including the partition and interface-type statements at the [edit interfaces ct3-*fpc/pic/port*] hierarchy level, specifying the t1 interface type:

   [edit interfaces ct3-*fpc/pic/port*]
   partition *partition-number* interface-type t1;

NOTE: Class-of-service (CoS) rules cannot be applied to an individual channel configured on channelized IQ interfaces. You can only apply CoS rules to the aggregate bit streams.

Figure 43 on page 418 shows VT-mapped and M13 or C-bit parity-mapped configurations of T1 interfaces.

Figure 43: T1 Interfaces on a Channelized OC12 PIC



Example: Configuring T1 Interfaces

Configure the following T1 interfaces:

```
t1-0/0/0:1:1
t1-0/0/0:1:2
t1-0/0/0:1:3
t1-0/0/0:1:4
t1-0/0/0:1:5
```

VT-Mapped Configuration

```
[edit interfaces coc12-0/0/0]
partition 1 oc-slice 1 interface-type coc1;

[edit interfaces coc1-0/0/0:1]
partition 1-5 interface-type t1;
```

M13 or C-bit Parity-Mapped Configuration

```
[edit interfaces coc12-0/0/0]
partition 1 oc-slice 1 interface-type coc1;

[edit interfaces coc1-0/0/0:1]
no-partition interface-type ct3;

[edit interfaces ct3-0/0/0:1]
```

```
partition 1-5 interface-type t1;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring NxDS0 Interfaces

To configure *N*xDS0 interfaces on a Channelized OC12 IQE PIC, perform the following tasks:

1. Partition the channelized OC12 IQE interface into channelized OC1 interfaces by including the partition, oc-slice, and interface-type statements at the [edit interfaces coc12-*fpc/pic/port*] hierarchy level, specifying the coc1 interface type:

   ```
   [edit interfaces coc12-fpc/pic/port]
   partition partition-number oc-slice oc-slice-range interface-type coc1;
   ```

2. If your network equipment uses VT mapping, partition the channelized OC1 interface into channelized T1 interfaces by including the partition and interface-type statements at the [edit interfaces coc1-*fpc/pic/port*] hierarchy level, specifying the ct1 interface type:

   ```
   [edit interfaces coc1-fpc/pic/port]
   partition partition-number interface-type ct1;
   ```

NOTE: Class-of-service (CoS) rules cannot be applied to an individual channel configured on channelized IQ interfaces. You can only apply CoS rules to the aggregate bit streams.

3. If your network equipment uses M13 or C-bit parity, convert the channelized OC1 interface into a channelized T3 interface by including the no-partition and interface-type statements at the [edit interfaces coc1-*fpc/pic/port*] hierarchy level, specifying the ct3 interface type:

   ```
   [edit interfaces coc1-fpc/pic/port]
   no-partition partition-number interface-type ct3;
   ```

NOTE: Because the no-partition statement is included, this configuration task does not create another level of channelization, as denoted by the number of colons in the resulting interface.

4. Partition the channelized T3 interface into channelized T1 interfaces by including the partition and interface-type statements at the [edit interfaces ct3-*fpc/pic/port*] hierarchy level, specifying the ct1 interface type:

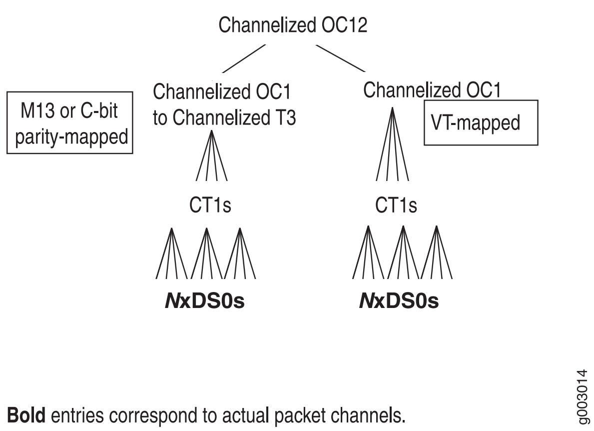
   ```
   [edit interfaces ct3-fpc/pic/port]
   partition partition-number interface-type ct1;
   ```

5. Configure channelized *N*xDS0 IQ interfaces on the channelized T1 IQ interface by including the partition, timeslots, and interface-type statements at the [edit interfaces ct1-*fpc/pic/port*] hierarchy level, specifying the ds interface type:

   [edit interfaces ct1-*fpc/pic/port*:*channel*:*channel*]
   partition *partition-number* timeslots *time-slot-range* interface-type ds;

Figure 44 on page 420 shows VT-mapped and M13 or C-bit parity-mapped configurations of *N*xDS0 IQ interfaces.

Figure 44: Sample Channelization of OC12 IQE PIC



Example: Configuring NxDS0 Interfaces

Configure the following two *N*xDS0 interfaces with 10 time slots and 4 time slots, respectively:

```
ds-0/0/0:1:2:1
ds-0/0/0:1:2:2
```

VT-Mapped Configuration

```
[edit interfaces coc12-0/0/0]
partition 1 oc-slice 1 interface-type coc1;

[edit interfaces coc1-0/0/0:1]
partition 2 interface-type ct1;

[edit interfaces ct1-0/0/0:1:2]
partition 1 timeslots 1-10 interface-type ds;
partition 2 timeslots 12-16 interface-type ds;
```

M13 or C-bit Parity-Mapped Configuration

```
[edit interfaces coc12-0/0/0]
partition 1 oc-slice 1 interface-type coc1;

[edit interfaces coc1-0/0/0:1]
no-partition interface-type ct3;

[edit interfaces ct3-0/0/0:1]
```

```
partition 2 interface-type ct1;

[edit interfaces ct1-0/0/0:1:2]
partition 1 timeslots 1-10 interface-type ds;
partition 2 timeslots 12-16 interface-type ds;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring Fractional T1 Interfaces

By default, all the time slots on a channelized T1 interface are used. To configure a fractional T1 interface on a Channelized OC12 IQE PIC, perform the following tasks:

1. Configure a T1 interface. For more information, see "Configuring T1 Interfaces" on page 396.
2. Configure the number of time slots allocated to the T1 interface by including the timeslots statement at the [edit interfaces t1-*fpc/pic/port*<:*channel*> t1-options] hierarchy level:

```
[edit interfaces t1-fpc/pic/port<:channel> t1-options]
timeslots  time-slot-range;
```

For channelized T1 interfaces, the time-slot range is from 1 through 24. You can designate any combination of time slots. To configure ranges, use hyphens. To configure discontinuous time slots, use commas. Do not include spaces. For more information, see "Configuring Fractional T1 Time Slots" on page 537.

Example: Configuring Fractional T1 Interfaces

Configure a fractional T1 interface that uses time slots 1 through 5 and 10:

```
[edit interfaces coc12-0/0/0]
partition 1 oc-slice 1 interface-type coc1;
[edit interfaces coc1-0/0/0:1]
partition 1 interface-type t1;
[edit interfaces t1-0/0/0:1:1 t1-options]
timeslots 1-5,10;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring Channelized OC12/STM4 IQE Interfaces (SDH Mode)

The Channelized OC12 IQE PIC configured for SDH mode creates a single channelized STM4 interface. You can configure this interface as unpartitioned using the no-partition statement at the [edit interfaces cstm4-*fpc/pic/port*] hierarchy level to create a single SDH VC-4-4C interface, or you can partition it into the following OC slices:

- SDH virtual concatenation 4 (VC-4) and channelized AU-4 interfaces (4 interfaces, any combination)
- E3 interfaces from a channelized AU-4 interface (3 interfaces, any combination)

- Channelized E1 or E1 interfaces from a channelized AU-4 interface (63 interfaces, any combination)
- *N*xDS0 interfaces from a channelized E1 interface

This section describes how to configure the following channelized OC12 IQE interfaces on a Channelized OC12 IQE PIC configured in SDH mode:

Configuring Channelized OC12/STM4 IQE PICs for SDH Mode

The 4-port Channelized OC12 IQE PIC allows SONET/SDH configuration on a per port basis, permitting combinations of SONET and SDH ports on the same PIC. The 1-port Channelized OC12 IQE PIC operates in either SONET or SDH mode only.

To configure a 1-port Channelized OC12 IQE PIC to operate in SDH mode, include the framing sdh statement at the [edit chassis fpc *fpc/pic/port*] hierarchy level:

```
[edit chassis]
fpc 0 {
   pic 2 {
      framing sdh;
   }
}
```

This configuration creates interface cstm4-0/2/0.

You can also use the above configuration example to configure all 4 ports of a 4-port Channelized OC12 IQE PIC for SDH mode. To configure individual ports to operate in SDH mode, include the framing sdh statement at the [edit chassis fpc *fpc/pic/port*] hierarchy level. The following example configures port 2 for SDH mode:

```
[edit chassis]
fpc 0 {
   pic 2 {
      port 2 {
         framing sdh;
      }
   }
}
```

This configuration creates interface cstm4-0/2/2:2.

For more information, see the *JUNOS System Basics Configuration Guide*.

Configuring an Unpartitioned SDH (VC-4-4C) Interface

On a Channelized OC12 IQE PIC, you can configure one SDH (VC-4-4C) interface. To configure an SDH (VC-4-4C) interface, include the no-partition and interface-type statements at the [edit interfaces cstm4-*fpc/pic/port*] hierarchy level:

```
[edit interfaces cstm4-fpc/pic/port]
no-partition interface-type so;
```

This configuration creates interface so-*fpc/pic/port*.

Example: Configuring an Unpartitioned SDH (VC-4-4C) Interface

Configure an unpartitioned SDH (VC-4-4C) interface, using partition 1 and OC slices 4 through 6:

```
[edit interfaces cstm4-0/2/0]
no-partition interface-type so;
```

This configuration creates the interface so-0/2/0.

Configuring SDH (VC-4) Interfaces

To configure an SDH (VC-4) interface on a Channelized OC12 IQE PIC, include the partition, oc-slice, and interface-type statements at the [edit interfaces cstm4-*fpc/pic/port*] hierarchy level, specifying the so interface type:

```
[edit interfaces cstm4-fpc/pic/port]
partition partition-number oc-slice oc-slice-range interface-type so;
```

This configuration creates interface so-*fpc/pic/port*:*channel*.

The partition number is the sublevel interface partition index and is correlated with the channel number. For Channelized OC12 IQE PICs, the OC-slice range can be from 1 through 12.

NOTE: For channelized OC12 IQE interfaces, channel numbering begins with 1 (:1).

The OC-slice range is the range of SONET/SDH slices. For SDH interfaces, the OC-slice range specifies the bandwidth size required for the interface type you are configuring. SDH (VC-4) interfaces must occupy three consecutive OC slices per interface, in one of the following forms:

- 1–3
- 4–6
- 7–9
- 10–12

The interface type is the channelized interface type or data channel you are creating.

Example: Configuring SDH (VC-4) Interfaces

Configure SDH (VC-4) interfaces:

```
[edit interfaces cstm4-0/2/0]
partition 1 oc-slice 1-3 interface-type so;
partition 2 oc-slice 4-6 interface-type so;
partition 3 oc-slice 7-9 interface-type so;
partition 4 oc-slice 10-12 interface-type so;
```

This configuration creates the interfaces so-0/2/0:1 through so-0/2/0:4.

Configuring Channelized AU-4 Interfaces

To configure a channelized AU-4 interface, include the partition, oc-slice, and interface-type statements at the [edit interfaces cstm4-*fpc/pic/port*] hierarchy level, specifying the cau4 interface type:

```
[edit interfaces cstm4-fpc/pic/port]
partition partition-number oc-slice oc-slice-range interface-type cau4;
```

This configuration creates interface cau4-*fpc/pic/port*:*channel*.

The partition number is the sublevel interface partition index. For SDH interfaces, the partition number is not correlated with bandwidth size. A channelized STM-4 interface can have from 1 through 4 partition numbers.

NOTE: For channelized OC12 interfaces, channel numbering begins with 0 (:0). For channelized OC12 IQE interfaces, channel numbering begins with 1 (:1).

The OC-slice range is the range of SONET/SDH slices. For SDH interfaces, the OC-slice range specifies the bandwidth size required for the interface type you are configuring. Channelized AU-4 IQ interfaces must occupy three consecutive OC slices per interface, in one of the following forms:

- 1–3
- 4–6
- 7–9
- 10–12

The interface type is the channelized interface type or data channel you are creating.

Example: Configuring Channelized AU-4 Interfaces

Configure channelized AU-4 interfaces, using partitions 1 through 4:

```
[edit interfaces cstm4-0/2/0]
```

```
partition 1 oc-slice 1-3 interface-type cau4;
partition 2 oc-slice 4-6 interface-type cau4;
partition 3 oc-slice 7-9 interface-type cau4;
partition 4 oc-slice 10-12 interface-type cau4;
```

This configuration creates the interfaces cau4-0/2/0:1 through cau4-0/2/0:4.

Configuring E3 Interfaces

To configure E3 interfaces, include the partition and interface-type statements at the [edit interfaces cau4-*fpc/pic/port*] hierarchy level, specifying the e3 interface type:

```
[edit interfaces]
cau4-fpc/pic/port {
   partition partition-number interface-type e3;
}
```

This configuration creates the interfaces e3-*fpc/pic/port*:*channel* and e3-*fpc/pic/port*:*channel.*

NOTE: Class-of-service (CoS) rules cannot be applied to an individual channel configured on channelized IQE interfaces. You can only apply CoS rules to the aggregate bit streams.

Example: Configuring E3 Interfaces

Configure E3 interfaces, using partition 1:

```
[edit interfaces]
cau4-0/2/0:1 {
   partition 1 interface-type e3;
}
e3-0/2/0:1:1;
```

Configuring E1 or Channelized E1 Interfaces

To configure E1 or channelized E1 interfaces, include the partition and interface-type statements at the [edit interfaces cau4-*fpc/pic/port*] hierarchy level, specifying the e1 or ce1 interface type:

```
[edit interfaces]
cau4-fpc/pic/port {
   partition partition-number interface-type e1;
}
cau4-fpc/pic/port {
   partition partition-number interface-type ce1;
}
```

This configuration creates the interfaces e1-*fpc/pic/port*:*channel* and ce1-*fpc/pic/port*:*channel*.

NOTE: Class-of-service (CoS) rules cannot be applied to an individual channel configured on channelized IQE interfaces. You can only apply CoS rules to the aggregate bit streams.

Example: Configuring E1 or Channelized CE1 Interfaces

Configure E1 or channelized CE1 interfaces, using partition 3 and partition 4:

```
[edit interfaces]
cau4-0/2/0:1 {
   partition 3 interface-type e1;
}
cau4-0/2/0:1 {
   partition 4 interface-type ce1;
}
```

This configuration creates interfaces e1-0/2/0:1:2:3 and ce1-0/2/0:1:2:4.

Configuring NxDS0 Interfaces

Configure channelized *N*xDS0 interfaces on the channelized E1 interface by including the partition, timeslots, and interface-type statements at the [edit interfaces ce1-*fpc/pic/port*:*channel*] hierarchy level, specifying the ds interface type:

```
[edit interfaces ce1-fpc/pic/port:channel:channel]
partition partition-number timeslots time-slot-range interface-type ds;
```

This configuration creates the interface ds-*fpc/pic/port*:*channel.*

The time-slot range is from 1 through 32. You can designate any combination of time slots. To configure ranges, use hyphens. To configure discontinuous time slots, use commas. You can use a combination of ranges and discontinuous time slots, for example:

```
1,9-18,21
```

Example: Configuring NxDS0 Interfaces

Configure channelized *N*xDS0 interfaces, using partition 4 and time slots 1 through 10:

```
[edit interfaces]
ce1-0/2/0:1:2:3 {
   partition 4 interface-type ds0 timeslots 1-10;
}
```

This configuration creates interface ds-0/2/0:1:2:3:4.

Configuring Channelized OC12/STM4 IQ Interfaces (SDH Mode)

The Channelized OC12 IQ PIC configured for SDH mode creates a single channelized STM4 interface. You can configure this interface as unpartitioned using the no-partition statement at the [edit interfaces cstm4-*fpc/pic/port*] hierarchy level to create a single SDH VC-4-4C interface, or you can partition it into the following OC slices:

- SDH virtual concatenation 4 (VC-4) and channelized AU-4 interfaces (4 interfaces, any combination)
- Channelized T3 or T3 interfaces from a channelized AU-4 interface (3 interfaces, any combination)
- Channelized T1 or T1 interfaces from a channelized T3 interface (28 interfaces, any combination)
- *N*xDS0 interfaces from a channelized T1 interface

This section describes how to configure the following channelized OC12 IQ interfaces on a Channelized OC12 IQ PIC configured in SDH mode:

Configuring a Channelized OC12/STM4 IQ PIC for SDH Mode

To configure a Channelized OC12 IQ PIC to operate in SDH mode, include the framing sdh statement at the [edit chassis fpc *fpc/pic/port*] hierarchy level:

```
[edit chassis]
fpc 0 {
   pic 2 {
      framing sdh;
   }
}
```

This configuration creates interface cstm4-0/2/0.

For more information, see the *JUNOS System Basics Configuration Guide*.

Configuring an Unpartitioned SDH (VC-4-4C) Interface

On a Channelized OC12 IQ PIC, you can configure one SDH (VC-4-4C) interface. To configure an SDH (VC-4-4C) interface, include the no-partition and interface-type statements at the [edit interfaces cstm4-*fpc/pic/port*] hierarchy level:

```
[edit interfaces cstm4-fpc/pic/port]
no-partition interface-type so;
```

This configuration creates interface so-*fpc/pic/port*.

Example: Configuring an Unpartitioned SDH (VC-4-4C) Interface

Configure an unpartitioned SDH (VC-4-4C) interface, using partition 1 and OC slices 4 through 6:

```
[edit interfaces cstm4-0/2/0]
no-partition interface-type so;
```

This configuration creates the interface so-0/2/0.

Configuring SDH (VC-4) Interfaces

To configure a SDH (VC-4) interface on a Channelized OC12 IQ PIC, include the partition, oc-slice, and interface-type statements at the [edit interfaces cstm4-*fpc/pic/port*] hierarchy level, specifying the so interface type:

```
[edit interfaces cstm4-fpc/pic/port]
partition partition-number oc-slice oc-slice-range interface-type so;
```

This configuration creates interface so-*fpc/pic/port*:*channel*.

The partition number is the sublevel interface partition index and is correlated with the channel number. For Channelized OC12 IQ PICs, the OC-slice range can be from 1 through 12.

NOTE: For channelized OC12 IQ interfaces, channel numbering begins with 1 (:1).

The OC-slice range is the range of SONET/SDH slices. For SDH interfaces, the OC-slice range specifies the bandwidth size required for the interface type you are configuring. SDH (VC-4) interfaces must occupy three consecutive OC-slices per interface, in one of the following forms:

- 1–3
- 4–6
- 7–9
- 10–12

The interface type is the channelized interface type or data channel you are creating.

Example: Configuring SDH (VC-4) Interfaces

Configure SDH (VC-4) interfaces:

```
[edit interfaces cstm4-0/2/0]
```

```
partition 1 oc-slice 1-3 interface-type so;
partition 2 oc-slice 4-6 interface-type so;
partition 3 oc-slice 7-9 interface-type so;
partition 4 oc-slice 10-12 interface-type so;
```

This configuration creates the interfaces so-0/2/0:1 through so-0/2/0:4.

Configuring Channelized AU-4 Interfaces

To configure a channelized AU-4 interface, include the partition, oc-slice, and interface-type statements at the [edit interfaces cstm4-*fpc/pic/port*] hierarchy level, specifying the cau4 interface type:

```
[edit interfaces cstm4-fpc/pic/port]
partition partition-number oc-slice oc-slice-range interface-type cau4;
```

This configuration creates interface cau4-*fpc/pic/port*:*channel*.

The partition number is the sublevel interface partition index. For SDH interfaces, the partition number is not correlated with bandwidth size. A channelized STM-4 interface can have from 1 through 4 partition numbers.

NOTE: For channelized OC12 interfaces, channel numbering begins with 0 (:0). For channelized OC12 IQ interfaces, channel numbering begins with 1 (:1).

The OC-slice range is the range of SONET/SDH slices. For SDH interfaces, the OC-slice range specifies the bandwidth size required for the interface type you are configuring. Channelized AU-4 IQ interfaces must occupy three consecutive OC slices per interface, in one of the following forms:

- 1–3
- 4–6
- 7–9
- 10–12

The interface type is the channelized interface type or data channel you are creating.

Example: Configuring Channelized AU-4 Interfaces

Configure channelized AU-4 interfaces, using partitions 1 through 4:

```
[edit interfaces cstm4-0/2/0]
partition 1 oc-slice 1-3 interface-type cau4;
partition 2 oc-slice 4-6 interface-type cau4;
partition 3 oc-slice 7-9 interface-type cau4;
partition 4 oc-slice 10-12 interface-type cau4;
```

This configuration creates the interfaces cau4-0/2/0:1 through cau4-0/2/0:4.

Configuring T3 or Channelized T3 Interfaces

To configure T3 or channelized T3 interfaces, include the partition and interface-type statements at the [edit interfaces cau4-*fpc/pic/port*] hierarchy level, specifying the t3 or ct3 interface type:

```
[edit interfaces]
cau4-fpc/pic/port {
   partition partition-number interface-type t3;
}
cau4-fpc/pic/port {
   partition partition-number interface-type ct3;
}
```

This configuration creates the interfaces t3-*fpc/pic/port*:*channel* and t3-*fpc/pic/port*:*channel.*

NOTE: Class-of-service (CoS) rules cannot be applied to an individual channel configured on channelized IQ interfaces. You can only apply CoS rules to the aggregate bit streams.

Example: Configuring T3 or Channelized T3 Interfaces

Configure T3 and channelized T3 interfaces, using partition 1 and partition 2:

```
[edit interfaces]
cau4-0/2/0:1 {
   partition 1 interface-type t3;
}
cau4-0/2/0:1 {
   partition 2 interface-type ct3;
}
t3-0/2/0:1:1 ct3-0/2/0:1:2;
```

Configuring T1 or Channelized T1 Interfaces

To configure T1 or channelized T1 interfaces, include the partition and interface-type statements at the [edit interfaces ct3-*fpc/pic/port*] hierarchy level, specifying the t1 or ct1 interface type:

```
[edit interfaces]
ct3-fpc/pic/port {
   partition partition-number interface-type t1;
}
ct3-fpc/pic/port {
   partition partition-number interface-type ct1;
}
```

This configuration creates the interfaces t1-*fpc/pic/port*:*channel* and ct1-*fpc/pic/port*:*channel*.

NOTE: Class-of-service (CoS) rules cannot be applied to an individual channel configured on channelized IQ interfaces. You can only apply CoS rules to the aggregate bit streams.

Example: Configuring T1 or Channelized T1 Interfaces

Configure T1 or channelized T1 interfaces, using partition 3 and partition 4:

```
[edit interfaces]
ct3-0/2/0:1:2 {
   partition 3 interface-type t1;
}
ct3-0/2/0:1:2 {
   partition 4 interface-type ct1;
}
```

This configuration creates interfaces t1-0/2/0:1:2:3 and ct1-0/2/0:1:2:4.

Configuring NxDS0 IQ Interfaces

Configure channelized *N*xDS0 IQ interfaces on the channelized T1 IQ interface by including the partition, timeslots, and interface-type statements at the [edit interfaces ct1-*fpc*/*pic*/*port*:*channel*] hierarchy level, specifying the ds interface type:

```
[edit interfaces ct1-fpc/pic/port:channel:channel]
partition partition-number timeslots time-slot-range interface-type ds;
```

This configuration creates the interface ds-*fpc*/*pic*/*port*:*channel.*

The time-slot range is from 1 through 24. You can designate any combination of time slots. To configure ranges, use hyphens. To configure discontinuous time slots, use commas. You can use a combination of ranges and discontinuous time slots:

```
1,9-18,21
```

Example: Configuring NxDS0 IQ Interfaces

Configure channelized *N*xDS0 interfaces, using partition 4 and time slots 1 through 10:

```
[edit interfaces]
ct1-0/2/0:1:2:3 {
   partition 4 interface-type ds0 timeslots 1-10;
}
```

This configuration creates interface ds-0/2/0:1:2:3:4.

Configuring Channelized OC12 Interfaces

On Channelized OC12 PICs, you can configure 12 T3 channels per port. To configure channelized OC12 interface properties, you can include the sonet-options and t3-options statements at the [edit interfaces *interface-name*] hierarchy level. Some SONET/SDH options are ignored, and some can only be configured for channel 0, though they apply equally to all channels. The long-buildout statement under t3-options is also ignored.

For T3 channels on a channelized OC12 interface, the clocking statement is supported only for channel 0; it is ignored if included in the configuration of channels 1 through 11. The clock source configured for channel 0 applies to all channels on the channelized OC12 interface. The individual T3 channels use a gapped 45-MHz clock as the transmit clock. When you configure the clock source for a channelized interface—ds-*fpc/pic/port* :0, for example—you must also include the channel-group statement at the [edit chassis] hierarchy level and specify channel group 0. For more information, see “Clock Sources on Channelized Interfaces” on page 376.

For more information, see “Configuring SONET/SDH Interfaces” on page 797 and “Configuring T3 Interfaces” on page 539. For a configuration example, see “Configuring Aggregated SONET/SDH Interfaces” on page 835.

Table 37 on page 432 summarizes the OC12-to-DS3 numbering scheme.

Table 37: OC12-to-DS3 Numbering Scheme

Two-Level STS-1 Number (STS-3,STS-1)	One-Level STS Number	OC12-to-DS3 PIC DS3 Number
1,1	1	0
1,2	2	1
1,3	3	2
2,1	4	3
2,2	5	4
2,3	6	5
3,1	7	6
3,2	8	7
3,3	9	8
4,1	10	9
4,2	11	10
4,3	12	11

Example: Configuring Channelized OC12 Interfaces

The following configuration is sufficient to get the channelized OC12 interface up and running. The OC12 interface can be divided into 12 channels. DS3 channels can use the following encapsulation types:

- PPP, PPP CCC, and PPP TCC
- Frame Relay, Frame Relay CCC, and Frame Relay TCC
- Cisco HDLC, Cisco HDLC CCC, and Cisco HDLC TCC

The channels can also have logical interfaces.

```
[edit interfaces]
t3-fpc/pic/port:0 {
    encapsulation cisco-hdlc;
    t3-options {
        compatibility-mode larscom;
        payload-scrambler;
    }
    unit 0 {
        family inet {
            address 10.11.30.1/30;
        }
        family iso;
    }
}
t3-fpc/pic/port:1 {
    encapsulation ppp;
    t3-options {
        compatibility-mode larscom;
        payload-scrambler;
    }
    unit 0 {
        family inet {
            address 10.11.30.5/30;
        }
        family iso;
    }
}
t3-fpc/pic/port:2 {
    encapsulation frame-relay;
    t3-options {
        compatibility-mode larscom;
        payload-scrambler;
    }
    unit 0 {
        dlci 100;
        family inet {
            address 10.11.30.9/30;
        }
        family iso;
    }
    unit 1 {
```

```
            dlci 101;
            family inet {
                address 10.11.31.9/30;
            }
            family iso;
        }
    }
    t3-1fpc/pic/port:3 {
        encapsulation cisco-hdlc-ccc;
        t3-options {
            compatibility-mode larscom;
            payload-scrambler;
        }
        unit 0;
    }
    t3-fpc/pic/port:4 {
        encapsulation ppp-ccc;
        t3-options {
            compatibility-mode larscom;
            payload-scrambler;
        }
        unit 0;
    }
    t3-fpc/pic/port:5 {
        dce;
        encapsulation frame-relay-ccc;
        t3-options {
            compatibility-mode larscom;
            payload-scrambler;
        }
        unit 0 {
            encapsulation frame-relay-ccc;
            dlci 1000;
        }
        unit 1 {
            encapsulation frame-relay-ccc;
            dlci 1001;
        }
    }
```

Configuring Link PIC Failover on Channelized OC12/STM4 IQ and IQE Interfaces

For Channelized OC12 IQ or IQE PICs used as linking PICs in redundant LSQ configurations, you can inhibit the router from sending PPP termination-request messages to the remote host if the link PIC fails. To do this, include the no-termination-request statement at the [edit interfaces *interface-name* ppp-options] hierarchy level:

```
no-termination-request;
```

The no-termination-request statement is supported only with MLPPP and SONET APS configurations and works with PPP, PPP over Frame Relay, and MLPPP interfaces only.

For information about interchassis and intrachassis LSQ failover, see the *JUNOS Services Interfaces Configuration Guide*.

Example: Configuring a Channelized OC12 IQ Interface as an Unpartitioned, Clear Channel

Configuring a SONET/SDH Interface

Configure a channelized OC12 interface as an unpartitioned, clear channel:

```
[edit interfaces]
coc12-5/0/0 {
   no-partition interface-type so; # so-5/0/0
}
```

Configuring Multiple Interface Types

Configure the following interfaces on a Channelized OC12 IQ or IQE PIC:

a. An OC3 interface
b. Another OC3 interface
c. A channelized OC1 partitioned into T1 interfaces
d. A channelized OC1 converted into a T3 interface
e. A channelized OC1 partitioned into T1 interfaces and channelized T1s, which are partitioned into *N*xDS0 interfaces
f. A channelized OC1 converted into a channelized T3, which is partitioned into T1 interfaces
g. A channelized OC1 converted into a channelized T3, which is partitioned into T1 interfaces and a channelized T1, which is partitioned into *N*xDS0 interfaces
h. A channelized OC1 partitioned into channelized T1s, which are partitioned into *N*xDS0 interfaces

Configuring the Interface Partitions

```
[edit interfaces]
coc12-1/1/0 {
   sonet-options {
      sonet-options-statements;
   }
   partition 1 oc-slice 1-3 interface-type so; # (a) so-1/1/0:1
   partition 2 oc-slice 4-6 interface-type so; # (b) so-1/1/0:2
   partition 3 oc-slice 7 interface-type coc1; # (c) coc1-1/1/0:3
   partition 4 oc-slice 8 interface-type coc1; #(d) coc1-1/1/0:4
   partition 5 oc-slice 9 interface-type coc1; # (e) coc1/1/0:5
   partition 6 oc-slice 10 interface-type coc1; # (f) coc1-1/1/0:6
   partition 7 oc-slice 11 interface-type coc1; # (g) coc1-1/1/0:7
   partition 8 oc-slice 12 interface-type coc1; # (h) coc1-1/1/0:8
}
```

(a)

```
so-1/1/0:1 {
   description “(a) OC-slice 1-3 of coc12-1/1/0. COC12 > OC3.;
   sonet-options {
      sonet-options-statements;
   }
}
```

```
(b)     so-1/1/0:2 {
          description "(b) OC-slice 4-6 of coc12-1/1/0. COC12 > OC3.;
          sonet-options {
            sonet-options-statements;
          }
        }

(c)     coc1-1/1/0:3 {
          description "(c) OC-slice 7 of coc12-1/1/0. COC12 to COC1 VT-mapped to T1s.";
          sonet-options {
            sonet-options-statements;
          }
          partition 1 - 10 interface-type t1; # t1-1/1/0:[1-10]
        }
        t1-1/1/0:3:1 {
          description "(c) OC-slice 7 of coc12-1/1/0. T1 interface configuration.";
          t1-options {
            t1-options-statements;
          }
        }
        ...

(d)     coc1-1/1/0:4 {
          description "(d) OC-slice 8 of coc12-1/1/0. COC12 to COC1 converted to a T3.";
          sonet-options {
            sonet-options-statements;
          }
          no-partition interface-type t3; # t3-1/1/0:4
        }
        t3-1/1/0:4 {
          description "(d) OC-slice 8 of coc12-1/1/0. T3 interface configuration.";
        }

(e)     coc1-1/1/0:5 {
          description "(e) OC-slice 9 of coc12-1/1/0. COC12 to COC1 VT-mapped to T1s.";
          sonet-options {
            sonet-options-statements;
          }
          partition 1 - 3 interface-type t1; # t1-1/1/0:5:[1-3]
          partition 4 interface-type ct1; # ct1-1/1/0:5:4
        }
        t1-1/1/0:5:1 {
          description "(e) OC-slice 9 of coc12-1/1/0. T1 interface configuration.";
          t1-options {
            t1-options-statements;
          }
        }
        ...
        ct1-1/1/0:5:4 {
          description "(e) OC-slice 9 of coc12-1/1/0. CT1 to NxDSOs.;
          t1-options {
            t1-options-statements;
          }
          partition 1 timeslots 0 - 10 interface-type ds0; # ds-1/1/0:5:4:1
          partition 2 timeslots 11- 23 interface-type ds0; # ds-1/1/0:5:4:2
```

```
    ...
}

(f) coc1-1/1/0:6 {
    description "(f) OC-slice 10 of coc12-1/1/0. COC12 to COC1 converted to a CT3
        to T1s.";
    sonet-options {
        sonet-options-statements;
    }
    no-partition interface-type ct3; # ct3-1/1/0:6
}
ct3-1/1/0:6 {
    description "(f) COC12 to CT3 M-13 and C-bit parity-mapped to T1s.;
    sonet-options {
        sonet-options-statements;
    }
    partition 1 - 10 interface-type t1; # t1-1/1/0:6:[1-10]
}
t1-1/1/0:6:1 {
    description "(f) T1 interface configuration.";
    t1-options {
        t1-options-statements;
    }
}
...

(g) coc1-1/1/0:7 {
    description "(g) OC-slice 11 of coc12-1/1/0. COC12 to COC1 converted to a CT3
        to T1s and CT1 to NxDS0s.";
    sonet-options {
        sonet-options-statements;
    }
    no-partition interface-type ct3; # ct3-1/1/0:7
}
ct3-1/1/0:7 {
    description "(g) COC12 to CT3 M-13 and C-bit parity-mapped to T1s and CT1.";
    sonet-options {
        sonet-options-statements;
    }
    partition 1 - 10 interface-type t1; # t1-1/1/0:7:[1-10]
    partition 2 interface-type ct1; # ct1-1/1/0:7:11
}
t1-1/1/0:7:1 {
    description "(g) T1 interface configuration.";
    t1-options {
        t1-options-statements;
    }
}
...
ct1-1/1/0:7:11 {
    description "(g) CT1 to NxDSOs.";
    t1-options {
        t1-options-statements;
    }
    partition 1 timeslots 0 - 10 interface-type ds0; # ds-1/1/0:7:11:1
```

```
    partition 2 timeslots 11- 23 interface-type ds0; # ds-1/1/0:7:11:2
    ...
}
```

(h)

```
coc1-1/1/0:8 {
    description "(h) OC-slice 12 of coc12-1/1/0. COC12 to COC1 VT-mapped to CT1
        to NxDS0s.";
    sonet-options {
        sonet-options-statements;
    }
    partition 1 interface-type t1; # ct1-1/1/0:8:1
}
ct1-1/1/0:8:1 {
    description "(h) CT1 to NxDSOs.";
    t1-options {
        t1-options-statements;
    }
    partition 1 timeslots 0 - 10 interface-type ds0; # ds-1/1/0:8:1:1
    partition 2 timeslots 11- 23 interface-type ds0; # ds-1/1/0:8:1:2
    ...
}
```

For a full configuration example, see the *JUNOS Feature Guide*.

Example: Configuring Channelized OC12 Interfaces with Partitioned Channels

The following configuration is sufficient to get the channelized OC12 interface up and running. The OC12 interface can be divided into 12 channels. DS3 channels can use the following encapsulation types:

- PPP, PPP CCC, and PPP TCC
- Frame Relay, Frame Relay CCC, and Frame Relay TCC
- Cisco HDLC, Cisco HDLC CCC, and Cisco HDLC TCC

The channels can also have logical interfaces.

```
[edit interfaces]
t3-fpc/pic/port:0 {
    encapsulation cisco-hdlc;
    t3-options {
        compatibility-mode larscom;
        payload-scrambler;
    }
    unit 0 {
        family inet {
            address 10.11.30.1/30;
        }
        family iso;
    }
}
t3-fpc/pic/port:1 {
    encapsulation ppp;
```

```
    t3-options {
        compatibility-mode larscom;
        payload-scrambler;
    }
    unit 0 {
        family inet {
            address 10.11.30.5/30;
        }
        family iso;
    }
}
t3-fpc/pic/port:2 {
    encapsulation frame-relay;
    t3-options {
        compatibility-mode larscom;
        payload-scrambler;
    }
    unit 0 {
        dlci 100;
        family inet {
            address 10.11.30.9/30;
        }
        family iso;
    }
    unit 1 {
        dlci 101;
        family inet {
            address 10.11.31.9/30;
        }
        family iso;
    }
}
t3-1fpc/pic/port:3 {
    encapsulation cisco-hdlc-ccc;
    t3-options {
        compatibility-mode larscom;
        payload-scrambler;
    }
    unit 0;
}
t3-fpc/pic/port:4 {
    encapsulation ppp-ccc;
    t3-options {
        compatibility-mode larscom;
        payload-scrambler;
    }
    unit 0;
}
t3-fpc/pic/port:5 {
    dce;
    encapsulation frame-relay-ccc;
    t3-options {
        compatibility-mode larscom;
        payload-scrambler;
    }
    unit 0 {
```

```
        encapsulation frame-relay-ccc;
        dlci 1000;
    }
    unit 1 {
        encapsulation frame-relay-ccc;
        dlci 1001;
    }
}
```

Chapter 20
Configuring Channelized OC3 IQ and IQE Interfaces

This chapter describes how to configure interfaces on Channelized OC3 IQ and IQE PICs, as follows:

Channelized OC3 IQ and IQE Overview

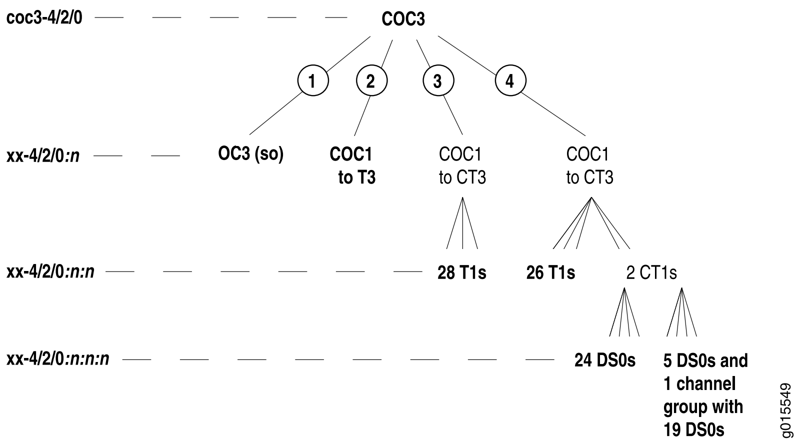
Channelized intelligent queuing (IQ) and channelized enhanced intelligent queuing (IQE) interfaces allow arbitrary and dynamic channelization of serial links, allowing greater flexibility than regular channelized interfaces.

On each port of a Channelized OC3 IQ or a Channelized OC3 IQE interface, you can configure the following interface types:

- One OC3 SONET interface
- Up to three T3 interfaces
- Up to 84 T1 interfaces
- Up to three E3 interfaces (COC3 IQE PICs in SDH mode)
- Up to 63 E1 interfaces (COC3 IQE PICs in SDH mode)
- Up to 336 *N*xDS0 interfaces on an M-series platform
- Up to 768 *N*xDS0 interfaces on a T-series platform

Figure 45 on page 442 shows an example of how a Channelized OC3 PIC might be partitioned. In the figure, the OC3 SONET interface would be a standalone interface because it would use the entire bandwidth of the PIC. The same applies to each port of the 2–port Channelized OC3 Enhanced IQ (IQE) PIC.

Figure 45: Channelized OC3 IQ Interface Example for Show Interfaces Controller



You can configure the following encapsulation types:

- PPP
- Frame Relay
- Cisco HDLC
- CCC
- TCC
- MPLS—On IQE interfaces.

For more information about interface encapsulation, see "Configuring Interface Encapsulation on Physical Interfaces" on page 100 and "Configuring Interface Encapsulation on Logical Interfaces" on page 151.

To configure channelized interfaces, include the following statements at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
no-partition interface-type type;
partition partition-number oc-slice oc-slice-range interface-type type;
partition partition-number timeslots time-slot-range interface-type type;
```

Partitions, OC Slices, Interface Types, and Time Slots

The partition number is the sublevel interface partition index and is correlated with the channel number. For channelized OC3 interfaces, you can configure up to three OC1 interfaces, so the partition number can be 1, 2, or 3. For channelized T3 interfaces (ct3), you can configure multiple interfaces at once by including a partition range, such as 1-3. This creates three T1 interfaces with channel numbers 1 through 3.

NOTE: For channelized IQ and IQE interfaces, channel numbering begins with 1 (:1). For regular channelized interfaces, channel numbering begins with 0 (:0).

You configure the OC-slice range for SONET/SDH interfaces only. The OC-slice range is correlated with the bandwidth size required for the interface type you are configuring. For example, a channelized OC3 interface (coc3) can be divided into three OC1 interfaces, each containing one OC slice. Therefore the OC-slice value must be 1, 2, or 3.

The configurable interface types are dependent on the hierarchy level at which you include the interface-type and partition or no-partition statements. For example, when you include the no-partition statement at the [edit interfaces coc3-*fpc/pic/port*] hierarchy level, the only configurable interface type is so, because the no-partition statement signals that you are creating a clear-channel SONET/SDH interface. When you include the partition statement at the [edit interfaces coc1-*fpc/pic/port*] hierarchy level, the configurable interface types are ct1 or t1. If you want to create a T1 interface, include the t1 option. If you want to further channelize down to the *N*xDS0 level, include the ct1 option as an intermediate step before dividing the channelized T1 interface (ct1) into *N*xDS0 interfaces.

You configure time slots for fractional T1 interfaces and *N*xDS0 interfaces. You can configure ranges by using hyphens. You can configure discontinuous time slots by using commas. Do not include spaces.

Configuring a Clear Channel on Channelized OC3 IQ and IQE PICs

A *clear channel* is an interface that uses the entire bandwidth of the PIC. To configure a clear channel, include the no-partition and interface-type statements in the configuration.

On Channelized OC3 IQ and IQE PICs, you can configure one OC3 clear-channel interface per port. To configure an OC3 interface, include the no-partition and interface-type statements at the [edit interfaces coc3-*fpc/pic/port*] hierarchy level:

```
[edit interfaces coc3-fpc/pic/port]
no-partition interface-type so;
```

This configuration creates interface so-*fpc/pic/port*. When you include the no-partition statement at the [edit interfaces coc3-*fpc/pic/port*] hierarchy level, the only configurable interface type is so, because the no-partition statement signals that you are creating a clear-channel SONET/SDH interface.

On a 2-port or 4–port Channelized OC3 IQE PIC, you can configure two to four separate OC3 clear-channel interfaces by additionally specifying the port numbers. Configuration is otherwise the same as previously described on a (1-port) Channelized OC3 IQ PIC.

Configuring T3 IQ Interfaces

To configure a T3 interface on an OC3 PIC, include the partition, oc-slice, and interface-type statements at the [edit interfaces coc3-*fpc/pic/port*] hierarchy level, specifying the coc1 interface type:

```
[edit interfaces coc3-fpc/pic/port]
partition partition-number oc-slice oc-slice-range interface-type coc1;
```

When you include the partition statement at the [edit interfaces coc3-*fpc/pic/port*] hierarchy level, the only configurable interface type is coc1. This configuration creates interface coc1-*fpc/pic/port*:*channel*.

NOTE: Class-of-service (CoS) rules cannot be applied to an individual channel configured on channelized IQ interfaces. You can only apply CoS rules to the aggregate bit streams.

Then, include the no-partition interface-type statement at the [edit interfaces coc1-*fpc/pic/port*:*channel*] hierarchy level, specifying the t3 interface type:

```
[edit interfaces coc1-fpc/pic/port:channel]
no-partition interface-type t3;
```

This configuration creates interface t3-*fpc/pic/port*:*channel*.

Example: Configuring T3 IQ Interfaces

Configure a T3 interface using partition 3 and OC slice 3. This configuration creates interface t3-1/1/0:3.

```
[edit interfaces coc3-1/1/0]
partition 3 oc-slice 3 interface-type coc1;
[edit interfaces coc1-1/1/0:3]
no-partition interface-type t3;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring T1 and NxDS0 Interfaces

To configure T1 interfaces on a Channelized OC3 IQ or IQE PIC, perform the following tasks:

1. Partition the channelized OC3 interface into channelized OC1 interfaces by including the partition, oc-slice, and interface-type statements at the [edit interfaces coc3-*fpc/pic/port*] hierarchy level, specifying the coc1 interface type:

   ```
   [edit interfaces coc3-fpc/pic/port]
   partition partition-number oc-slice oc-slice-range interface-type coc1;
   ```

2. If your network equipment uses VT mapping, partition the channelized OC1 interface into T1 interfaces by including the partition and interface-type statements at the [edit interfaces coc1-*fpc/pic/port:channel*] hierarchy level, specifying the t1 interface type:

   ```
   [edit interfaces coc1-fpc/pic/port:channel]
   partition partition-number interface-type t1;
   ```

3. If your network equipment uses M13 or C-bit parity, convert the channelized OC1 interface into a channelized T3 interface by including the no-partition and

interface-type statements at the [edit interfaces coc1-*fpc/pic/port:channel*] hierarchy level, specifying the ct3 interface type:

```
[edit interfaces coc1-fpc/pic/port:channel]
no-partition partition-number interface-type ct3;
```

NOTE: Class-of-service (CoS) rules cannot be applied to an individual channel configured on channelized IQ interfaces. You can only apply CoS rules to the aggregate bit streams.

Note that because the no-partition statement is included, this configuration does not create another level of channelization, as denoted by the number of colons in the resulting interface.

4. To configure T1 interfaces, partition the channelized T3 interface into T1 interfaces by specifying the t1 interface type:

```
[edit interfaces ct3-fpc/pic/port:channel]
partition partition-number interface-type t1;
```

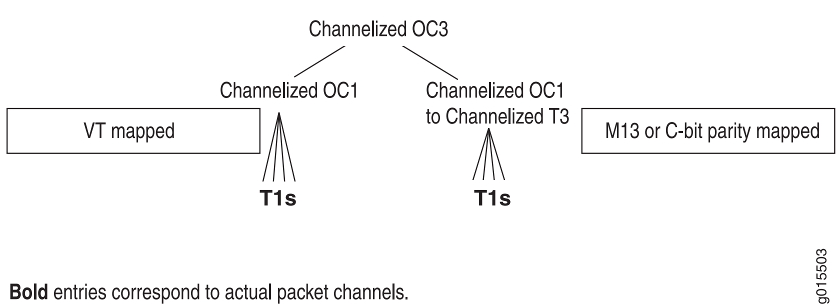
5. To configure *N*xDS0 interfaces, partition the channelized T3 interface into channelized T1 interfaces by specifying the ct1 interface type:

```
[edit interfaces ct3-fpc/pic/port:channel]
partition partition-number interface-type ct1;
```

NOTE: Class-of-service (CoS) rules cannot be applied to an individual channel configured on channelized IQ interfaces. You can only apply CoS rules to the aggregate bit streams.

Figure 46 on page 445 shows VT-mapped and M13 or C-bit parity-mapped configurations of T1 IQ interfaces.

Figure 46: T1 Interfaces on a Channelized OC3 PIC

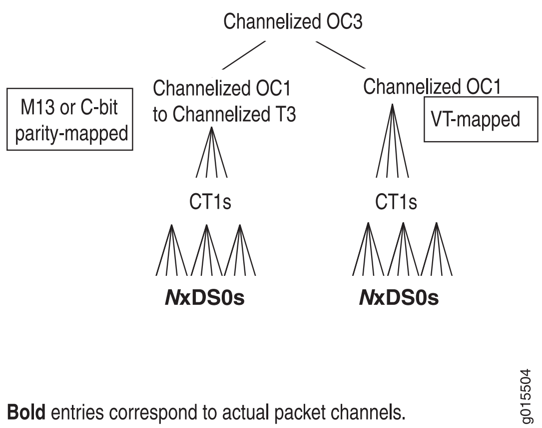


6. Configure channelized *N*xDS0 IQ interfaces on the channelized T1 IQ interface by including the partition, timeslots, and interface-type statements at the [edit interfaces ct1-*fpc/pic/port*<:*channel*>] hierarchy level, specifying the ds interface type:

```
[edit interfaces ct1-fpc/pic/port:channel]
partition partition-number timeslots time-slot-range interface-type ds;
```

Figure 47 on page 446 shows VT-mapped and M13 or C-bit parity-mapped configurations of *N*xDS0 IQ interfaces.

Figure 47: Sample Channelization of OC3 IQ or IQE PIC



Example: Configuring T1 and NxDS0 IQ Interfaces

Configure the following T1 interfaces:

```
t1-0/0/0:1:1
t1-0/0/0:1:2
t1-0/0/0:1:3
t1-0/0/0:1:4
t1-0/0/0:1:5
```

VT-Mapped Configuration

```
[edit interfaces coc3-0/0/0]
partition 1 oc-slice 1 interface-type coc1;
[edit interfaces coc1-0/0/0:1]
partition 1-5 interface-type t1;
```

M13 or C-bit Parity-Mapped Configuration

```
[edit interfaces coc3-0/0/0]
partition 1 oc-slice 1 interface-type coc1;
[edit interfaces coc1-0/0/0:1]
no-partition interface-type ct3;
[edit interfaces ct3-0/0/0:1]
partition 1-5 interface-type t1;
```

Configure the following two *N*xDS0 interfaces with 10 time slots and 4 time slots, respectively:

```
ds-0/0/0:1:2:1
ds-0/0/0:1:2:2
```

VT-Mapped Configuration

```
[edit interfaces coc3-0/0/0]
partition 1 oc-slice 1 interface-type coc1;
[edit interfaces coc1-0/0/0:1]
```

```
partition 2 interface-type ct1;
[edit interfaces ct1-0/0/0:1:2]
partition 1 timeslots 1-10 interface-type ds;
partition 2 timeslots 12-16 interface-type ds;
```

M13 or C-bit Parity-Mapped Configuration

```
[edit interfaces coc3-0/0/0]
partition 1 oc-slice 1 interface-type coc1;
[edit interfaces coc1-0/0/0:1]
no-partition interface-type ct3;
[edit interfaces ct3-0/0/0:1]
partition 2 interface-type ct1;
[edit interfaces ct1-0/0/0:1:2]
partition 1 timeslots 1-10 interface-type ds;
partition 2 timeslots 12-16 interface-type ds;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Example: Setting Remote Loopback and Running BERT Tests on NxDS0 Interfaces

For Channelized OC3 IQ and IQE PICs, if you need remote loopback on a far-end *N*xDS0 interface, and you are running a BERT test from the local *N*xDS0 interface, you must set remote loopback on the far-end router's associated channelized T1 interface (ct1). To do this, include the loopback remote statement at the [edit interfaces ct1-*fpc/picport* t1-options] hierarchy level. For example:

Local router:

```
[edit interfaces]
ct1-0/0/0:2:2 {
    partition 1 timeslots 1-10 interface-type ds;
    ds-0/0/0:2:2:1 {
        ds0-options {
            bert-period 30;
        }
    }
}
```

Remote router:

```
[edit interfaces]
ct1-0/0/0:2:2 {
    partition 1 timeslots 1-10 interface-type ds;
    t1-options {
        loopback remote;
    }
}
```

Configuring Fractional T1 IQ Interfaces

By default, all the time slots on a channelized T1 interface are used. To configure a fractional T1 interface on a Channelized OC3 IQ or IQE PIC, you must perform the following tasks:

1. Configure a T1 interface on the Channelized OC3 IQ or IQE PIC. For more information, see “Configuring T1 and NxDS0 Interfaces” on page 444.
2. Configure the number of time slots allocated to the T1 IQ interface by including the timeslots statement at the [edit interfaces t1-*fpc/pic/port*<:*channel*> t1-options] hierarchy level:

```
[edit interfaces t1-fpc/pic/port<:channel> t1-options]
timeslots time-slot-range;
```

For channelized T1 IQ interfaces, the time-slot range is from 1 through 24. You can designate any combination of time slots. To configure ranges, use hyphens. To configure discontinuous time slots, use commas. Do not include spaces. For more information, see “Configuring Fractional T1 Time Slots” on page 537.

Example: Configuring Fractional T1 IQ Interfaces

Configure a fractional T1 interface that uses time slots 1 through 5 and 10:

```
[edit interfaces coc3-0/0/0]
partition 1 oc-slice 1 interface-type coc1;
[edit interfaces coc1-0/0/0:1]
partition 1 interface-type t1;
[edit interfaces t1-0/0/0:1:1 t1-options]
timeslots 1-5,10;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring Link PIC Failover on Channelized OC3 IQ and IQE Interfaces

For Channelized OC3 IQ or IQE PICs used as linking PICs in redundant LSQ configurations, you can inhibit the router from sending PPP termination-request messages to the remote host if the link PIC fails. To do this, include the no-termination-request statement at the [edit interfaces *interface-name* ppp-options] hierarchy level:

```
no-termination-request;
```

The no-termination-request statement is supported only with MLPPP and SONET APS configurations and works with PPP, PPP over Frame Relay, and MLPPP interfaces only.

For information about interchassis and intrachassis LSQ failover, see the *JUNOS Services Interfaces Configuration Guide*.

Chapter 21

Configuring Channelized STM1 Interfaces

Each Channelized STM1 PIC and Channelized STM1 Intelligent Queuing (IQ) PIC has one STM1 port.

For the Channelized STM1 IQ or IQE PIC, you can channelize the single port to the *N*xDS0 level. Each E1 interface has 32 time slots (DS0), in which time slot 0 is reserved.

You can combine one or more of these DS0 time slots (channels) to create a channel group (*N*xDS0).

This section contains the following topics:

Configuring Channelized STM1 IQ and IQE Interfaces

This section includes the following topics:

Configuring an STM1 IQ or STM1 IQE Interface

On a one-port Channelized STM1 IQ PIC, or each individual port of the 4-port Channelized STM1 IQE PIC, you can configure one SDH STM1 interface. To configure an SDH STM1 interface, include the no-partition interface-type statement at the [edit interfaces cstm1-*fpc/pic/port*] hierarchy level, specifying the so interface type:

```
[edit interfaces cstm1-fpc/pic/port]
no-partition interface-type so;
```

This configuration creates interface so-*fpc/pic/port*.

NOTE: Class-of-service (CoS) rules cannot be applied to an individual channel configured on channelized IQ and IQE interfaces. You can only apply CoS rules to the aggregate bit streams.

Configuring E1 IQ and IQE Interfaces

To configure an E1 interface on a Channelized STM1 IQ or IQE PIC, perform the following tasks:

1. Include the no-partition and interface-type statements at the [edit interfaces cstm1-*fpc/pic/port*] hierarchy level, specifying the cau4 interface type. This converts the channelized STM1 interface into a channelized AU-4 interface. The resulting interface name is cau4-*fpc/pic/port*:

   [edit interfaces cstm1-*fpc/pic/port*]
   no-partition interface-type cau4;

2. Partition the channelized AU-4 interface into E1 interfaces by including the partition and interface-type statements at the [edit interfaces cau4-*fpc/pic/port*] hierarchy level, specifying the e1 interface type. This configuration creates interface e1-*fpc/pic/port*:*channel*. The partition number is the sublevel interface partition index and is correlated with the channel number. For channelized E1 interfaces, the partition number can be from 1 through 63. The interface type is the channelized interface type or clear channel you are creating. For channelized AU-4 interfaces, *type* can be ce1 or e1.

   [edit interfaces cau4-*fpc/pic/port*]
   partition *partition-number* interface-type e1;

NOTE: Class-of-service (CoS) rules cannot be applied to an individual channel configured on channelized IQ or IQE interfaces. You can only apply CoS rules to the aggregate bit streams.

NOTE: For channelized STM1 interfaces, channel numbering begins with 0 (:0). For channelized STM1 IQ and IQE interfaces, channel numbering begins with 1 (:1).

Example: Configuring E1 IQ and IQE Interfaces

Configure the following five E1 interfaces:

e1-0/0/0:1
e1-0/0/0:2
e1-0/0/0:3
e1-0/0/0:4
e1-0/0/0:5

```
[edit interfaces cstm1-0/0/0]
no-partition interface-type cau4;
[edit interfaces cau4-0/0/0]
partition 1-5 interface-type e1;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring Fractional E1 IQ Interfaces

By default, all the time slots on a channelized E1 interface are used. To configure a fractional E1 interface on a Channelized STM1 IQ or IQE PIC,perform the following tasks:

1. Include the no-partition and interface-type statements at the [edit interfaces cstm1-*fpc/pic/port*] hierarchy level, specifying the cau4 interface type. This converts the channelized STM1 interface into a channelized AU-4 interface. The resulting interface name is cau4-*fpc/pic/port*:

   ```
   [edit interfaces cstm1-fpc/pic/port]
   no-partition interface-type cau4;
   ```

2. Partition the channelized AU-4 interface into E1 interfaces by including the partition and interface-type statements at the [edit interfaces cau4-*fpc/pic/port*] hierarchy level, specifying the e1 interface type. The partition number is the sublevel interface partition index and is correlated with the channel number. For channelized E1 interfaces, the partition number can be from 1 through 63. The interface type is the channelized interface type or clear channel you are creating. For channelized AU-4 interfaces, *type* can be ce1 or e1. This configuration creates interface e1-*fpc/pic/port*:*channel*:

   ```
   [edit interfaces cau4-fpc/pic/port]
   partition partition-number interface-type e1;
   ```

3. Configure the number of time slots allocated to the E1 IQ or IQE interface by including the timeslots statement at the [edit interfaces e1-*fpc/pic/port*:*channel* e1-options] hierarchy level. *N*xDS0 time slots configured on either a channelized STM1 IQ or IQE interface or channelized E1 IQ or IQE interface are numbered from 1 to 31 (0 is reserved), while fractional E1 time slots range from 2 to 32 (1 is reserved). To configure ranges, use hyphens. To configure discontinuous time slots, use commas. Do not include spaces.

   ```
   [edit interfaces e1-fpc/pic/port:channel e1-options]
   timeslots time-slot-range;
   ```

NOTE: For channelized STM1 interfaces, channel numbering begins with 0 (:0). For channelized STM1 IQ or IQE interfaces, channel numbering begins with 1 (:1).

For more information about E1 time slots, see “Configuring Fractional E1 Time Slots” on page 518.

Example: Configuring Fractional E1 IQ Interfaces

Configure a fractional E1 interface that uses time slots 2 through 10:

```
[edit interfaces cstm1-0/0/0]
no-partition cau4;
[edit interfaces cau4-0/0/0]
partition 1 interface-type e1;
[edit interfaces e1-0/0/0 e1-options]
timeslots 2-10;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring an NxDS0 IQ Interface

By default, all the time slots on a channelized STM1 interface are used. To configure an *N*xDS0 IQ interface on a Channelized STM1 IQ or IQE PIC, perform the following tasks:

1. Include the no-partition and interface-type statements at the [edit interfaces cstm1-*fpc/pic/port*] hierarchy level, specifying the cau4 interface type. This converts the channelized STM1 interface into a channelized AU-4 interface. The resulting interface name is cau4-*fpc/pic/port*:

   ```
   [edit interfaces cstm1-fpc/pic/port]
   no-partition interface-type cau4;
   ```

2. Partition the channelized AU-4 interface into E1 interfaces by including the partition and interface-type statements at the [edit interfaces cau4-*fpc/pic/port*] hierarchy level, specifying the ce1 interface type. This configuration creates interface ce1-*fpc/pic/port*:*channel*. The partition number is the sublevel interface partition index and is correlated with the channel number. For channelized E1 interfaces, the partition number can be from 1 through 63. The interface type is the channelized interface type or clear channel you are creating. For channelized AU-4 interfaces, *type* can be ce1 or e1:

   ```
   [edit interfaces cau4-fpc/pic/port]
   partition partition-number interface-type ce1;
   ```

3. Configure the number of time slots allocated to the *N*xDS0 IQ interface by including the partition, timeslots, and interface-type statements at the [edit interfaces e1-*fpc/pic/port*:*channel*] hierarchy level, specifying the ds interface type. For channelized E1 IQ interfaces, the partition number range is from 1 through 31. For E1 IQ interfaces (e1-*fpc/pic/port*), the time-slot range is from 2 through 31. For channelized E1 IQ interfaces (ce1-*fpc/pic/port*), the time-slot range is from 1 through 31. You can designate any combination of time slots. To configure ranges, use hyphens. To configure discontinuous time slots, use commas. Do not include spaces:

   ```
   [edit interfaces ce1-fpc/pic/port:channel]
   partition partition-number timeslots time-slot-range interface-type ds;
   ```

NOTE: Class-of-service (CoS) rules cannot be applied to an individual channel configured on channelized IQ and IQE interfaces. You can only apply CoS rules to the aggregate bit streams.

NOTE: For channelized STM1 interfaces, channel numbering begins with 0 (:0). For channelized STM1 IQ and IQE interfaces, channel numbering begins with 1 (:1).

For more information about E1 time slots, see "Configuring Fractional E1 Time Slots" on page 518.

Example: Configuring an NxDS0 IQ Interface

Configure an *N*xDS0 interface that uses time slots 1 through 10. This configuration creates the ds-0/0/0:1:1 interface.

```
[edit interfaces cstm1-0/0/0]
no-partition interface-type cau4;
[edit interfaces cau4-0/0/0]
partition 1 interface-type ce1;
[edit interfaces ce1-0/0/0:1]
partition 1 timeslots 1-10 interface-type ds;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Example: Configuring Channelized STM1 IQ and IQE Interfaces

Configure STM1, E1, fractional E1, and *N*xDS0 interfaces:

STM1 Interface

```
[edit interfaces]
cstm1-0/0/0 {
   no-partition interface-type so;
}
so-0/0/0 {
   unit 0 {
      family inet {
         address 10.10.12.1/30;
      }
   }
}
```

E1 Interface

```
[edit interfaces]
cstm1-1/1/0 {
   no-partition interface-type cau4;
}
[edit interfaces]
cau4-1/1/0 {
   partition 1-63 interface-type e1;
}
[edit interfaces]
e1-1/1/0:1 {
```

```
    unit 0 {
        family inet {
            address 10.10.10.1/30;
        }
    }
}
...
```

Fractional E1 Interface

```
[edit interfaces]
cstm1-1/0/0 {
    no-partition interface-type cau4;
}
[edit interfaces]
cau4-1/0/0 {
    partition 1-63 interface-type e1;
}
[edit interfaces]
e1-1/1/0:1 {
    e1-options {
        timeslots 2-10;
    }
    unit 0 {
        family inet {
            address 10.10.10.1/30;
        }
    }
}
...
```

DS0 Interface

```
[edit interfaces]
cstm1-2/0/0 {
    no-partition interface-type cau4;
}
[edit interfaces]
cau4-2/0/0 {
    partition 1-10 interface-type ce1;
}
[edit interfaces]
ce1-2/0/0:1 {
    partition 1 interface-type ds timeslots 2-10;
    [edit interfaces]
    ds-2/0/0:1:1 {
        unit 0 {
            family inet {
                address 10.12.12.1/30;
            }
        }
    }
    ...
}
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring Channelized STM1 Interfaces

To specify the channel number, include it after the colon (:) in the interface name. For example, a Channelized STM1-to-E1 PIC in FPC 1 and slot 1 will have the following physical interface, depending on the media type:

e1-1/1/0:*x*

The E1 channel number can be from 0 through 62.

This section contains the following topics:

- Configuring Channelized STM1 Interface Properties on page 455
- Configuring Virtual Tributary Mapping of Channelized STM1 Interfaces on page 456

Configuring Channelized STM1 Interface Properties

To configure the interface properties for Channelized STM1-to-E1 PICs, include the e1-options and sonet-options statements for both sides of the connection. The following configurations list all the valid statements.

To specify options for each of the E1 channels on the Channelized STM1-to-E1 PIC, include the e1-options statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
e1-options {
    bert-error-rate;
    bert-period;
    fcs (16 | 32);
    framing (g704 | g704-no-crc4 | unframed);
    idle-cycle-flag (flags | ones);
    loopback (local | remote);
    start-end-flag (filler | shared);
    timeslots time-slot-number;
}
```

NOTE: When a channelized STM1 interface experiences a line transition, the E1 channels configured in unframed mode log a large number of drops (around 24,000) as the channelized STM1 interface clocks resynchronize. This does not occur on framed channels, because the framing resynchronizes clocks very quickly.

To specify options for the SONET/SDH side of the connection, include the sonet-options statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
sonet-options {
    aps {
        advertise-interval milliseconds;
        authentication-key key;
        force;
```

```
            hold-time milliseconds;
            lockout;
            neighbor address;
            paired-group group-name;
            protect-circuit group-name;
            request;
            revert-time seconds;
            switching-mode (bidirectional | unidirectional);
            working-circuit group-name;
        }
        bytes {
            e1-quiet value;
            f1 value;
            f2 value;
            s1 value;
            z3 value;
            z4 value;
        }
        loopback (local | remote);
    }
```

NOTE: On channelized STM1 interfaces, you should configure the clock source on one side of the connection to be internal (the default JUNOS configuration) and on the other side of the connection to be external.

For information about Frame Relay DLCI limitations for channelized interfaces, see "Data-Link Connection Identifiers on Channelized Interfaces" on page 374. For more information about Frame Relay DLCIs, see "Configuring a Point-to-Point Frame Relay Connection" on page 366. For information about DLCI sparse mode, see the *JUNOS System Basics Configuration Guide*.

For more information about specific statements, see "Configuring E1 Interfaces" on page 513, "Configuring SONET/SDH Interfaces" on page 797, and "Configuring T1 Interfaces" on page 529. For a configuration example, see "Example: Configuring Channelized STM1 Interfaces" on page 459.

Configuring Virtual Tributary Mapping of Channelized STM1 Interfaces

You can configure virtual tributary mapping to use KLM mode or ITU-T mode. To configure virtual tributary mapping, include the vtmapping statement at the [edit chassis fpc *slot-number* pic *pic-number*] hierarchy level:

```
[edit chassis fpc slot-number pic pic-number]
vtmapping (klm | itu-t);
```

By default, virtual tributary mapping uses KLM mode. For more information, see the *JUNOS System Basics Configuration Guide*.

For the Channelized STM1 IQ and IQE PICs, you can configure virtual tributary mapping by including the vtmapping statement at the [edit interfaces cau4-*fpc/pic/port* sonet-options] hierarchy level:

[edit interfaces cau4-*fpc/pic/port* sonet-options]
vtmapping (klm | itu-t);

Table 38 on page 457 lists the KLM mappings used by the channelized STM1-to-E1 PIC interfaces. The PIC defaults to KLM numbering with an offset of –1; for example, KLM 1 = STM1 PIC 0.

Table 38: Channelized STM1-to-E1 Channel Mapping

Channel Number	KLM Number	Tributary Unit Group 3	Tributary Unit Group 2	Virtual Tributary	ITU-T Number
0	1	1	1	1	1
1	2	1	1	2	22
2	3	1	1	3	43
3	4	1	2	1	4
4	5	1	2	2	25
5	6	1	2	3	46
6	7	1	3	1	7
7	8	1	3	2	28
8	9	1	3	3	49
9	10	1	4	1	10
10	11	1	4	2	31
11	12	1	4	3	52
12	13	1	5	1	13
13	14	1	5	2	34
14	15	1	5	3	55
15	16	1	6	1	16
16	17	1	6	2	37
17	18	1	6	3	58
18	19	1	7	1	19
19	20	1	7	2	40
20	21	1	7	3	61
21	22	2	1	1	2
22	23	2	1	2	23

Table 38: Channelized STM1-to-E1 Channel Mapping *(continued)*

Channel Number	KLM Number	Tributary Unit Group 3	Tributary Unit Group 2	Virtual Tributary	ITU-T Number
23	24	2	1	3	44
24	25	2	2	1	5
25	26	2	2	2	26
26	27	2	2	3	47
27	28	2	3	1	8
28	29	2	3	2	29
29	30	2	3	3	50
30	31	2	4	1	11
31	32	2	4	2	32
32	33	2	4	3	53
33	34	2	5	1	14
34	35	2	5	2	35
35	36	2	5	3	56
36	37	2	6	1	17
37	38	2	6	2	38
38	39	2	6	3	59
39	40	2	7	1	20
40	41	2	7	2	41
41	42	2	7	3	62
42	43	3	1	1	3
43	44	3	1	2	24
44	45	3	1	3	45
45	46	3	2	1	6
46	47	3	2	2	27
47	48	3	2	3	48
48	49	3	3	1	9
49	50	3	3	2	30

Table 38: Channelized STM1-to-E1 Channel Mapping *(continued)*

Channel Number	KLM Number	Tributary Unit Group 3	Tributary Unit Group 2	Virtual Tributary	ITU-T Number
50	51	3	3	3	51
51	52	3	4	1	12
52	53	3	4	2	33
53	54	3	4	3	54
54	55	3	5	1	15
55	56	3	5	2	36
56	57	3	5	3	57
57	58	3	6	1	18
58	59	3	6	2	39
59	60	3	6	3	60
60	61	3	7	1	21
61	62	3	7	2	42
62	63	3	7	3	63

Configuring Link PIC Failover on Channelized STM1 Interfaces

For Channelized STM1 IQ and IQE PICs used as linking PICs in redundant LSQ configurations, you can inhibit the router from sending PPP termination-request messages to the remote host if the link PIC fails. To do this, include the no-termination-request statement at the [edit interfaces *interface-name* ppp-options] hierarchy level:

```
no-termination-request;
```

The no-termination-request statement is supported only with MLPPP and SONET APS configurations and works with PPP, PPP over Frame Relay, and MLPPP interfaces only.

For information about interchassis and intrachassis LSQ failover, see the *JUNOS Services Interfaces Configuration Guide*.

Example: Configuring Channelized STM1 Interfaces

The following configuration is sufficient to get the Channelized STM1-to-E1 PIC interface up and running. The channelized STM1-to-E1 interface is an STM1 that is divided into 63 E1 interfaces. E1 interfaces can use the following encapsulation types:

- PPP, PPP CCC, and PPP TCC
- Frame Relay, Frame Relay CCC, and Frame Relay TCC
- Cisco HDLC, Cisco HDLC CCC, and Cisco HDLC TCC

The channels can also have logical interfaces. For information about Frame Relay DLCI limitations for channelized interfaces, see "Data-Link Connection Identifiers on Channelized Interfaces" on page 374. For more information about Frame Relay DLCIs, see "Configuring a Point-to-Point Frame Relay Connection" on page 366. For more information about DLCI sparse mode, see the *JUNOS System Basics Configuration Guide*.

You apply all STM1 interface SONET/SDH options to the first E1 interface in the configuration by including the sonet-options statement at the [edit interfaces e1-*fpc/pic/port*:*channel*] hierarchy level:

```
[edit]
interfaces {
    e1-fpc/pic/port:0 {
        encapsulation cisco-hdlc;
        sonet-options {
            no-z0-increment;
        }
        e1-options {
            framing g704;
        }
        unit 0 {
            family inet {
                address 10.11.30.1/30;
            }
        }
    }
    e1-fpc/pic/port:1 {
        encapsulation frame-relay;
        e1-options {
            framing g704;
        }
        unit 1 {
            dlci 16;
            family inet {
                address 10.11.31.9/30;
            }
        }
    }
    e1-fpc/pic/port:2 {
        encapsulation ppp;
        no-keepalives;
        unit 0 {
            family inet {
                address 10.11.31.47/30;
            }
        }
    }
}
[edit]
```

```
chassis {
    fpc 2 {
        pic 0 {
            vtmapping klm;
        }
    }
}
```

Chapter 22

Configuring Channelized T3 Interfaces

NOTE: Class-of-service (CoS) rules cannot be applied to an individual channel configured on channelized IQ interfaces. You can only apply CoS rules to the aggregate bit streams.

This section contains the following topics:

Configuring Channelized T3 IQ Interfaces

This section describes how to configure channelized T3 intelligent queuing (IQ) interfaces, discussing the following topics:

Configuring T3 IQ Interfaces

To configure a T3 interface, include the no-partition and interface-type statements at the [edit interfaces ct3-*fpc/pic/port*] hierarchy level:

```
[edit interfaces ct3-fpc/pic/port]
no-partition interface-type t3;
```

This configuration creates interface t3-*fpc/pic/port*.

Configuring T1 IQ Interfaces

On a Channelized DS3 IQ or IQE Physical Interface Card (PIC), you can create up to 112 T1 interfaces. To configure a T1 interface on a Channelized DS3 IQ or IQE PIC, include the partition and interface-type statements at the [edit interfaces ct3-*fpc/pic/port*] hierarchy level, specifying the t1 interface type:

```
[edit interfaces ct3-fpc/pic/port]
partition partition-number interface-type t1;
```

This configuration creates interface t1-*fpc/pic/port*:*channel*.

The partition number is the sublevel interface partition index and is correlated with the channel number. For channelized T3 interfaces, the partition number can be from 1 through 28.

NOTE: For channelized T3 interfaces, channel numbering begins with 0 (:0). For channelized T3 IQ and IQE interfaces, channel numbering begins with 1 (:1).

The interface type is the channelized interface type or clear channel you are creating. For channelized T3 interfaces, *type* can be ct1 or t1.

Example: Configuring T1 IQ and IQE Interfaces

Configure the following five T1 interfaces:

t1-0/0/0:1
t1-0/0/0:2
t1-0/0/0:3
t1-0/0/0:4
t1-0/0/0:5

```
[edit interfaces ct3-0/0/0]
partition 1-5 interface-type t1;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring Fractional T1 IQ and IQE Interfaces

By default, all the time slots on a channelized T1 interface are used. To configure a fractional T1 interface on a Channelized DS3 IQ or IQE PIC, perform the following tasks:

1. Configure a T1 IQ interface. For more information, see "Configuring T1 IQ Interfaces" on page 464.

   This configuration creates interface t1-*fpc/pic/port*:*channel*.

2. Configure the number of time slots allocated to the T1 IQ interface by including the timeslots statement at the [edit interfaces t1-*fpc/pic/port*:*channel* t1-options] hierarchy level:

   ```
   [edit interfaces t1-fpc/pic/port t1-options]
   timeslots time-slot-range;
   ```

For channelized T1 IQ interfaces, the time-slot range is from 1 through 24. You can designate any combination of time slots. To configure ranges, use hyphens. To configure discontinuous time slots, use commas. Do not include spaces. For more information about T1 time slots, see "Configuring Fractional T1 Time Slots" on page 537.

Example: Configuring Fractional T1 IQ Interfaces

Configure a fractional T1 interface that uses time slots 1 through 10:

```
[edit interfaces ct3-0/0/0:1]
partition 1 interface-type t1;
[edit interfaces t1-0/0/0:1:1 t1-options]
timeslots 1-10;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring an NxDS0 IQ Interface

By default, all the time slots on a channelized T3 interface are used. To configure an *N*xDS0 IQ interface on a Channelized DS3 IQ or IQE PIC, perform the following tasks:

1. Partition the channelized T3 interface into channelized T1 interfaces by including the partition and interface-type statements at the [edit interfaces ct3-*fpc/pic/port*] hierarchy level, specifying the ct1 interface type:

   ```
   [edit interfaces ct3-fpc/pic/port]
   partition partition-number interface-type ct1;
   ```

   This configuration creates interface ct1-*fpc/pic/port*:*channel*.

   The partition number is the sublevel interface partition index and is correlated with the channel number. For channelized T1 interfaces, the partition number can be from 1 through 28.

   The interface type is the channelized interface type or clear channel you are creating. For channelized T3 interfaces, *type* can be ct1 or t1.

NOTE: For channelized T3 interfaces, channel numbering begins with 0 (:0). For channelized T3 IQ interfaces, channel numbering begins with 1 (:1).

2. Configure the number of time slots allocated to the *N*xDS0 IQ interface by including the partition, timeslots, and interface-type statements at the [edit

interfaces ct1-*fpc/pic/port*:*channel*] hierarchy level, specifying the ds interface type:

```
[edit interfaces ct1-fpc/pic/port:channel]
partition partition-number timeslots time-slot-range interface-type ds;
```

For channelized T1 IQ interfaces, the partition number range is from 1 through 28; the time-slot range is from 1 through 24. You can designate any combination of time slots. To configure ranges, use hyphens. To configure discontinuous time slots, use commas. Do not include spaces. For more information about T1 time slots, see "Configuring Fractional T1 Time Slots" on page 537.

Example: Configuring an NxDS0 IQ Interface

Configure the following two *N*xDS0 interfaces with 10 time slots and 4 time slots, respectively:

ds-0/0/0:1:1
ds-0/0/0:1:2

```
[edit interfaces ct3-0/0/0]
partition 1 interface-type ct1;
[edit interfaces ct1-0/0/0:1]
partition 1 timeslots 1-10 interface-type ds;
partition 2 timeslots 12-16 interface-type ds;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring Channelized DS3-to-DS0 Interfaces

For channelized interfaces, you can configure 28 T1 channels per T3 interface. Each T1 link can have up to eight DS0 channel groups, and each channel group can hold any combination of DS0 time slots. To specify the T1 link and DS0 channel group number in the interface name, use colons (:) as separators. For example, a Multichannel DS3 PIC might have the following physical and virtual interfaces:

```
ds-0/0/0:x:y
```

where *x* is a T1 link ranging from 0 through 27 and *y* is a DS0 channel group from 0 through 7. For more information about ranges, see Table 39 on page 467.

You can use any of the values within the range available for *x* and *y*, and you do not have to configure the links sequentially. In addition, the JUNOS software applies the interface options you configure according to the following rules:

- To configure the T1 options, you must set channel group *y* to 0; the T1 link *x* can be any value:

  ```
  ds-0/0/0:x:0
  ```

- To configure the T3 options, you must set the T1 link *x* to 0 and channel group *y* to 0:

ds-0/0/0:0:0

- There are no restrictions on configuring the DS0 options.
- If you delete a configuration you previously committed for channel group 0, the options return to default values.

By default, all the time slots are used. To configure the channel groups and time slots for a channelized DS3-to-DS0 interface, include the channel-group and timeslots statements at the [edit chassis fpc *slot-number* pic *pic-number* ct3 port *port-number* t1 *link-number*] hierarchy level:

```
[edit chassis fpc slot-number pic pic-number ct3 port port-number t1 link-number ]
channel-group group-number;
timeslots time-slot-range;
```

NOTE: If you commit the interface name but do not include the [edit chassis] configuration, the channelized DS3-to-DS0 interface behaves like a channelized DS3-to-DS1 interface: none of the DS0 functionality is accessible.

Table 39 on page 467 shows the ranges you can specify for each of the elements in the preceding configuration.

Table 39: Ranges for Channelized DS3-to-DS0 Configuration

Item	Option	Range
FPC slot	slot-number	0 through 7 (see note below)
PIC slot	pic-number	0 through 3
Port	port-number	0 through 1
T1 link	link-number	0 through 27
DS0 channel group	group-number	0 through 7
Time slot	time-slot-range	1 through 24

NOTE: The FPC slot range depends on the routing platform. For the TX Matrix platform, the range is from 0 through 31. For M40, M40e, M160, M320, M120, and other T-series routing platforms, the range is from 0 through 7. For M20 routing platforms, the range is from 0 through 3. For M10 and M10i routing platforms the range is from 0 through 1. For M5 and M7i routing platforms, the only applicable value is 0.

Bandwidth limitations restrict the interface to a maximum of 128 channel groups per T3 port, rather than the theoretical maximum of 8 * 28 = 224.

There are 24 time slots on a T1 interface. You can designate any combination of time slots. To configure ranges, use hyphens. To configure discontinuous time slots, use commas. Do not include spaces. You can use each time slot number on only one channel group within the same T1 link.

To configure channelized DS3-to-DS0 interface properties, you can include the t3-options, t1-options, and ds0-options statements. Only a subset of the T3 options are valid for this configuration, and the buildout, invert-data, and line-encoding statements at the [edit interfaces *interface-name* t1-options] hierarchy level are ignored. Likewise, only a subset of the DS0 options are valid for this configuration, and the bert-algorithm, bert-error-rate, bert-period, and loopback payload statements at the [edit interfaces *interface-name* ds0-options] hierarchy level are ignored. The following configurations list all the valid parameters.

NOTE: The set of options the JUNOS software applies to the interface depends on how you specify the interface name. For more information, see "Examples: Configuring Channelized DS3-to-DS0 Interfaces" on page 471.

To specify options for the T3 side of the connection, include the t3-options statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
t3-options {
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    (cbit-parity | no-cbit-parity);
    (long-buildout | no-long-buildout);
    loopback (local | payload | remote);
}
```

The statements at the t3-options hierarchy are supported only for channel 0; they are ignored if configured on other channels. To specify options for each of the T1 channels, include the t1-options statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
t1-options {
    byte-encoding (nx56 | nx64);
    fcs (16 | 32);
    framing (esf | lf);
    idle-cycle-flag (flags | ones);
    invert-data;
    loopback (local | payload | remote);
    start-end-flag (filler | shared);
    timeslots time-slot-number;
}
```

To specify options for each of the DS0 channels, include the ds0-options statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
ds0-options {
```

```
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    byte-encoding (nx56 | nx64);
    fcs (16 | 32);
    idle-cycle-flag (flags | ones);
    invert-data;
    loopback payload;
    start-end-flag (filler | shared);
}
```

For more information about specific parameters, see "Configuring E1 Interfaces" on page 513, "Configuring E3 Interfaces" on page 521, "Configuring T1 Interfaces" on page 529, and "Configuring T3 Interfaces" on page 539. For a configuration example, see "Examples: Configuring Channelized DS3-to-DS0 Interfaces" on page 471.

For information about Frame Relay DLCI limitations for channelized interfaces, see "Data-Link Connection Identifiers on Channelized Interfaces" on page 374. For more information about Frame Relay DLCIs, see "Configuring a Point-to-Point Frame Relay Connection" on page 366. For more information about DLCI sparse mode, see the *JUNOS System Basics Configuration Guide*.

Each T1 link can have up to eight DS0 channel groups, and each channel group can hold any combination of DS0 time slots.

Configuring Channelized DS3-to-DS1 Interfaces

You can configure 28 T1 channels per T3 interface, and each interface can have logical interfaces. To specify the channel number, include it after the colon (:) in the interface name. For example, a 4-port T3 PIC in FPC 1 and slot 1 will have the following physical interfaces, depending on the media type:

```
t1-1/1/0:x
t1-1/1/1:x
t1-1/1/2:x
t1-1/1/3:x
```

where *x* is a channel number ranging from 0 through 27.

To configure channelized DS3-to-DS1 interface properties, you can include both the t1-options and t3-options statements. Only a subset of the T3 options is valid for this configuration, and the buildout, invert-data, and line-encoding statements at the [edit interfaces *interface-name* t1-options] hierarchy level are ignored. Likewise, only a subset of the DS0 options are valid for this configuration, and the bert-algorithm, bert-error-rate, bert-period, and loopback payload statements at the [edit interfaces *interface-name* ds0-options] hierarchy level are ignored. The following configuration lists all the valid parameters.

To specify options for the T3 side of the connection, include the t3-options statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
t3-options {
```

```
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    (cbit-parity | no-cbit-parity);
    (feac-loop-respond | no-feac-loop-respond);
    loopback (local | payload | remote);
}
```

The statements in the t3-options hierarchy are supported only for channel 0; they are ignored if configured on other channels.

To specify options for each of the T1 channels, include the t1-options statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
t1-options {
    byte-encoding (nx56 | nx64);
    fcs (16 | 32);
    framing (sf | esf);
    idle-cycle-flag (flags | ones);
    loopback (local | payload | remote);
    start-end-flag (filler | shared);
    timeslots time-slot-number;
}
```

For T1 channels on a channelized T3 interface, the clocking statement is supported only for channel 0; it is ignored if included in the configuration of channels 1 through 11. The clock source configured for channel 0 applies to all channels on the channelized T3 interface. The individual T1 channels use a gapped 45-MHz clock as the transmit clock. When you configure the clock source for a channelized interface—ds-*fpc/pic/port* :0, for example—you must also include the channel-group statement at the [edit chassis] hierarchy level, and specify channel group 0. For more information, see “Clock Sources on Channelized Interfaces” on page 376.

For information about Frame Relay DLCI limitations for channelized interfaces, see “Data-Link Connection Identifiers on Channelized Interfaces” on page 374. For more information about Frame Relay DLCIs, see “Configuring a Point-to-Point Frame Relay Connection” on page 366. For more information about DLCI sparse mode, see the *JUNOS System Basics Configuration Guide*.

For more information about specific parameters, see “Configuring T1 Interfaces” on page 529 and “Configuring T3 Interfaces” on page 539. For a configuration example, see “Examples: Configuring Channelized DS3-to-DS1 Interfaces” on page 474.

Example: Configuring Channelized T3 IQ Interfaces

Configure a channelized T3 interface as an unpartitioned, clear channel.

Configuring a T3 Interface

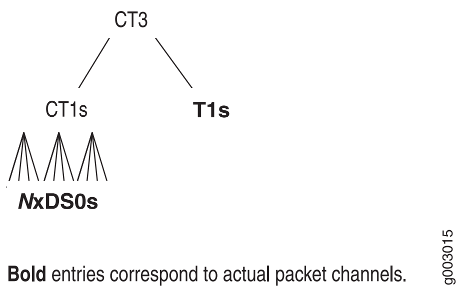
```
[edit interfaces]
ct3-5/0/0 {
    no-partition interface-type t3;
}
```

Configuring NxDS0 and T1 Interfaces

Figure 48 on page 471 shows the following interfaces on a Channelized DS3 IQ or IQE PIC:

- A channelized T1, which is partitioned into *N*xDS0 interfaces
- T1 interfaces

Figure 48: Sample Channelization of DS3 IQ or IQE PIC




```
[edit interfaces]
ct3-1/1/0 {
   description "CT3 to CT1 and CT3 to T1.";
   t3-options {
      loopback remote;
      looptiming;
   }
   partition 1 interface-type ct1; # ct1-1/1/0:1.
   partition 2-28 interface-type t1; # t1-1/1/0:[2-28]
}
ct1-1/1/0:1 {
   description "case (a) CT1s to NxDSOs.";
   t1-options {
      bert-algorithm all-ones-repeating;
      framing sf;
      line-encoding ami;
   }
   partition 1 timeslots 2 - 10 interface-type ds0; # ds-1/1/0:1:1, channel group with
      10 DS0s
   partition 2 timeslots 11- 23 interface-type ds0; # ds-1/1/0:1:2, channel group with
      13 DS0s
   ...
}
```

Examples: Configuring Channelized DS3-to-DS0 Interfaces

The following configuration is sufficient to get the channelized DS3-to-DS0 interface up and running. The T3 interface can be divided into 28 channels, each at T1 line rate. DS3 channels can use the following encapsulation types for their logical interfaces:

- PPP, PPP CCC, and PPP TCC
- Frame Relay, Frame Relay CCC, and Frame Relay TCC

- Cisco HDLC, Cisco HDLC CCC, and Cisco HDLC TCC

For more information, see "Configuring a Point-to-Point Frame Relay Connection" on page 366.

NOTE: All these configuration examples specify channel group 0 in the interface address, which is required for configuring the t3-options and t1-options statements.

Configuring Cisco HDLC Encapsulation on a Channelized DS3-to-DS0 Interface

```
[edit interfaces]
ds-2/0/1:20:0 {
    encapsulation cisco-hdlc;
    unit 0 {
        family inet {
            address 10.0.4.40/32 {
                destination 10.0.4.41;
            }
        }
    }
}
[edit chassis]
fpc 2 {
    pic 0 {
        ct3 {
            port 1 {
                t1 20 {
                    channel-group 0 timeslots 1-5;
                }
            }
        }
    }
}
```

Configuring PPP Encapsulation on a Channelized DS3-to-DS0 Interface

```
[edit interfaces]
ds-2/0/1:20:0 {
    encapsulation ppp;
    unit 0 {
        family inet {
            address 10.0.4.40/32 {
                destination 10.0.4.41;
            }
        }
    }
}
[edit chassis]
fpc 2 {
    pic 0 {
        ct3 {
            port 1 {
                t1 20 {
                    channel-group 0 timeslots 1-5;
                }
            }
        }
```

```
    }
}
```

Configuring Three Frame Relay DLCIs on a Channelized DS3 Interface

```
[edit interfaces]
t1-5/1/3:0 {
    mtu 9192;
    encapsulation frame-relay;
    unit 1 {
        dlci 101;
        family inet {
            mtu 9000;
            address 10.123.1.2/32 {
                destination 10.123.1.1;
            }
        }
        family iso {
            mtu 9000;
        }
        family mpls {
            mtu 9000;
        }
    }
    unit 2 {
        dlci 102;
        family inet {
            mtu 9000;
            address 10.123.1.4/32 {
                destination 10.123.1.3;
            }
        }
        family iso {
            mtu 9000;
        }
        family mpls {
            mtu 9000;
        }
    }
    unit 3 {
        dlci 103;
        family inet {
            mtu 9000;
            address 10.123.1.6/32 {
                destination 10.123.1.5;
            }
        }
        family iso {
            mtu 9000;
        }
        family mpls {
            mtu 9000;
        }
    }
}
```

Configuring Cisco HDLC Encapsulation with Byte-Encoding

```
[edit interfaces ds-0/1/0:5:0]
no-keepalives;
encapsulation cisco-hdlc;
ds0-options {
   byte-encoding nx56;
}
unit 0 {
   family inet {
      address 10.221.2.8/24;
   }
}
```

Configuring Cisco HDLC Encapsulation with Byte-Encoding and Framing

```
[edit interfaces ds-0/1/0:5:0]
no-keepalives;
encapsulation cisco-hdlc;
t1-options {
   byte-encoding nx56;
   framing sf;
}
unit 0 {
   family inet {
      address 10.221.2.8/24;
   }
}
```

Use Time Slots 1 Through 10

```
[edit chassis fpc slot-number pic pic-number ct3 port port-number t1 link-number]
channel-group group-number;
timeslots 1-10;
```

Use Time Slots 1 Through 5, 10, and 24

```
[edit chassis fpc slot-number pic pic-number ct3 port port-number t1 link-number]
channel-group group-number;
timeslots 1-5,10,24;
```

Examples: Configuring Channelized DS3-to-DS1 Interfaces

The following configuration is sufficient to get the channelized DS3-to-DS1 interface up and running. The T3 interface can be divided into 28 channels, each at T1 line rate. DS3 channels can use the following encapsulation types for their logical interfaces:

- PPP, PPP CCC, and PPP TCC
- Frame Relay, Frame Relay CCC, and Frame Relay TCC
- Cisco HDLC, Cisco HDLC CCC, and Cisco HDLC TCC

For more information, see “Configuring a Point-to-Point Frame Relay Connection” on page 366.

Configuring Cisco HDLC Encapsulation on a Channelized DS3 Interface

```
[edit interfaces]
t1-2/0/1:20 {
   encapsulation cisco-hdlc;
   unit 0 {
      family inet {
```

```
            address 10.0.4.40/32 {
                destination 10.0.4.41;
            }
        }
    }
}
```

Configuring PPP Encapsulation on a Channelized DS3 Interface

```
[edit interfaces]
t1-2/0/1:20 {
    encapsulation ppp;
    unit 0 {
        family inet {
            address 10.0.4.40/32 {
                destination 10.0.4.41;
            }
        }
    }
}
```

Configuring Five Frame Relay DLCIs on a Channelized DS3 Interface

```
[edit interfaces]
t1-5/1/3:0 {
    mtu 9192;
    encapsulation frame-relay;
    unit 1 {
        dlci 101;
        family inet {
            mtu 9000;
            address 10.123.1.2/32 {
                destination 10.123.1.1;
            }
        }
        family iso {
            mtu 9000;
        }
        family mpls {
            mtu 9000;
        }
    }
    unit 2 {
        dlci 102;
        family inet {
            mtu 9000;
            address 10.123.1.4/32 {
                destination 10.123.1.3;
            }
        }
        family iso {
            mtu 9000;
        }
        family mpls {
            mtu 9000;
        }
    }
    unit 3 {
        dlci 103;
```

```
        family inet {
            mtu 9000;
            address 10.123.1.6/32 {
                destination 10.123.1.5;
            }
        }
        family iso {
            mtu 9000;
        }
        family mpls {
            mtu 9000;
        }
    }
    unit 4 {
        dlci 104;
        family inet {
            mtu 9000;
            address 10.123.1.8/32 {
                destination 10.123.1.7;
            }
        }
        family iso {
            mtu 9000;
        }
        family mpls {
            mtu 9000;
        }
    }
    unit 5 {
        dlci 105;
        family inet {
            mtu 9000;
            address 10.123.1.10/32 {
                destination 10.123.1.9;
            }
        }
        family iso {
            mtu 9000;
        }
        family mpls {
            mtu 9000;
        }
    }
}
```

Configuring Cisco HDLC Encapsulation with Byte-Encoding

```
[edit interfaces t1-1/1/0:1]
no-keepalives;
encapsulation cisco-hdlc;
t1-options {
    byte-encoding nx56;
}
unit 0 {
    family inet {
        address 10.221.2.8/24;
    }
```

```
}
```

Configuring Cisco HDLC Encapsulation with Byte-Encoding and Framing

```
[edit interfaces t1-1/1/0:1]
no-keepalives;
encapsulation cisco-hdlc;
t1-options {
    byte-encoding nx56;
    framing sf;
}
unit 0 {
    family inet {
        address 10.221.2.8/24;
    }
}
```

Chapter 23

Configuring Channelized T1 Interfaces

The Channelized T1 intelligent queuing (IQ) and enhanced intelligent queuing (IQE) PICs have 10 T1 ports that you can channelize to the DS0 level. Each T1 interface has 24 DS0 time slots. You can combine DS0 time slots (channels) to create a channel group (*N*xDS0).

The Channelized T1 IQ and IQE PICs are supported on the M7i, M10i, M20, M40e, M120, and M320 platforms.

This section contains the following topics:

Configuring Channelized T1 IQ and IQE Interfaces

This section describes how to configure channelized T1 IQ and IQE interfaces, discussing the following topics:

Configuring T1 IQ and IQE Interfaces

To configure a T1 interface, include the no-partition and interface-type statements at the [edit interfaces ct1-*fpc/pic/port*] hierarchy level:

```
[edit interfaces ct1-fpc/pic/port]
no-partition interface-type t1;
```

This configuration creates the interface t1-*fpc/pic/port*.

NOTE: For a T1 (t1-) interface configured on channelized T1 (ct1-) interface on a Channelized T1 IQ or IQE PIC, you can configure the following T1 options, but these options do not take effect for the T1 interface:

- bert-algorithm
- bert-error-rate
- bert-period
- buildout
- framing
- line-encoding
- loopback
- remote-loopback-respond

The T1 interface inherits these option settings from the parent channelized T1 interface.

Configuring Fractional T1 IQ and IQE Interfaces

By default, all the time slots on a channelized T1 interface are used. To configure a fractional T1 interface on a Channelized T1 IQ or IQE PIC, perform the following tasks:

1. Include the no-partition statement at the [edit interfaces ct1-*fpc/pic/port*] hierarchy level. This configuration creates the interface t1-*fpc/pic/port*.

   ```
   [edit interfaces ct1-fpc/pic/port]
   no-partition interface-type t1;
   ```

2. Configure the number of time slots allocated to the T1 IQ or IQE interface by including the timeslots statement at the [edit interfaces t1-*fpc/pic/port* t1-options] hierarchy level. DS0 time slots configured on the channelized T1 IQ or IQE interface are numbered from 1 to 24. To configure ranges, use hyphens. To configure discontinuous time slots, use commas. Do not include spaces.

   ```
   [edit interfaces t1-fpc/pic/port t1-options]
   timeslots time-slot-range;
   ```

For more information about T1 time slots, see “Configuring Fractional T1 Time Slots” on page 537.

Example: Configuring Fractional T1 IQ and IQE Interfaces

Configure a fractional T1 interface that uses time slots 2 through 10:

```
[edit interfaces t1-0/0/0]
no-partition interface-type t1;
[edit interfaces t1-0/0/0 t1-options]
```

```
timeslots 1-10;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring NxDS0 IQ and IQE Interfaces

By default, all the time slots on a channelized T1 interface are used. To configure an *N*xDS0 IQ or IQE interface on a Channelized T1 IQ or IQE PIC, you must configure the number of time slots allocated to the *N*xDS0 IQ or IQE interface by including the partition, timeslots, and interface-type statements at the [edit interfaces t1-*fpc/pic/port*] hierarchy level, specifying the ds interface type:

```
[edit interfaces t1-fpc/pic/port]
partition partition-number timeslots time-slot-rangeinterface-type ds;
```

For channelized T1 IQ or IQE interfaces, the partition number range is from 1 through 24.

For channelized T1 IQ or IQE interfaces (t1-*fpc/pic/port*), the time-slot range is from 1 through 24. You can designate any combination of time slots. To configure ranges, use hyphens. To configure discontinuous time slots, use commas. Do not include spaces. For more information about T1 time slots, see “Configuring Fractional T1 Time Slots” on page 537.

Example: Configuring an NxDS0 IQ or IQE Interface

Configure an *N*xDS0 interface that uses time slots 2 through 10. This configuration creates the ds-0/0/0:1 interface.

```
[edit interfaces t1-0/0/0:1]
partition 1 timeslots 1-10 interface-type ds;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring Payload Loopback

Clocking and loopback options are configured at the controller level for all IQ-based and IQE-based interfaces. However, for the channelized T1 IQ or IQE interfaces, configure the payload loopback on the T1 interfaces instead of the channelized T1 IQ or IQE interface. To configure the payload option, include the payload statement at the [edit interfaces t1-*fpc/pic/port* t1-options loopback] hierarchy level.

By default, all the time slots on a channelized T1 IQ or IQE interface are used. There can be a maximum of 24 channel groups per channelized T1 IQ or IQE interface. Thus, you can configure a maximum of 240 channel groups per PIC.

To specify the DS0 channel group number in the interface name, include a colon (:) as a separator. For example, a Channelized T1 IQ or IQE PIC might have the following physical and virtual interfaces:

```
ds-0/0/0:x
```

x is a DS0 channel group from 1 through 24 (for more information about ranges, see Table 40 on page 482).

You can use any of the values within the range available for *x*; you do not have to configure the links sequentially. In addition, the JUNOS software applies the interface options you configure according to the following rules:

- To configure the t1-options statement, you must set channel group *x* to 0:

  ds-0/0/0:0

- There are no restrictions on configuring the ds0-options statement.
- If you delete a configuration you previously committed for channel group 0, the options return to default values.

To configure the channel groups and time slots for a channelized T1 IQ or IQE interface, include the following statements at the [edit chassis] hierarchy level:

```
[edit chassis]
fpc slot-number {
    pic pic-number {
        ct1 {
            t1 link-number {
                channel-group group-number;
                timeslots time-slot-range;
            }
        }
    }
}
```

There are 24 time slots on a T1 interface. You can designate any combination of time slots. To configure ranges, use hyphens. To configure discontinuous time slots, use commas. Do not include spaces.

Table 40 on page 482 shows the ranges you can specify.

Table 40: Ranges for Channelized T1 IQ Configuration

Item	Option	Range
FPC slot	*slot-number*	0 through 7
PIC slot	*pic-number*	0 through 3
T1 port	*port-number*	0 through 9
DS0 channel group	*partition*	1 through 24
Time slot	*time-slot-range*	1 through 24

The theoretical maximum number of channel groups possible per PIC is 10 * 24 = 240. This is within the maximum bandwidth available.

Configuring Channelized T1 Interface Properties

To configure channelized T1 IQ or IQE interface properties, include the t1-options statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
t1-options {
   byte-encoding (nx56 | nx64)
   fcs (16 | 32);
   framing (esf | sf);
   idle-cycle-flag (flags | ones);
   invert-data;
   line-encoding (ami | b8zs);
   loopback (local | payload | remote);
   start-end-flag (filler | shared);
}
```

NOTE: If you configure the line-encoding statement with the ami option and the byte-encoding statement with the nx64 option, excessive zeros in the payload area may bring the interface down. To prevent this, configure the byte-encoding statement with the nx56 option or include the invert-data statement.

To specify options for each of the DS0 channels, include the ds0-options statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
ds0-options {
   byte-encoding (nx56 | nx64);
   fcs (16 | 32);
   idle-cycle-flag (flags | ones);
   loopback payload;
   start-end-flag (filler | shared);
}
```

Only a subset of the T1 options is valid for the channelized configuration; you specify the time slots using the [edit chassis] configuration described in “Examples: Interface Naming” on page 58. For more information about the T1 and DS0 options, see “Configuring T1 Interfaces” on page 529.

Each T1 interface has 24 time slots (DS0s). You can combine one or more of these DS0 time slots (channels) to create a channel group (*N*xDS0). There can be a maximum of 24 channel groups per T1 interface.

Example: Configuring Channelized T1 IQ and IQE Interfaces

Configure a channelized T1 interface as an unpartitioned, clear channel.

Configuring a T1 Interface

```
[edit interfaces]
ct1-2/0/0 {
   no-partition interface-type t1; # t1-2/0/0
}
```

Configure a partitioned channel group.

Configuring a Channel Group

```
[edit interfaces]
ct1-0/0/1 {
   partition 1 interface-type ds0 timeslots 1-10;
   partition 2interface-type ds0 timeslots 11-20;
}
```

The following configuration is sufficient to get the channelized T1 IQ or IQE interface up and running:

Configuring Multiple Interface Types

```
[edit]
interfaces {
   ct1-1/2/3 {
      partition 1 timeslots 10 interface-type ds; # ds-1/2/3:1
      partition 2 timeslots 1-9 interface-type ds; # ds-1/2/3:2
   }
   ds-1/2/3:1 {
      unit 0 {
         family inet {
            address 10.25.1.2/24;
         }
      }
   }
   ds-1/2/3:2 {
      unit 0 {
         family inet {
            address 10.25.2.2/24;
         }
      }
   }
}
[edit]
interfaces {
   ct1-1/2/6 {
      no-partition interface-type t1; # t1-1/2/6
   }
   t1-1/2/6 {
      t1-options {
         timeslots 1-2;
      }
      unit 0 {
         family inet {
            address 10.255.126.2/24;
         }
      }
   }
}
```

Chapter 24

Configuring Channelized E1 Interfaces

Each Channelized E1 PIC, Channelized E1 Intelligent Queuing (IQ) PIC and Channelized E1 Enhanced Intelligent Queuing (IQE) PIC has 10 E1 ports that you can channelize to the *N*xDS0 level. Each E1 interface has 32 time slots (DS0), in which time slot 0 is reserved. You can combine one or more of these DS0 time slots (channels) to create a channel group *N*xDS0.

This section contains the following topics:

Configuring Channelized E1 IQ and IQE Interfaces

This section describes how to configure channelized E1 IQ and IQE interfaces, discussing the following topics:

NOTE: Class-of-service (CoS) rules cannot be applied to an individual channel configured on channelized IQ and IQE interfaces. You can only apply CoS rules to the aggregate bit streams.

Configuring E1 IQ and IQE Interfaces

To configure an E1 interface, include the no-partition and interface-type statements at the [edit interfaces ce1-*fpc/pic/port*] hierarchy level:

```
[edit interfaces ce1-fpc/pic/port]
no-partition interface-type e1;
```

This configuration creates interface e1-*fpc/pic/port*.

Configuring Fractional E1 IQ and IQE Interfaces

By default, all the time slots on a channelized E1 interface are used. To configure a fractional E1 interface on a Channelized E1 IQ PIC, perform the following tasks:

1. Include the no-partition statement at the [edit interfaces ce1-*fpc/pic/port*] hierarchy level:

   ```
   [edit interfaces ce1-fpc/pic/port]
   no-partition interface-type e1;
   ```

   This configuration creates interface e1-*fpc/pic/port*.

2. Configure the number of time slots allocated to the E1 IQ or IQE interface by including the timeslots statement at the [edit interfaces e1-*fpc/pic/port* e1-options] hierarchy level:

   ```
   [edit interfaces e1-fpc/pic/port e1-options]
   timeslots time-slot-range;
   ```

*N*xDS0 time slots configured on either a channelized STM1 IQ or IQE interface or a channelized E1 IQ or IQE interface are numbered from 1 to 31 (0 is reserved), while fractional E1 time slots are numbered from 2 to 32 (1 is reserved).

To configure ranges, use hyphens. To configure discontinuous time slots, use commas. Do not include spaces.

For more information about E1 time slots, see "Configuring Fractional E1 Time Slots" on page 518.

Example: Configuring Fractional E1 IQ and IQE Interfaces

Configure a fractional E1 interface that uses time slots 2 through 10:

```
[edit interfaces ce1-0/0/0]
no-partition interface-type e1;
[edit interfaces e1-0/0/0 e1-options]
timeslots 2-10;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring NxDS0 IQ and IQE Interfaces

By default, all the time slots on a channelized E1 interface are used. To configure an *N*xDS0 IQ interface on a Channelized E1 IQ or IQE PIC, you must configure the number of time slots allocated to the *N*xDS0 IQ or IQE interface by including the partition, timeslots, and interface-type statements at the [edit interfaces ce1-*fpc/pic/port*] hierarchy level, specifying the ds interface type:

```
[edit interfaces ce1-fpc/pic/port]
partition partition-number timeslots time-slot-range interface-type ds;
```

For channelized E1 IQ and IQE interfaces, the partition number range is from 1 through 31.

For E1 IQ and IQE interfaces (e1-*fpc/pic/port*), the time-slot range is from 2 through 31. For channelized E1 IQ and IQE interfaces (ce1-*fpc/pic/port*), the time-slot range is from 1 through 31. You can designate any combination of time slots. To configure ranges, use hyphens. To configure discontinuous time slots, use commas. Do not include spaces. For more information about E1 time slots, see “Configuring Fractional E1 Time Slots” on page 518.

Example: Configuring an NxDS0 IQ or IQE Interface

Configure an *N*xDS0 interface that uses time slots 2 through 10. This configuration creates the ds-0/0/0:1:1 interface.

```
[edit interfaces ce1-0/0/0:1]
partition 1 timeslots 2-10 interface-type ds;
```

For a full configuration example, see the *JUNOS Feature Guide*.

Configuring Channelized E1 Interfaces

By default, all the time slots on a channelized E1 interface are used. There can be a maximum of 24 channel groups per channelized E1 interface. Thus, you can configure a maximum of 240 channel groups per PIC.

To specify the DS0 channel group number in the interface name, include a colon (:) as a separator. For example, a Channelized E1 PIC might have the following physical and virtual interfaces:

```
ds-0/0/0:x
```

where *x* is a DS0 channel group from 0 through 23 (for more information about ranges, see Table 41 on page 488).

You can use any of the values within the range available for *x*; you do not have to configure the links sequentially. In addition, the JUNOS software applies the interface options you configure according to the following rules:

- To configure the e1-options statement, you must set channel group *x* to 0:

  ```
  ds-0/0/0:0
  ```

- There are no restrictions on configuring the ds0-options statement.
- If you delete a configuration you previously committed for channel group 0, the options return to default values.

To configure the channel groups and time slots for a channelized E1 interface, include the following statements at the [edit chassis] hierarchy level:

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

```
        ce1 {
            e1 link-number {
                channel-group group-number;
                timeslots time-slot-range;
            }
        }
    }
}
```

NOTE: If you commit the interface name but do not include the [edit chassis] configuration, the Channelized E1 PIC behaves like a standard E1 PIC, and none of the DS0 functionality is accessible.

There are 32 time slots on an E1 interface; however, time slot 0 is reserved. You can designate any combination of time slots. To configure ranges, use hyphens. To configure discontinuous time slots, use commas. Do not include spaces.

Table 41 on page 488 shows the ranges you can specify.

Table 41: Ranges for Channelized E1 Configuration

Item	Option	Range
FPC slot	*slot-number*	0 through 7 (see note below)
PIC slot	*pic-number*	0 through 3
E1 link	*link-number*	0 through 9
DS0 channel group	*group-number*	0 through 23
Time slot	*time-slot-range*	0 through 31 (with time slot 0 reserved) (see note below)

The theoretical maximum number of channel groups possible per PIC is 10 * 24 = 240. This is within the maximum bandwidth available.

NOTE: *N*xDS0 time slots configured on either a channelized STM1 IQ or IQE interface or channelized E1 IQ or IQE interface are numbered from 1 to 31 (0 is reserved), while fractional E1 time slots range from 2 to 32 (1 is reserved).

The FPC slot range depends on the routing platform. For the TX Matrix platform, the range is from 0 through 31. For M40, M40e, M160, M320, M120, and other T-series routing platforms, the range is from 0 through 7. For M20 routing platforms, the range is from 0 through 3. For M10 and M10i routing platforms, the range is from 0 through 1. For M5 and M7i routing platforms, the only applicable value is 0.

Configuring Channelized E1 Interface Properties

To configure channelized E1 interface properties, include the e1-options statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
e1-options {
   fcs (16 | 32);
   framing (g704 | g704-no-crc4 | unframed);
   idle-cycle-flag (flags | ones);
   loopback (local | remote);
   start-end-flag (filler | shared);
}
```

To specify options for each of the DS0 channels, include the ds0-options statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
ds0-options {
   byte-encoding (nx56 | nx64);
   fcs (16 | 32);
   idle-cycle-flag (flags | ones);
   loopback payload;
   start-end-flag (filler | shared);
}
```

For DS0 channels on a channelized E1 interface, the clocking statement is supported only for channel 0; it is ignored if included in the configuration of channels 1 through 11. The clock source configured for channel 0 applies to all channels on the channelized E1 interface. The individual DS0 channels use a gapped 45-MHz clock as the transmit clock. When you configure the clock source for a channelized interface—ds-*fpc/pic/port*:0, for example—you must also include the channel-group statement at the [edit chassis] hierarchy level, and specify channel group 0. For more information, see "Clock Sources on Channelized Interfaces" on page 376.

Only a subset of the E1 options is valid for the channelized configuration; you specify the time slots using the [edit chassis] configuration described in "Examples: Interface Naming" on page 58. For more information about the E1 and DS0 options, see "Configuring E1 Interfaces" on page 513 and "Configuring T1 Interfaces" on page 529.

Each E1 interface has 32 time slots (DS0s), in which time slot 0 is reserved. You can combine one or more of these DS0 time slots (channels) to create a channel group (*N*xDS0). There can be a maximum of 24 channel groups per E1 interface.

Example: Configuring Channelized E1 IQ or IQE Interfaces

Configure a channelized E1 interface as an unpartitioned, clear channel:

Configuring an E1 Interface

```
[edit interfaces]
ce1-2/0/0 {
   no-partition interface-type e1; # e1-2/0/0
}
```

The following configuration is sufficient to get the channelized E1 IQ or IQE interface up and running:

Configuring Multiple Interface Types

```
[edit]
interfaces {
   ce1-1/2/3 {
      partition 1 timeslots 10 interface-type ds; # ds-1/2/3:1
      partition 2 timeslots 1-9 interface-type ds; # ds-1/2/3:2
   }
   ds-1/2/3:1 {
      unit 0 {
         family inet {
            address 10.25.1.2/24;
         }
      }
   }
   ds-1/2/3:2 {
      unit 0 {
         family inet {
            address 10.25.2.2/24;
         }
      }
   }
}
[edit]
interfaces {
   ce1-1/2/6 {
      no-partition interface-type e1; # e1-1/2/6
   }
   e1-1/2/6 {
      e1-options {
         timeslots 1-2;
      }
      unit 0 {
         family inet {
            address 10.255.126.2/24;
         }
      }
   }
}
```

Example: Configuring Channelized E1 Interfaces

The following configuration is sufficient to get the channelized E1 interface up and running:

Configuring an E1 Interface, E1 Options, and DS0 Options

```
[edit chassis]
fpc 0 {
   pic 1 {
      ce1 {
         e1 0 {
            channel-group 0 timeslots 1;
            channel-group 1 timeslots 2;
            channel-group 5 timeslots 5-7;
         }
```

```
            e1 4 {
                channel-group 10 timeslots 11,17,28-31;
            }
        }
    }
}
[edit interfaces ds-0/1/0:0]
e1-options {
    fcs 32;
    framing g704-non-grc;
    loopback remote;
}
[edit interfaces ds-0/1/4:10]
ds0-options {
    byte-encoding nx56;
    start-end-flag filler;
}
```

The above configuration results in the following interfaces:

```
ds-0/1/0:1, with time slot 1 allocated
ds-0/1/0:5, with time slots 5 through 7 allocated
ds-0/1/4:10, with time slots 11, 17, and 28 through 31 allocated
```

The remaining ports (other than 0 and 4) remain as regular E1 interfaces (and follow the e1-0/1/*x* naming convention).

```
[edit chassis]
fpc 0 {
    pic 1 {
        ce1 {
            e1 0 {
                channel-group 1 timeslots 1;
                channel-group 5 timeslots 5-7;
            }
            e1 4 {
                channel-group 10 timeslots 11,17, 28-31;
            }
        }
    }
}
```

Use Time Slots 1 Through 10

[edit chassis fpc *slot-number* pic *pic-number* ce1 e1 *link-number*]
channel-group *group-number*;
timeslots 1-10;

Use Time Slots 1 Through 5, 10, and 24

[edit chassis fpc *slot-number* pic *pic-number* ce1 e1 *link-number*]
channel-group *group-number*;
timeslots 1-5,10,24;

Chapter 25

Configuring Channelized E1 PRI and T1 PRI Interfaces

This section contains the following topics:

Channelized E1 PRI and T1 PRI Overview

J-series Services Routers equipped with a Dual-Port Channelized T1/E1 PIM support Integrated Services Digital Network (ISDN) Primary Rate Interfaces (PRIs). ISDN PRI, referred to as S2M in Europe, is the “primary” extended ISDN network interface. It offers a larger capacity of digital channels utilizing a variety of improved mediums, and is used by large organizations with intensive communication needs. In contrast, the ISDN Basic Rate Interface (BRI), known as SO in Europe, provides a limited number of channels, transmitting over copper wire, and is used by smaller organizations or individuals with less intensive communication needs. For more information about configuring ISDN BRI interfaces, see “Configuring ISDN Physical Interface Properties” on page 775.

Unlike channelized PICs on the M-series and T-series routing platforms, the interface type on the Dual-Port Channelized T1/E1 PIM is configurable. A single interface can operate as either a channelized T1 or channelized E1 interface (or clear channel) or as an ISDN PRI. The ISDN PRI channels can operate on the same interface as T1 or E1 channels. The PIM also supports a “drop-and-insert” feature, allowing you to insert channels from one port on the PIM into the other port on the PIM.

These ISDN channels are delivered to the user in one of two predefined configurations:

- ISDN BRI is configured by specifying properties for a physical (br-) interface and a logical (dl*n*) interface.

- For ISDN PRI, you configure:
  1. Either a channelized E1 (ce1-*pim*/0/*port*) or channelized T1 (ct1-*pim*/0/*port*) interface.
  2. Time slots within a ce1-*pim*/0/*port* interface or ct1-*pim*/0/*port* interface.
  3. A bearer (B) channel bc-*pim*/0/*port*:*channel* interface for each time slot that you want to function as an ISDN PRI B-channel. The B-channel is used for data, video, voice, and multimedia. You can create up to 30 B-channels on a channelized E1 interface, and 23 B-channels on a channelized T1 interface.
  4. One delta (D) channel, used between switching equipment in the ISDN network and the ISDN equipment at your site for signaling. For channelized E1, the D-channel must be time slot 16. For channelized T1, the D-channel must be time slot 24.

NOTE: Time slots can also be shared with ds-*pim*/0/*port* time slots within the same channelized interface.

Channelized E1 and T1 PIMs on J-series Services Routers provide support for ISDN PRI connectivity for dial-in and callback, and for use as primary or backup network connections.

Configuring a Clear Channel on a Dual-Port Channelized T1-E1 PIM

A *clear channel* is an interface that uses the entire bandwidth of the port on a PIM. To configure a clear channel, include the no-partition and interface-type statements in the configuration. On a Dual-Port Channelized T1-E1 PIM, you can configure two clear-channel interfaces.

To configure an E1 interface, include the no-partition and interface-type statements at the [edit interfaces ce1-*pim*/0/*port*] hierarchy level:

```
[edit interfaces ce1-pim/0/port]
no-partition interface-type e1;
```

This configuration creates interface e1-*pim*/0/*port*.

To configure aT1 interface, include the no-partition and interface-type statements at the [edit interfaces ct1-*pim*/0/*port*] hierarchy level:

```
[edit interfaces ct1-pim/0/port]
no-partition interface-type t1;
```

This configuration creates interface t1-*pim*/0/*port*.

Configuring a Channelized T1/E1 Interface to Drop and Insert Time Slots

On channelized T1/E1 interfaces configured for channelized operation, you can insert channels (time slots) from one port (for example, channels carrying voice) directly into the other port on the PIM, to replace channels coming through the Routing Engine. This feature, known as drop and insert, allows you to integrate voice and data on a single T1 or E1 link by removing the DS0 time slots of one T1 or E1 port and replacing them by inserting the time slots of another T1 or E1 port. It is not necessary to use the same time slots on both interfaces, but the time slots count must be same. The channels that are not configured for the drop-and-insert feature are used for normal traffic.

You can configure:

- 30 channelized E1 time slots, with the 16th time slot operating as the signaling channel
- 23 channelized T1 time slots, with the 24th time slot operating as the signaling channel

The signaling channel, or D-channel, must be part of the channels that are being switched through the drop-and-insert functionality. The JUNOS software does not support switching of voice and data between ports by default.

Both ports involved in the drop-and-insert configuration must use the same clock source—either the router's internal clock or an external clock.

The following clock source settings are valid:

- When port 0 is set to use the internal clock, port 1 must also be set to use it, and vice versa.
- When port 0 is set to use its external clock, port 1 must be set to run on the same clock—the external clock for port 0.
- When port 1 is set to use its external clock, port 0 must be set to run on the same clock—the external clock for port 1.

For more details about valid clock combinations, see the *J-series Services Router Basic LAN and WAN Access Configuration Guide*.

To configure drop-and-insert time slots on a channelized T1 interface, include the partition statement at the [edit interfaces ct1-*pim*/0/*port*] hierarchy level with the timeslots statement and interface-type statements specified:

```
[edit interfaces]
ct1-pim/0/port {
   partition 1 timeslots 1-10 interface-type ds;
   partition 2 timeslots 11-14 interface-type ds;
   partition 3 timeslots 15-32 interface-type ds;
}
```

This configuration creates interfaces ds-*pim*/0/*port*:1, ds-*pim*/0/*port*:2, and ds-*pim*/0/*port*:3.

Use the same configuration to create drop-and insert time slots on a channelized E1 interface by including the partition statement and options at the [edit interfaces ce1-*pim*/0/*port*] hierarchy level.

Configuring Primary Rate Interfaces

Primary rate interfaces are a combination of B-channels with one controlling D-channel for the group. Configure B-channel interfaces for each time slot that you want to function as an ISDN PRI interface. The B-channel is used for data, video, voice, and multimedia. You can create:

- 23 B-channels on a channelized T1 interface
- 30 B-channels on a channelized E1 interface

To configure B-channels on a channelized T1 interface, include the partition statement at the [edit interfaces ct1-*pim*/0/*port*] hierarchy level with the timeslots statement and interface-type bc specified:

```
[edit interfaces]
ct1-pim/0/port {
   partition 1-23 timeslots 1-23 interface-type bc;
}
```

This configuration creates interfaces bc-*pim*/0/*port*:1 through bc-*pim*/0/*port*:1, and ds-*pim*/0/*port*:3.

Use the same configuration to create B-channels on a channelized E1 interface by including the partition statement and options at the [edit interfaces ce1-*pim*/0/*port*] hierarchy level.

One D-channel is used between switching equipment in the ISDN network and the ISDN equipment at your site for signaling. For channelized E1, the D-channel must be time slot 16. For channelized T1, the D-channel must be time slot 24.

To configure a D-channel on a channelized T1 interface, include the partition statement at the [edit interfaces ct1-*pim*/0/*port*] hierarchy level with the timeslots statement and interface-type dc specified:

```
[edit interfaces]
ct1-pim/0/port {
partition 24 timeslots 24 interface-type dc;
```

This configuration creates interfaces dc-*pim*/0/*port*.

Use the same configuration to create B-channels on a channelized E1 interface by including the partition statement and options at the [edit interfaces ce1-*pim*/0/*port*] hierarchy level.

```
[edit interfaces]
ce1-pim/0/port {
   partition 16 timeslots 16 interface-type dc;
}
```

To view PRI or ISDN options information about interface, use the following operational mode commands supporting BRI interfaces:

- show interfaces *interface-name* detail
- show interface *dln*
- show isdn calls
- show isdn history
- show isdn q921 statistics
- show isdn q931 statistics
- show isdn status

NOTE: You must configure a D-channel and B-channels to complete your ISDN PRI line configuration.

NOTE: You can configure dso-options on the B-channel, but you cannot configure parameters for a D-channel. However, when interface statistics are displayed, both B-channel and D-channel interfaces have statistical values.

Allocating B-Channels for Dialout

You can configure the system to allocate B-channels for dialout from lowest or highest numbered B-channel (ascending or descending order). By configuring this feature, you reduce chances of "glare" on PRI lines carrying a mix of incoming and outgoing calls.

To configure the B-channel allocation, include the idsn-options and bchannel-allocation statements at the [edit interfaces ct1-*pim*/0/*port* | ce1-*pim*/0/*port*] hierarchy level:

```
[edit interfaces]
(ct1-pim/0/port | ce1-pim/0/port) {
    isdn-options {
    (bchannel-allocation (ascending | descending);
    }
}
```

Configuring PRI Interfaces

When you create a PRI from a channelized E1 or channelized T1 interface, you can select all the slots for the PRI, or just a few of them, leaving the rest as ds- interfaces.

To configure a PRI from a channelized T1 interface, include the partition statement at the [edit interfaces ct1-*pim*/0/*port*] hierarchy level with the timeslots statement and interface-type bc specified:

```
[edit interfaces]
ct1-pim/0/port {
    partition 1 timeslots 1-10 interface-type ds;
```

```
    partition 2 timeslots 11-24 interface-type pr;
}
```

This configuration creates interfaces ds-*pim*/0/*port*:1 through pr-*pim*/0/*port*:2.

Use the same configuration to create interfaces on a channelized E1 interface by including the partition statement and options at the [edit interfaces ce1-*pim*/0/*port*] hierarchy level.

To configure channelized E1 interface properties, include the e1-options statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
e1-options {
    fcs (16 | 32);
    framing (g704 | g704-no-crc4 | unframed);
    idle-cycle-flag (flags | ones);
    loopback (local | remote);
    start-end-flag (filler | shared);
}
```

To specify options for each of the DS0 channels, include the ds0-options statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
ds0-options {
    byte-encoding (nx56 | nx64);
    fcs (16 | 32);
    idle-cycle-flag (flags | ones);
    loopback payload;
    start-end-flag (filler | shared);
}
```

Example: Configuring a Channelized T1 Interface as Primary Rate Interface

Configure a channelized T1 interface to operate fully as a PRI:

```
[edit interfaces]
ct1-2/0/0 {
    partition 1-23 timeslots 1-23 interface-type bc;
    partition 24 timeslots 24 interface-type dc;
    t1-options {
        line-encoding b8zs;
        framing esf;
    }
    traceoptions {
        flag q931;
        flag q921;
        file {
            pri_trace_log;
        }
    }
    dialer-options {
        pool 1 priority 25;
```

```
    }
    isdn-options {
        switch-type att5e;
        bchannel-allocation descending;
        incoming-called-number 384101;
        incoming-called-number 384102;
        incoming-called-number 384103;
    }
}

[edit interfaces]
dl0 {
    unit 0 {
        dialer-options {
            pool 1;
            dial-string 384010;
            incoming-map {
                accept-all;
            }
        }
        family inet {
            filter {
                dialer int-packet;
            }
            address 13.1.1.2/24;
        }
    }
}
[edit firewall]
family inet {
    dialer-filter int-packet {
        term term1 {
            from {
                destination address {
                    13.1.1.1/24;
                }
                protocol icmp;
                then note;
            }
        }
        term term2 {
            then ignore;
        }
    }
}
```

Part 7
Configuring Circuit Emulation Interfaces

Chapter 26
Circuit Emulation Interfaces Overview

This section provides an overview of the circuit emulation interfaces, describes their main features, indicates which routers support them, describes their configuration, and includes the following subsections:

Mobile Backhaul and Circuit Emulation Overview

Juniper Networks mobile backhaul (IP/MPLS) solutions provide the following benefits:

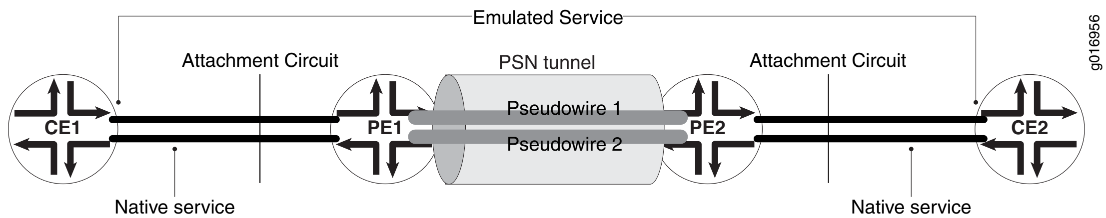
- Flexibility to support converged networks that accommodate both IP and legacy services (leveraging proven circuit emulation techniques).
- Scalability to support emerging data intensive technologies.
- Cost-effectiveness to compensate for rising levels of backhaul traffic.

M7i, M10i, M40e, M120, and M320 routers with 12–port T1/E1 CE and 4–port Channelized OC3/STM1 CE circuit emulation (CE) 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.

Mobile Backhaul Application Overview

This section provides an application example (see Figure 49 on page 504) 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 49: Mobile Backhaul Application



Circuit Emulation Interface Types

The following circuit emulation interfaces are specifically designed for mobile backhaul applications:

- Four-Port Channelized OC3/STM1 Circuit Emulation Interface on page 504
- Twelve-Port T1/E1 Circuit Emulation Interface on page 504

Four-Port Channelized OC3/STM1 Circuit Emulation Interface

The 4-port Channelized OC3/STM1 CE PIC operates as either a four-port channelized OC3 circuit emulation interface in SONET mode or as a four-port channelized STM1 circuit emulation interface in SDH mode. In SONET mode, each OC3 port can be channelized down to three coc1 channels, and then each coc1 channel down to 28 T1 channels. In SDH mode, each STM1 port can be channelized down to four cau4 channels, and then each cau4 channel down to 63 E1 channels. The T1/E1 channels support time-division multiplexing (TDM) interfaces using the Structure-Agnostic time-division multiplexing over Packet (SAToP) protocol [RFC 4553] encapsulation, and support T1/E1 and SONET clocking features. Mixing T1 and E1 channels is not supported.

Twelve-Port T1/E1 Circuit Emulation Interface

The 12-port Channelized T1/E1 CE PIC is a 12-port circuit emulation interface that supports time-division multiplexing (TDM) interfaces using the Structure-Agnostic time-division multiplexing over Packet (SAToP) protocol [RFC 4553] encapsulation, and supports T1/E1 and SONET clocking features. The 12-port Channelized T1/E1 PIC can be configured to work as either 12 T1s or 12 E1s. Mixing T1s and E1s is not supported.

Circuit Emulation Interface Clocking Features

All Circuit Emulation PICs support the following clocking features:

- External clocking—Also known as "loop timing". Clock is distributed via the TDM interfaces.

- Internal clocking with external synchronization—Also known as “external timing” or “external synchronization”.
- Internal clocking with PIC-level line synchronization—Synchronizing the PIC’s internal clock 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 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.

Configuring SAToP Emulation on 4-port Channelized OC3/STM1 CE PICs

This configuration example applies to the mobile backhaul application shown in Figure 49 on page 504.

Configuring SONET/SDH Framing 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]
framing (sonet | sdh); # SONET for COC3 or SDH for CSTM1
```

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 sonet statement (for a COC3 CE PIC), four COC3 interfaces are created.
- If you include the framing sdh statement (for a CSTM1 CE PIC), four CSTM1 interfaces are created.

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

Configuring COC3 CE Channelization Down to T1 Partitions

On each of the four COC3 ports (numbered 0 through 3), 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, include the partition statement at the [edit interfaces (coc1 | coc3)-*fpc/pic/port*] hierarchy level as in the following example:

```
[edit interfaces]
coc3-1/0/0 {
  partition 1 oc-slice 1 interface-type coc1;
```

```
}
coc1-1/0/0:1 {
   partition 1 interface-type t1;
}
```

After you partition the T1 channels, configure the SAToP options on them in the same way as for T1 interfaces. See "Setting the SAToP Options" on page 508.

Configuring CSTM1 Channelization Down to E1 Channels

On each of the four CSTM1 ports (numbered 0 through 3), you can configure four CAU4 channels (numbered 0 through 3). On each CAU4 channel, you can configure 63 T1 channels (numbered 1 through 63). To configure CSTM1 channelization down to CAU4 and then down to E1 channels, include statements for the various interface types at the [edit interfaces] hierarchy level as in the following example:

```
[edit interfaces]
cstm1-1/0/1 {
   no-partition interface-type cau4;
}
cau4-1/0/1 {
   partition 1 interface-type e1;
}
e1-1/0/1:1 {
   encapsulation satop;
   unit 0;
}
```

After you configure the E1 channels, configure SAToP options on them in the same way as for E1 interfaces. See "Setting the SAToP Options" on page 508.

Configuring SAToP Emulation on T1/E1 interfaces on CE PICs

This configuration example applies to the mobile backhaul application shown in Figure 49 on page 504.

- Setting the Emulation Mode on page 506
- Configuring SAToP Emulation on T1/E1 Interfaces on page 507

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]
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 CE PIC), 12 CT1 interfaces are created.

- If you include the framing 31 statement (for an E1 CE PIC), 12 CE1 interfaces are created.

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

CE PICs with SONET and SDH ports require prior channelization down to T1 or E1 before configuring. Only T1/E1 channels support SAToP encapsulation or SAToP options.

Configuring SAToP Emulation on T1/E1 Interfaces

The following topics are covered in this section:

Setting the Encapsulation Mode

T1/E1 channels on CE PICs can be configured with SAToP encapsulation at the PE router, as follows:

```
[edit interfaces (t1|e1)-fpc/pic/port]
encapsulation satop;
unit logical-unit-number;
```

You do not need to configure any cross-connect circuit family because it is automatically created for the above 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” on page 534 and “Configuring E1 Loopback Capability” on page 517.

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

The following are SAToP options:

- groups—Specify groups.
- excessive-packet-loss-rate—Set packet loss options.
- idle-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.
- jitter-buffer-latency—Number of milliseconds delay in the jitter buffer (from 1 to 1000 milliseconds).
- jitter-buffer-packets—Number of packets in the jitter buffer (from 1 to 64 packets).
- payload-size—Configure the payload size, in bytes (from 32 to 1024 bytes).
- sample-period—Number of milliseconds over which excessive packet loss rate is calculated.
- threshold—Percentile designating the threshold of excessive packet loss rate (from 1 to 100 percent).

The following example shows the SAToP configuration options:

```
[edit interfaces (t1|e1)-fpc/pic/port]
satop-options {
   excessive-packet-loss-rate {
      groups group-names;
      sample-period milliseconds;
      threshold percentile;
   )
   idle-pattern pattern;
   jitter-buffer-auto-adjust;
   jitter-buffer-latency milliseconds;
   jitter-buffer-packets packets;
   payload-size bytes;
}
```

Pseudowire Interface Configuration

Configuration for the TDM pseudowire at the PE uses the existing Layer 2 circuit infrastructure:

```
[edit protocols l2circuit]
neighbor address {
   interface t1-fpc/pic/port.0 {
      virtual-circuit-id 1;
   }
}
```

After the CE-bound interfaces (for both PEs) are configured with proper encapsulation, payload size, and other parameters, the two PEs try to establish a pseudowire with pseudowire emulation 3 (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 world bit are equal, the pseudowire is established.

For detailed information about configuring TDM pseudowire, see the *JUNOS VPNs Configuration Guide*.

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

Displaying Information About Circuit Emulation PICs

Use the CLI show chassis hardware command to display information about the PIC configuration.

- For a T1 CE PIC configuration, the output designation is T1 CE.
- For an E1 CE PIC configuration, the output designation is E1 CE.
- For a COC3 CE PIC configuration, the output designation is COC1 CE.
- For a CSTM1 CE PIC configuration, the output designation is CSTM1 CE.

Part 8
Configuring E1, E3, T1, and T3 Interfaces

Chapter 27

Configuring E1 Interfaces

This chapter contains the following sections:

E1 Interfaces Overview

E1 is a standard WAN digital communication format designed to operate over copper facilities at a rate of 2.048 Mbps. Widely used outside North America, it is a basic time-division multiplexing scheme used to carry digital circuits. The following standards apply to E1 interfaces:

- ITU-T Recommendation G.703, *Physical/electrical characteristics of hierarchical digital interfaces*, describes data rates and multiplexing schemes for the E series.
- ITU-T Recommendation G.751, *General Aspects of Digital Transmission Systems: Terminal Equipment*, describes framing methods.
- ITU-T Recommendation G.775, *Loss of Signal (LOS) and Alarm Indication Signal (AIS) Defect Detection and Clearance Criteria*, describes alarm reporting methods.

NOTE: The Juniper Networks E1 Physical Interface Card (PIC) does not support Channel Associated Signaling (CAS).

Configuring E1 Physical Interface Properties

To configure E1-specific physical interface properties, include the e1-options statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
e1-options {
   bert-error-rate rate;
   bert-period seconds;
   fcs (16 | 32);
   framing (g704 | g704-no-crc4 | unframed);
   idle-cycle-flag (flags | ones);
   invert-data;
   loopback (local | remote);
   start-end-flag (filler | shared);
   timeslots time-slot-range;
}
```

Configuring E1 BERT Properties

This section discusses BERT properties for the E1 interface specifically. For general information about the JUNOS implementation of the BERT procedure, see “Interface Diagnostics” on page 127.

You can configure an E1 interface or a CE1 or E1 partition on a channelized PIC to execute a bit error rate test (BERT) when the interface receives a request to run this test. You specify the duration of the test and the error rate to include in the bit stream by including the bert-period and bert-error-rate statements at the [edit interfaces *interface-name* e1-options] hierarchy level:

```
[edit interfaces interface-name e1-options]
bert-error-rate rate;
bert-period seconds;
```

By default, the BERT period is 10 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. Standard CE1, standard E1, E1 IQ, and E1 IQE interfaces, and PICs partitioned to CE1 and E1 channels, support an extended BERT period range, up to 86,400 seconds (24 hours), and have a default BERT period value of 240 seconds.

NOTE: When configuring E1 and CE1 interfaces on 10-port Channelized E1/T1 IQE PICs, bert-period must be set at the [edit interface ce1-fpc/pic/port] hierarchy level.

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} (0, which corresponds to no errors) to 10^{-7} (1 error per 10 million bits). The default is 0.

Individual concatenated E1 interfaces do not support the bert-algorithm configuration statement. For individual concatenated E1 interfaces, the bert-algorithm statement at the [edit interfaces *interface-name* e1-options] hierarchy level is ignored. The algorithm for the E1 BERT procedure is pseudo-2e15-o151 (pattern is 2^{15}–1, as defined in the CCITT/ITU O.151 standard).

For channelized E1 intelligent queuing (IQ and IQE) interfaces, you can configure the BERT algorithm by including the bert-algorithm statement at the [edit interfaces ce1-*fpc/pic/port* e1-options] or [edit interfaces e1-*fpc/pic/port* e1-options] hierarchy level:

```
[edit interfaces ce1-fpc/pic/port e1-options]
bert-algorithm algorithm;
[edit interfaces e1-fpc/pic/port e1-options]
bert-algorithm algorithm;
```

For a list of supported algorithms, enter a ? after the bert-algorithm statement; for example:

```
[edit interfaces ce1-0/0/0 e1-options]
user@host# set bert-algorithm ?
Possible completions:
pseudo-2e11-o152 Pattern is 2^11 -1 (per O.152 standard)
pseudo-2e15-o151 Pattern is 2^15 - 1 (per O.152 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)
```

Configuring the E1 Frame Checksum

By default, the E1 interface supports a 16-bit checksum. You can configure a 32-bit checksum, which provides more reliable packet verification. However, some older equipment might not support 32-bit checksums.

To configure a 32-bit checksum, include the fcs 32 statement at the [edit interfaces *interface-name* e1-options] hierarchy level:

```
[edit interfaces interface-name e1-options]
fcs 32;
```

To return to the default 16-bit frame checksum, delete the fcs 32 statement from the configuration:

```
[edit]
user@host# delete interfaces e1-fpc/pic/port e1-options fcs 32
```

To explicitly configure a 16-bit checksum, include the fcs 16 statement at the [edit interfaces *interface-name* e1-options] hierarchy level:

```
[edit interfaces interface-name e1-options]
fcs 16;
```

Configuring E1 Framing

By default, E1 interfaces use the G704 framing mode. You can configure the alternative unframed mode if needed.

To have the interface use the unframed mode, include the framing statement at the [edit interfaces *interface-name* e1-options] hierarchy level, specifying the unframed option:

```
[edit interfaces interface-name e1-options]
framing unframed;
```

To explicitly configure G704 framing, include the framing statement at the [edit interfaces *interface-name* e1-options] hierarchy level, specifying the g704 option:

```
[edit interfaces interface-name e1-options]
framing g704;
```

By default, G704 framing uses CRC4. To explicitly configure an interface's G704 framing to not use CRC4, include the framing statement at the [edit interfaces *interface-name* e1-options] hierarchy level, specifying the g704-no-crc4 option:

```
[edit interfaces interface-name e1-options]
framing g704-no-crc4;
```

Configuring the E1 Idle Cycle Flag

By default, an E1 interface transmits the value 0x7E in the idle cycles. To have the interface transmit the value 0xFF (all ones) instead, include the idle-cycle-flag statement at the [edit interfaces *interface-name* e1-options] hierarchy level, specifying the ones option:

```
[edit interfaces interface-name e1-options]
idle-cycle-flag ones;
```

To explicitly configure the default value of 0x7E, include the idle-cycle-flag statement with the flags option:

```
[edit interfaces interface-name e1-options]
idle-cycle-flag flags;
```

Configuring E1 Data Inversion

By default, data inversion is disabled. To enable data inversion at the HDLC level, include the invert-data statement at the [edit interfaces *interface-name* e1-options] hierarchy level:

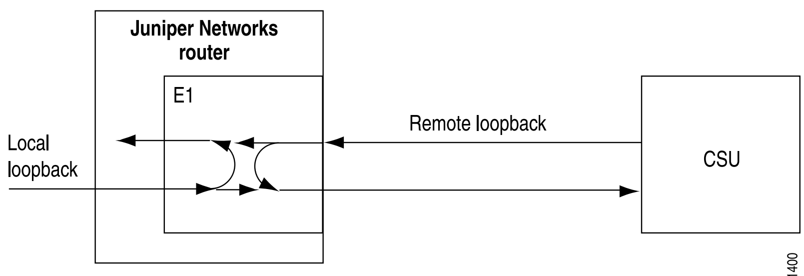
```
[edit interfaces interface-name e1-options]
invert-data;
```

When you enable data inversion, all data bits in the data stream are transmitted inverted; that is, zeroes are transmitted as ones and ones as zeroes. Data inversion is normally used only in AMI mode to guarantee ones density in the transmitted stream.

Configuring E1 Loopback Capability

You can configure loopback capability between the local E1 interface and the remote channel service unit (CSU), as shown in Figure 50 on page 517. You can configure the loopback to be local or remote. With local loopback, the E1 interface can transmit packets to the CSU, but receives its own transmission back again and ignores data from the CSU. With remote loopback, packets sent from the CSU are received by the E1 interface, forwarded if there is a valid route, and immediately retransmitted to the CSU.

Figure 50: Remote and Local E1 Loopback



To configure loopback capability on an E1 interface, include the loopback statement at the [edit interfaces *interface-name* e1-options] hierarchy level:

```
[edit interfaces interface-name e1-options]
loopback (local | remote);
```

Packets can be looped on either the local routing platform or the remote CSU.

To exchange BERT patterns between a local routing platform and a remote routing platform, include the loopback remote statement in the interface configuration at the remote end of the link. From the local routing platform, you issue the test interface command.

For more information about configuring BERT, see "Interface Diagnostics" on page 127. For more information about using operational mode commands to test interfaces, see the *JUNOS System Basics and Services Command Reference*.

To turn off the loopback capability, remove the loopback statement from the configuration:

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

You can determine whether there is an internal problem or an external problem by checking the error counters in the output of the show interface *interface-name* extensive command:

```
user@host> show interfaces interface-name extensive
```

Example: Configuring E1 Loopback Capability

To determine whether a problem is internal or external, loop packets on both the local and the remote routing platform. To do this, include the no-keepalives and encapsulation cisco-hdlc statements at the [edit interfaces *interface-name*] hierarchy level and the loopback local statement at the [edit interfaces *interface-name* e1-options] hierarchy level.

With this configuration, the link stays up, so you can loop ping packets to a remote routing platform. The loopback local statement causes the interface to loop within the PIC just before the data reaches the transceiver.

```
[edit interfaces]
e1-1/0/0 {
   no-keepalives;
   encapsulation cisco-hdlc;
   e1-options {
      loopback local;
   }
   unit 0 {
      family inet {
         address 10.100.100.1/24;
      }
   }
}
```

Configuring E1 Start and End Flags

By default, start and end flags are shared.

To configure an E1 interface to wait two idle cycles between the start and end flags, include the start-end-flag statement with the filler option at the [edit interfaces *interface-name* e1-options] hierarchy level:

```
[edit interfaces interface-name e1-options]
start-end-flag filler;
```

To revert to the default behavior, sharing the transmission of start and end flags, include the start-end-flag statement with the shared option at the [edit interfaces *interface-name* e1-options] hierarchy level:

```
[edit interfaces interface-name e1-options]
start-end-flag shared;
```

Configuring Fractional E1 Time Slots

By default, all the time slots on an E1 interface are used. To configure the number of time slots allocated to a fractional E1 interface, include the timeslots statement at the [edit interfaces *interface-name* e1-options] hierarchy level:

```
[edit interfaces interface-name e1-options]
```

```
timeslots time-slot-range;
```

There are 32 time slots on an E1 interface. Time slot 0 is always reserved for framing and cannot be used to configure a fractional E1 interface.

Time slot numbering constraints vary for different E1 PICs. For 4-port E1 PICs, the configurable time-slot range is 1 through 31 (time slot 0 is reserved for framing).

For 10-port Channelized E1 and 10-port Channelized E1 IQ PICs, the configurable time-slot range is 2 through 32 (time slots 0 and 1 are reserved for framing).

For Enhanced Intelligent Queuing (IQE) PICs, the configurable time-slot range is 2 through 32.

For fractional E1 interfaces only, if you connect a 4-port E1 PIC interface to a device that uses time slot numbering from 2 through 32, you must subtract 1 from the configured number of time slots. To do this, include the timeslots statement at the [edit interfaces *interface-name* e1-options] hierarchy level, and offset 1 from the specified slot number.

NOTE: When configuring fractional E1 time slots, you also must include the framing g704 statement at the [edit interfaces e1-*fpc/pic/port* e1-options] hierarchy level.

To configure ranges, use hyphens. To configure discontinuous time slots, use commas. Do not include spaces

Example: Configuring Fractional E1 Time Slots

In this example, time slots are offset by 1 to compensate for the fractional E1 interface being connected to a device that uses time slot numbering from 0 through 31.

Use Time Slots 3 Through 5, 10, and 24

```
[edit interfaces interface-name e1-options] # Fractional E1 interface
timeslots 4-6,11,25;
```

Use Time Slots 1 Through 10

```
[edit interfaces interface-name e1-options]
timeslots 1-10;
```

Use Time Slots 1 Through 5, 10, and 24

```
[edit interfaces interface-name e1-options]
timeslots 1-5,10,24;
```

Chapter 28

Configuring E3 Interfaces

This chapter contains the following sections:

E3 Interfaces Overview

E3 is a high-speed WAN digital communication technique designed to operate over copper facilities at a rate of 34.368 Mbps. Widely used outside North America, it is the time-division multiplexing scheme used to carry 16 E1 circuits. The following standards apply to E3 interfaces:

- ITU-T Recommendation G.703, *Physical/electrical characteristics of hierarchical digital interfaces*, describes data rates and multiplexing schemes for the E series.
- ITU-T Recommendation G.751, *General Aspects of Digital Transmission Systems: Terminal Equipment*, describes framing methods.
- ITU-T Recommendation G.775, *Loss of Signal (LOS) and Alarm Indication Signal (AIS) Defect Detection and Clearance Criteria*, describes alarm reporting methods.

The JUNOS software supports the E3 Physical Interface Card (PIC) and the E3 Intelligent Queuing (IQ and IQE) PICs. The E3 IQ and E3 IQE PICs supports transmission scheduling on logical interfaces. For more information, see the *JUNOS Class of Service Configuration Guide*.

NOTE: In unframed mode, the E3 IQ and E3 IQE PICs do not detect yellow or loss-of-frame alarms.

Configuring E3 Physical Interface Properties

To configure E3-specific physical interface properties, include the e3-options statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
e3-options {
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    compatibility-mode (digital-link | kentrox | larscom) <subrate value>;
    fcs (16 | 32);
    idle-cycle-flag value;
    invert-data;
    loopback (local | remote);
    (payload-scrambler | no-payload-scrambler);
    start-end-flag value;
    (unframed | no-unframed);
}
```

Configuring E3 BERT Properties

This section discusses BERT properties for the E3 interface specifically. For general information about the JUNOS implementation of the BERT procedure, see “Interface Diagnostics” on page 127.

You can configure an E3 interface to execute a bit error rate test (BERT) when the interface receives a request to run this test. You specify the duration of the test, the pattern to send in the bit stream, and the error rate to include in the bit stream by including the bert-period, bert-algorithm, and bert-error-rate statements at the [edit interfaces *interface-name* e3-options] hierarchy level:

```
[edit interfaces interface-name e3-options]
bert-algorithm algorithm;
bert-error-rate rate;
bert-period seconds;
```

By default, the BERT period is 10 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.

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} (0, which corresponds to no errors) to 10^{-7} (1 error per 10 million bits).

algorithm is the pattern to send in the bit stream. On E3 interfaces, you can also select the pattern to send in the bit stream by including the bert-algorithm statement at the [edit interfaces *interface-name interface-options*] hierarchy level:

```
[edit interfaces interface-name interface-options]
bert-algorithm algorithm;
```

For a list of supported algorithms, enter a ? after the bert-algorithm statement; for example:

```
[edit interfaces e3-0/0/0 e3-options]
user@host# set bert-algorithm ?
Possible completions:
pseudo-2e11-o152 Pattern is 2^11 -1 (per O.152 standard)
pseudo-2e15-o151 Pattern is 2^15 - 1 (per O.152 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)
```

For specific hierarchy information, see individual interface types. For information about running the BERT procedure, see the *JUNOS System Basics and Services Command Reference*.

Configuring the E3 CSU Compatibility Mode

Subrating an E3 interface reduces the maximum allowable peak rate by limiting the High-level Data Link Control (HDLC)-encapsulated payload. Subrate modes configure the PIC to connect with channel service units (CSUs) that use proprietary methods of multiplexing.

On M-series and T-series routing platforms, you can configure E3 interfaces to be compatible with a Digital Link, Kentrox, or Larscom CSU. On J-series Services Routers, you can configure E3 interfaces to be compatible with a Digital Link or Kentrox CSU.

NOTE: To subrate an E3 interface to be compatible with a Kentrox CSU, you must have an IQ or IQE-based PIC. Non-IQ or IQE PICs allow a commit of the configuration, but the interfaces remain at the full E3 rate for the Kentrox compatibility mode.

To configure an E3 interface so that it is compatible with the CSU at the remote end of the line, include the compatibility-mode statement at the [edit interfaces *interface-name* e3-options] hierarchy level:

```
[edit interfaces interface-name e3-options]
compatibility-mode (digital-link | kentrox | larscom) <subrate value>;
```

The subrate of an E3 interface must exactly match that of the remote CSU. To specify the subrate, include the subrate statement in the configuration:

- For Kentrox CSUs, specify the subrate as a number from 1 through 48 that exactly matches the value configured on the CSU. Each increment of the subrate value corresponds to a rate increment of about 0.5 Mbps.
- For Digital Link CSUs, you can specify the subrate value to match the data rate configured on the CSU in the format *x*kb or *x.x*Mb. You can configure the subrate values shown in Table 42 on page 524.
- Larscom CSUs do not support the E3 subrate.

Table 42: Subrate Values for E3 Digital Link Compatibility Mode

358 Kbps	7.2 Mbps	14.0 Mbps	20.8 Mbps	27.6 Mbps
716 Kbps	7.5 Mbps	14.3 Mbps	21.1 Mbps	27.9 Mbps
1.1 Mbps	7.9 Mbps	14.7 Mbps	21.5 Mbps	28.3 Mbps
1.4 Mbps	8.2 Mbps	15.0 Mbps	21.8 Mbps	28.6 Mbps
1.8 Mbps	8.6 Mbps	15.4 Mbps	22.2 Mbps	29.0 Mbps
2.1 Mbps	9.0 Mbps	15.8 Mbps	22.6 Mbps	29.4 Mbps
2.5 Mbps	9.3 Mbps	16.1 Mbps	22.9 Mbps	29.7 Mbps
2.9 Mbps	9.7 Mbps	16.5 Mbps	23.3 Mbps	30.1 Mbps
3.2 Mbps	10.0 Mbps	16.8 Mbps	23.6 Mbps	30.4 Mbps
3.6 Mbps	10.4 Mbps	17.2 Mbps	24.0 Mbps	30.8 Mbps
3.9 Mbps	10.7 Mbps	17.5 Mbps	24.3 Mbps	31.1 Mbps
4.3 Mbps	11.1 Mbps	17.9 Mbps	24.7 Mbps	31.5 Mbps
4.7 Mbps	11.5 Mbps	18.3 Mbps	25.1 Mbps	31.9 Mbps
5.0 Mbps	11.8 Mbps	18.6 Mbps	25.4 Mbps	32.2 Mbps
5.4 Mbps	12.2 Mbps	19.0 Mbps	25.8 Mbps	32.6 Mbps
5.7 Mbps	12.5 Mbps	19.3 Mbps	26.1 Mbps	32.9 Mbps
6.1 Mbps	12.9 Mbps	19.7 Mbps	26.5 Mbps	33.3 Mbps
6.4 Mbps	13.2 Mbps	20.0 Mbps	26.9 Mbps	33.7 Mbps
6.8 Mbps	13.6 Mbps	20.4 Mbps	27.2 Mbps	

For information about subrating a T3 interface, see “Configuring the T3 CSU Compatibility Mode” on page 542.

Configuring the E3 Frame Checksum

You can configure a 32-bit checksum, which provides more reliable packet verification. However, some older equipment might not support 32-bit checksums.

On a channelized OC12 interface, the fcs statement is not supported. To configure FCS on each E3 channel, you must include the e3-options fcs statement in the configuration for each channel.

To configure a 32-bit checksum, include the fcs statement at the [edit interfaces *interface-name* e3-options] hierarchy level:

```
[edit interfaces interface-name e3-options]
fcs 32;
```

To return to the default 16-bit frame checksum, delete the fcs 32 statement from the configuration:

```
[edit]
user@host# delete interfaces e3-fpc/pic/port e3-options fcs 32
```

To explicitly configure a 16-bit checksum, include the fcs statement at the [edit interfaces *interface-name* e3-options] hierarchy level:

```
[edit interfaces interface-name e3-options]
fcs 16;
```

Configuring the E3 Idle Cycle Flag

By default, an E3 interface transmits the value 0x7E in the idle cycles. To have the interface transmit the value 0xFF (all ones) instead, include the idle-cycle-flag statement at the [edit interfaces *interface-name* e3-options] hierarchy level, specifying the ones option:

```
[edit interfaces interface-name e3-options]
idle-cycle-flag ones;
```

To explicitly configure the default value of 0x7E, include the idle-cycle-flag statement with the flags option:

```
[edit interfaces interface-name e3-options]
idle-cycle-flag flags;
```

Configuring E3 Data Inversion

By default, data inversion is disabled. To enable data inversion at the HDLC level, include the invert-data statement at the [edit interfaces *interface-name* e3-options] hierarchy level:

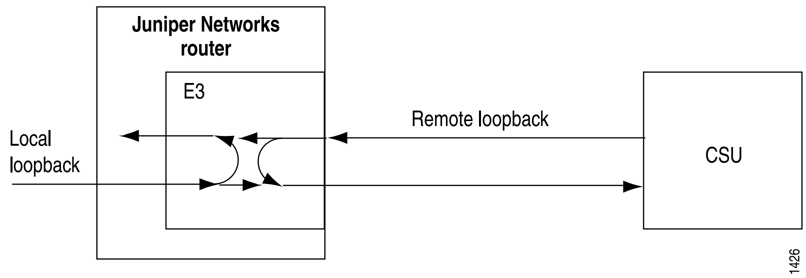
```
[edit interfaces interface-name e3-options]
invert-data;
```

When you enable data inversion, unused data bits in the data stream are transmitted inverted; that is, zeroes are transmitted as ones and ones as zeroes. Enable inversion to be compatible with another vendor's E3 interface.

Configuring E3 Loopback Capability

You can configure loopback capability between the local E3 interface and the remote CSU. You can configure the loopback to be local or remote. With local loopback, the E3 interface can transmit packets to the CSU, but receives its own transmission back again and ignores data from the CSU. With remote loopback, packets sent from the CSU are received by the E3 interface, forwarded if there is a valid route, and immediately retransmitted to the CSU (see Figure 51 on page 526).

Figure 51: Remote and Local E3 Loopback



To configure loopback capability on an E3 interface, include the loopback statement at the [edit interfaces *interface-name* e3-options] hierarchy level:

```
[edit interfaces interface-name e3-options]
loopback (local | remote);
```

Packets can be looped on either the local routing platform or the remote CSU.

To exchange BERT patterns between a local routing platform and a remote routing platform, include the loopback remote statement in the interface configuration at the remote end of the link. From the local routing platform, you issue the test interface command.

For more information about configuring BERT, see "Interface Diagnostics" on page 127. For more information about using operational mode commands to test interfaces, see the *JUNOS System Basics and Services Command Reference*.

To turn off the loopback capability, remove the loopback statement from the configuration:

```
[edit]
user@host# delete interfaces e3-fpc/pic/port e3-options loopback
```

You can determine whether there is an internal problem or an external problem by checking the error counters in the output of the show interface *interface-name* extensive command:

```
user@host> show interfaces interface-name extensive
```

Example: Configuring E3 Loopback Capability

To determine whether a problem is internal or external, loop packets on both the local and the remote routing platform. To do this, include the no-keepalives and encapsulation cisco-hdlc statements at the [edit interfaces *interface-name*] hierarchy level and the loopback local statement at the [edit interfaces *interface-name* e3-options] hierarchy level. With this configuration, the link stays up, so you can loop ping packets to a remote routing platform. The loopback local statement causes the interface to loop within the PIC just before the data reaches the transceiver.

```
[edit interfaces]
e3-1/0/0 {
   no-keepalives;
```

```
  encapsulation cisco-hdlc;
  e3-options {
    loopback local;
  }
  unit 0 {
    family inet {
      address 10.100.100.1/24;
    }
  }
}
```

Configuring E3 HDLC Payload Scrambling

E3 HDLC payload scrambling, which is disabled by default, provides better link stability. Both sides of a connection must either use or not use scrambling.

To configure scrambling on the interface, you can include the payload-scrambler statement at the [edit interfaces *interface-name* e3-options] hierarchy level:

```
[edit interfaces interface-name e3-options]
payload-scrambler;
```

To explicitly disable HDLC payload scrambling, include the no-payload-scrambler statement at the [edit interfaces *interface-name* e3-options] hierarchy level:

```
[edit interfaces interface-name e3-options]
no-payload-scrambler;
```

To disable payload scrambling again (return to the default), delete the payload-scrambler statement from the configuration:

```
[edit]
user@host# delete interfaces e3-fpc/pic/port e3-options payload-scrambler
```

Configuring the E3 Start and End Flags

By default, an E3 interface shares the transmission of the start and end flags

To configure an E3 interface to wait two idle cycles between the start and end flags, include the start-end-flag statement with the filler option at the [edit interfaces *interface-name* e3-options] hierarchy level:

```
[edit interfaces interface-name e3-options]
start-end-flag filler;
```

To revert to the default behavior, sharing the transmission of start and end flags, include the start-end-flag statement with the shared option at the [edit interfaces *interface-name* e3-options] hierarchy level:

```
[edit interfaces interface-name e3-options]
start-end-flag shared;
```

Configuring E3 IQ and IQE Unframed Mode

For E3 IQ and IQE interfaces only, you can enable or disable unframed mode. In unframed mode, the E3 IQ and IQE interfaces do not detect yellow (ylw) or loss-of-frame (lof) alarms.

By default, unframed mode is disabled. To enable unframed mode, include the unframed statement at the [edit interfaces *interface-name* e3-options] hierarchy level:

```
[edit interfaces interface-name e3-options]
unframed;
```

To explicitly configure the default of framed mode, include the no-unframed statement:

```
[edit interfaces interface-name e3-options]
no-unframed;
```

Chapter 29

Configuring T1 Interfaces

This chapter includes an overview of T1 interfaces and configuration information as follows:

T1 Interfaces Overview

T1 is the basic physical layer protocol used by the Digital Signal level 1(DS1) multiplexing method in North America. A T1 interface operates at a bit rate of 1.544 Mbps and can support 24 DS0 channels. Supported DS1 standards include:

- ANSI TI.107, TI.102
- GR 499-core, GR 253-core
- AT&T Pub 54014
- ITU G.751, G.703

Configuring T1 Physical Interface Properties

To configure T1-specific physical interface properties, include the t1-options statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
t1-options {
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    buildout value;
    byte-encoding (nx56 | nx64);
    crc-major-alarm-threshold (1e-3 | 5e-4 | 1e-4 | 5e-5 | 1e-5);
    crc-minor-alarm-threshold (1e-3 | 5e-4 | 1e-4 | 5e-5 | 1e-5 | 5e-6 | 1e-6);
    fcs (16 | 32);
    framing (esf | sf);
    idle-cycle-flag (flags | ones);
    invert-data;
    line-encoding (ami | b8zs);
    loopback (local | payload | remote);
    remote-loopback-respond;
    start-end-flag (filler | shared);
    timeslots time-slot-range;
}
```

Configuring T1 BERT Properties

This section discusses BERT properties for the T1 interface specifically. For general information about the JUNOS implementation of the BERT procedure, see “Interface Diagnostics” on page 127.

You can configure a T1 interface or partitioned CT1 or T1 channel to execute a bit error rate test (BERT) when the interface receives a request to run this test. You specify the duration of the test and the error rate to include in the bit stream by including the bert-period and bert-error-rate statements at the [edit interfaces *interface-name* t1-options] hierarchy level:

```
[edit interfaces interface-name t1-options]
bert-algorithm algorithm;
bert-error-rate rate;
bert-period seconds;
```

seconds is the duration of the BERT procedure. The test can last from 1 through 239 seconds; the default is 10 seconds. Standard CT1, standard T1, T1 IQ, and T1 IQE interfaces, and PICs partitioned to CT1 and T1 channels, support an extended BERT period range, up to 86,400 seconds (24 hours), and have a default BERT period value of 240 seconds.

NOTE: When configuring T1 and CT1 interfaces on 10-port Channelized E1/T1 IQE PICs, bert-period must be set at the [edit interface ct1-fpc/pic/port] hierarchy level.

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).

algorithm is the pattern to send in the bit stream. On T1 interfaces, you can also select the pattern to send in the bit stream by including the bert-algorithm statement at the [edit interfaces *interface-name interface*-options] hierarchy level:

```
[edit interfaces interface-name interface-options]
bert-algorithm algorithm;
```

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 O.152 standard)
pseudo-2e15-o151 Pattern is 2^15 - 1 (per O.152 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)
```

For specific hierarchy information, see individual interface types. For information about running the BERT procedure, see the *JUNOS System Basics and Services Command Reference*.

Configuring the T1 Buildout

A T1 interface has five possible setting ranges for the T1 line buildout: 0-132, 133-265, 266-398, 399-531, or 532-655 feet. By default, the T1 interface uses the shortest setting (0-132).

To have the interface drive a line at one of the longer distance ranges, include the buildout statement with the appropriate value at the [edit interfaces *interface-name* t1-options] hierarchy level:

```
[edit interfaces interface-name t1-options]
buildout value;
```

Configuring T1 Byte Encoding

By default, T1 interfaces use a byte encoding of 8 bits per byte (nx64). You can configure an alternative byte encoding of 7 bits per byte (nx56).

To have the interface use 7 bits per byte encoding, include the byte-encoding statement at the [edit interfaces *interface-name* t1-options] hierarchy level, specifying the nx56 option:

```
[edit interfaces interface-name t1-options]
byte-encoding nx56;
```

To explicitly configure nx64 byte encoding, include the byte-encoding statement at the [edit interfaces *interface-name* t1-options] hierarchy level, specifying the nx64 option:

```
[edit interfaces interface-name t1-options]
byte-encoding nx64;
```

Configuring T1 CRC Error Major Alarm Thresholds

JUNOS software collects CRC errors from PICs every second. On Channelized OC3 IQ and IQE PICs, Channelized OC12 IQ and IQE PICs, and Channelized T3 IQ PICs, you can configure major error thresholds for T1 CRC errors.

When the threshold is exceeded for 1 second, a defect condition is declared. If the defect condition continues for the monitoring period, an alarm condition is declared. You can display the CRC error threshold configuration, CRC errors count, and the alarm condition using the show interfaces extensive command.

To configure a CRC major error threshold, include the crc-major-alarm-threshold statement at the [edit interfaces *interface-name* t1-options] hierarchy level, specifying the errors per bits as 1e-3, 5e-4, 1e-4, 5e-5 or 1e-5:

```
[edit interfaces interface-name t1-options]
crc-major-alarm-threshold (1e-3 | 5e-4 | 1e-4 | 5e-5 | 1e-5);
```

To configure a T1 CRC error major alarm for five errors in 10^{-4} bits, include the crc-major-alarm-threshold statement at the [edit interfaces *interface-name* t1-options] hierarchy level, specifying the 5e-4 option:

```
[edit interfaces interface-name t1-options]
crc-major-alarm-threshold 5e-4;
```

All settings except 1e-5 use a 10-second monitoring period. The 1e-5 value uses a 50-second monitoring period.

Configuring T1 CRC Error Minor Alarm Thresholds

JUNOS software collects CRC errors from PICs every second. On Channelized OC3 IQ and IQE PICs, Channelized OC12 IQ and IQE PICs, and Channelized T3 IQ PICs, you can configure minor error thresholds for T1 CRC errors.

When the threshold is exceeded for 1 second, a defect condition is declared. If the defect condition continues for the monitoring period, an alarm condition is declared. You can display the CRC error threshold configuration, CRC errors count, and the alarm condition using the show interfaces extensive command.

To configure a CRC minor error threshold, include the crc-minor-alarm-threshold statement at the [edit interfaces *interface-name* t1-options] hierarchy level, specifying the errors per bits as 1e-3, 5e-4, 1e-4, 5e-5, 1e-5, 5e-6, or 1e-6:

```
[edit interfaces interface-name t1-options]
crc-minor-alarm-threshold (1e-3 | 5e-4 | 1e-4 | 5e-5 | 1e-5 | 5e-6 | 1e-6);
```

To configure a T1 CRC error minor alarm for five errors in 10^{-4} bits, include the crc-minor-alarm-threshold statement at the [edit interfaces *interface-name* t1-options] hierarchy level, specifying the 5e-4 option:

```
[edit interfaces interface-name t1-options]
crc-minor-alarm-threshold 5e-4;
```

The 10-second monitoring period is used for values 1e-3, 5e-4, 1e-4, and 5e-5. The 1e-5 value uses a 50-second monitoring period. The 5e-6 value uses a 100-second monitoring period. The 1e-6 value uses a 500-second monitoring period.

Configuring T1 Data Inversion

By default, data inversion is disabled. To enable data inversion at the HDLC level, include the invert-data statement at the [edit interfaces *interface-name* t1-options] hierarchy level:

```
[edit interfaces interface-name t1-options]
invert-data;
```

When you enable data inversion, all data bits in the data stream are transmitted inverted; that is, zeroes are transmitted as ones and ones as zeroes. Data inversion is normally used only in AMI mode to guarantee ones density in the transmitted stream.

Configuring the T1 Frame Checksum

By default, T1 interfaces use a 16-bit frame checksum. You can configure a 32-bit checksum, which provides more reliable packet verification. However, some older equipment might not support 32-bit checksums.

To configure a 32-bit checksum, include the fcs 32 statement at the [edit interfaces *interface-name* t1-options] hierarchy level:

```
[edit interfaces interface-name t1-options]
fcs 32;
```

To return to the default 16-bit frame checksum, delete the fcs 32 statement from the configuration:

```
[edit]
user@host# delete interfaces t1-fpc/pic/port t1-options fcs 32
```

To explicitly configure a 16-bit checksum, include the fcs 16 statement at the [edit interfaces *interface-name* t1-options] hierarchy level:

```
[edit interfaces interface-name t1-options]
fcs 16;
```

Configuring the T1 Remote Loopback Response

The T1 facilities data-link loop request signal is used to communicate various network information in the form of in-service monitoring and diagnostics. Extended superframe, through the facilities data link (FDL), supports nonintrusive signaling and control, thereby offering clear-channel communication. Remote loopback requests can be over the FDL or inband. To configure the routing platform to respond to remote loopback requests, include the remote-loopback-respond statement at the [edit interfaces *interface-name* t1-options] hierarchy level:

```
[edit interfaces interface-name t1-options]
remote-loopback-respond;
```

By default, the routing platform does not respond to remote loopback requests.

Configuring T1 Framing

By default, T1 interfaces use extended superframe framing format. You can configure SF (superframe) as an alternative.

To have the interface use the SF framing format, include the framing statement at the [edit interfaces *interface-name* t1-options] hierarchy level, specifying the sf option:

```
[edit interfaces interface-name t1-options]
framing sf;
```

To explicitly configure ESF framing, include the framing statement at the [edit interfaces *interface-name* t1-options] hierarchy level, specifying the esf option:

```
[edit interfaces interface-name t1-options]
framing esf;
```

Configuring T1 Line Encoding

By default, T1 interfaces use B8ZS line encoding. You can configure AMI line encoding if necessary.

To have the interface use AMI line encoding, include the line-encoding statement at the [edit interfaces *interface-name* t1-options] hierarchy level, specifying the ami option:

```
[edit interfaces interface-name t1-options]
line-encoding ami;
```

To explicitly configure B8ZS line encoding, include the line-encoding statement at the [edit interfaces *interface-name* t1-options] hierarchy level, specifying the b8zs option:

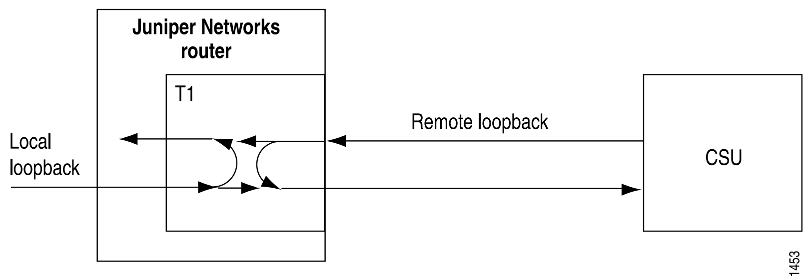
```
[edit interfaces interface-name t1-options]
line-encoding b8zs;
```

For M-series and T-series routing platforms, you must set the line encoding parameter for paired ports to the same value. Ports 0 and 1 must share the same value, and likewise ports 2 and 3 must share the same value, but ports 0 and 1 can have a different value from that of ports 2 and 3.

Configuring T1 Loopback Capability

You can configure loopback capability between the local T1 interface and the remote channel service unit (CSU), as shown in Figure 52 on page 535. You can configure the loopback to be local or remote. With local loopback, the T1 interface can transmit packets to the CSU, but receives its own transmission back again and ignores data from the CSU. With remote loopback, packets sent from the CSU are received by the T1 interface, forwarded if there is a valid route, and immediately retransmitted to the CSU.

Figure 52: Remote and Local T1 Loopback



To configure loopback capability on a T1 interface, include the loopback statement at the [edit interfaces *interface-name* t1-options] hierarchy level:

```
[edit interfaces interface-name t1-options]
loopback (local | payload | remote);
```

Packets can be looped on either the local routing platform or the remote CSU. Local and remote loopback loop back both data and clocking information.

To exchange BERT patterns between a local routing platform and a remote routing platform, include the loopback remote statement in the interface configuration at the remote end of the link. From the local routing platform, issue the test interface command.

For more information about configuring BERT, see "Interface Diagnostics" on page 127. For more information about using operational mode commands to test interfaces, see the *JUNOS System Basics and Services Command Reference*.

For channelized T3, T1, and *N*xDS0 intelligent queuing (IQ) interfaces only, you can include the loopback payload statement in the configuration to loop back data only (without clocking information) on the remote routing platform's PIC. In payload loopback, overhead is recalculated. For T3 IQ interfaces, you can include the loopback payload statement at the [edit interfaces ct3-*fpc/pic/port*] and [edit interfaces t3-*fpc/pic/port*:*channel*] hierarchy levels. For T1 interfaces, you can include the loopback payload statement in the configuration at the [edit interfaces t1-*fpc/pic/port*:*channel*] hierarchy level; it is ignored if included at the [edit interfaces ct1-*fpc/pic/port*] hierarchy level. For *N*xDS0 interfaces, payload and remote loopback are the same. If you configure one, the other is ignored. *N*xDS0 IQ interfaces do not support local loopback.

To determine whether a problem is internal or external, you can loop packets on both the local and the remote routing platform. To do this, include the no-keepalives and encapsulation cisco-hdlc statements at the [edit interfaces *interface-name*] hierarchy level and the loopback local statement at the [edit interfaces *interface-name* t1-options] hierarchy level, as shown in the following example:

```
[edit interfaces]
t1-1/0/0 {
    no-keepalives;
    encapsulation cisco-hdlc;
    t1-options {
        loopback local;
    }
    unit 0 {
        family inet {
            address 10.100.100.1/24;
        }
    }
}
```

With this configuration, the link stays up, so you can loop ping packets to a remote routing platform. The loopback local statement causes the interface to loop within the PIC just before the data reaches the transceiver.

To turn off the loopback capability, remove the loopback statement from the configuration:

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

You can determine whether there is an internal problem or an external problem by checking the error counters in the output of the show interface *interface-name* extensive command, for example:

```
user@host> show interfaces t1-fpc/pic/port extensive
```

Configuring the T1 Idle Cycle Flag

By default, a T1 interface transmits the value 0x7E in the idle cycles. To have the interface transmit the value 0xFF (all ones) instead, include the idle-cycle-flag statement at the [edit interfaces *interface-name* t1-options] hierarchy level, specifying the ones option:

```
[edit interfaces interface-name t1-options]
idle-cycle-flag ones;
```

To explicitly configure the default value of 0x7E, include the idle-cycle-flag statement with the flags option:

```
[edit interfaces interface-name t1-options]
idle-cycle-flag flags;
```

Configuring T1 Start and End Flags

By default, a T1 interface shares the transmission of the start and end flags.

To configure a T1 interface to wait two idle cycles between the start and end flags, include the start-end-flag statement with the filler option at the [edit interfaces *interface-name* t1-options] hierarchy level:

```
[edit interfaces interface-name t1-options]
start-end-flag filler;
```

To revert to the default behavior, sharing the transmission of start and end flags, include the start-end-flag statement with the shared option at the [edit interfaces *interface-name* t1-options] hierarchy level:

```
[edit interfaces interface-name t1-options]
start-end-flag shared;
```

Configuring Fractional T1 Time Slots

By default, all the time slots on a T1 interface are used. To configure the number of time slots allocated to a fractional T1 interface, include the timeslots statement at the [edit interfaces *interface-name* t1-options] hierarchy level:

```
[edit interfaces interface-name t1-options]
timeslots time-slot-range;
```

For T1 interfaces, the time-slot range is from 1 through 24. There are 24 time slots on a T1 interface. You can designate any combination of time slots. To configure ranges, use hyphens. To configure discontinuous time slots, use commas. Do not include spaces.

Example: Configuring Fractional T1 Time Slots

Use Time Slots 1 Through 10

```
[edit interfaces interface-name t1-options]
timeslots 1-10;
```

Use Time Slots 1 Through 5, 10, and 24

```
[edit interfaces interface-name t1-options]
timeslots 1-5,10,24;
```

Use the First Four Odd-Numbered Time Slots

```
[edit interfaces interface-name t1-options]
timeslots 1,3,5,7;
```

Chapter 30

Configuring T3 Interfaces

This chapter includes an overview of T3 interfaces and configuration information as follows:

T3 Interfaces Overview

T3 is the physical layer protocol used by the Digital Signal level 3 (DS3) multiplexing method in North America. A T3 interface operates at a bit rate of 44.736 Mbps. The JUNOS software supports payload scrambling and subrate operation on each physical T3 interface. One encapsulation format—Point-to-Point Protocol (PPP), Frame Relay, or High-level Data Link Control (HDLC)—must be configured for the interface. DS3 standards supported include:

- ANSI TI.107, TI.102
- GR 499-core, GR 253-core
- Bellcore TR-TSY-000009
- AT&T Pub 5404
- ITU G.751, G.703, G823

Configuring T3 Physical Interface Properties

To configure T3-specific physical interface properties, include the t3-options statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
t3-options {
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    (cbit-parity | no-cbit-parity);
    compatibility-mode (adtran | digital-link | kentrox | larscom | verilink) <subrate value>;
    fcs (16 | 32);
    (feac-loop-respond | no-feac-loop-respond);
    idle-cycle-flag value;
    (long-buildout | no-long-buildout);
    (loop-timing | no-loop-timing);
    loopback (local | payload | remote);
    (payload-scrambler | no-payload-scrambler);
    start-end-flag value;
}
```

Configuring T3 BERT Properties

This section discusses BERT properties for the T3 interface specifically. For general information about the JUNOS implementation of the BERT procedure, see "Interface Diagnostics" on page 127.

You can configure a T3 interface to execute a bit error rate test (BERT) when the interface receives a request to run this test. You specify the duration of the test, the pattern to send in the bit stream, and the error rate to include in the bit stream by including the bert-period, bert-algorithm, and bert-error-rate statements at the [edit interfaces *interface-name* t3-options] hierarchy level:

```
[edit interfaces interface-name t3-options]
bert-algorithm algorithm;
bert-error-rate rate;
bert-period seconds;
```

By default, the BERT period is 10 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.

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).

algorithm is the pattern to send in the bit stream. The default algorithm for the DS3 BERT procedure is pseudo-2e15-o151 (pattern is $2^{15}-1$, as defined in the CCITT/ITU O.151 standard).

On T3 interfaces, you can also select the pattern to send in the bit stream by including the bert-algorithm statement at the [edit interfaces *interface-name interface*-options] hierarchy level:

```
[edit interfaces interface-name interface-options]
bert-algorithm algorithm;
```

For a list of supported algorithms, enter a ? after the bert-algorithm statement; for example:

```
[edit interfaces t3-0/0/0 t3-options]
user@host# set bert-algorithm ?
Possible completions:
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-2e10 Pattern is 2^10 - 1
...
```

For specific hierarchy information, see individual interface types. For information about running the BERT procedure, see the *JUNOS System Basics and Services Command Reference*.

Disabling T3 C-Bit Parity Mode

C-bit parity mode controls the type of framing that is present on the transmitted T3 signal. When C-bit parity mode is enabled, the C-bit positions are used for the FEBE, FEAC, terminal data link, path parity, and mode indicator bits, as defined in ANSI T1.107a-1989. When C-bit parity mode is disabled, the basic T3 framing mode (M13) is used.

By default, C-bit parity mode is enabled. To disable C-bit parity mode and use M13 framing for your T3 link, include the no-cbit-parity statement at the [edit interfaces *interface-name* t3-options] hierarchy level:

```
[edit interfaces interface-name t3-options]
no-cbit-parity;
```

NOTE: For ATM and ATM2 IQ2 and IQ2-E interfaces, M23 framing is used when the no-cbit-parity statement is included. For all other interfaces, M13 framing is used when the no-cbit-parity statement is included.

To return to the default, enabling C-bit parity mode, delete the no-cbit-parity statement from the configuration:

```
[edit]
user@host# delete interfaces t3-fpc/pic/port t3-options no-cbit-parity
```

To explicitly enable C-bit parity mode, include the cbit-parity statement at the [edit interfaces *interface-name* t3-options] hierarchy level:

```
[edit interfaces interface-name t3-options]
cbit-parity;
```

Configuring the T3 CSU Compatibility Mode

Subrating a T3 interface reduces the maximum allowable peak rate by limiting the HDLC-encapsulated payload. Subrate modes configure the PIC to connect with channel service units (CSUs) that use proprietary methods of multiplexing.

You can configure T3 interfaces to be compatible with a Digital Link, Kentrox, or Larscom CSUs. For T3 intelligent queuing (IQ) channels only, you can also configure Adtran or Verilink CSU compatibility.

NOTE: To subrate an E3 interface to be compatible with a Kentrox CSU, you must have an IQ or IQE based PIC. Non-IQ or IQE PICs allow a commit of the configuration, but the interfaces remain at the full E3 rate for the Kentrox compatibility mode.

To configure a T3 interface so that it is compatible with the CSU at the remote end of the line, include the compatibility statement at the [edit interfaces *interface-name* t3-options] hierarchy level:

```
[edit interfaces interface-name t3-options]
compatibility-mode (adtran | digital-link | kentrox | larscom | verilink) <subrate value>;
```

The subrate of a T3 interface must exactly match that of the remote CSU. To specify the subrate, include the subrate statement in the configuration:

- For Adtran CSUs, specify the subrate as a number from 1 through 588 that exactly matches the value configured on the CSU. A subrate value of 588 corresponds to 44.2 Mbps, or 100 percent of the HDLC-encapsulated payload. A subrate value of 1 corresponds to 44.2 / 588, which is 75.17 Kbps, or 0.17 percent of the HDLC-encapsulated payload.
- For Digital Link CSUs, specify the subrate as the data rate you configured on the CSU in the format xKb or x.xMb. For Digital Link CSUs, you can specify the subrate value to match the data rate configured on the CSU in the format xkb or x.xMb. You can configure the subrate values shown in Table 43 on page 543.
- For Kentrox CSUs, specify the subrate as a number from 1 through 69 that exactly matches the value configured on the CSU. A subrate value of 69 corresponds to 34.995097 Mbps, or 79.17 percent of the HDLC-encapsulated payload (44.2 Mbps). A subrate value of 1 corresponds to 999.958 Kbps, which is 2.26 percent of the HDLC-encapsulated payload. Each increment of the subrate value corresponds to a rate increment of about 0.5 Mbps.
- For Larscom CSUs, specify the subrate as a number from 1 through 14 that exactly matches the value configured on the CSU. A subrate value of 14 corresponds to 44.2 Mbps, or 100 percent of the HDLC-encapsulated payload. A subrate value of 1 corresponds to 44.2 / 14, which is 3.16 Mbps, 7.15 percent of the HDLC-encapsulated payload.
- For Verilink CSUs, specify the subrate as a number from 1 through 28 that exactly matches the value configured on the CSU. To calculate the maximum allowable

peak rate, multiply the configured subrate by 1.578 Mbps. For example, a subrate value of 28 corresponds to 28 x 1.578 Mbps, which is 44.2 Mbps, 100 percent of the HDLC-encapsulated payload. A subrate value of 1 corresponds to 1.578 Mbps, 3.57 percent of the HDLC-encapsulated payload. A subrate value of 20 corresponds to 20 x 1.578 Mbps, which is 31.56 Mbps, 71.42 percent of the HDLC-encapsulated payload.

NOTE: Verilink configuration is not functional if an IQ interface is paired with an IQE interface.

Table 43: Subrate Values for T3 Digital Link Compatibility Mode

301 Kbps	9.3 Mbps	18.3 Mbps	27.4 Mbps	36.4 Mbps
601 Kbps	9.6 Mbps	18.6 Mbps	27.7 Mbps	36.7 Mbps
902 Kbps	9.9 Mbps	18.9 Mbps	28.0 Mbps	37.0 Mbps
1.2 Mbps	10.2 Mbps	19.2 Mbps	28.3 Mbps	37.3 Mbps
1.5 Mbps	10.5 Mbps	19.5 Mbps	28.6 Mbps	37.6 Mbps
1.8 Mbps	10.8 Mbps	19.8 Mbps	28.9 Mbps	37.9 Mbps
2.1 Mbps	11.1 Mbps	20.1 Mbps	29.2 Mbps	38.2 Mbps
2.4 Mbps	11.4 Mbps	20.5 Mbps	29.5 Mbps	38.5 Mbps
2.7 Mbps	11.7 Mbps	20.8 Mbps	29.8 Mbps	38.8 Mbps
3.0 Mbps	12.0 Mbps	21.1 Mbps	30.1 Mbps	39.1 Mbps
3.3 Mbps	12.3 Mbps	21.4 Mbps	30.4 Mbps	39.4 Mbps
3.6 Mbps	12.6 Mbps	21.7 Mbps	30.7 Mbps	39.7 Mbps
3.9 Mbps	12.9 Mbps	22.0 Mbps	31.0 Mbps	40.0 Mbps
4.2 Mbps	13.2 Mbps	22.3 Mbps	31.3 Mbps	40.3 Mbps
4.5 Mbps	13.5 Mbps	22.6 Mbps	31.6 Mbps	40.6 Mbps
4.8 Mbps	13.8 Mbps	22.9 Mbps	31.9 Mbps	40.9 Mbps
5.1 Mbps	14.1 Mbps	23.2 Mbps	32.2 Mbps	41.2 Mbps
5.4 Mbps	14.4 Mbps	23.5 Mbps	32.5 Mbps	41.5 Mbps
5.7 Mbps	14.7 Mbps	23.8 Mbps	32.8 Mbps	41.8 Mbps
6.0 Mbps	15.0 Mbps	24.1 Mbps	33.1 Mbps	42.1 Mbps
6.3 Mbps	15.3 Mbps	24.4 Mbps	33.4 Mbps	42.4 Mbps

Table 43: Subrate Values for T3 Digital Link Compatibility Mode *(continued)*

6.6 Mbps	15.6 Mbps	24.7 Mbps	33.7 Mbps	42.7 Mbps
6.9 Mbps	15.9 Mbps	25.0 Mbps	34.0 Mbps	43.0 Mbps
7.2 Mbps	16.2 Mbps	25.3 Mbps	34.3 Mbps	43.3 Mbps
7.5 Mbps	16.5 Mbps	25.6 Mbps	34.6 Mbps	43.6 Mbps
7.8 Mbps	16.8 Mbps	25.9 Mbps	34.9 Mbps	43.9 Mbps
8.1 Mbps	17.1 Mbps	26.2 Mbps	35.2 Mbps	44.2 Mbps
8.4 Mbps	17.4 Mbps	26.5 Mbps	35.5 Mbps	
8.7 Mbps	17.7 Mbps	26.8 Mbps	35.8 Mbps	
9.0 Mbps	18.0 Mbps	27.1 Mbps	36.1 Mbps	

For information about subrating an E3 interface, see "Configuring the E3 CSU Compatibility Mode" on page 523.

Configuring the T3 Frame Checksum

By default, T3 interfaces use a 16-bit frame checksum. You can configure a 32-bit checksum, which provides more reliable packet verification. However, some older equipment might not support 32-bit checksums.

On a channelized OC12 interface, the fcs statement is not supported. To configure FCS on each DS3 channel, you must include the t3-options fcs statement in the configuration for each channel.

To configure a 32-bit checksum, include the fcs statement at the [edit interfaces *interface-name* t3-options] hierarchy level:

```
[edit interfaces interface-name t3-options]
fcs 32;
```

To return to the default 16-bit frame checksum, delete the fcs 32 statement from the configuration:

```
[edit]
user@host# delete interfaces t3-fpc/pic/port t3-options fcs 32
```

To explicitly configure a 16-bit checksum, include the fcs statement at the [edit interfaces *interface-name* t3-options] hierarchy level:

```
[edit interfaces interface-name t3-options]
fcs 16;
```

Configuring the T3 FEAC Response

The T3 far-end alarm and control (FEAC) signal is used to send alarm or status information from the far-end terminal back to the near-end terminal and to initiate T3 loopbacks at the far-end terminal from the near-end terminal.

By default, the routing platform does not respond to FEAC requests. To allow the remote CSU to place the local routing platform into loopback, you must configure the routing platform to respond to the CSU's FEAC request by including the feac-loop-respond statement at the [edit interfaces *interface-name* t3-options] hierarchy level:

```
[edit interfaces interface-name t3-options]
feac-loop-respond;
```

If you configure remote or local loopback with the T3 loopback statement, the routing platform does not respond to FEAC requests from the CSU even if you include the feac-loop-respond statement in the configuration. For the routing platform to respond, you must delete the loopback statement from the configuration.

To explicitly configure the routing platform not to respond to FEAC requests, include the no-feac-loop statement at the [edit interfaces *interface-name* t3-options] hierarchy level:

```
[edit interfaces interface-name t3-options]
no-feac-loop-respond;
```

Configuring the T3 Idle Cycle Flag

By default, a T3 interface transmits the value 0x7E in the idle cycles. To have the interface transmit the value 0xFF (all ones) instead, include the idle-cycle-flag statement at the [edit interfaces *interface-name* t3-options] hierarchy level, specifying the ones option:

```
[edit interfaces interface-name t3-options]
idle-cycle-flag ones;
```

To explicitly configure the default value of 0x7E, include the idle-cycle-flag statement with the flags option:

```
[edit interfaces interface-name t3-options]
idle-cycle-flag flags;
```

Configuring the T3 Line Buildout

A T3 interface has two settings for the T3 line buildout: a short setting, which is less than 255 feet (about 68 meters), and a long setting, which is greater than 255 feet and less than 450 feet (about 137 meters). By default, the interface uses the short setting.

The long-buildout and no-long-buildout statements apply only to copper-cable-based T3 interfaces. You cannot configure a line buildout for a DS3 channel on a channelized OC12 interface, which runs over fiber-optic cable. If you configure this statement on a channelized OC12 interface, it is ignored.

To have the interface drive a line that is longer than 255 feet and shorter than 450 feet, include the long-buildout statement at the [edit interfaces *interface-name* t3-options] hierarchy level:

```
[edit interfaces interface-name t3-options]
long-buildout;
```

To explicitly configure the default short line buildout, include the no-long-buildout statement at the [edit interfaces *interface-name* t3-options] hierarchy level:

```
[edit interfaces interface-name t3-options]
no-long-buildout;
```

Configuring the Channelized T3 Loop Timing

By default, internal clocking (line timing) is used on channelized IQ and IQE interfaces. To configure SONET/SDH or DS3-level external clocking, include the loop-timing statement:

```
loop-timing;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces ct3-*fpc/pic/port* t3-options]
- [edit interfaces stm1-*fpc/pic/port* sonet-options]

To explicitly configure the default line timing, include the no-loop-timing statement in the configuration:

```
no-loop-timing;
```

The loop-timing and no-loop-timing statements apply only to E1 and T1 interfaces you configure on channelized IQ and IQE PICs. If you attempt to include these statements on any other interface type, they are ignored.

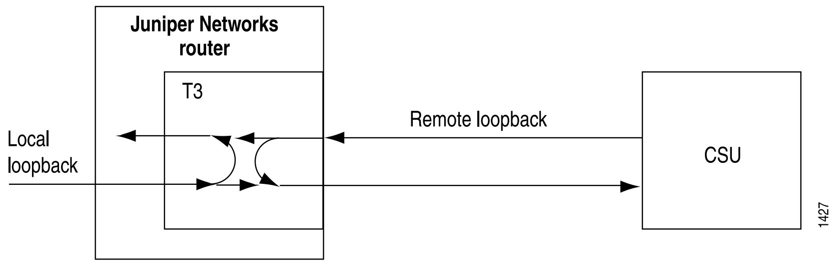
For all channelized IQ and IQE PICs, the clocking statement is supported on all channels. To configure clocking on individual interfaces, include the clocking statement at the [edit interfaces *type-fpc/pic/port:channel*] hierarchy level. If you do not include the clocking statement, the individual interfaces use internal clocking by default.

For more information, see “Configuring the Clock Source” on page 121 and “Clock Sources on Channelized Interfaces” on page 376.

Configuring T3 Loopback Capability

You can configure loopback capability between the local T3 interface and the remote CSU, as shown in Figure 53 on page 547. You can configure the loopback to be local or remote. With local loopback, the T3 interface can transmit packets to the CSU, but receives its own transmission back again and ignores data from the CSU. With remote loopback, packets sent from the CSU are received by the T3 interface, forwarded if there is a valid route, and immediately retransmitted to the CSU.

Figure 53: Remote and Local T3 Loopback



To configure loopback capability on a T3 interface, include the loopback statement at the [edit interfaces *interface-name* t3-options] hierarchy level:

```
[edit interfaces interface-name t3-options]
loopback (local | payload | remote);
```

Packets can be looped on either the local routing platform or the remote CSU. Local and remote loopback loop back both data and clocking information.

To exchange BERT patterns between a local routing platform and a remote routing platform, include the loopback remote statement in the interface configuration at the remote end of the link. From the local routing platform, you issue the test interface command.

For more information about configuring BERT, see “Interface Diagnostics” on page 127. For more information about using operational mode commands to test interfaces, see the *JUNOS System Basics and Services Command Reference*.

For channelized T3, T1, and *N*xDS0 IQ interfaces only, you can include the loopback payload statement in the configuration to loop back data only (without clocking information) on the remote routing platform’s PIC. In payload loopback, overhead is recalculated. For T3 IQ interfaces, you can include the loopback payload statement at the [edit interfaces ct3-*fpc/pic/port*] and [edit interfaces t3-*fpc/pic/port*:*channel*] hierarchy levels. For T1 interfaces, you can include the loopback payload statement in the configuration at the [edit interfaces t1-*fpc/pic/port*:*channel*] hierarchy level; it is ignored if included at the [edit interfaces ct1-*fpc/pic/port*] hierarchy level. For *N*xDS0 interfaces, payload and remote loopback are the same. If you configure one, the other is ignored. *N*xDS0 IQ interfaces do not support local loopback.

To determine whether a problem is internal or external, you can loop packets on both the local and the remote routing platform. To do this, include the no-keepalives and encapsulation cisco-hdlc statements at the [edit interfaces *interface-name*] hierarchy level and the loopback local statement at the [edit interfaces *interface-name* t3-options] hierarchy level, as shown in the following example:

```
[edit interfaces]
t3-1/0/0 {
```

```
        no-keepalives;
        encapsulation cisco-hdlc;
        t3-options {
            loopback local;
        }
        unit 0 {
            family inet {
                address 10.100.100.1/24;
            }
        }
    }
```

With this configuration, the link stays up, so you can loop ping packets to a remote routing platform. The loopback local statement causes the interface to loop within the PIC just before the data reaches the transceiver.

To turn off the loopback capability, remove the loopback statement from the configuration:

```
[edit]
user@host# delete interfaces t3-fpc/pic/port t3-options loopback
```

You can determine whether there is an internal problem or an external problem by checking the error counters in the output of the show interface *interface-name* extensive command, for example:

```
user@host> show interfaces t3-fpc/pic/port extensive
```

For channel 0 on channelized interfaces only, you can include the loopback statement at the [edit interfaces *interface-name interface-type*-options] hierarchy level. The loopback setting configured for channel 0 applies to all channels on the channelized interface. The loopback statement is ignored if you include it at this hierarchy level in the configuration of other channels. To configure loopbacks on individual channels, you must include the *channel-type*-options loopback statement in the configuration for each channel. This allows each channel to be put in loopback mode independently.

For example, for DS3 channels on a channelized OC12 interface, the sonet-options loopback statement is supported only for channel 0; it is ignored if included in the configuration for channels 1 through 11. The SONET loopback configured for channel 0 applies to all 12 channels equally. To configure loopbacks on the individual DS3 channels, you must include the t3-options loopback statement in the configuration for each channel. This allows each DS3 channel can be put in loopback mode independently.

Configuring T3 HDLC Payload Scrambling

T3 HDLC payload scrambling, which is disabled by default, provides better link stability. Both sides of a connection must either use or not use scrambling.

On a channelized OC12 interface, the SONET payload-scrambler statement is ignored. To configure scrambling on the DS3 channels on the interface, you can include the t3-options payload-scrambler statement at the [edit interfaces *interface-name* t3-options] hierarchy level for each DS3 channel.

If you enable HDLC payload scrambling on a T3 interface, you must also configure the interface to be compatible with the channel service unit (CSU) at the remote end of the line before you commit the interface configuration. For information about subrating a T3 interface, see “Configuring the T3 CSU Compatibility Mode” on page 542.

```
[edit interfaces interface-name t3-options]
compatibility-mode (adtran | digital-link | kentrox | larscom | verilink) <subrate value>;
payload-scrambler;
```

To explicitly disable HDLC payload scrambling, include the no-payload-scrambler statement at the [edit interfaces *interface-name* t3-options] hierarchy level:

```
[edit interfaces interface-name t3-options]
no-payload-scrambler;
```

To disable payload scrambling again (return to the default), delete the payload-scrambler statement from the configuration:

```
[edit]
user@host# delete interfaces t3-fpc/pic/port t3-options payload-scrambler
```

Configuring T3 Start and End Flags

By default, a T3 interface shares the transmission of the start and end flags.

To configure a T3 interface to wait two idle cycles between the start and end flags, include the start-end-flag statement with the filler option at the [edit interfaces *interface-name* t3-options] hierarchy level:

```
[edit interfaces interface-name t3-options]
start-end-flag filler;
```

To revert to the default behavior, sharing the transmission of start and end flags, include the start-end-flag statement with the shared option at the [edit interfaces *interface-name* t3-options] hierarchy level:

```
[edit interfaces interface-name t3-options]
start-end-flag shared;
```

Examples: Configuring T3 Interfaces

T3 interfaces can use PPP, Cisco HDLC, or Frame Relay encapsulation.

PPP Encapsulation on a DS3 PIC

```
[edit]
interfaces {
    t3-0/0/0 {
        encapsulation ppp;
        t3-options {
            no-long-buildout;
            compatibility-mode larscom;
            payload-scrambler;
        }
        unit 0 {
```

```
            family inet {
                address 10.0.0.1/32 {
                    destination 10.0.0.2;
                }
            }
            family iso;
        }
    }
}
```

Cisco HDLC Encapsulation on a DS3 PIC

```
[edit]
interfaces {
    t3-0/0/1 {
        encapsulation cisco-hdlc;
        t3-options {
            no-long-buildout;
            compatibility-mode larscom;
            payload-scrambler;
        }
        unit 0 {
            family inet {
                address 10.0.0.1/32 {
                    destination 10.0.0.2;
                }
            }
            family iso;
        }
    }
}
```

Configure Frame Relay encapsulation on two platforms, where one platform is a DTE device and the other is a DCE device:

On DTE Router

```
[edit]
interfaces {
    t3-1/0/1 {
        encapsulation frame-relay;
        t3-options {
            no-long-buildout;
            compatibility-mode larscom;
            payload-scrambler;
        }
        unit 1 {
            dlci 1;
            family inet {
                address 10.0.0.1/32 {
                    destination 10.0.0.2;
                }
            }
            family iso;
        }
        unit 2 {
            dlci 2;
            family inet {
                address 10.0.0.3/32 {
```

```
                destination 10.0.0.4;
            }
        }
        family iso;
    }
}
}
```

On DCE Router

```
[edit]
interfaces {
    t3-1/1/1 {
        dce;
        encapsulation frame-relay;
        t3-options {
            no-long-buildout;
            compatibility-mode larscom;
            payload-scrambler;
        }
        unit 1 {
            dlci 1;
            family inet {
                address 10.0.0.2/32 {
                    destination 10.0.0.1;
                }
            }
            family iso;
        }
        unit 2 {
            dlci 2;
            family inet {
                address 10.0.0.4/32 {
                    destination 10.0.0.3;
                }
            }
            family iso;
        }
    }
}
```

Part 9
Configuring Ethernet Interfaces

Chapter 31

Configuring Ethernet Interfaces

You can configure the following properties specific to aggregated Ethernet, Fast Ethernet, Tri-Rate Ethernet copper, Gigabit Ethernet, and 10-Gigabit Ethernet interfaces:

Ethernet Interfaces Overview

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

Juniper Networks routing platforms support the following types of Ethernet interfaces:

- Fast Ethernet
- Tri-Rate Ethernet copper
- Gigabit Ethernet
- Gigabit Ethernet intelligent queuing (IQ)

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

Configuring Ethernet Physical Interface Properties

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

```
[edit interfaces fe-fpc/pic/port]
link-mode (full-duplex | half-duplex);
speed (10m | 100m);
vlan-tagging;
fastether-options {
   802.3ad aex (primary | backup);
   (flow-control | no-flow-control);
   ignore-l3-incompletes;
   ingress-rate-limit rate;
   (loopback | no-loopback);
   source-address-filter {
      mac-address;
   }
   (source-filtering | no-source-filtering);
}
```

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

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

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

```
[edit interfaces ge-fpc/pic/port]
gigether-options {
    802.3ad aex (primary | backup);
    auto-negotiation | no-auto-negotiation) remote-fault <local-interface-online |
        local-interface-offline>
    (flow-control | no-flow-control);
    ignore-l3-incompletes;
    (loopback | no-loopback);
    source-address-filter {
        mac-address;
    }
    (source-filtering | no-source-filtering);
}
```

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

```
[edit interfaces ge-fpc/pic/port]
optics-options {
    wavelength nm;
}
```

To configure Gigabit Ethernet IQ-specific physical interface properties, include the gigether-options statement at the [edit interfaces ge-*fpc/pic/port*] hierarchy level. These statements are supported on 10-Gigabit Ethernet IQ2 and IQ2-E PIC. Some of these statements are also supported on Gigabit Ethernet PICs with small form-factor pluggable transceivers (SFPs) (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform). For more information, see "Example: Configuring Gigabit Ethernet Interfaces" on page 767.

```
[edit interfaces ge-fpc/pic/port]
flexible-vlan-tagging;
gigether-options {
    802.3ad aex (primary | backup);
    auto-negotiation | no-auto-negotiation) remote-fault <local-interface-online |
        local-interface-offline>
    (flow-control | no-flow-control);
    ignore-l3-incompletes;
    (loopback | no-loopback);
    (source-filtering | no-source-filtering);
    ethernet-switch-profile {
        (mac-learn-enable | no-mac-learn-enable);
        tag-protocol-id [tpids ];
        ethernet-policer-profile {
            input-priority-map {
                ieee802.1p premium [values ];
            }
            output-priority-map {
                classifier {
                    premium {
```

```
                    forwarding-class class-name {
                        loss-priority (high | low);
                    }
                }
            }
        }
        policer cos-policer-name {
            aggregate {
                bandwidth-limit (ethernet) bps;
                burst-size-limit (ethernet) bytes;
            }
            premium {
                bandwidth-limit (ethernet) bps;
                burst-size-limit (ethernet) bytes;
            }
        }
    }
}
native-vlan-id number;
}
```

To configure 10-Gigabit Ethernet IQ2 and IQ2-E-specific physical interface properties, include the lan-phy or wan-phy statement at the [edit interfaces xe-*fpc/pic/port* framing] hierarchy level. For more information, see "Configuring 10-Gigabit Ethernet Framing" on page 735.

```
[edit interfaces]
xe-0/0/0 {
    framing {
        (lan-phy | wan-phy);
    }
}
```

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

```
oam {
    ethernet {
        link-fault-management {
            interfaces {
                interface-name{
                    pdu-interval interval;
                    link-discovery (active | passive);
                    pdu-threshold count;
                }
            }
        }
    }
}
```

To configure Gigabit Ethernet IQ-specific logical interface properties, include the input-vlan-map, output-vlan-map, and layer2-policer statements:

```
input-vlan-map {
    (pop | pop-pop | pop-swap | push | push-push | swap | swap-push | swap-swap);
```

```
        inner-tag-protocol-id tpid;
        inner-vlan-id number;
        tag-protocol-id tpid;
        vlan-id number;
    }
    output-vlan-map {
        (pop | pop-pop | pop-swap | push | push-push | swap | swap-push | swap-swap);
        inner-tag-protocol-id tpid;
        inner-vlan-id number;
        tag-protocol-id tpid;
        vlan-id number;
    }
    layer2-policer {
        input-policer policer-name;
        input-three-color policer-name;
        output-policer policer-name;
        output-three-color policer-name;
    }
    vlan-tags inner tpid.vlan-id outer tpid.vlan-id;
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

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

```
[edit interfaces aex]
aggregated-ether-options {
    ethernet-switch-profile {
        tag-protocol-id tpid;
    }
    (flow-control | no-flow-control);
    lacp mode {
        periodic interval;
    }
    link-protection;
    link-speed speed;
    (loopback | no-loopback);
    minimum-links number;
    source-address-filter {
        mac-address;
    }
    (source-filtering | no-source-filtering);
}
```

Configuring J-series Services Router Switching Interfaces

The J-series services routers with multiport Gigabit Ethernet uPIMs can support Ethernet access switching. This functionality provides the ability to switch traffic at Layer 2 in addition to routing traffic at Layer 3.

J-series services routers with multiport Gigabit Ethernet uPIMs can be deployed in branch offices as an access or desktop switch with integrated routing capability. The multiport Gigabit Ethernet uPIM provides Ethernet switching, while the Routing Engine provides routing functionality.

Routed traffic is forwarded from any port of the multiport Gigabit Ethernet uPIM to the WAN interface. Switched traffic is forwarded from one port of the multiport Gigabit Ethernet uPIM to another port on the same the multiport Gigabit Ethernet uPIM. Switched traffic is not forwarded from a port on one multiport Gigabit Ethernet uPIM to a port on a different multiport Gigabit Ethernet uPIM. For more information about configuring the multiport Gigabit Ethernet uPIM switching mode, see the *JUNOS System Basics Configuration Guide*.

In access switching mode, only one physical interface is configured for the entire multiport Gigabit Ethernet uPIM. The single physical interface serves as a Virtual Router Interface (VRI). Configuration of the physical port characteristics is done under the single physical interface.

To configure multiport Gigabit Ethernet uPIM Ethernet port properties, include the switch-port statement at the [edit interfaces ge-*pim*/0/0] hierarchy level:

```
[edit interfaces ge-pim/0/0]
switch-options {
  switch-port port-number {
    (auto-negotiation | no-auto-negotiation);
    speed 1g;
    link-mode (full-duplex | half-duplex);
  }
}
```

Access switching mode is supported on the 6-port, 8-port, and 16-port Gigabit Ethernet uPIMs.

The multiport Gigabit Ethernet uPIMs are supported on the J2320, J2350, J4350, and J6350 Services Routers.

The 6-port and 8-port multiport Gigabit Ethernet uPIM occupies a single slot and can be installed in any slot. Because the 16-port Gigabit Ethernet uPIM is two slots high, you cannot install a 16-port uPIM in the top slots (slots 1 and 4). Ports are numbered 0 through 5 on the 6-port Gigabit Ethernet uPIM, 0 through 7 on the 8-port Gigabit Ethernet uPIM, and 0 through 15 on the 16-port Gigabit Ethernet uPIM.

Example: Configuring J-series Services Router Switching Interfaces

Configure a single physical interface for the uPIM and set the port parameters for port 0 and port 1:

```
[edit interfaces]
ge-2/0/0 {
  switch-options {
    switch-port 0 {
      no-auto-negotiation;
      speed 1g;
      link-mode full-duplex;
```

```
        }
        switch-port 1 {
            no-auto-negotiation;
            speed 10m;
            link-mode half-duplex;
        }
    }
}
```

MX-series Router Interface Identifiers

The MX-series routers use the convention ge-*fpc*/*pic*/*port* to identify interfaces.

fpc identifies the number of the FPC or DPC card on which the physical interface is located. Specifically, it is the number of the slot in which the card is installed. If two Switch Control Boards (SCBs) are installed in an MX960 router, the FPC range is from 0 through 11. If three SCBs are installed, the range is from 0 through 5 and from 7 through 11. On the MX480 router, the range is 0 through 6. On the MX240 router, the range is 0 through 2 with one SCB installed. With two SCBs installed, the DPC can be installed in any of two consecutive interface card slots, the range is from 1 through 2.

For DPCs, the PIC and port numbers are identified on the DPC front panel. Use the PIC and port numbers that correspond to the port you are configuring.

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

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

Enabling Ethernet MAC Address Filtering

By default, source address filtering is disabled. On aggregated Ethernet interfaces, Fast Ethernet, Gigabit Ethernet, Gigabit Ethernet IQ, and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform), you can enable source address filtering, which blocks all incoming packets to an interface.

NOTE: Source address filtering is not supported on J-series Services Routers.

To enable the filtering, include the source-filtering statement:

```
source-filtering;
```

To explicitly disable filtering, include the no-source-filtering statement:

```
no-source-filtering;
```

You can include these statements at the following hierarchy levels:

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

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

Filtering Specific MAC Addresses

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

```
source-address-filter {
    mac-address;
    <additional-mac-address>;
}
```

You can include these statements at the following hierarchy levels:

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

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

NOTE: The source-address-filter statement is not supported on Gigabit Ethernet IQ and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform); instead, include the accept-source-mac statement. For more information, see “Configuring MAC Address Filtering” on page 713.

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

Source address filtering does not work when Link Aggregation Control Protocol (LACP) is enabled. For more information about LACP, see “Configuring Aggregated Ethernet LACP” on page 597.

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

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

Configuring Ethernet Loopback Capability

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

```
loopback;
```

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

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

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

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

```
no-loopback;
```

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

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

Configuring Flow Control

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

You can disable flow control if you want the routing platform to permit unrestricted traffic. To disable flow control, include the no-flow-control statement:

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

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

```
flow-control;
```

You can include these statements at the following hierarchy levels:

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

Ignoring Layer 3 Incomplete Errors

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

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

```
ignore-l3-incompletes;
```

You can include this statement at the following hierarchy levels:

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

Configuring the Link Characteristics on Ethernet Interfaces

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

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

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

NOTE: On a J-series ePIM Fast Ethernet interface, if you specify half-duplex (or if full-duplex mode is not autonegotiated), the following message is written to the system log: "Half-duplex mode not supported on this PIC, forcing full-duplex mode."

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

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

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

Configuring Gratuitous ARP

Gratuitous Address Resolution Protocol (ARP) requests provide duplicate IP address detection. A gratuitous ARP request is a broadcast request for a routing platform's own IP address. If a routing platform sends an ARP request for its own IP address and no ARP replies are received, the routing platform's assigned IP address is not being used by other nodes. If a routing platform sends an ARP request for its own IP address and an ARP reply is received, the routing platform's assigned IP address is already being used by another node.

By default, the routing platform responds to gratuitous ARP requests. On Ethernet interfaces, you can disable responses to gratuitous ARP requests. To disable responses to gratuitous ARP requests, include the no-gratuitous-arp-request statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
no-gratuitous-arp-request;
```

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

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

Gratuitous ARP replies are reply packets sent to the broadcast MAC address with the target IP address set to be the same as the sender's IP address. When the routing platform receives a gratuitous ARP reply, the routing platform can insert an entry for that reply in the ARP cache.

By default, updating the ARP cache on gratuitous ARP replies is disabled on the routing platform. On Ethernet interfaces, you can enable handling of gratuitous ARP replies on a specific interface by including the gratuitous-arp-reply statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
gratuitous-arp-reply;
```

To restore the default behavior, include the no-gratuitous-arp-reply statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
no-gratuitous-arp-reply;
```

Adjusting the ARP Aging Timer

By default, the ARP aging timer is set at 20 minutes. In most network environments, this default value does not cause a problem. However, in environments with many directly attached hosts, such as metro Ethernet, the number of ARP entries to update can be high. In such environments, you might want to increase the amount of time between ARP updates by configuring the ARP aging timer.

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

```
[edit system arp]
aging-timer minutes;
```

The aging timer range is from 20 through 240 minutes. The timer value you configure takes effect as ARP entries expire. In other words, each subsequent refreshed ARP entry receives the new timer value. The new timer value does not apply to ARP entries that exist at the time you commit the configuration.

For more information about statements you can configure at the [edit system] hierarchy level, see the *JUNOS System Basics Configuration Guide*.

Configuring the Interface Speed on Ethernet Interfaces

For M-series and T-series Fast Ethernet 12-port and 48-port PIC interfaces, the management Ethernet interface (fxp0), the J-series Gigabit Ethernet uPIM interfaces, and the MX-series Tri-Rate Ethernet copper interfaces, you can explicitly set the interface speed. The Fast Ethernet and fxp0 interfaces can be configured for 10 Mbps or 100 Mbps (10m | 100m). The J-series Gigabit Ethernet uPIM interfaces and the MX-series Tri-Rate Ethernet copper interfaces can be configured for 10 Mbps, 100 Mbps, or 1 Gbps (10m | 100m | 1g). MX-series routers, with MX-DPC and Tri-Rate Copper SFPs, support 20x1 Copper to provide backwards compatibility with

100/10BASE-T and 1000BASE-T operation through an Serial Gigabit Media Independent Interface (SGMII) interface.

NOTE: On MX-series routers with tri-rate copper SFP interfaces, if the port speed is negotiated to the configured value and the negotiated speed and interface speed do not match, the link will not be brought up.

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

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

```
[edit interfaces interface-name]
speed (10m | 100m | 1g);
```

Configuring the Ingress Rate Limit

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

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

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

rate can range in value from 1 through 100 Mbps.

Configuring Weighted Random Early Detection

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

Related Topics For information on configuring WRED, see *Class of Service Configuration Guide*.

Chapter 32

Configuring 802.1Q VLANs

For examples of 802.1Q VLAN configuration, see the following sections:

802.1Q VLANs Overview

For Ethernet, Fast Ethernet, Tri-Rate Ethernet copper, Gigabit Ethernet, 10-Gigabit Ethernet, and aggregated Ethernet interfaces supporting VPLS, the JUNOS software supports a subset of the IEEE 802.1Q standard for channelizing an Ethernet interface into multiple logical interfaces, allowing many hosts to be connected to the same Gigabit Ethernet switch, but preventing them from being in the same routing or bridging domain.

Configuring Dynamic 802.1Q VLANs

You can configure the router to dynamically create VLANs when a client accesses an interface and requests a VLAN ID that does not yet exist. When a client accesses a VLAN interface, the router instantiates a VLAN dynamic profile that you have associated with the interface. Using the settings in the dynamic profile, the router extracts information about the client from the incoming packet (for example, the interface and unit values), saves this information in the routing table, and creates a VLAN or stacked VLAN ID for the client from a range of VLAN IDs that you configure for the interface.

Dynamically configuring VLANs or stacked VLANs requires the following general steps:

1. Configure a dynamic profile for dynamic VLAN or dynamic stacked VLAN creation.
2. Associate the VLAN or stacked VLAN dynamic profile with the interface.
3. Specify the Ethernet packet type that the VLAN dynamic profile accepts.
4. Define VLAN ranges for use by the dynamic profile when creating VLAN IDs.

For procedures on how to configure dynamic VLANs and dynamic stacked VLANs for client access, see the *JUNOS Subscriber Access Configuration Guide*.

802.1Q VLAN IDs and Ethernet Interface Types

You can partition the routing platform into up to 4095 different VLANs—depending on the routing platform model and the physical interface types—by associating logical interfaces with specific VLAN IDs.

VLAN ID 0 is reserved for tagging the priority of frames. VLAN IDs 1 through 511 are reserved for normal VLANs. VLAN IDs 512 and above are reserved for VLAN circuit cross-connect (CCCs).

For Gigabit Ethernet IQ interfaces and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform), you can configure flexible Ethernet services encapsulation on the physical interface. With flexible Ethernet services encapsulation, VLAN IDs from 1 through 511 are no longer reserved for normal VLANs.

Table 44 on page 570 lists VLAN ID range by interface type.

Table 44: VLAN ID Range by Interface Type

Interface Type	VLAN ID Range
Aggregated Ethernet for Fast Ethernet	1 through 1023
Aggregate Ethernet for Gigabit Ethernet	1 through 4094
4-port, 8-port, and 12-port Fast Ethernet	1 through 1023

Table 44: VLAN ID Range by Interface Type *(continued)*

Interface Type	VLAN ID Range
48-port Fast Ethernet	1 through 4094
Tri-Rate Ethernet copper	1 through 4094
Gigabit Ethernet	1 through 4094
Gigabit Ethernet IQ	1 through 4094
10-Gigabit Ethernet	1 through 4094
Management and internal Ethernet interfaces	1 through 1023

NOTE: For Gigabit Ethernet IQ and Gigabit Ethernet PICs with SFPs (except the built-in Gigabit Ethernet port on the M7i platform), VLAN IDs on a single interface can differ from each other.

Because IS-IS has an 8-bit limit for broadcast multiaccess media, you cannot set up more than 255 adjacencies over Gigabit Ethernet using VLAN tagging. For more information, see the *JUNOS Routing Protocols Configuration Guide*.

Enabling VLAN Tagging

You can configure the routing platform to receive and forward single-tag frames, dual-tag frames, or a mixture of single-tag and dual-tag frames. For more information, see the following sections:

- Configuring Single-Tag Framing on page 572
- Configuring Dual Tagging on page 572
- Configuring Mixed Tagging on page 572
- Configuring Mixed Tagging Support for Untagged Packets on page 573
- Example: Configuring Mixed Tagging on page 573
- Example: Configuring Mixed Tagging to Support Untagged Packets on page 574

NOTE: If you configure VLAN tagging on Gigabit Ethernet IQ, IQ2 and IQ2-E interfaces on M320, M120, and T-series routing platforms, the JUNOS software creates an internal logical interface that reserves 50 Kbps of bandwidth from Gigabit Ethernet IQ interfaces and 2 Mbps of bandwidth from Gigabit Ethernet IQ2 and IQ2-E interfaces. As a result, the effective available bandwidth for these interface types is now 999.5 Mbps and 998 Mbps, respectively.

Configuring Single-Tag Framing

To configure the routing platform to receive and forward single-tag frames with 802.1Q VLAN tags, include the vlan-tagging statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
vlan-tagging;
```

Configuring Dual Tagging

To configure the routing platform to receive and forward dual-tag frames with 802.1Q VLAN tags, include the stacked-vlan-tagging statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
stacked-vlan-tagging;
```

Configuring Mixed Tagging

Mixed tagging is supported for Gigabit Ethernet interfaces on Gigabit Ethernet IQ2 and IQ2-E, and IQ or IQE PICs on M-series and T-series routing platforms, for all MX-series router Gigabit and 10-Gigabit Ethernet interfaces, and for aggregated Ethernet interfaces with member links in IQ2 and IQ2-E PICs or in MX-series DPCs. Mixed tagging lets you configure two logical interfaces on the same Ethernet port, one with single-tag framing and one with dual-tag framing.

NOTE: Mixed tagging is not supported on Fast Ethernet interfaces or on J-series Services Routers.

To configure mixed tagging, include the flexible-vlan-tagging statement at the [edit interfaces ge-*fpc/pic/port*] hierarchy level. You must also include the vlan-tags statement with inner and outer options or the vlan-id statement at the [edit interfaces ge-*fpc/pic/port* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces ge-fpc/pic/port]
flexible-vlan-tagging;
unit logical-unit-number {
   vlan-id number;
   family family {
      address address;
   }
}
unit logical-unit-number {
   vlan-tags inner tpid.vlan-id outer tpid.vlan-id;
   family family {
      address address;
   }
}
```

NOTE: When you configure the physical interface MTU for mixed tagging, you must increase the MTU to 4 bytes more than the MTU value you would configure for a standard VLAN-tagged interface.

For example, if the MTU value is configured to be 1018 on a VLAN-tagged interface, then the MTU value on a flexible VLAN tagged interface must be 1022—4 bytes more. The additional 4 bytes accommodates the future addition of a stacked VLAN tag configuration on the same physical interface.

If the same physical interface MTU value is configured on both the VLAN and flexible VLAN-tag routers, the L2 circuit configuration does not come up and a MTU mismatch is logged. However, normal traffic flow is unaffected.

Configuring Mixed Tagging Support for Untagged Packets

For 1-, 4-, and 8-port Gigabit Ethernet IQ2 and IQ2-E PICs, for 1-port 10-Gigabit Ethernet IQ2 and IQ2-E PICs, for all MX-series router Gigabit Ethernet, Tri-Rate Ethernet copper, and 10-Gigabit Ethernet interfaces configured for 802.1Q flexible VLAN tagging, and for aggregated Ethernet interfaces on IQ2 and IQ2-E PICs or MX-series DPCs, you can configure mixed tagging support for untagged packets on a port. Untagged packets are accepted on the same mixed VLAN-tagged port. To accept untagged packets, include the native-vlan-id statement and the flexible-vlan-tagging statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces ge-fpc/pic/port]
flexible-vlan-tagging;
native-vlan-id number;
```

The logical interface on which untagged packets are to be received must be configured with the same native VLAN ID as that configured on the physical interface. To configure the logical interface, include the vlan-id statement (matching the native-vlan-id statement on the physical interface) at the [edit interface *interface-name* unit *logical-unit-number*] hierarchy level.

Example: Configuring Mixed Tagging

The following example configures mixed tagging. Dual-tag and single-tag logical interfaces are under the same physical interface:

```
[edit interfaces ge-3/0/1]
flexible-vlan-tagging;
unit 0 {
  vlan-id 232;
  family inet {
    address 10.66.1.2/30;
  }
}
unit 1 {
  vlan-tags outer 0x8100.222 inner 0x8100.221;
  family inet {
    address 10.66.1.2/30;
```

```
    }
}
```

For information about binding VLAN IDs to logical interfaces, see "Binding VLAN IDs to Logical Interfaces" on page 574. For information about configuring dual VLAN tags using the vlan-tag statement, see "Stacking a VLAN Tag" on page 614.

Example: Configuring Mixed Tagging to Support Untagged Packets

The following example configures untagged packets to be mapped to logical unit number 0:

```
[edit interfaces ge-0/2/0]
flexible-vlan-tagging;
native-vlan-id 232;
unit 0 {
    vlan-id 232;
    family inet {
        address 10.66.1.2/30;
    }
}
unit 1 {
    vlan-tags outer 0x8100.222 inner 0x8100.221;
    family inet {
        address 10.66.1.2/30;
    }
}
```

Binding VLAN IDs to Logical Interfaces

The following sections describe how to configure logical interfaces to receive and forward VLAN-tagged frames:

Binding VLAN IDs to Logical Interfaces Overview

To configure a logical interface to receive and forward VLAN-tagged frames, you must bind a VLAN ID, a range of VLAN IDs, or a list of VLAN IDs to the logical interface. Table 45 on page 575 lists the configuration statements you use to bind VLAN IDs to logical interfaces, organized by scope of the VLAN IDs used to match incoming packets:

Table 45: Configuration Statements Used to Bind VLAN IDs to Logical Interfaces

Scope of VLAN ID Matching	Type of VLAN Framing Supported on the Logical Interface	
	Single-Tag Framing	**Dual-Tag Framing**
VLAN ID	vlan-id *vlan-id*;	vlan-tags outer *tpid*.<*vlan-id*> inner *tpidvlan-id*;
VLAN ID Range	vlan-id-range *vlan-id–vlan-id*;	vlan-tags outer <*tpid*.>*vlan-id* inner-range *tpid*.*vlan-id–vlan-id*;
VLAN ID List	vlan-id-list [*vlan-id vlan-id–vlan-id*];	vlan-tags outer <*tpid*.>*vlan-id* inner-list [*vlan-id vlan-id–vlan-id*];

You can include the statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

NOTE: The inner-list option of the vlan-tags statement does not support Tag Protocol ID (TPID) values.

Binding a VLAN ID to a Logical Interface

A logical interface that you have associated (bound) to a particular VLAN ID will receive and forward incoming frames that contain a matching VLAN ID.

Binding a VLAN ID to a Single-Tag Logical Interface

To bind a VLAN ID to a single-tag logical interface, include the vlan-id statement:

```
vlan-id vlan-id;
```

You can include the statement at the following hierarchy levels:

- [edit interfaces *ethernet-interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *ethernet-interface-name* unit *logical-unit-number*]

To configure an Ethernet interface to support single-tag logical interfaces, include the vlan-tagging statement at the [interfaces *ethernet-interface-name*] hierarchy level. To support mixed tagging, include the flexible-vlan-tagging statement instead.

Binding a VLAN ID to a Dual-Tag Logical Interface

To bind a VLAN ID to a dual-tag logical interface, include the vlan-tags statement:

```
vlan-tags outer <tpid.>vlan-id inner <tpid.>vlan-id;
```

You can include the statement at the following hierarchy levels:

- [edit interfaces *ethernet-interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *ethernet-interface-name* unit *logical-unit-number*]

To configure an Ethernet interface to support dual-tag logical interfaces, include the stacked-vlan-tagging statement at the [interfaces *ethernet-interface-name*] hierarchy level. To support mixed tagging, include the flexible-vlan-tagging statement instead.

Binding a Range of VLAN IDs to a Logical Interface

. A VLAN range can be used by service providers to interconnect multiple VLANs belonging to a particular customer over multiple sites. Using a VLAN ID range conserves switch resources and simplifies configuration.

Binding a Range of VLAN IDs to a Single-Tag Logical Interface

To bind a range of VLAN IDs to a single-tag logical interface, include the vlan-id-range statement:

vlan-id-range *vlan-id-vlan-id*;

You can include the statement at the following hierarchy levels:

- [edit interfaces *ethernet-interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *ethernet-interface-name* unit *logical-unit-number*]

To configure an Ethernet interface to support single-tag logical interfaces, include the vlan-tagging statement at the [interfaces *ethernet-interface-name*] hierarchy level. To support mixed tagging, include the flexible-vlan-tagging statement instead.

Binding a Range of VLAN IDs to a Dual-Tag Logical Interface

To bind a range of VLAN IDs to a dual-tag logical interface, include the vlan-tags statement. Use the inner–list option to specify the VLAN IDs as an inclusive range by separating the starting VLAN ID and ending VLAN ID with a hyphen.

vlan-tags outer *vlan-id* inner–list *vlan-id–vlan-id*;

You can include the statement at the following hierarchy levels:

- [edit interfaces *ethernet-interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *ethernet-interface-name* unit *logical-unit-number*]

To configure an Ethernet interface to support dual-tag logical interfaces, include the stacked-vlan-tagging statement at the [interfaces *ethernet-interface-name*] hierarchy level. To support mixed tagging, include the flexible-vlan-tagging statement instead.

Example: Binding Ranges VLAN IDs to Logical Interfaces

The following example configures two different ranges of VLAN IDs on two different logical ports:

```
[edit interfaces]
ge-3/0/0 {
   unit 0 {
      encapsulation vlan-bridge;
      vlan-id-range 500-600;
   }
}
ge-3/0/1 {
   flexible-vlan-tagging;
      unit 0 {
         encapsulation vlan-bridge;
         vlan-id-range 200-300;
      }
      unit 1 {
         encapsulation vlan-bridge;
         vlan-tags outer 1000 inner-range 100-200;
      }
}
```

Binding a List of VLAN IDs to a Logical Interface

Beginning with JUNOS software Release 9.5, MX-series routers allow a list of VLAN IDs to be bound to a single logical interface. You no longer need to configure a separate logical interface for every VLAN or VLAN range. A logical interface that accepts packets tagged with any VLAN ID specified in a VLAN ID list is called a *VLAN-bundled* logical interface.

You can use VLAN-bundled logical interfaces to configure circuit cross-connects between Layer 2 VPN routing instances or Layer 2 circuits. Using VLAN-bundled logical interfaces simplifies configuration and reduces use of system resources such as logical interfaces, next hops, and circuits.

As an alternative to configuring multiple logical interfaces (one for each VLAN ID and one for each range of VLAN IDs), you can configure a single VLAN-bundled logical interface based on a list of VLAN IDs.

Binding a List of VLAN IDs to a Single-Tag Logical Interface

To bind a list of VLAN IDs to a single-tag logical interface, include the vlan-id-list statement. Specify the VLAN IDs in the list individually by using a space to separate each ID, as an inclusive list by separating the starting VLAN ID and ending VLAN ID with a hyphen, or as a combination of both.

vlan-id-list [*vlan-id vlan-id–vlan-id*];

You can include the statement at the following hierarchy levels:

- [edit interfaces *ethernet-interface-name* unit *logical-unit-number*]

- [edit logical-systems *logical-system-name* interfaces *ethernet-interface-name* unit *logical-unit-number*]

To configure an Ethernet interface to support single-tag logical interfaces, include the vlan-tagging statement at the [interfaces *ethernet-interface-name*] hierarchy level. To support mixed tagging, include the flexible-vlan-tagging statement instead.

Binding a List of VLAN IDs to a Dual-Tag Logical Interface

To bind a list of VLAN IDs to a dual-tag logical interface, include the vlan-tags statement. Use the inner-list option to specify the VLAN IDs individually by using a space to separate each ID, as an inclusive list by separating the starting VLAN ID and ending VLAN ID with a hyphen, or as a combination of both:

```
vlan-tags outer <tpid.>vlan-id inner-list [vlan-id vlan-id–vlan-id];
```

NOTE: The inner-list option of the vlan-tags statement does not support Tag Protocol ID (TPID) values.

You can include the statement at the following hierarchy levels:

- [edit interfaces *ethernet-interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *ethernet-interface-name* unit *logical-unit-number*]

To configure an Ethernet interface to support dual-tag logical interfaces, include the stacked-vlan-tagging statement at the [interfaces *ethernet-interface-name*] hierarchy level. To support mixed tagging, include the flexible-vlan-tagging statement instead.

Example: Binding Lists of VLAN IDs to Logical Interfaces

The following example configures two different lists of VLAN IDs on two different logical ports:

```
[edit interfaces]
ge-1/1/0 {
    vlan-tagging; # Only for single-tagging
    encapsulation flexible-ethernet-services;
    unit 10 {
        encapsulation vlan-ccc;
        vlan-id-list [20 30–40 45];
    }
}
ge-1/1/1 {
    flexible-vlan-tagging; # Only for mixed tagging
    encapsulation flexible-ethernet-services;
    unit 10 {
        encapsulation vlan-ccc;
        vlan-id-list [1 10 20 30–40];
    }
    unit 20 {
```

```
            encapsulation vlan-ccc;
            vlan-tags outer 200 inner-list [50–60 80 90–100];
        }
    }
```

In the example configuration above, ge-1/1/0 supports single-tag logical interfaces, and ge-1/1/1 supports mixed tagging. The single-tag logical interfaces ge-1/1/0.10 and ge-1/1/1.20 each bundle lists of VLAN IDs. The dual-tag logical interface ge-1/1/1.20 bundles lists of inner VLAN IDs.

Configuring VLAN Encapsulation

Gigabit Ethernet IQ, Gigabit Ethernet PICs with small form-factor pluggable optics (SFPs), and MX-series router Gigabit Ethernet, Tri-Rate Ethernet copper, and 10-Gigabit Ethernet interfaces with VLAN tagging enabled can use flexible Ethernet services, VLAN CCC, or VLAN virtual private LAN service (VPLS) encapsulation.

Aggregated Ethernet interfaces configured for VPLS can use Ethernet VPLS or VLAN VPLS.

To configure the encapsulation on a Gigabit Ethernet IQ or Gigabit Ethernet physical interface, include the encapsulation statement at the [edit interfaces *interface-name*] hierarchy level, specifying flexible-ethernet-services, vlan-ccc, or vlan-vpls:

```
[edit interfaces interface-name]
encapsulation (flexible-ethernet-services | vlan-ccc | vlan-vpls);
```

To configure the encapsulation on an aggregated Ethernet interface, include the encapsulation statement at the [edit interfaces *interface-name*] hierarchy level, specifying ethernet-vpls or vlan-vpls:

```
[edit interfaces interface-name]
encapsulation (ethernet-vpls | vlan-vpls);
```

Ethernet interfaces in VLAN mode can have multiple logical interfaces. In CCC and VPLS modes, VLAN IDs from 1 through 511 are reserved for normal VLANs, and VLAN IDs 512 through 4094 are reserved for CCC or VPLS VLANs. For 4-port Fast Ethernet interfaces, you can use VLAN IDs 512 through 1024 for CCC or VPLS VLANs.

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

In general, you configure an interface's encapsulation at the [edit interfaces *interface-name*] hierarchy level. However, for some encapsulation types, including flexible Ethernet services, Ethernet VLAN CCC and VLAN VPLS, you can also configure the encapsulation type that is used inside the VLAN circuit itself. To do this, include the encapsulation statement:

```
encapsulation (vlan-ccc | vlan-tcc | vlan-vpls);
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]

- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

You cannot configure a logical interface with VLAN CCC or VLAN VPLS encapsulation unless you also configure the physical device with the same encapsulation or with flexible Ethernet services encapsulation. In general, the logical interface must have a VLAN ID of 512 or higher; if the VLAN ID is 511 or lower, it will be subject to the normal destination filter lookups in addition to source address filtering. However if you configure flexible Ethernet services encapsulation, this VLAN ID restriction is removed.

Example: Configuring VLAN Encapsulation on a Gigabit Ethernet Interface

Configure VLAN CCC encapsulation on a Gigabit Ethernet interface:

```
interfaces ge-2/1/0 {
    vlan-tagging;
    encapsulation vlan-ccc;
    unit 0 {
        encapsulation vlan-ccc;
        vlan-id 600;
    }
}
```

Example: Configuring VLAN Encapsulation on an Aggregated Ethernet Interface

Configure VLAN CCC encapsulation on an aggregated Gigabit Ethernet interface:

```
interfaces ae0 {
    vlan-tagging;
    encapsulation vlan-vpls;
    unit 0 {
        vlan-id 100;
    }
}
```

Configuring Extended VLAN Encapsulation

Gigabit Ethernet, 4-port Fast Ethernet, MX-series router Gigabit Ethernet, Tri-Rate Ethernet copper, 10-Gigabit Ethernet, and aggregated Ethernet interfaces with VLAN tagging enabled can use extended VLAN CCC or VLAN VPLS, which allow 802.1Q tagging. To configure the encapsulation on a physical interface, include the encapsulation statement at the [edit interfaces *interface-name*] hierarchy level, specifying extended-vlan-ccc or extended-vlan-vpls:

```
[edit interfaces interface-name]
encapsulation (extended-vlan-ccc | extended-vlan-vpls);
```

For extended VLAN CCC and extended VLAN VPLS encapsulation, all VLAN IDs 1 and higher are valid. VLAN ID 0 is reserved for tagging the priority of frames.

NOTE: For extended VLAN CCC, the VLAN IDs on ingress and egress interfaces must be the same. For back-to-back connections, all VLAN IDs must be the same.

Example: Configuring Extended VLAN Encapsulation on a Gigabit Ethernet Interface

Configure extended VLAN CCC encapsulation on Gigabit Ethernet ingress and egress interfaces:

```
interfaces ge-0/0/0 {
  vlan-tagging;
  encapsulation extended-vlan-ccc;
  unit 0 {
    vlan-id 2;
    family ccc;
  }
}
interfaces ge-1/0/0 {
  vlan-tagging;
  encapsulation extended-vlan-ccc;
  unit 0 {
    vlan-id 2;
    family ccc;
  }
}
```

Example: Configuring Extended VLAN Encapsulation on an Aggregated Ethernet Interface

Configure extended VLAN VPLS encapsulation on an aggregated Ethernet interface:

```
interfaces ae0 {
  vlan-tagging;
  encapsulation extended-vlan-vpls;
  unit 0 {
    vlan-id 100;
  }
}
```

Guidelines for Configuring VLAN ID List-Bundled Logical Interfaces That Connect CCCs

For MX-series routers, you can bind a list of VLAN IDs to a logical interface, configure a Layer 2 VPN routing instance or Layer 2 circuit on the logical interface, and then use the logical interface to configure a circuit cross-connect (CCC) to another Layer 2 VPN routing instance or Layer 2 circuit.

A CCC allows you to configure transparent connections between two circuits so that packets from the source circuit are delivered to the destination circuit with, at most, the Layer 2 address being changed. You configure a CCC by connecting circuit interfaces of the same type. For more information, see "Configuring Circuit and Translational Cross-Connects" on page 213.

NOTE: The JUNOS software supports binding of Ethernet logical interfaces to lists of VLAN IDs on MX-series routers only. For all other routing platforms, you can bind an Ethernet logical interface to only a single VLAN ID or to a single range of VLAN IDs.

The following configuration guidelines apply to bundling lists of VLAN IDs to Ethernet logical interfaces used to configure CCCs:

- Guidelines for Configuring Physical Link-Layer Encapsulation to Support CCCs on page 582
- Guidelines for Configuring Logical Link-Layer Encapsulation to Support CCCs on page 582

Guidelines for Configuring Physical Link-Layer Encapsulation to Support CCCs

To enable a physical interface to support VLAN-bundled logical interfaces that you will use to configure a CCC, you must configure one of the following physical link-layer encapsulation types:

- extended-vlan-ccc—For Ethernet interfaces with standard TPID tagging.
- flexible-ethernet-services—For supported Gigabit Ethernet interfaces for which you want to configure multiple per-unit Ethernet encapsulations.

To specify the physical link-layer encapsulation type, include the encapsulation (Physical Interface) statement. For information about configuring the interface encapsulation on a physical interface, see "Configuring Interface Encapsulation on Physical Interfaces" on page 100.

Guidelines for Configuring Logical Link-Layer Encapsulation to Support CCCs

For VLAN-bundled logical interfaces that you use to configure a CCC, specific logical link-layer encapsulation types are used inside the circuits themselves.

Table 46 on page 583 describes the logical link-layer encapsulation types used within circuits connected using VLAN-bundled logical interfaces of the same type.

Table 46: Encapsulation Inside Circuits CCC-Connected by VLAN-Bundled Logical Interfaces

Encapsulation Inside the Circuit	Layer 2 Circuit Joined by Configuring an Interface-to-Interface CCC Connection	
	Layer 2 VPN Routing Instance	**Layer 2 Circuit**
Syntax	encapsulation-type (ethernet | ethernet-vlan);	encapsulation vlan-ccc;
Hierarchy Level	[edit routing-instances *routing-instance-name* protocols l2vpn], [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn]	[edit interfaces *ethernet-interface-name* unit *logical-unit-number*], [edit logical-systems *logical-system-name* interfaces *ethernet-interface-name* unit *logical-unit-number*]
Usage Guidelines	See the *JUNOS VPNs Configuration Guide*.	See "Configuring Interface Encapsulation on Logical Interfaces" on page 151, "Configuring Circuit and Translational Cross-Connects" on page 213, and "Defining the Encapsulation for Switching Cross-Connects" on page 215.
For a Single-Tag Logical Interface	The MX-series router automatically uses ethernet as the Layer 2 protocol used to encapsulate incoming traffic. Although the connection spans multiple VLANs, the VLANs are bundled and therefore can be encapsulated as a single VLAN. **NOTE:** With ethernet encapsulation, the circuit signal processing does not check that the VLAN ID list is the same at both ends of the CCC connection.	Configure the MX-series router to use vlan-ccc as the logical link-layer encapsulation type.
For a Dual-Tag Logical Interface	Configure the MX-series router to use ethernet-vlan as the Layer 2 protocol to encapsulate incoming traffic. With ethernet-vlan encapsulation, circuit signal processing checks that the VLAN ID list is the same at both ends of the CCC connection. If a VLAN ID list mismatch is detected, you can view the error condition in the show interfaces command output.	The MX-series router automatically uses vlan-ccc as the logical link-layer encapsulation type, regardless of the value configured.

Related Topics

- Binding VLAN IDs to Logical Interfaces on page 574
- Defining the Encapsulation for Switching Cross-Connects on page 215

Configuring a Layer 2 VPN Routing Instance on a VLAN-Bundled Logical Interface

This topic describes how to configure a Layer 2 VPN routing instance on a logical interface bound to a list of VLAN IDs.

The topic consists of the following tasks:

- Configuring a VLAN-Bundled Logical Interface on page 584
- Specifying the Interface Over Which VPN Traffic Travels to the CE Router on page 584
- Specifying the Interface to Handle Traffic for a CCC on page 585

Configuring a VLAN-Bundled Logical Interface

To configure a VLAN-bundled logical interface, specify the list of VLAN IDs by including the vlan-id-list statement or the vlan-tags statement on a provider edge (PE) router:

```
interfaces {
    ethernet-interface-name {
        vlan-tagging; # Support single- or dual-tag logical interfaces
        flexible-vlan-tagging; # Support mixed tagging
        encapsulation (extended-vlan-ccc | flexible-ethernet-services);
        unit logical-unit-number {
            vlan-id-list [vlan-id vlan-id–vlan-id]; # For single-tag
            vlan-tags outer <tpid.>vlan-id inner-list [vlan-id vlan-id–vlan-id]; # For dual-tag
        }
        . . .
    }
}
```

You can include the statements at the following hierarchy levels:

- [edit]
- [edit logical-systems *logical-system-name*]

Specifying the Interface Over Which VPN Traffic Travels to the CE Router

To configure a Layer 2 VPN routing instance on a PE router, include the instance-type statement and specify the value l2vpn. To specify an interface connected to the router, include the interface statement and specify the VLAN-bundled logical interface:

```
instance-type l2vpn;
interface logical-interface-name;
```

You can include the statements at the following hierarchy levels:

- [edit routing-instances *routing-instance-name* protocols]
- [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols]

Specifying the Interface to Handle Traffic for a CCC

To configure the VLAN-bundled logical interface as the interface to handle traffic for a circuit connected to the Layer 2 VPN routing instance, include the following statements:

```
protocols {
    l2vpn {
        (control-word | no-control-word);
        encapsulation-type (ethernet | ethernet-vlan);
        site site-name {
            site-identifier identifier;
            interface logical-interface-name { # VLAN-bundled logical interface
                . . . interface_options . . .
            }
        }
    }
}
```

You can include the statements at the same hierarchy level at which you include the instance-type l2vpn and interface *logical-interface-name* statements:

- [edit routing-instances *routing-instance-name* protocols]
- [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols]

To enable a Layer 2 VPN routing instance on a PE router, include the l2vpn statement. For more information, see the *JUNOS VPNs Configuration Guide*.

The encapsulation-type statement specifies the Layer 2 protocol used for traffic from the customer edge (CE) router. If the Layer 2 VPN routing instance is being connected to a single-tag Layer 2 circuit, specify ethernet as the encapsulation type. If the Layer 2 VPN routing instance is being connected to a dual-tag Layer 2 circuit, specify ethernet-vlan as the encapsulation type.

To specify the interface to handle traffic for a circuit connected to the Layer 2 VPN routing instance, include the interface statement and specify the VLAN-bundled logical interface.

Configuring a Layer 2 Circuit on a VLAN-Bundled Logical Interface

This topic describes how to configure a Layer 2 circuit on a logical interface bound to a list of VLAN IDs.

The topic consists of the following tasks:

Configuring a VLAN-Bundled Logical Interface

To configure a VLAN-bundled logical interface, specify the list of VLAN IDs by including the vlan-id-list statement or the vlan-tags statement:

```
interfaces {
  ethernet-interface-name {
    vlan-tagging; # Support single- or dual-tag logical interfaces
    flexible-vlan-tagging; # Support mixed tagging
    encapsulation (extended-vlan-ccc | flexible-ethernet-services);
    unit logical-unit-number {
      encapsulation vlan–ccc; # Required for single-tag
      vlan-id-list [vlan-id vlan-id–vlan-id]; # For single-tag
      vlan-tags outer <tpid.>vlan-id inner-list [vlan-id vlan-id–vlan-id]; # For dual-tag
    }
    . . .
  }
}
```

You can include the statements at the following hierarchy levels:

- [edit]
- [edit logical-systems *logical-system-name*]

For a single-tag logical interface, include the encapsulation statement and specify vlan-ccc so that CCC circuit encapsulation is used inside the Layer 2 circuit.

NOTE: In the case of a dual-tag logical interface, the JUNOS software automatically uses the vlan-ccc encapsulation type.

Specifying the Interface to Handle Traffic for a CCC Connected to the Layer 2 Circuit

To configure the VLAN-bundled logical interface as the interface to handle traffic for a circuit connected to the Layer 2 circuit, include the following statements:

```
l2circuit {
  neighbor address {
    interface logical-interface-name {
      virtual-circuit-id number;
      no-control-word;
    }
  }
}
```

You can include the statements at the following hierarchy levels:

- [edit protocols]
- [edit logical-systems *logical-system-name* protocols]

To enable a Layer 2 circuit, include the l2circuit statement.

To configure the router as a neighbor for a Layer 2 circuit, specify the neighbor address using the neighbor statement.

To specify the interface to handle traffic for a circuit connected to the Layer 2 circuit, include the interface statement and specify the VLAN-bundled logical interface.

Example: Configuring a Layer 2 VPN Routing Instance on a VLAN-Bundled Logical Interface

The following configuration shows that the single-tag logical interface ge-1/0/5.0 bundles a list of VLAN IDs, and the logical interface ge-1/1/1.0 supports IPv4 traffic using IP address 10.30.1.130 and can participate in an MPLS path.

```
[edit interfaces]
ge-1/0/5 {
   vlan-tagging;
   encapsulation extended-vlan-ccc;
   unit 0 { # VLAN-bundled logical interface
      vlan-id-list [513 516 520-525];
   }
}
   ge-1/1/1 {
      unit 0 {
         family inet {
            address 10.30.1.1/30;
         }
         family mpls;
      }
   }
```

The following configuration shows the type of traffic supported on the Layer 2 VPN routing instance:

```
[edit protocols]
rsvp {
   interface all;
   interface lo0.0;
}
mpls {
   label-switched-path lsp {
      to 10.255.69.128;
   }
   interface all;
}
bgp {
   group g1 {
      type internal;
      local-address 10.255.69.96;
      family l2vpn {
         signaling;
      }
      neighbor 10.255.69.128;
   }
}
ospf {
```

```
        traffic-engineering;
        area 0.0.0.0 {
            interface lo0.0;
            interface ge-1/1/1.0;
        }
    }
```

The following configuration shows that the VLAN-bundled logical interface is the interface over which VPN traffic travels to the CE router and handles traffic for a CCC to which the VPN connects.

```
[edit routing-instances]
red {
    instance-type l2vpn;
    interface ge-1/0/5.0; # VLAN-bundled logical interface
    route-distinguisher 10.255.69.96:100;
    vrf-target target:1:1;
    protocols {
        l2vpn {
            encapsulation-type ethernet; # For single-tag VLAN logical interface
            site CE_ultima {
                site-identifier 1;
                interface ge-1/0/5.0;
            }
        }
    }
}
```

NOTE: Because the VLAN-bundled logical interface supports single-tag frames, Ethernet is the Layer 2 protocol used to encapsulate incoming traffic. Although the connection spans multiple VLANs, the VLANs are bundled and therefore can be encapsulated as a single VLAN.

However, with Ethernet encapsulation, the circuit signal processing does not check that the VLAN ID list is the same at both ends of the CCC connection.

Example: Configuring a Layer 2 Circuit on a VLAN-Bundled Logical Interface

The following configuration shows that the single-tag logical interface ge-1/0/5.0 bundles a list of VLAN IDs, and the logical interface ge-1/1/1.0 supports IPv4 traffic using IP address 10.30.1.1/30 and can participate in an MPLS path.

```
[edit interfaces]
ge-1/0/5 {
    vlan-tagging;
    encapsulation extended-vlan-ccc;
    unit 0 { # VLAN-bundled logical interface
        vlan-id-list [513 516 520-525];
    }
}
ge-1/1/1 {
    unit 0 {
```

```
        family inet {
            address 10.30.1.1/30;
        }
        family mpls;
    }
}
```

The following configuration shows the type of traffic supported on the Layer 2 VPN routing instance, and shows that the VLAN-bundled logical interface handles traffic for a CCC to which the Layer 2 circuit connects:

```
[edit protocols]
rsvp {
    interface all;
    interface lo0.0;
}
mpls {
    label-switched-path lsp {
        to 10.255.69.128;
    }
    interface all;
}
ospf {
    traffic-engineering;
    area 0.0.0.0 {
        interface lo0.0;
        interface ge-1/1/1.0;
    }
}
ldp {
    interface ge-1/1/1.0;
    interface ge-1/0/5.0; # VLAN-bundled logical interface
    interface lo0.0;
}
l2circuit {
    neighbor 10.255.69.128 {
        interface ge-1/0/5.0 { # VLAN-bundled logical interface
            virtual-circuit-id 3;
            no-control-word;
        }
    }
}
```

Configuring a Logical Interface for Access Mode

Enterprise network administrators can configure a single logical interface to accept untagged packets and forward the packets within a specified bridge domain. A logical interface configured to accept untagged packets is called an *access interface* or *access port*. Access interface configuration is supported on MX-series routers only.

```
interface-mode access;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family bridge]

- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family bridge]

When an untagged or tagged packet is received on an access interface, the packet is accepted, the VLAN ID is added to the packet, and the packet is forwarded within the bridge domain that is configured with the matching VLAN ID.

Example: Configuring a Logical Interface for Access Mode

The following example configures a logical interface as an access port with a VLAN ID of 20:

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

Configuring a Logical Interface for Trunk Mode

As an alternative to configuring a logical interface for each VLAN, enterprise network administrators can configure a single logical interface to accept untagged packets or packets tagged with any VLAN ID specified in a list of VLAN IDs. Using a VLAN ID list conserves switch resources and simplifies configuration. A logical interface configured to accept packets tagged with any VLAN ID specified in a list is called a *trunk interface* or *trunk port*. Trunk interface configuration is supported on MX-series routers only. Trunk interfaces support integrated routing and bridging (IRB).

To configure a logical interface to accept any packet tagged with a VLAN ID that matches the list of VLAN IDs, include the interface-mode statement and specify the trunk option:

```
interface-mode trunk;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family bridge]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family bridge]

Configuring the VLAN ID List for a Trunk Interface

To configure the list of VLAN IDs to be accepted by the trunk port, include the vlan-id-list statement and specify the list of VLAN IDs. You can specify individual VLAN IDs with a space separating the ID numbers, specify a range of VLAN IDs with a dash separating the ID numbers, or specify a combination of individual VLAN IDs and a range of VLAN IDs.

```
vlan-id-list [number number-number];
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family bridge interface-mode trunk]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family bridge interface-mode trunk]

When a packet is received that is tagged with a VLAN ID specified in the trunk interface list of VLAN IDs, the packet is accepted and forwarded within the bridge domain that is configured with the matching VLAN ID.

When a packet is received that is tagged with a VLAN ID not specified in the trunk interface list of VLAN IDs, the native VLAN ID is pushed in front of the existing VLAN tag or tags and the packet is forwarded within the bridge domain that is configured with the matching VLAN ID.

When an untagged packet is received on a trunk interface, the native VLAN ID is added to the packet and the packet is forwarded within the bridge domain that is configured with the matching VLAN ID.

A bridge domain configured with a matching VLAN ID must be configured before the trunk interface is configured. To learn more about configuring bridge domains, see the *JUNOS Routing Protocols Configuration Guide*.

Configuring a Trunk Interface on a Bridge Network

On MX-series routers, you can configure a trunk interface on a bridge network.

The following output sample shows trunk port configuration on a bridge network:

```
user@host# run show interfaces
ge-0/0/0 {
    flexible-vlan-tagging;
    encapsulation flexible-ethernet-services;
    unit 0 {
        encapsulation vlan-bridge;
        vlan-id 1;
    }
}
ge-2/0/0 {
    unit 0 {
        family bridge {
            interface-mode trunk;
            vlan-id-list 1-200;
        }
    }
}
ge-2/0/1 {
    flexible-vlan-tagging;
    encapsulation flexible-ethernet-services;
    unit 0 {
        encapsulation vlan-bridge;
        vlan-id 1;
    }
}
```

Chapter 33

Configuring Aggregated Ethernet Interfaces

This chapter contains the following sections:

Aggregated Ethernet Interfaces Overview

Link aggregation of Ethernet interfaces is defined in the IEEE 802.3ad standard. The JUNOS implementation of 802.3ad balances traffic across the member links within an aggregated Ethernet bundle based on the Layer 3 information carried in the packet. This implementation uses the same load-balancing algorithm used for per-packet load balancing. For information about per-packet load balancing, see the *JUNOS Routing Protocols Configuration Guide*.

NOTE: For information about configuring circuit cross-connects over aggregated Ethernet, see “Examples: Configuring Switching Cross-Connects” on page 223.

Configuring Aggregated Ethernet Interfaces

You configure an aggregated Ethernet virtual link by specifying the link number as a physical device and then associating a set of ports that have the same speed and are in full-duplex mode. The physical interfaces can be Fast Ethernet, Tri-Rate Ethernet copper, Gigabit Ethernet, Gigabit Ethernet IQ, 10-Gigabit Ethernet IQ, Gigabit Ethernet IQ2 and IQ2-E, or 10-Gigabit Ethernet IQ2 and IQ2-E interfaces. Generally, you cannot use a combination of these interfaces within the same aggregated link; however, you can combine Gigabit Ethernet and Gigabit Ethernet IQ interfaces in a single aggregated Ethernet bundle.

The following routing platforms support a maximum of 16 physical interfaces per single aggregated Ethernet bundle:

- M120
- M320
- MX960
- MX480
- MX240
- All T-series routing platforms

All other routing platforms support a maximum of 8 physical interfaces per aggregated Ethernet bundle.

Aggregated Ethernet interfaces can use interfaces from different FPCs, DPCs, or PICs.

Simple filters are not supported for interfaces in aggregated Ethernet bundles:

- in M-series routing platforms, simple filters are supported in Gigabit Ethernet Enhanced Intelligent Queuing interfaces only, except when the interface is part of an aggregated Ethernet bundle.
- in MX-series routing platforms, simple filters are supported in Enhanced Queuing Dense Port Concentrator (EQ DPC) interfaces only, except when the interface is part of an aggregated Ethernet bundle.

On the aggregated bundle, no IQ-specific capabilities such as MAC accounting, VLAN rewrites, and VLAN queuing are available. For more information about IQ-specific capabilities, see “Configuring Gigabit Ethernet Accounting and Policing” on page 707.

Aggregated Ethernet interfaces can be either tagged or untagged, with LACP enabled or disabled. Aggregated Ethernet interfaces on Ethernet IQ2 and IQ2-E PICs in MX-series routing platforms support the configuration of flexible-vlan-tagging, native-vlan-id, and rewrite operations on dual-tagged frames, which consist of the following configuration statements:

- inner-tag-protocol-id
- inner-vlan-id
- pop-pop
- pop-swap
- push-push
- swap-push
- swap-swap

In all cases, you must set the number of aggregated Ethernet interfaces on the chassis. You can also set the link speed and the minimum links in a bundle.

Configuring Ethernet Link Aggregation

On Fast Ethernet, Tri-Rate Ethernet copper, Gigabit Ethernet, and 10-Gigabit Ethernet interfaces on M-series and T-series routing platforms, you can associate a physical interface with an aggregated Ethernet interface. To enable the aggregated link, include the 802.3ad statement at the [edit interfaces *interface-name* fastether-options] or [edit interfaces *interface-name* gigether-options] hierarchy level:

```
[edit interfaces interface-name (fastether-options | gigether-options)]
802.3ad aex;
```

You specify the interface instance number *x* to complete the link association; *x* can be from 0 through 127, for a total of 128 aggregated interfaces. You must also include a statement defining ae*x* at the [edit interfaces] hierarchy level. You can optionally specify other physical properties that apply specifically to the aggregated Ethernet interfaces; for details, see "Configuring Ethernet Interfaces" on page 555, and for a sample configuration, see "Example: Configuring Aggregated Ethernet Interfaces" on page 768.

NOTE: In general, aggregated Ethernet bundles support the features available on all supported interfaces that can become a member link within the bundle. As an exception, Gigabit Ethernet IQ features and some newer Gigabit Ethernet features are not supported in aggregated Ethernet bundles.

Gigabit Ethernet IQ and SFP interfaces can be member links, but IQ- and SFP-specific features are not supported on the aggregated Ethernet bundle even if all the member links individually support those features.

To delete an aggregated Ethernet interface from the configuration, issue the delete interfaces ae*x* command at the [edit] hierarchy level in configuration mode:

```
[edit]
user@host# delete interfaces aex
```

If you delete an aggregated Ethernet interface from the configuration, the JUNOS software removes the configuration statements related to ae*x* and sets this interface to down state. However, the aggregated Ethernet interface is not deleted until you delete the chassis aggregated-devices ethernet device-count configuration statement.

Configuring Aggregated Ethernet Link Protection

To support JUNOS QoS features, aggregated Ethernet interfaces support link protection. On aggregated Ethernet interfaces, you designate a primary and backup link. Egress traffic passes only through the designated primary link. This includes transit traffic and locally generated traffic on the router. When the primary link fails, traffic is routed through the backup link. Because some traffic loss is unavoidable, egress traffic is not automatically routed back to the primary link when the primary link is reestablished. Instead, you manually control when traffic should be diverted back to the primary link from the designated backup link by issuing the request interface revert ae*x* operational command.

To enable link protection on aggregated Ethernet interfaces, include the link-protection statement at the [edit interfaces ae*x* aggregated-ether-options] hierarchy level:

```
[edit interfaces]
aex {
   aggregated-ether-options {
      link-protection;
   }
}
```

You also must specify a primary and a secondary, or backup, link. To configure a primary and a backup link, include the primary and backup statement at the [edit interfaces ge-*fpc/pic/port* gigether-options 802.3ad ae*x*] hierarchy level or the [edit interfaces fe-*fpc/pic/port* fastether-options 802.3ad ae*x*] hierarchy level:

```
[edit interfaces]
interface-name {
   (gigether-options | fastether-options) {
      802.3ad aex (primary | backup);
   }
}
```

To revert back to sending traffic to the primary designated link when traffic is passing through the designated backup link, issue the request interface revert ae*x* operational mode command:

```
user@host# request interface revert aex
```

To disable link protection, issue the delete interfaces ae*x* aggregated-ether-options link-protection command in configuration mode and commit the configuration:

```
[edit interfaces aex]
user@host# delete interfaces aex aggregated-ether-options link-protection
```

For a sample configuration, see “Example: Configuring Aggregated Ethernet Link Protection” on page 769.

Setting the Number of Aggregated Ethernet Interfaces on the Chassis

By default, no aggregated Ethernet interfaces are created. You must define the number of aggregated Ethernet interfaces by including the device-count statement at the [edit chassis aggregated-devices ethernet] hierarchy level:

```
[edit chassis]
aggregated-devices {
   ethernet {
      device-count number;
   }
}
[edit interfaces]
```

```
ae x{
    aggregated-ether-options {
        link-protection;
    }
    unit logical-unit number {
        family inet {
            address address;
        }
    }
}
```

The maximum number of aggregated devices you can configure is 128. The aggregated interfaces are numbered from ae0 through ae127. For information about configuring aggregated devices, see the *JUNOS System Basics Configuration Guide*.

You must also specify the constituent physical links by including the 802.3ad statement at the [edit interfaces *interface-name* fastether-options] or [edit interfaces *interface-name* gigether-options] hierarchy level; for more information, see "Configuring Ethernet Link Aggregation" on page 595. For a sample configuration, see "Example: Configuring Aggregated Ethernet Interfaces" on page 768.

Configuring Aggregated Ethernet LACP

For aggregated Ethernet interfaces, you can configure the Link Aggregation Control Protocol (LACP). LACP is one method of bundling several physical interfaces to form one logical interface. You can configure both VLAN-tagged and untagged aggregated Ethernet with or without LACP enabled.

LACP exchanges are made between actors and partners. An actor is the local interface in an LACP exchange. A partner is the remote interface in an LACP exchange.

LACP is defined in IEEE 802.3ad, *Aggregation of Multiple Link Segments*.

LACP was designed to achieve the following:

- Automatic addition and deletion of individual links to the aggregate bundle without user intervention
- Link monitoring to check whether both ends of the bundle are connected to the correct group

The JUNOS implementation of LACP provides link monitoring but not automatic addition and deletion of links.

The LACP mode can be active or passive. If the actor and partner are both in passive mode, they do not exchange LACP packets, which results in the aggregated Ethernet links not coming up. If either the actor or partner is active, they do exchange LACP packets. By default, LACP is in passive mode on aggregated Ethernet interfaces. To initiate transmission of LACP packets and response to LACP packets, you must enable LACP active mode.

To enable LACP active mode, include the lacp statement at the [edit interfaces *interface-name* aggregated-ether-options] hierarchy level, and specify the active option:

```
[edit interfaces interface-name aggregated-ether-options]
lacp {
    active;
}
```

To restore the default behavior, include the lacp statement at the [edit interfaces *interface-name* aggregated-ether-options] hierarchy level, and specify the passive option:

```
[edit interfaces interface-name aggregated-ether-options]
lacp {
    passive;
}
```

For more information, see the following sections:

- Configuring the LACP Interval on page 598
- Configuring LACP Link Protection on page 599
- Tracing LACP Operations on page 600
- Example: Configuring Aggregated Ethernet LACP on page 601

Configuring the LACP Interval

By default, the actor and partner send LACP packets every second. You can configure the interval at which the interfaces send LACP packets by including the periodic statement at the [edit interfaces *interface-name* aggregated-ether-options lacp] hierarchy level:

```
[edit interfaces interface-name aggregated-ether-options lacp]
periodic interval;
```

The interval can be fast (every second) or slow (every 30 seconds). You can configure different periodic rates on active and passive interfaces. When you configure the active and passive interfaces at different rates, the transmitter honors the receiver's rate.

NOTE: Source address filtering does not work when LACP is enabled. For more information about source address filtering, see "Enabling Ethernet MAC Address Filtering" on page 561.

Percentage policers are not supported on aggregated Ethernet interfaces with the CCC protocol family configured. For more information about percentage policers, see the *JUNOS Policy Framework Configuration Guide*.

Generally, LACP is supported on all untagged aggregated Ethernet interfaces. For more information, see "Configuring Untagged Aggregated Ethernet Interfaces" on page 602.

For M-series routers with enhanced Flexible PIC Concentrators (FPCs) and T-series routing platforms, LACP over VLAN-tagged aggregated Ethernet interfaces is supported. For 8-port, 12-port, and 48-port Fast Ethernet PICs, LACP over VLAN-tagged interfaces is not supported.

Configuring LACP Link Protection

NOTE: When using LACP link protection, you can configure only two member links to an aggregated Ethernet interface: one active and one standby.

To force active and standby links within an aggregated Ethernet, you can configure LACP link protection and system priority at the aggregated Ethernet interface level using the link-protection and system-priority statements. Configuring values at this level results in only the configured interfaces using the defined configuration. LACP interface configuration also enables you to override global (chassis) LACP settings.

LACP link protection also uses port priority. You can configure port priority at the Ethernet interface [gigether-options] hierarchy level using the port-priority statement. If you choose not to configure port priority, LACP link protection uses the default value for port priority (127).

NOTE: LACP link protection supports per-unit scheduling configuration on aggregated Ethernet interfaces.

Enabling LACP Link Protection

To enable LACP link protection for an aggregated Ethernet interfaces, use the link-protection statement at the [edit interfaces ae*X* aggregated-ether-options lacp] hierarchy level:

```
[edit interfaces aeX aggregated-ether-options lacp]
link-protection;
   disable (Link Protection);
   revertive;
   non-revertive;
}
```

By default, LACP link protection reverts to a higher-priority (lower-numbered) link when that higher-priority link becomes operational or a link is added to the aggregator that is determined to be higher in priority. However, you can suppress link calculation by adding the non-revertive statement to the LACP link protection configuration. In nonrevertive mode, once a link is active and collecting and distributing packets, the subsequent addition of a higher-priority (better) link does not result in a switch and the current link remains active.

If LACP link protection is configured to be nonrevertive at the global ([edit chassis] hierarchy) level, you can add the revertive statement to the LACP link protection configuration to override the nonrevertive setting for the interface. In revertive mode, the addition of a higher-priority link to the aggregator results in LACP performing a priority recalculation and switching from the current active link to the new active link.

CAUTION: If both ends of an aggregator have LACP link protection enabled, make sure to configure both ends of the aggregator to use the same mode. Mismatching LACP link protection modes can result in lost traffic.

Configuring LACP System Priority

To configure LACP system priority for aggregated Ethernet interfaces on the interface, use the system-priority statement at the [edit interfaces ae*X* aggregated-ether-options lacp] hierarchy level:

```
[edit interfaces aeX aggregated-ether-options lacp]
system-priority;
```

The system priority is a 2-octet binary value that is part of the LACP system ID. The LACP system ID consists of the system priority as the two most-significant octets and the interface MAC address as the six least-significant octets. The system with the numerically lower value for system priority has the higher priority. By default, system priority is 127, with a range of 0 to 65,535.

Configuring LACP Port Priority

To configure LACP port priority for aggregated Ethernet interfaces, use the port-priority statement at the [edit interfaces *interface-name* gigether-options 802.3ad ae*X* lacp] or [edit interfaces *interface-name* fastether-options 802.3ad ae*X* lacp] hierarchy levels:

```
[edit interfaces interface-name gigether-options 802.3ad aeX lacp]
port-priority priority;
```

The port priority is a 2-octet field that is part of the LACP port ID. The LACP port ID consists of the port priority as the two most-significant octets and the port number as the two least-significant octets. The system with the numerically lower value for port priority has the higher priority. By default, port priority is 127, with a range of 0 to 65,535.

Port aggregation selection is made by each system based on the highest port priority and are assigned by the system with the highest priority. Ports are selected and assigned starting with the highest priority port of the highest priority system and working down in priority from there.

Tracing LACP Operations

To trace the operations of the LACP process, include the traceoptions statement at the [edit protocols lacp] hierarchy level:

```
[edit protocols lacp]
traceoptions {
   file <filename> <files number> <size size> <world-readable | no-world-readable>;
   flag flag;
   no-remote-trace;
}
```

You can specify the following flags in the protocols lacp traceoptions statement:

- all—All LACP tracing operations
- configuration—Configuration code
- packet—Packets sent and received
- process—LACP process events
- protocol—LACP protocol state machine
- routing-socket—Routing socket events
- startup—Process startup events

For general information about tracing, see the tracing and logging information in the *JUNOS System Basics Configuration Guide*.

Example: Configuring Aggregated Ethernet LACP

Configure aggregated Ethernet LACP over a VLAN-tagged interface:

LACP with VLAN-Tagged Aggregated Ethernet

```
[edit interfaces]
fe-5/0/1 {
   fastether-options {
      802.3ad ae0;
   }
}
ae0 {
   aggregated-ether-options {
      lacp {
         active;
      }
   }
   vlan-tagging;
   unit 0 {
      vlan-id 100;
      family inet {
         address 10.1.1.2/24 {
            vrrp-group 0 {
               virtual-address 10.1.1.4;
               priority 200;
            }
         }
      }
   }
}
```

Configure aggregated Ethernet LACP over an untagged interface:

LACP with Untagged Aggregated Ethernet

```
[edit interfaces]
fe-5/0/1 {
   fastether-options {
```

```
            802.3ad ae0;
        }
    }
    ae0 {
        aggregated-ether-options {
            lacp {
                active;
            }
        }
        unit 0 {
            family inet {
                address 10.1.1.2/24 {
                    vrrp-group 0 {
                        virtual-address 10.1.1.4;
                        priority 200;
                    }
                }
            }
        }
    }
```

Configuring Tagged Aggregated Ethernet Interfaces

To specify aggregated Ethernet interfaces, include the vlan-tagging statement at the [edit interfaces ae*X*] hierarchy level:

```
[edit interfaces aex]
vlan-tagging;
```

You must also include the vlan-id statement:

```
vlan-id number;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

For more information about the vlan-tagging and vlan-id statements, see "Configuring 802.1Q VLANs" on page 569.

Configuring Untagged Aggregated Ethernet Interfaces

When you configure an untagged Aggregated Ethernet interface, the existing rules for untagged interfaces apply. These rules are as follows:

- You can configure only one logical interface (unit 0) on the port. The logical unit 0 is used to send and receive LACP or marker protocol data units (PDUs) to and from the individual links.

- You cannot include the vlan-id statement in the configuration of the logical interface.

Table 47 on page 603 lists untagged aggregated Ethernet and LACP support by PIC and platform.

Table 47: Untagged Aggregated Ethernet and LACP Support by PIC and Platform

PIC Type	M-series	LACP	T-series	LACP
4-port Fast Ethernet PIC Type 1	Yes	Yes	Yes	Yes
1-port Gigabit Ethernet PIC Type 1	Yes	Yes	Yes	Yes
2-port Gigabit Ethernet PIC Type 2	Yes	Yes	Yes	Yes
4-port Gigabit Ethernet PIC Type 2	Yes	Yes	Yes	Yes
1-port 10-Gigabit Ethernet M160	Yes	Yes	NA	NA
10-port Gigabit Ethernet PIC Type 3	Yes (M120, M320)	Yes	Yes	Yes
1-port 10-Gigabit Ethernet PIC Type 3	N/A	NA	Yes	Yes
8-port Gigabit Ethernet PIC Type 3	Yes	Yes	Yes	Yes

The 8–port Fast Ethernet PIC does not support untagged aggregated Ethernet or LACP.

Syslog messages are logged if you try to configure an untagged aggregated Ethernet interface using an unsupported PIC type.

For more information about configuring LACP, see “Configuring Aggregated Ethernet LACP” on page 597.

Example: Configuring Untagged Aggregated Ethernet Interfaces

Configure an untagged aggregated Ethernet interface by omitting the vlan-tagging and vlan-id statements from the configuration:

```
[edit interfaces]
fe-5/0/1 {
   fastether-options {
      802.3ad ae0;
   }
}
ae0 {
   unit 0 {
      family inet {
         address 13.1.1.2/24 {
            vrrp-group 0 {
               virtual-address 13.1.1.4;
```

```
                    priority 200;
                }
            }
        }
    }
}
```

Configuring Aggregated Ethernet Link Speed

On aggregated Ethernet interfaces, you can set the required link speed for all interfaces included in the bundle. All interfaces that make up a bundle must be the same speed. If you include in the aggregated Ethernet interface an individual link that has a speed different from the speed you specify in the link-speed parameter, an error message will be logged. To set the required link speed, include the link-speed statement at the [edit interfaces *interface-name* aggregated-ether-options] hierarchy level:

```
[edit interfaces interface-name aggregated-ether-options]
link-speed speed ;
```

speed can be in bits per second either as a complete decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000).

Aggregated Ethernet interfaces on the M120 routing platform can have one of the following speed values:

- 100m—Links are 100 Mbps.
- 10g—Links are 10 Gbps.
- 1g—Links are 1 Gbps.
- OC192—Links are OC192 or STM64c.

Configuring Aggregated Ethernet Minimum Links

On aggregated Ethernet interfaces, you can configure the minimum number of links that must be up for the bundle as a whole to be labeled up. By default, only one link must be up for the bundle to be labeled up.

To configure the minimum number of links, include the minimum-links statement at the [edit interfaces *interface-name* aggregated-ether-options] hierarchy level:

```
[edit interfaces interface-name aggregated-ether-options]
minimum-links number;
```

On M120, M320, MX-series, T-series, and TX Matrix routing platforms with Ethernet interfaces, the valid range for minimum-links *number* is 1 through 16. When the maximum value (16) is specified, all configured links of a bundle must be up for the bundle to be labeled up.

On all other routers, the range of valid values for minimum-links *number* is 1 through 8. When the maximum value (8) is specified, all configured links of a bundle must be up for the bundle to be labeled up.

If the number of links configured in an aggregated Ethernet interface is less than the minimum link value configured under the aggregated-ether-options statement, the configuration commit fails and an error message is displayed.

Chapter 34

Stacking and Rewriting Gigabit Ethernet VLAN Tags

This section discusses the following topics:

Stacking and Rewriting Gigabit Ethernet VLAN Tags Overview

On Gigabit Ethernet, Gigabit Ethernet IQ, Gigabit Ethernet IQ2 and IQ2-E, 10-Gigabit Ethernet IQ2 and IQ2-E interfaces, and MX-series router Gigabit Ethernet, Tri-Rate Ethernet copper, and 10-Gigabit Ethernet interfaces with the VLAN encapsulation type configured to support Layer 2 tunneling protocols such as CCC or VPLS (as described in “Configuring 802.1Q VLANs” on page 569), you can stack and rewrite VLAN tags. Stacking and rewriting VLAN tags allows you to use an additional (outer) VLAN tag to differentiate between customer edge (CE) routing platforms that share one VLAN ID. A frame can be received on an interface, or it can be internal to the system (as a result of the input-vlan-map statement).

NOTE: On IQ2 and IQ2-E interfaces and MX-series interfaces, when a VLAN tag is pushed, the inner VLAN IEEE 802.1p bits are copied to the IEEE bits of the VLAN or VLANs being pushed. If the original packet is untagged, the IEEE bits of the VLAN or VLANs being pushed are set to 0.

Stacking and Rewriting Gigabit Ethernet VLAN Tags

You can configure rewrite operations to stack (push), remove (pop), or rewrite (swap) tags on single-tagged frames and dual-tagged frames. If a port is not tagged, rewrite operations are not supported on any logical interface on that port.

You can configure the following VLAN rewrite operations:

- pop—Remove a VLAN tag from the top of the VLAN tag stack. The outer VLAN tag of the frame is removed.
- pop-pop—For Ethernet IQ2 and IQ2-E interfaces, remove both the outer and inner VLAN tags of the frame.
- pop-swap—For Ethernet IQ2 and IQ2-E interfaces, remove the outer VLAN tag of the frame, and replace the inner VLAN tag of the frame with a user-specified VLAN tag value. The inner tag becomes the outer tag in the final frame
- push—Add a new VLAN tag to the top of the VLAN stack. An outer VLAN tag is pushed in front of the existing VLAN tag.
- push-push—For Ethernet IQ2 and IQ2-E interfaces, push two VLAN tags in front of the frame.
- swap-push—For Ethernet IQ2 and IQ2-E interfaces, replace the outer VLAN tag of the frame with a user-specified VLAN tag value. A user-specified outer VLAN tag is pushed in front. The outer tag becomes an inner tag in the final frame.
- swap-swap—For Ethernet IQ2 and IQ2-E interfaces, replace both the inner and the outer VLAN tags of the incoming frame with a user-specified VLAN tag value.

You configure VLAN rewrite operations for logical interfaces in the input VLAN map for incoming frames and in the output VLAN map for outgoing frames. To configure the input VLAN map, include the input-vlan-map statement:

```
input-vlan-map {
    ...interface-specific configuration...
}
```

To configure the output VLAN map, include the output-vlan-map statement:

```
output-vlan-map {
    ...interface-specific configuration...
}
```

You can include both statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]

- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

The type of VLAN rewrite operation permitted depends upon whether the frame is single-tagged or dual-tagged. Table 48 on page 609 shows supported rewrite operations and whether they can be applied to single-tagged frames or dual-tagged frames. The table also indicates the number of tags being added or removed during the operation.

Table 48: Rewrite Operations on Not Tagged, Single-Tagged, and Dual-Tagged Frames

Rewrite Operation	Not Tagged	Single-Tagged	Dual-Tagged	Number of Tags
pop	No	Yes	Yes	– 1
push	Sometimes	Yes	Yes	+ 1
swap	No	Yes	Yes	0
push-push	Sometimes	Yes	Yes	+ 2
swap-push	No	Yes	Yes	+ 1
swap-swap	No	No	Yes	0
pop-pop	No	No	Yes	– 2
pop-swap	No	No	Yes	– 1

The rewrite operations push and push-push can be valid in certain circumstances on frames that are not tagged. For example, a single-tagged logical interface (interface 1) and a dual-tagged logical interface (interface 2) have the following configurations:

Interface 1

```
[edit interfaces interface-name unit logical-unit-number]
input-vlan-map {
    pop;
}
output-vlan-map {
    push;
}
```

Interface 2

```
[edit interfaces interface-name unit logical-unit-number]
input-vlan-map {
    pop-pop;
}
output-vlan-map {
    push-push;
}
```

When a frame is received on the interface as a result of the input-vlan-map operation, the frame is not tagged. As it goes out of the second interface, the output-vlan-map operation push-push is applied to it. The resulting frame will be dual-tagged at the logical interface output.

Depending on the VLAN rewrite operation, you configure the rewrite operation for the interface in the input VLAN map, the output VLAN map, or in both the input VLAN map and the output VLAN map. Table 49 on page 610 shows what rewrite operation combinations you can configure. “None” means that no rewrite operation is specified for the VLAN map.

Table 49: Applying Rewrite Operations to VLAN Maps

	Output VLAN Map								
Input VLAN Map	**none**	**push**	**pop**	**swap**	**push-push**	**swap-push**	**swap-swap**	**pop-pop**	**swap-pop**
none	Yes	No	No	Yes	No	No	Yes	No	No
push	No	No	Yes	No	No	No	No	No	No
pop	No	Yes	No	No	No	No	No	No	No
swap	Yes	No	No	Yes	No	No	No	No	No
push-push	No	No	No	No	No	No	No	Yes	No
swap-push	No	No	No	No	No	No	No	No	Yes
swap-swap	Yes	No	No	No	No	No	Yes	No	No
pop-pop	No	No	No	No	Yes	No	No	No	No
pop-swap	No	No	No	No	No	Yes	No	No	No

As well as knowing if the VLAN rewrite operation is valid, and whether it is applied to the input VLAN map or the output VLAN map, you must also know whether the rewrite operation requires you to include statements to configure the inner and outer TPIDs and inner and outer VLAN IDs in the input VLAN map or output VLAN map. For information about configuring inner and outer TPIDs and inner and outer VLAN IDs, see “Configuring Inner and Outer TPIDs and VLAN IDs” on page 611.

Configuring Frames with Particular TPIDs to Be Processed as Tagged Frames

For Gigabit Ethernet IQ interfaces, aggregated Ethernet with Gigabit Ethernet IQ interfaces, Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform), and MX-series router Gigabit Ethernet, Tri-Rate Ethernet copper, and 10-Gigabit Ethernet interfaces, you can configure frames with particular TPIDs to be processed as tagged frames. To do this, you specify up to eight IEEE 802.1Q TPID values per port; a frame with any of the specified TPIDs is processed as a tagged frame; however, with IQ2 and IQ2-E interfaces, only the first four IEEE 802.1Q TPID values per port are supported. To configure the TPID values, include the tag-protocol-id statement:

```
tag-protocol-id [ tpids ];
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* gigether-options ethernet-switch-profile]
- [edit interfaces *interface-name* aggregated-ether-options ethernet-switch-profile]

All TPIDs you include in input and output VLAN maps must be among those you specify at the [edit interfaces *interface-name* gigether-options ethernet-switch-profile tag-protocol-id [*tpids*]] or [edit interfaces *interface-name* aggregated-ether-options ethernet-switch-profile tag-protocol-id [*tpids*]] hierarchy level.

Configuring Stacked VLAN Tagging

To configure stacked VLAN tagging for all logical interfaces on a physical interface, include the stacked-vlan-tagging statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
stacked-vlan-tagging;
```

If you include the stacked-vlan-tagging statement in the configuration, you must configure dual VLAN tags for all logical interfaces on the physical interface. For more information, see “Stacking a VLAN Tag” on page 614.

Configuring Dual VLAN Tags

To configure dual VLAN tags on a logical interface, include the vlan-tags statement:

```
vlan-tags inner tpid.vlan-id outer tpid.vlan-id;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

The outer tag VLAN ID range is from 1 through 511 for normal interfaces, and from 512 through 4094 for VLAN CCC or VLAN VPLS interfaces. The inner tag is not restricted.

You must also include the stacked-vlan-tagging statement in the configuration. See “Examples: Stacking and Rewriting Gigabit Ethernet IQ VLAN Tags” on page 622.

Configuring Inner and Outer TPIDs and VLAN IDs

For some rewrite operations, you must configure the inner or outer TPID values and inner or outer VLAN ID values. These values can be applied to either the input VLAN map or the output VLAN map.

On Ethernet IQ, IQ2 and IQ2-E interfaces, on MX-series router Gigabit Ethernet, Tri-Rate Ethernet copper, and 10-Gigabit Ethernet interfaces, and on aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX-series routing platforms, include the inner-tag-protocol-id statement to configure the inner TPID. For the inner VLAN ID, include the inner-vlan-id statement. For the outer TPID, include the tag-protocol-id statement. For the outer VLAN ID, include the vlan-id statement:

```
input-vlan-map {
    (pop | pop-pop | pop-swap | push | push-push | swap | swap-push | swap-swap);
    inner-tag-protocol-id tpid;
    inner-vlan-id number;
    tag-protocol-id tpid;
    vlan-id number;
}
output-vlan-map {
    (pop | pop-pop | pop-swap | push | push-push | swap | swap-push | swap-swap);
    inner-tag-protocol-id tpid;
    inner-vlan-id number;
    tag-protocol-id tpid;
    vlan-id number;
}
```

For aggregated Ethernet interfaces using Gigabit Ethernet IQ interfaces, include the tag-protocol-id statement for the outer TPID. For the outer VLAN ID, include the vlan-id statement:

```
input-vlan-map {
    (pop | push | swap);
    tag-protocol-id tpid;
    vlan-id number;
}
output-vlan-map {
    (pop | push | swap);
    tag-protocol-id tpid;
    vlan-id number;
}
```

For the input VLAN map, include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* input-vlan-map]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* input-vlan-map]

For the output VLAN map, include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* output-vlan-map]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* output-vlan-map]

The VLAN IDs you define in the input VLAN maps are stacked on top of the VLAN ID bound to the logical interface. For more information about binding a VLAN ID to the logical interface, see "Configuring 802.1Q VLANs" on page 569.

All TPIDs you include in input and output VLAN maps must be among those you specify at the [edit interfaces *interface-name* gigether-options ethernet-switch-profile tag-protocol-id [*tpids*]] hierarchy level or [edit interfaces *interface-name* aggregated-ether-options ethernet-switch-profile tag-protocol-id [*tpids*]] hierarchy level. For more information, see “Configuring Frames with Particular TPIDs to Be Processed as Tagged Frames” on page 610.

Table 50 on page 613 and Table 51 on page 613 specify when these statements are required. Table 50 on page 613 indicates valid statement combinations for rewrite operations for the input VLAN map. “No” means the statement must not be included in the input VLAN map for the rewrite operation. “Optional” means the statement may be optionally specified for the rewrite operation in the input VLAN map. “Any” means that you must include the vlan-id statement, tag-protocol-id statement, inner-vlan-id statement, or inner-tag-protocol-id statement.

Table 50: Rewrite Operations and Statement Usage for Input VLAN Maps

	Input VLAN Map Statements			
Rewrite Operation	**vlan-id**	**tag-protocol-id**	**inner-vlan-id**	**inner-tag-protocol-id**
push	Optional	Optional	No	No
pop	No	No	No	No
swap	Any	Any	No	No
push-push	Optional	Optional	Optional	optional
swap-push	Optional	Optional	Any	Any
swap-swap	Optional	Optional	Any	Any
pop-swap	No	No	Any	Any
pop-pop	No	No	No	No

Table 51 on page 613 indicates valid statement combinations for rewrite operations for the output VLAN map. “No” means the statement must not be included in the output VLAN map for the rewrite operation. “Optional” means the statement may be optionally specified for the rewrite operation in the output VLAN map.

Table 51: Rewrite Operations and Statement Usage for Output VLAN Maps

	Output VLAN Map Statements			
Rewrite Operation	**vlan-id**	**tag-protocol-id**	**inner-vlan-id**	**inner-tag-protocol-id**
push	No	Optional	No	No
pop	No	No	No	No
swap	No	Optional	No	No
push-push	No	Optional	No	Optional
swap-push	No	Optional	No	Optional

Table 51: Rewrite Operations and Statement Usage for Output VLAN Maps *(continued)*

	Output VLAN Map Statements			
swap-swap	No	Optional	No	Optional
pop-swap	No	No	No	Optional
pop-pop	No	No	No	No

The following examples use Table 50 on page 613 and Table 51 on page 613 and show how the pop-swap operation can be configured in an input VLAN map and an output VLAN map:

Input VLAN Map with inner-vlan-id Statement, Output VLAN Map with Optional inner-tag-protocol-id Statement

```
[edit interfaces interface-name unit logical-unit-number]
input-vlan-map {
    pop-swap;
    inner-vlan-id number;
}
output-vlan-map {
    pop-swap;
    inner-tag-protocol-id tpid;
}
```

Input VLAN Map with inner-tag-protocol-id Statement, Output VLAN map with Optional inner-tag-protocol-id Statement

```
[edit interfaces interface-name unit logical-unit-number]
input-vlan-map {
    pop-swap;
    inner-tag-protocol-id tpid;
}
output-vlan-map {
    pop-swap;
    inner-tag-protocol-id tpid;
}
```

Input VLAN Map with inner-tag-protocol-id and inner-vlan-id Statements

```
[edit interfaces interface-name unit logical-unit-number]
input-vlan-map {
    pop-swap;
    inner-vlan-id number;
    inner-tag-protocol-id tpid;
}
```

Stacking a VLAN Tag

To stack a VLAN tag on all tagged frames entering or exiting the interface, include the push, vlan-id, and tag-protocol-id statements in the input VLAN map or the output VLAN map:

```
input-vlan-map {
    push;
    vlan-id number;
    tag-protocol-id tpid;
}
```

```
output-vlan-map {
    push;
    tag-protocol-id tpid;
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* input-vlan-map]
- [edit interfaces *interface-name* unit *logical-unit-number* output-vlan-map]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* input-vlan-map]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* output-vlan-map]

If you include the push statement in an interface's input VLAN map, see Table 49 on page 610 for information about permissible rewrite operations,

The VLAN IDs you define in the input VLAN maps are stacked on top of the VLAN ID bound to the logical interface. For more information about binding a VLAN ID to the logical interface, see "Configuring 802.1Q VLANs" on page 569.

All TPIDs you include in input and output VLAN maps must be among those you specify at the [edit interfaces *interface-name* gigether-options ethernet-switch-profile tag-protocol-id [*tpids*]] hierarchy level. For more information, see "Configuring Inner and Outer TPIDs and VLAN IDs" on page 611.

Removing a VLAN Tag

To remove a VLAN tag from all tagged frames entering or exiting the interface, include the pop statement in the input VLAN map or output VLAN map:

```
input-vlan-map {
    pop;
}
output-vlan-map {
    pop;
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Removing the Outer and Inner VLAN Tags

On Ethernet IQ, IQ2 and IQ2-E interfaces, on MX-series router Gigabit Ethernet, Tri-Rate Ethernet copper, and 10-Gigabit Ethernet interfaces, and on aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX-series routing platforms, to remove both the outer and inner VLAN tags of the frame, include the pop-pop statement in the input VLAN map or output VLAN map:

```
input-vlan-map {
   pop-pop;
}
output-vlan-map {
   pop-pop;
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* input-vlan-map]
- [edit interfaces *interface-name* unit *logical-unit-number* output-vlan-map]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* input-vlan-map]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* output-vlan-map]

See Table 50 on page 613 and Table 51 on page 613 for information about configuring inner and outer VLAN ID values and inner and outer TPID values required for VLAN maps.

Removing the Outer VLAN Tag and Rewriting the Inner VLAN Tag

On Ethernet IQ, IQ2 and IQ2-E interfaces, on MX-series router Gigabit Ethernet, Tri-Rate Ethernet copper, and 10-Gigabit Ethernet interfaces, and on aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX-series routing platforms, to remove the outer VLAN tag of the frame and replace the inner VLAN tag of the frame with a user-specified VLAN tag value, include the pop-swap statement in the input VLAN map or output VLAN map:

```
input-vlan-map {
   pop-swap;
}
output-vlan-map {
   pop-swap;
}
```

The inner tag becomes the outer tag in the final frame.

You can include this statements a the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* input-vlan-map]
- [edit interfaces *interface-name* unit *logical-unit-number* output-vlan-map]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* input-vlan-map]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* output-vlan-map]

See Table 50 on page 613 and Table 51 on page 613 for information about configuring inner and outer VLAN ID values and inner and outer TPID values required for VLAN maps.

Stacking Two VLAN Tags

On Ethernet IQ, IQ2 and IQ2-E interfaces, on MX-series router Gigabit Ethernet, Tri-Rate Ethernet copper, and 10-Gigabit Ethernet interfaces, and on aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX-series routing platforms, to push two VLAN tags in front of tagged frames entering or exiting the interface, include the push-push statement in the input VLAN map or the output VLAN map:

```
input-vlan-map {
    push-push;
}
output-vlan-map {
    push-push;
}
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* input-vlan-map]
- [edit interfaces *interface-name* unit *logical-unit-number* output-vlan-map]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* input-vlan-map]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* output-vlan-map]

See Table 50 on page 613 and Table 51 on page 613 for information about configuring inner and outer VLAN ID values and inner and outer TPID values required for VLAN maps.

Rewriting the VLAN Tag on Tagged Frames

To rewrite the VLAN tag on all tagged frames entering the interface to a specified VLAN ID and TPID, include the swap, tag-protocol-id, and vlan-id statements in the input VLAN map:

```
input-vlan-map {
    swap;
    vlan-id number;
    tag-protocol-id tpid;
}
```

To rewrite the VLAN tag on all tagged frames exiting the interface to a specified VLAN ID and TPID, include the swap and tag-protocol-id statements in the output VLAN map:

```
output-vlan-map {
    swap;
```

```
    vlan-id number;
    tag-protocol-id tpid;
}
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* input-vlan-map]
- [edit interfaces *interface-name* unit *logical-unit-number* output-vlan-map]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* input-vlan-map]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* output-vlan-map]

You cannot include both the swap statement and the vlan-id statement in the output VLAN map configuration. If you include the swap statement in the configuration, the VLAN ID in outgoing frames is rewritten to the VLAN ID bound to the logical interface. For more information about binding a VLAN ID to the logical interface, see "Configuring 802.1Q VLANs" on page 569.

The swap operation works on the outer tag only, whether or not you include the stacked-vlan-tagging statement in the configuration. For more information, see "Examples: Stacking and Rewriting Gigabit Ethernet IQ VLAN Tags" on page 622.

Rewriting a VLAN Tag on Untagged Frames

On M320, M120, and MX-series routers with Gigabit Ethernet IQ, IQ2, and IQ2E PICs, 10-Gigabit Ethernet IQ, IQ2, and IQ2E PICs, and on MX-series 40-port Gigabit Ethernet R, 40-port Gigabit Ethernet R EQ, 4-port 10-Gigabit Ethernet R, and 4-port 10-Gigabit Ethernet R EQ DPCs, you can rewrite VLAN tags on untagged incoming and outgoing frames under ethernet-ccc and ethernet-vpls encapsulations. On MX-series routers with IQ2 and IQ2-E PICs, you can perform all rewrite VLAN tag operations. These features provide added flexibility.

Consider a network where two provider edges (PE) are connected by a layer 2 circuit. PE1 is receiving traffic on an untagged port while the corresponding port on PE2 is tagged. In the normal case, packets coming from PE1 will be dropped at PE2 because it is expecting tagged packets. However, if PE1 can push a VLAN tag on the incoming packet before sending it across to PE2, you can ensure that packets are not dropped. To make it work in both directions, PE1 must strip the VLAN tag from outgoing packets. Therefore, a push on the ingress side is always paired with a pop on the egress side.

The following rewrite operations are supported under ethernet-ccc and ethernet-vpls encapsulations:

- **push**—A VLAN tag is added to the incoming untagged frame.
- **pop**—VLAN tag is removed from the outgoing frame.
- **push-push**—An outer and inner VLAN tag are added to the incoming untagged frame.
- **pop-pop**—Both the outer and inner VLAN tags of the outgoing frame are removed.

IQ2 and 10-Gigabit Ethernet PICs support all rewrite operations described above. Details on the possible combinations of usage are explained later in this section.

NOTE: **push-push** and **pop-pop** operations are not supported on the Gigabit Ethernet IQ PIC.

In the input-vlan-map, only the push and push-push operations are permitted because it does not make sense to remove a VLAN tag from an incoming untagged frame. Similarly, only pop and pop-pop operations are allowed in the output-vlan-map. Also, for push and push-push operations, the tag parameters have to be explicitly specified. Apart from this, the other rules for configuring input-vlan-map and output-vlan-map remain the same as for tagged frames. Table 52 on page 619 through Table 54 on page 619 explain the rules in more detail.

In the input-vlan-map, only the push and push-push operations are permitted because it does not make sense to remove a VLAN tag from an incoming untagged frame. Similarly, only pop and pop-pop operations will be allowed in the output-vlan-map. Also, for push and push-push operations, the vlan-id parameters (vlan-id for push and vlan-id/inner-vlan-id for push-push) have to be explicitly specified. TPID however, is optional and the default value of *0x8100* will be set if not configured. Apart from this, the other rules for configuring input-vlan-map and output-vlan-map remain the same as for tagged frames.

Table 52: Input VLAN map statements allowed for ethernet-ccc and ethernet-vpls encapsulations

Operation	vlan-id	tag-protocol-id	inner-vlan-id	inner-tag-protocol-id
push	Yes	Optional	No	Optional
push-push	Yes	Optional	Yes	Optional

Table 53: Output VLAN map statements allowed for ethernet-ccc and ethernet-vpls encapsulations

Operation	vlan-id	tag-protocol-id	inner-vlan-id	inner-tag-protocol-id
pop	No	No	No	No
pop-pop	No	No	No	No

Table 54: Rules for applying rewrite operations to VLAN maps

	Output VLAN Map		
Input VLAN Map	None	pop	pop-pop
None	Yes	No	No
push	No	Yes	No
push-push	No	No	Yes

Example: push and pop with Ethernet CCC Encapsulation

```
ge-3/1/0 {
    encapsulation ethernet-ccc;
    unit 0 {
        encapsulation ethernet-ccc;
        input-vlan-map {
            push;
            tag-protocol-id 0x8100;
            vlan-id 600;
        }
        output-vlan-map pop;
        family ccc;
    }
}
```

Example: push-push and pop-pop with Ethernet CCC Encapsulation

```
ge-3/1/0 {
    encapsulation ethernet-ccc;
    unit 0 {
        encapsulation ethernet-ccc;
        input-vlan-map {
            push-push;
            tag-protocol-id 0x8100;
            inner-tag-protocol-id 0x8100;
            vlan-id 600;
            inner-vlan-id 575;
        }
        output-vlan-map pop-pop;
        family ccc;
    }
}
```

Example: push and pop with Ethernet VPLS Encapsulation

```
ge-3/1/0 {
    encapsulation ethernet-vpls;
    unit 0 {
        encapsulation ethernet-vpls;
        input-vlan-map {
            push;
            tag-protocol-id 0x8100;
            vlan-id 700;
        }
        output-vlan-map pop;
        family vpls;
    }
}
```

Example: push-push and pop-pop with Ethernet VPLS Encapsulation

```
ge-3/1/0 {
    encapsulation ethernet-vpls;
    unit 0 {
        encapsulation ethernet-vpls;
        input-vlan-map {
            push-push;
            tag-protocol-id 0x8100;
            inner-tag-protocol-id 0x8100;
            vlan-id 600;
            inner-vlan-id 575;
```

```
        }
        output-vlan-map pop-pop;
        family vpls;
    }
}
```

You can use the show interface *interface-name* command to display the status of a modified VLAN map for the specified interface.

Rewriting a VLAN Tag and Adding a New Tag

On Ethernet IQ, IQ2 and IQ2-E interfaces, on MX-series router Gigabit Ethernet, Tri-Rate Ethernet copper, and 10-Gigabit Ethernet interfaces, and on aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX-series routing platforms, to replace the outer VLAN tag of the incoming frame with a user-specified VLAN tag value, include the swap-push statement in the input VLAN map or output VLAN map:

```
input-vlan-map {
    swap-push;
}
output-vlan-map {
    swap-push;
}
```

A user-specified outer VLAN tag is pushed in front. The outer tag becomes an inner tag in the final frame.

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

See Table 50 on page 613 and Table 51 on page 613 for information about configuring inner and outer VLAN ID values and inner and outer TPID values required for VLAN maps.

Rewriting the Inner and Outer VLAN Tags

On Ethernet IQ, IQ2 and IQ2-E interfaces, on MX-series router Gigabit Ethernet, Tri-Rate Ethernet copper, and 10-Gigabit Ethernet interfaces, and on aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX-series routing platforms, to replace both the inner and the outer VLAN tags of the incoming frame with a user-specified VLAN tag value, include the swap-swap statement in the input VLAN map or output VLAN map:

```
input-vlan-map {
    swap-swap;
}
output-vlan-map {
```

```
    swap-swap;
}
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* output-vlan-map]
- [edit interfaces *interface-name* unit *logical-unit-number* input-vlan-map]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* output-vlan-map]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* input-vlan-map]

See Table 50 on page 613 and Table 51 on page 613 for information about configuring inner and outer VLAN ID values and inner and outer TPID values required for VLAN maps.

Examples: Stacking and Rewriting Gigabit Ethernet IQ VLAN Tags

Configure a VLAN CCC tunnel in which Ethernet frames enter the tunnel at interface ge-4/0/0 and exit the tunnel at interface ge-4/2/0.

The following examples show how to perform the following tasks:

- Push a TPID and VLAN ID pair on ingress.
- Stack inner and outer VLAN tags.
- Swap a VLAN ID on ingress.
- Swap a VLAN ID on egress.
- Swap a VLAN ID on both ingress and egress.
- Swap the outer VLAN tag and push a new VLAN tag on ingress; pop the outer VLAN tag and swap the inner VLAN tag on egress.
- Swap a VLAN ID and TPID pair for both VLAN tags on ingress and on egress.
- Pop the outer VLAN tag and swap the inner VLAN tag on ingress; swap the outer VLAN tag and push a new VLAN tag on egress.
- Pop two VLAN ID and TPID pairs on ingress; push two VLAN ID and TPID pairs on egress.

Push a TPID and VLAN ID Pair on Ingress

```
[edit interfaces]
ge-4/0/0 {
    vlan-tagging;
    encapsulation vlan-ccc;
    gigether-options {
        ethernet-switch-profile {
            tag-protocol-id 0x9909;
        }
    }
    unit 0 {
        encapsulation vlan-ccc;
        vlan-id 512;
```

```
        input-vlan-map {
            push;
            tag-protocol-id 0x9909;
            vlan-id 520;
        }
        output-vlan-map pop;
    }
}
ge-4/2/0 {
    vlan-tagging;
    encapsulation vlan-ccc;
    unit 0 {
        encapsulation vlan-ccc;
        vlan-id 515;
        input-vlan-map {
            swap-push;
            vlan-id 520;
            inner-vlan-id 512;
        }
        output-vlan-map {
            pop-swap;
        }
    }
    [edit protocols]
    mpls {
        interface ge-4/0/0.0;
        interface ge-4/2/0.0;
    }
    connections {
        interface-switch vlan-tag-push {
            interface ge-4/0/0.0;
            interface ge-4/2/0.0;
        }
    }
}
```

Stack Inner and Outer VLAN Tags

```
[edit interfaces]
ge-0/2/0 {
    stacked-vlan-tagging;
    mac 00.01.02.03.04.05;
    gigether-options {
        loopback;
    }
    unit 0 {
        vlan-tags outer 0x8100.200 inner 0x8100.200;
    }
}
```

Swap a VLAN ID on Ingress

```
[edit interfaces]
ge-4/0/0 {
    vlan-tagging;
    encapsulation vlan-ccc;
    gigether-options {
        ethernet-switch-profile {
            tag-protocol-id 0x9100;
```

```
        }
    }
    ...
    unit 1 {
        encapsulation vlan-ccc;
        vlan-id 1000;
        input-vlan-map {
            swap;
            tag-protocol-id 0x9100;
            vlan-id 2000;
        }
    }
}
ge-4/2/0 {
    vlan-tagging;
    encapsulation vlan-ccc;
    ...
    unit 1 {
        encapsulation vlan-ccc;
        vlan-id 2000;
        input-vlan-map {
            swap;
            tag-protocol-id 0x9100;
            vlan-id 1000;
        }
    }
    [edit protocols]
    mpls {
        ...
        interface ge-4/0/0.1;
        interface ge-4/2/0.1;
    }
    connections {
        ...
        interface-switch vlan-tag-swap {
            interface ge-4/2/0.1;
            interface ge-4/0/0.1;
        }
    }
}
```

Swap a VLAN ID on Egress

```
[edit interfaces]
ge-4/0/0 {
    vlan-tagging;
    encapsulation vlan-ccc;
    ...
    unit 1 {
        encapsulation vlan-ccc;
        vlan-id 1000;
    }
}
ge-4/2/0 {
    vlan-tagging;
    encapsulation vlan-ccc;
    gigether-options {
```

```
        ethernet-switch-profile {
            tag-protocol-id 0x8800;
        }
    }
    ...
    unit 1 {
        encapsulation vlan-ccc;
        vlan-id 2000;
        output-vlan-map {
            swap;
            tag-protocol-id 0x8800;
        }
    }
}
[edit protocols]
mpls {
    ...
    interface ge-4/0/0.1;
    interface ge-4/2/0.1;
}
connections {
    ...
    interface-switch vlan-tag-swap {
        interface ge-4/2/0.1;
        interface ge-4/0/0.1;
    }
}
```

Swap a VLAN ID on Both Ingress and Egress

```
[edit interfaces]
ge-4/0/0 {
    vlan-tagging;
    encapsulation vlan-ccc;
    gigether-options {
        ethernet-switch-profile {
            tag-protocol-id [ 0x8800 0x9100 ];
        }
    }
    ...
    unit 1 {
        encapsulation vlan-ccc;
        vlan-id 1000;
        input-vlan-map {
            swap;
            tag-protocol-id 0x9100;
            vlan-id 2000;
        }
    }
}
ge-4/2/0 {
    vlan-tagging;
    encapsulation vlan-ccc;
    gigether-options {
        ethernet-switch-profile {
            tag-protocol-id [ 0x8800 0x9100 ];
        }
```

```
    }
    unit 1 {
        encapsulation vlan-ccc;
        vlan-id 2000;
        output-vlan-map {
            swap;
            tag-protocol-id 0x8800;
        }
    }
}
[edit protocols]
mpls {
    ...
    interface ge-4/0/0.1;
    interface ge-4/2/0.1;
}
connections {
    ...
    interface-switch vlan-tag-swap {
        interface ge-4/2/0.1;
        interface ge-4/0/0.1;
    }
}
```

Swap the Outer VLAN Tag and Push a New VLAN Tag on Ingress; Pop the Outer VLAN Tag and Swap the Inner VLAN Tag on Egress

```
[edit interfaces]
ge-1/1/0 {
    unit 1 {
        vlan-id 200;
        input-vlan-map {
            swap-push;
            tag-protocol-id 0x9100;
            vlan-id 400;
            inner-tag-protocol-id 0x9100;
            inner-vlan-id 500;
        }
        output-vlan-map {
            pop-swap;
            inner-tag-protocol-id 0x9100;
        }
    }
}
```

Swap a TPID and VLAN ID Pair for Both VLAN Tags on Ingress and on Egress

```
[edit interfaces]
ge-1/1/0 {
    unit 0 {
        vlan-tags {
            inner 0x9100.425;
            outer 0x9200.525;
        }
        input-vlan-map {
            swap-swap;
            tag-protocol-id 0x9100;
            vlan-id 400;
            inner-tag-protocol-id 0x9100;
            inner-vlan-id 500;
```

```
        }
        output-vlan-map {
            swap-swap;
            tag-protocol-id 0x9200;
            inner-tag-protocol-id 0x9100;
        }
    }
}
```

Pop the Outer VLAN Tag and Swap the Inner VLAN Tag on Ingress; Swap the Outer VLAN Tag and Push a New VLAN Tag on Egress

```
[edit interfaces]
ge-1/1/0 {
    unit 0 {
        vlan-tags {
            inner 0x9100.425;
            outer 0x9200.525;
        }
        input-vlan-map {
            pop-swap;
            tag-protocol-id 0x9100;
            vlan-id 400;
        }
        output-vlan-map{
            swap-push;
            tag-protocol-id 0x9200;
            inner-tag-protocol-id 0x9100;
        }
    }
}
```

Pop a TPID and VLAN ID Pair on Ingress; Push a VLAN ID and TPID Pair on Egress

```
[edit interfaces]
ge-1/1/0 {
    unit 0 {
        vlan-tags {
            inner 0x9100.425;
            outer 0x9200.525;
        }
        input-vlan-map{
            pop-pop;
        }
        output-vlan-map {
            push-push;
            tag-protocol-id 0x9200;
            inner-tag-protocol-id 0x9100;
        }
    }
}
```

POP an Outer VLAN Tag to Connect an Untagged VPLS Interface to Tagged VPLS Interfaces

```
[edit interfaces]
ge-1/1/0 {
    vlan-tagging;
    encapsulation extended-vlan-vpls;
    unit 0 {
        vlan-id 0;
        input-vlan-map {
            push;
```

```
            vlan-id 0;
        }
        output-vlan-map pop;
        family vpls;
    }
}
```

Chapter 35

Configuring Layer 2 Bridging Interfaces

This section contains the following topics:

Layer 2 Bridging Interfaces Overview

Bridging operates at Layer 2 of the OSI reference model while routing operates at Layer 3. A set of logical ports configured for bridging can be said to constitute a bridging domain.

A bridging domain can be created by configuring a routing instance and specifying the instance-type as bridge.

Integrated routing and bridging (IRB) is the ability to:

- Route a packet if the destination MAC address is the MAC address of the router and the packet ethertype is IPv4, IPv6, or MPLS.
- Switch all multicast and broadcast packets within a bridging domain at layer 2.
- Route a copy of the packet if the destination MAC address is a multicast address and the ethertype is IPv4 or IPv6.
- Switch all other unicast packets at Layer 2.
- Handle supported Layer 2 control packets such as STP and LACP.
- Handle supported Layer 3 control packets such as OSPF and RIP.

Configuring Layer 2 Bridging Interfaces

You can configure an IRB logical interface at the [edit interfaces ge-*fpc /pic/port* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces ge-fpc/pic/port]
unit logical-unit-number {
}
```

You can configure Layer 3 information on the IRB logical interface by including the irb statement at the [edit interfaces] hierarchy level:

```
[edit interfaces]
irb {
   unit logical-unit-number {
      family inet {
         address address {
         }
      }
   }
}
```

For examples of Layer 2 bridging configuration, see the *JUNOS Routing Protocols Configuration Guide*.

Example: Configuring Layer 2 Bridging Interfaces

The following example configures an IRB logical interface and Layer 3 information on the interface.

```
[edit interfaces]
ge-1/0/0 {
   unit 0 {
   }
}
irb {
   unit 0 {
      family inet {
      address 192.168.12.1/28;
      }
   }
}
```

Chapter 36

Configuring TCC and Layer 2.5 Switching

This section contains the following topics:

TCC and Layer 2.5 Switching Overview

Translational cross-connect (TCC) is a switching concept that allows you to forward traffic between a variety of Layer 2 protocols or circuits. It is similar to its predecessor, CCC. However, while CCC requires the same Layer 2 encapsulations on both sides of a routing platform (such as Point-to-Point Protocol [PPP] or Frame Relay-to-Frame Relay), TCC lets you connect different types of Layer 2 protocols interchangeably. With TCC, combinations such as PPP-to-ATM and Ethernet-to-Frame Relay cross-connections are possible.

Configuring VLAN TCC Encapsulation

VLAN TCC encapsulation allows circuits to have different media on either side of the forwarding path. VLAN TCC encapsulation supports TPID 0x8100 only. You must include configuration statements at the logical and physical interface hierarchy levels.

To configure VLAN TCC encapsulation, include the encapsulation statement and specify the vlan-tcc option:

```
[edit interfaces interface-name unit logical-unit-number]
encapsulation vlan-tcc;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Additionally, configure the logical interface by including the proxy and remote statements:

```
proxy {
  inet-address;
```

```
}
remote {
   (inet-address | mac-address);
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family tcc]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family tcc]

The proxy address is the IP address of the non-Ethernet TCC neighbor for which the TCC routing platform is acting as a proxy.

The remote address is the IP or MAC address of the remote routing platform. The remote statement provides ARP capability from the TCC switching routing platform to the Ethernet neighbor. The MAC address is the physical Layer 2 address of the Ethernet neighbor.

When VLAN TCC encapsulation is configured on the logical interface, you also must specify flexible Ethernet services on the physical interface. To specify flexible Ethernet services, include the encapsulation statement at the [edit interfaces *interface-name*] hierarchy level and specify the flexible-ethernet-services option:

```
[edit interfaces interface-name]
encapsulation flexible-ethernet-services;
```

Extended VLAN TCC encapsulation supports TPIDs 0x8100 and 0x9901. Extended VLAN TCC is specified at the physical interface level. When configured, all units on that interface must use VLAN TCC encapsulation, and no explicit configuration is needed on logical interfaces.

One-port Gigabit Ethernet, 2-port Gigabit Ethernet, and 4-port Fast Ethernet PICs with VLAN tagging enabled can use VLAN TCC encapsulation. To configure the encapsulation on a physical interface, include the encapsulation statement at the [edit interfaces *interface-name*] hierarchy level and specify the extended-vlan-tcc option:

```
[edit interfaces interface-name]
encapsulation extended-vlan-tcc;
```

For VLAN TCC encapsulation, all VLAN IDs from 1 through 1024 are valid. VLAN ID 0 is reserved for tagging the priority of frames.

Extended VLAN TCC is not supported on 4-port Gigabit Ethernet PICs.

Configuring Ethernet TCC

For Layer 2.5 virtual private networks (VPNs) using an Ethernet interface as the TCC routing platform, you can configure an Ethernet TCC.

To configure an Ethernet TCC, include the encapsulation statement and specify the ethernet-tcc option at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
encapsulation ethernet-tcc;
```

For Ethernet TCC encapsulation, you must also configure the logical interface by including the proxy and remote statements:

```
proxy {
   inet-address;
}
remote {
   (inet-address | mac-address);
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family tcc]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family tcc]

The proxy address is the IP address of the non-Ethernet TCC neighbor for which the TCC routing platform is acting as a proxy.

The remote address is the IP or MAC address of the remote routing platform. The remote statement provides ARP capability from the TCC switching routing platform to the Ethernet neighbor. The MAC address is the physical Layer 2 address of the Ethernet neighbor.

Ethernet TCC is supported on interfaces that carry IPv4 traffic only. For 8-port, 12-port, and 48-port Fast Ethernet PICs, TCC and extended VLAN CCC are not supported. For 4-port Gigabit Ethernet PICs, extended VLAN CCC and extended VLAN TCC are not supported.

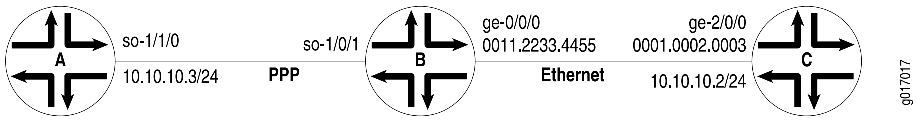
Example: Configuring an Ethernet TCC or Extended VLAN TCC

Configure a full-duplex Layer 2.5 translational cross-connect between Router A and Router C, using a Juniper Networks routing platform, Router B, as the TCC interface. Ethernet TCC encapsulation provides an Ethernet wide area circuit for interconnecting IP traffic. (See the topology in Figure 54 on page 634.)

The Router A-to-Router B circuit is PPP, and the Router B-to-Router C circuit accepts packets carrying standard TPID values.

If traffic flows from Router A to Router C, the JUNOS software strips all PPP encapsulation data from incoming packets and adds Ethernet encapsulation data before forwarding the packets. If traffic flows from Router C to Router A, the JUNOS software strips all Ethernet encapsulation data from incoming packets and adds PPP encapsulation data before forwarding the packets.

Figure 54: Topology of Layer 2.5 Translational Cross-Connect



On Router B

```
interfaces ge-0/0/0 {
    encapsulation ethernet-tcc;
    unit 0 {
        family tcc {
            proxy {
                inet-address 10.10.10.3;
            }
            remote {
                inet-address 10.10.10.2;
            }
        }
    }
}
```

Configure a full-duplex Layer 2.5 translational cross-connect between Router A and Router C, using a Juniper Networks routing platform, Router B, as the TCC interface. Extended VLAN TCC encapsulation provides an Ethernet wide area circuit for interconnecting IP traffic. (See the topology in Figure 54 on page 634.)

Configuring an Extended VLAN TCC

The Router A-to-Router B circuit is PPP, and the Router B-to-Router C circuit is Ethernet with VLAN tagging enabled.

On Router B

```
interfaces ge-0/0/0 {
    vlan-tagging;
    encapsulation extended-vlan-tcc;
    unit 0 {
        vlan-id 1;
        family tcc {
            proxy {
                inet-address 10.10.10.3/24;
            }
            remote {
                inet-address 10.10.10.2/24;
            }
        }
    }
}
```

Chapter 37

Configuring Static ARP Table Entries

This section contains the following topics:

Static ARP Table Entries Overview

For Fast Ethernet, Gigabit Ethernet, Tri-Rate Ethernet copper, and 10-Gigabit Ethernet interfaces, you can configure static ARP table entries, defining mappings between IP and MAC addresses.

Configuring Static ARP Table Entries

To configure static ARP table entries, include the arp statement:

```
arp ip-address (mac | multicast-mac) mac-address <publish>;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address*]

The IP address that you specify must be part of the subnet defined in the enclosing address statement.

To associate a multicast MAC address with a unicast IP address, include the multicast-mac statement.

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

For unicast MAC addresses only, if you include the publish option, the routing platform replies to proxy ARP requests.

NOTE: By default, an ARP policer is installed that is shared among all the Ethernet interfaces on which you have configured the family inet statement. By including the arp statement at the [edit interfaces *interface-name* unit *logical-unit-number* family inet policer] hierarchy level, you can apply a specific ARP-packet policer to an interface. For more information, see "Applying Policers" on page 185.

When you need to conserve IP addresses, you can configure an Ethernet interface to be unnumbered by including the unnumbered-address statement at the [edit interfaces *interface-name* unit *logical-unit-number* family inet] hierarchy level. For more information, see "Configuring an Unnumbered Interface" on page 176.

NOTE: The JUNOS software supports the IPv6 static neighbor discovery cache entries, similar to the static ARP entries in IPv4.

Example: Configuring Static ARP Table Entries

Configure two static ARP table entries on the routing platform's management interface:

```
[edit interfaces]
fxp0 {
    unit 0 {
        family inet {
            address 10.10.0.11/24 {
                arp 10.10.0.99 mac 0001.0002.0003;
                arp 10.10.0.101 mac 00:11:22:33:44:55 publish;
            }
        }
    }
}
```

Chapter 38

Configuring Unrestricted Proxy ARP

This section contains the following topics:

Unrestricted Proxy ARP Overview

By default, the JUNOS software responds to an ARP request only if the destination address of the ARP request is local to the incoming interface.

For Ethernet interfaces, you can configure unrestricted proxy ARP, which enables the router to respond to any ARP request, on condition that the router has an active route to the destination address of the ARP request. The route is not limited to the incoming interface of the request, nor is it required to be a direct route.

You might want to configure unrestricted proxy ARP for routers that are acting as provider edge (PE) devices in Ethernet Layer 2 LAN switching domains.

WARNING: If you configure unrestricted proxy ARP, the proxy router replies to ARP requests for the target IP address on the same interface as the incoming ARP request. This behavior is appropriate for cable modem termination system (CMTS) environments, but might cause Layer 2 reachability problems if you enable unrestricted proxy ARP in other environments.

When an IP client broadcasts the ARP request across the Ethernet wire, the end node with the correct IP address responds to the ARP request and provides the correct MAC address. If the unrestricted proxy ARP feature is enabled, the router response is redundant and might fool the IP client into determining that the destination MAC address within its own subnet is the same as the address of the router.

While the destination address can be remote, the source address of the ARP request must be on the same subnet as the interface upon which the ARP request is received. For security reasons, this rule applies to both unrestricted and restricted proxy ARP.

In most situations, you should not configure the router to perform unrestricted proxy ARP. Do so only for special situations, such as when cable modems are used. Figure 55 on page 638 and Figure 56 on page 638 show examples of situations in which you might want to configure unrestricted proxy ARP.

In Figure 55 on page 638, the edge device is not running any IP protocols. In this case, you configure the core router to perform unrestricted proxy ARP. The edge device is the client of the proxy.

In Figure 56 on page 638, the Broadcast Remote Access Server (B-RAS) routers are not running any IP protocols. In this case, you configure unrestricted proxy ARP on the B-RAS interfaces. This allows the core device to behave as though it is directly connected to the end users.

Figure 55: Edge Device Case for Unrestricted Proxy ARP

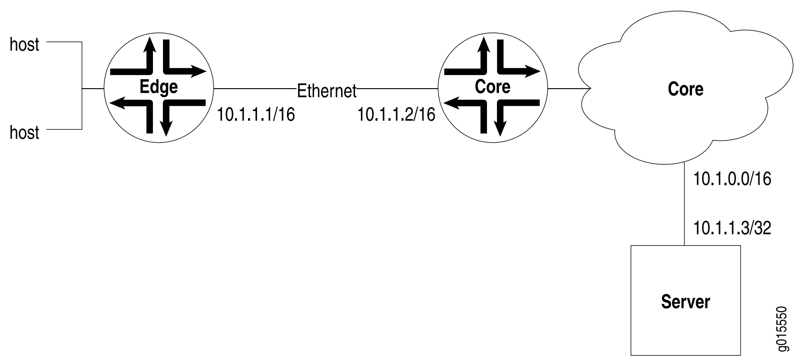
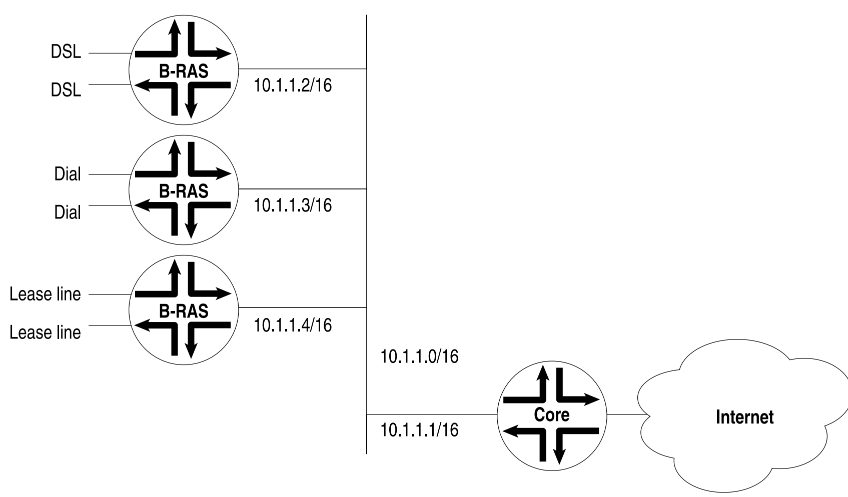


Figure 56: Core Device Case for Unrestricted Proxy ARP



Configuring Unrestricted Proxy ARP

To configure unrestricted proxy ARP, include the proxy-arp statement:

```
proxy-arp;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]

- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

To return to the default—that is, to disable unrestricted proxy ARP—delete the proxy-arp statement from the configuration:

```
[edit]
user@host# delete interfaces interface-name unit logical-unit-number proxy-arp
```

You can track the number of unrestricted proxy ARP requests processed by the router by issuing the show system statistics arp operational mode command.

Chapter 39

Configuring MAC Address Validation on Static Ethernet Interfaces

This section contains the following topics:

MAC Address Validation on Static Ethernet Interfaces Overview

MAC address validation enables the router to validate that received packets contain a trusted IP source and an Ethernet MAC source address.

MAC address validation is supported on AE, Fast Ethernet, Gigabit Ethernet, and 10–Gigabit Ethernet interfaces (with or without VLAN tagging) on MX-series routers only.

There are two types of MAC address validation that you can configure:

- Loose—Forwards packets when both the IP source address and the MAC source address match one of the trusted address tuples.

  Drops packets when the IP source address matches one of the trusted tuples, but the MAC address does not support the MAC address of the tuple

  Continues to forward packets when the source address of the incoming packet does not match any of the trusted IP addresses.

- Strict—Forwards packets when both the IP source address and the MAC source address match one of the trusted address tuples.

  Drops packets when the MAC address does not match the tuple's MAC source address, or when IP source address of the incoming packet does not match any of the trusted IP addresses.

Configuring MAC Address Validation on Static Ethernet Interfaces

To configure MAC address validation on static Ethernet interfaces, include the mac-validate (loose | strict) statement in the [edit interfaces *interface-name* unit *logical-unit-number* family *family*] hierarchy:

```
[edit interfaces interface-name unit logical-unit-number family family]
mac-validate (loose | strict);
```

Example of Strict MAC Validation on a Static Ethernet Interface

This example shows strict MAC address validation on a static Ethernet interface without VLAN tagging.

```
[edit interfaces]
ge-2/1/9 {
    unit 0 {
        proxy-arp;
        family inet {
            mac-validate strict;
            address 88.22.100.1/24 {
                arp 88.22.100.3 mac 00:00:58:16:64:03;
            }
        }
    }
}
```

Chapter 40

Enabling Passive Monitoring on Ethernet Interfaces

This section contains the following topics:

Passive Monitoring on Ethernet Interfaces Overview

The Monitoring Services I and Monitoring Services II PICs are designed to enable IP services. If you have a Monitoring Services PIC and a 4-port Fast Ethernet, 4-port Gigabit Ethernet PIC with SFPs, 10-port Gigabit Ethernet PIC with SFPs, or 1-port 10-Gigabit Ethernet PIC installed in an M40e, M160, MX-series, or T-series routing platform, you can monitor IP version 4 (IPv4) traffic from another routing platform.

Enabling Passive Monitoring on Ethernet Interfaces

On Ethernet interfaces, enable packet flow monitoring by including the passive-monitor-mode statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
passive-monitor-mode;
```

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

- Gigabit and Fast Ethernet interfaces can support both per-port passive monitoring and per-VLAN passive monitoring. The destination MAC filter on the receive port of the Ethernet interfaces is disabled.
- Ethernet encapsulation options are not allowed.

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

```
[edit interfaces mo-fpc/pic/port unit logical-unit-number]
family inet;
```

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

```
[edit interfaces mo-fpc/pic/port unit logical-unit-number family inet]
receive-options-packets;
receive-ttl-exceeded;
```

For the monitoring services interface, you can configure multiservice physical interface properties. For more information, see "Configuring Multiservice Physical Interface Properties" on page 132 and the *JUNOS Services Interfaces Configuration Guide*.

Chapter 41

Configuring IEEE 802.1ag OAM Connectivity-Fault Management

This section contains the following topics:

IEEE 802.1ag OAM Connectivity-Fault Management Overview

Ethernet interfaces on M120, M320, MX-series, and T-series routing platforms support the IEEE 802.1ag standard for Operation, Administration, and Management (OAM). The IEEE 802.1ag specification provides for Ethernet connectivity-fault management (CFM). The goal of CFM is to monitor an Ethernet network that may comprise one or more service instances. JUNOS software supports IEEE 802.1ag connectivity fault management.

Network entities such as operators, providers, and customers may be part of different administrative domains. Each administrative domain is mapped into one maintenance domain. Maintenance domains are configured with different level values to keep them separate. Each domain provides enough information for the entities to perform their own management, perform end-to-end monitoring, and still avoid security breaches.

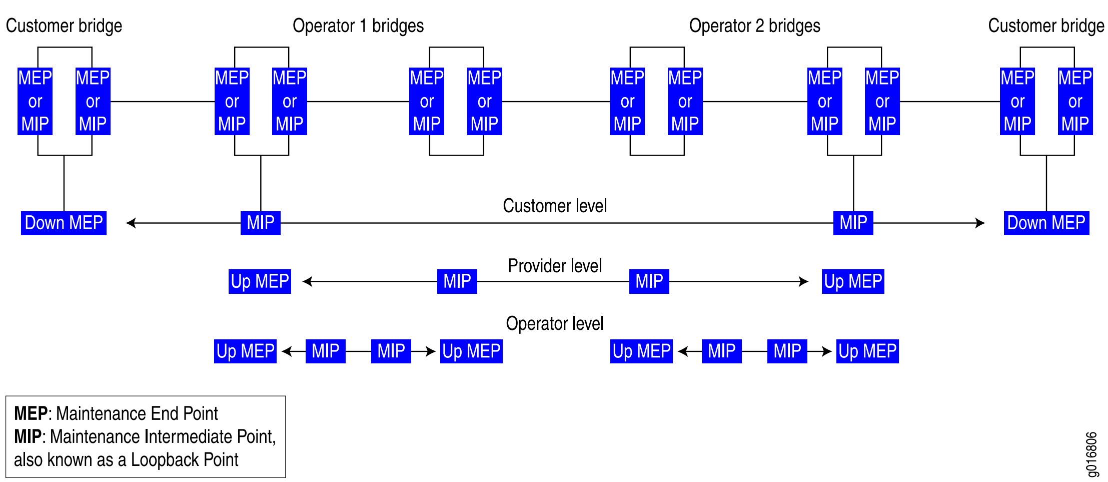
NOTE: As a requirement for Ethernet OAM 802.1ag to work, distributed periodic packet management (PPM) runs on the Routing Engine (RE) and Packet Forwarding Engine (PFE) by default. You can only disable PPM on the PFE. To disable PPM on the PFE, include the ppm <no-delegate-processing> statement at the [edit routing-options ppm] hierarchy level.

IEEE 802.1ag OAM supports graceful Routing Engine switchover. IEEE 802.1ag OAM is supported on untagged, single tagged, and stacked VLAN interfaces.

Connectivity Fault Management Key Elements

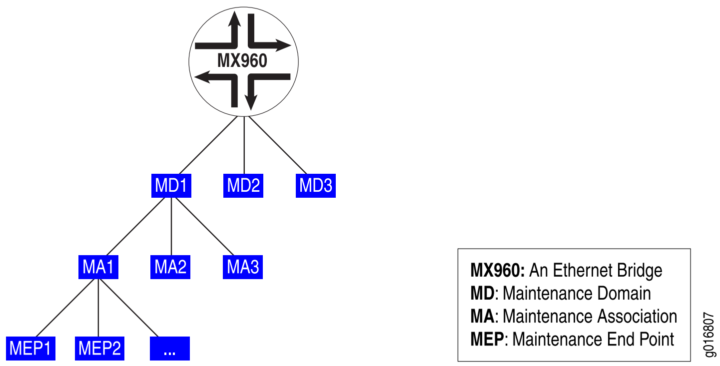
Figure 57 on page 646 shows the relationships between the customer, provider, and operator Ethernet bridges, maintenance domains, maintenance association end points (MEPs), and maintenance intermediate points (MIPs).

Figure 57: Relationship of MEPs, MIPs, and Maintenance Domain Levels



A maintenance association is a set of MEPs configured with the same maintenance association identifier and maintenance domain level. Figure 58 on page 647 shows the hierarchical relationships between the Ethernet bridge, maintenance domains, maintenance associations, and MEPs.

Figure 58: Relationship of Bridges, Maintenance Domains, Maintenance Associations, and MEPs



Continuity Check Protocol

The continuity check protocol is used for fault detection by a MEP within a maintenance association. The MEP periodically sends continuity check multicast messages. The receiving MEPs use the CC messages to build a MEP database of all MEPs in the maintenance association.

The continuity check protocol packets use the ethertype value 0x8902 and the multicast destination MAC address 01:80:c2:00:00:30.

Linktrace Protocol

The linktrace protocol is used for path discovery between a pair of maintenance points. Linktrace messages are triggered by an administrator using the traceroute command to verify the path between a pair of MEPs under the same maintenance association. Linktrace messages can also be used to verify the path between an MEP and an MIP under the same maintenance domain. The operation of IEEE 802.1ag linktrace request and response messages is similar to the operation of Layer 3 traceroute commands. For more information about the traceroute command, see the *JUNOS System Basics Configuration Guide*.

Creating the Maintenance Domain

To enable CFM on an Ethernet interface, maintenance domains, maintenance associations, and MEPs must be created and configured.

To create a maintenance domain, include the maintenance-domain *domain-name* statement at the [edit protocols oam ethernet connectivity-fault-management] hierarchy level.

Give the maintenance domain a name. Names can be in one of several formats.

- Configuring the Maintenance Domain Name Format on page 648
- Configuring the Maintenance Domain Level on page 648

Configuring the Maintenance Domain Name Format

You can specify the maintenance domain name format as a plain ASCII character string, a domain name service (DNS) format, a MAC address plus a two-octet identifier in the range from 0 through 65,535, or none. If none is specified, the maintenance domain name is not used. The default name format is an ASCII character string.

To configure the maintenance domain name format, include the name-format (character-string | none | dns | mac+2octet) statement at the [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name*] hierarchy level.

Configuring the Maintenance Domain Level

The maintenance domain level is a mandatory parameter that indicates the nesting relationship between various maintenance domains. The level is embedded in each of the CFM frames. CFM messages within a given level are processed by MEPs at that same level. For example, the operator domain can be level 0, the provider domain at level 3, and the customer domain level 7.

To configure the maintenance domain level, include the level *number* statement at the [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name*] hierarchy level.

Configuring Maintenance Intermediate Points

MX-series platforms support Maintenance Intermediate Points (MIPs) for Ethernet OAM 802.1ag CFM Protocol at a bridge-domain level. This enables you to define a maintenance domain (MD) for each default level. The MIPs names are created as default-*level-number* at the [edit protocols oam ethernet connectivity-fault-management maintenance-domain] hierarchy level. Use the bridge-domain, routing-instance, domain-instance, and mip-half-function MIP options to specify the MIP configuration.

NOTE: Whenever a MIP is configured and a bridge domain is mapped to multiple maintenance domains (MD) or maintenance associations (MA), it is essential that the mip-half-function value for all MDs and MAs are the same.

To display MIP configurations, use the show oam ethernet connectivity-fault-management mip (bridge-domain | instance-name | interface-name) command.

The following sections describe MIP configuration:

- Configuring the Maintenance Domain Routing Instances Bridge Domain on page 649
- Configuring the Maintenance Domain Routing Instance on page 649

Configuring the Maintenance Domain Routing Instances Bridge Domain

The VLAN corresponds to the bridge domain.

To configure the bridge domain, include the bridge-domain statement at the [edit protocols oam ethernet connectivity-fault-management maintenance-domain routing-instances *name*] hierarchy level.

Configuring the Maintenance Domain Routing Instance

To configure the routing instance, include the routing-instance statement at the [edit protocols oam ethernet connectivity-fault-management maintenance-domain] hierarchy level.

Configuring the Maintenance Domain Instance

To configure the maintenance domain instance, include the instance statement at the [edit protocols oam ethernet connectivity-fault-management maintenance-domain] hierarchy level.

Configuring the Maintenance Domain MIP Half Function

To configure the MIP half function, include the mip-half-function statement at the [edit protocols oam ethernet connectivity-fault-management maintenance-domain] hierarchy level.

Creating the Maintenance Association

To create a maintenance association, include the maintenance-association *ma-name* statement at the [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name*] hierarchy level.

Give the maintenance association a name. The names can be in one of several formats.

Configuring the Maintenance Association Short Name Format

You can specify the maintenance association short name format as a plain ASCII character string, the VLAN identifier of the VLAN you primarily associate with the maintenance association, a two-octet identifier in the range from 0 through 65,535, or a name in the format specified by RFC 2685. The default short name format is ASCII character string.

To configure the maintenance association short name format, include the short-name-format (character-string | vlan | 2octet | rfc-2685-vpn-id) statement at the [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name*] hierarchy level.

Configuring the Continuity Check

You can configure continuity check protocol parameters.

To enable the continuity check protocol, include the continuity-check statement at the [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name*] hierarchy level.

Configuring the Continuity Check Hold Interval

You can specify the continuity check hold interval. The hold interval is the number of minutes to wait before flushing the MEP database if no updates occur. The default value is 10 minutes.

To configure the hold interval, include the hold-interval statement at the [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name* continuity-check] hierarchy level.

Configuring the Continuity Check Interval

You can specify the continuity check message (CCMs) interval. The interval is the time between the transmission of CCMs. You can specify 10 minutes (10m), 1 minute (1m), 10 seconds (10s), 1 second (1s), 100 milliseconds (100ms), or 10 milliseconds (10ms). The default value is 1 minute.

NOTE: For the continuity check message interval to be configured for 10 milliseconds, periodic packet management (PPM) runs on the Routing Engine (RE) and Packet Forwarding Engine (PFE) by default. You can only disable PPM on the PFE. To disable PPM on the PFE, you can use the no-delegate-processing statement at the [edit routing-options ppm] hierarchy level.

To configure the interval, include the interval statement at the [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name* continuity-check] hierarchy level.

Configuring the Continuity Check Loss Threshold

You can specify number of continuity check messages that can be lost before marking the MEP as down. The default value is 3 PDUs.

To configure the loss threshold, include the loss-threshold statement at the [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name* continuity-check] hierarchy level.

Creating a Maintenance End Point

You can configure an MEP.

To configure the maintenance end point, include the mep *mep-id* statement at the [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name*] hierarchy level.

Enabling Maintenance End Point Automatic Discovery

You can enable the MEP to accept continuity check messages from all remote MEPs of the same maintenance association.

To configure the automatic discovery, include the auto-discovery statement at the [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name* mep *mep-id*] hierarchy level:

Configuring the Maintenance End Point Direction

You can specify the direction in which CFM packets are transmitted for the MEP.

Direction up CCMs are transmitted out of every logical interface which is part of the same bridging or VPLS instance except for the interface configured on this MEP.

Direction down CCMs are transmitted only out of the interface configured on this MEP.

NOTE: Ports in the STP blocking state do not block CFM packets destined to a down MEP. Ports in STP blocking state without the continuity check protocol configured, do block CFM packets.

To configure the direction, include the direction statement at the [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name* mep *mep-id*] hierarchy level.

Configuring the Maintenance End Point Interface

You must specify the interface to which the MEP is attached. It can be a physical interface, logical interface or trunk interface.

On MX-series routers, you can enable the MEP on a specific VLAN of a trunk interface.

To configure the interface, include the interface *interface-name* statement at the [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name* mep *mep-id*] hierarchy level.

MEP Interface Configuration

This example shows the MEP interface configuration statements:

```
[edit protocols oam ethernet connectivity-fault-management maintenance-domain
   domain-name maintenance-association ma-name]
mep mep-id {
   direction (up | down);
   interface (ge | xe)-(fpc/pic/port | fpc/pic/port.domain | fpc/pic/port.domain vlan
      vlan-id);
   auto-discovery;
   priority number;
}
```

Configuring the Maintenance End Point Priority

You can specify the IEEE 802.1 priority bits that are used by continuity check and link trace messages.

To configure the priority, include the priority statement at the [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name* mep *mep-id*] hierarchy level.

Creating a Remote Maintenance End Point

You can configure a remote MEP from which CCM messages are expected. If autodiscovery is not enabled, the remote MEP must be configured under the mep statement. If the remote MEP is not configured under the mep statement, the CCMs from the remote MEP are treated as errors.

To configure the remote MEP, include the remote-mep statement at the [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name* mep *mep-id*] hierarchy level.

Configuring the Remote Maintenance End Point Action Profile

You can specify the name of the action profile to use for the remote MEP.

To configure the action profile, include the action-profile *profile-name* statement at the [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name* mep *mep-id* remote-mep *mep-id*] hierarchy level. The profile must already be defined at the [edit protocols oam ethernet connectivity-fault-management] hierarchy level.

Creating a Connectivity-Fault Management Action Profile

You can create an action profile and configure the action to be taken when connectivity to a remote MEP fails.

To configure the action profile name, include the action-profile statement at the [edit protocols oam ethernet connectivity-fault-management] hierarchy level.

Configuring a CFM Action Profile Action

You can configure the action to be taken when connectivity to a remote MEP fails.

To configure the action profile action, include the default-action statement at the [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name* mep *mep-id* remote-mep *mep-id* action-profile] hierarchy level.

NOTE: The action profile is supported only on the physical interface level, and not on the logical interface level.

Configuring a CFM Interface Down Action Profile Action

You can enable the interface down action to be taken when connectivity to a remote MEP fails.

To enable the interface down action, include the interface-down statement at the [edit protocols oam ethernet connectivity-fault-management action-profile *profile-name* default-action] hierarchy level.

```
[edit]
protocols {
    oam {
        ethernet {
            connectivity-fault-management {
                action-profile bring-down {
                    default-actions {
                        interface-down;
                    }
                }
                maintenance-domain md1 {
                    level 0;
                        maintenance-association ma1 {
                        continuity-check {
                            interval 100 ms;
                        }
                        mep 4001 {
                            interface ge-4/1/0;
                            direction down;
                            remote-mep 1 {
                                action-profile bring-down;
                            }
                        }
                    }
                }
            }
        }
    }
}
```

NOTE: The action profile is supported only on the physical interface level, and not on the logical interface level.

Configuring the Linktrace Path Age Timer

If no response to a linktrace request is received, the request and response entry is deleted after the age timer expires. The timer is configured in seconds.

Configuring the Linktrace Database Size

Configure the number of linktrace reply entries to be stored per linktrace request. The linktrace database is displayed using the show oam ethernet connectivity-fault-management path-database command.

Configuring Ethernet Local Management Interface

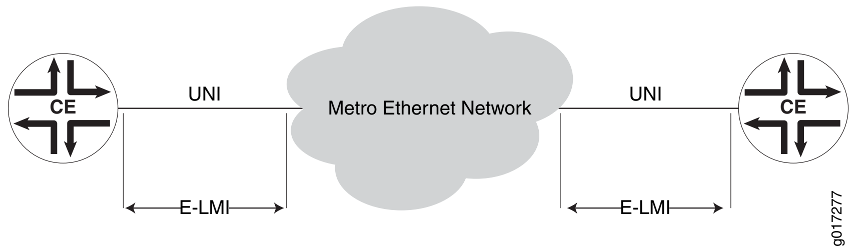
This section contains the following topics:

Ethernet Local Management Interface Overview

MX-series routers with Gigabit Ethernet (ge), 10-Gigabit Ethernet (xe), or Aggregated Ethernet (ae) interfaces support E-LMI. The Ethernet Local Management Interface specification is available at the Metro Ethernet Forum. E-LMI procedures and protocols are used for enabling automatic configuration of the customer edge (CE) to support Metro Ethernet services. The E-LMI protocol also provides user-to-network interface (UNI) and Ethernet Virtual Connection (EVC) status information to the CE. The UNI and EVC information enables automatic configuration of CE operation based on the Metro Ethernet configuration.

The E-LMI protocol operates between the CE device and the provider edge (PE) device. It runs only on the PE-CE link and notifies the CE of connectivity status and configuration parameters of Ethernet services available on the CE port. The scope of the E-LMI protocol is shown in Figure 59 on page 655.

Figure 59: Scope of the E-LMI Protocol



The E-LMI implementation on the MX-series includes only the PE side of the E-LMI protocol.

E-LMI interoperates with an OAM protocol, such as Connectivity Fault Management (CFM), that runs within the provider network to collect OAM status. CFM runs at the provider maintenance level (UNI-N to UNI-N with up MEPs at the UNI). E-LMI relies on the CFM for end-to-end status of Ethernet virtual connections (EVCs) across CFM domains (SVLAN domain or VPLS).

The E-LMI protocol relays the following information:

- Notification to the CE of the addition/deletion of an EVC (active, not active, or partially active)
- Notification to the CE of the availability state of a configured EVC
- Communication of UNI and EVC attributes to the CE:
  - UNI attributes:
    - UNI Identifier (a user-configured name for UNI)
    - CE-VLAN ID/EVC map type (all-to-one bundling, service multiplexing with bundling or no bundling)
    - Bandwidth profile is not supported (including the following features):
      - CM (coupling mode)
      - CF (color flag)
      - CIR (committed Information rate)
      - CBR (committed burst size)
      - EIR (excess information rate)
      - EBS (excess burst size)
  - EVC attributes:
    - EVC reference ID
    - EVC status type (active, not active, or partially active)
    - EVC type (point-to-point or multipoint-to-multipoint)

    - EVC ID (a user-configured name for EVC)
    - Bandwidth profile (not supported)
  - CE-VLAN ID/EVC map

E-LMI on the MX-series supports the following EVC types:

- QinQ SVLAN (point-to-point or multipoint-to-multipoint)—Requires an end-to-end CFM session between UNI-Ns to monitor the EVS status.
- VPLS (BGP or LDP) (point-to-point or multipoint-to-multipoint)—Either VPLS pseudowire status or end-to-end CFM sessions between UNI-Ns can be used to monitor EVC status.
- L2 circuit/L2VPN (point-to-point)—Either VPLS Pseudo-wire status or end-to-end CFM sessions between UNI-Ns can be used to monitor EVC status.

NOTE: l2-circuit and l2vpn are not supported.

Configuring Ethernet Local Management Interface

To configure E-LMI, perform the following steps:

- Configure an OAM Protocol (CFM) on page 656
- Assigning the OAM Protocol to an EVC on page 656
- Enabling E-LMI on an Interface and Mapping CE VLAN IDs to an EVC on page 657

Configure an OAM Protocol (CFM)

For information on configuring OAM protocol (CFM), see "Configuring IEEE 802.1ag OAM Connectivity-Fault Management" on page 645.

Assigning the OAM Protocol to an EVC

To configure an EVC, you must specify a name for the EVC using the evcs*evc-id* statement at the [edit protocols oam ethernet] hierarchy level. You can set the EVC protocol for monitoring EVC statistics to cfm or vpls using the evc-protocol statement and its options at the [edit protocols oam ethernet evcs] hierarchy level.

You can set the number of remote UNIs in the EVC using the remote-uni-count *number* statement at the [edit protocols oam ethernet evcs evcs-protocol] hierarchy level. remote-uni-count defaults to 1. Configuring a value greater than 1 makes the EVC multipoint-to-multipoint. If you enter a value greater than the actual number of endpoints, the EVC status will display as partially active even if all endpoints are up. if you enter a remote-uni-count less than the actual number of endpoints; the status will display as active, even if all endpoints are not up.

Example: Assigning OAM protocol to an EVC

You can configure EVCS using the evcs statement at the [edit protocols oam ethernet] hierarchy level:

```
[edit protocols oam ethernet]
evcs evc-id {
   evc-protocol (<cfm (<management-domain name> <management-association name> )
      |<< vpls (routing-instance name>>>)){
      remote-uni-count <number>; # Optional, defaults to 1
      multipoint-to-multipoint; # Optional, defaults to point-to-point if remote-uni-count
         is 1
   }
}
```

Enabling E-LMI on an Interface and Mapping CE VLAN IDs to an EVC

To configure LMI, use the lmi (Ethernet) statement at the [edit protocols oam ethernet] hierarchy level.

You can set the status counter to count consecutive errors using the status-counter *count* statement at the [edit protocols oam ethernet lmi] hierarchy level. The status counter is used to determine if E-LMI is operational or not. The default value is 4.

You can set the polling-verification-timer *value* statement at the [edit protocols oam ethernet lmi] hierarchy level. The default value is 15 seconds.

You can enable an interface and set its options for use with E-LMI using the interface *name* statement at the [edit protocols oam ethernet lmi] hierarchy level. Only ge, xe and ae interfaces are supported. You can use the interface uni-id option to specify a name for the UNI. If uni-id is not configured, it defaults to the name variable of interface *name*.

You can specify the CE-VLAN ID/EVC map type using the evc-map-type <type> interface option. The options are <all-to-one-bundling>, <bundling>, or <service-multiplexing>. Service multiplexing is with no bundling. The default type is <all-to-one-bundling>.

To specify the EVC that an interfaces uses, use the evc *evc-id* statement at the [edit protocols oam ethernet lmi interface *name*] hierarchy level. You can specify an interface as the default EVC interface using the default-evc statement at the [edit protocols oam ethernet lmi interface *name* evc *evc-id*] hierarchy level. All VIDs that are not mapped to any other EVCs are mapped to this EVC. Only one EVC can be configured as the default.

You can map a list of VLANs to an EVC using the vlan-list *vlan-id-list* statement at the [edit protocols oam ethernet lmi interface *name* evc *evc-id*] hierarchy level.

Example: Enabling E-LMI on an Interface and Mapping CE VLAN IDs to an EVC

You can configure E-LMI using the lmi statement at the [edit protocols oam ethernet] hierarchy level:

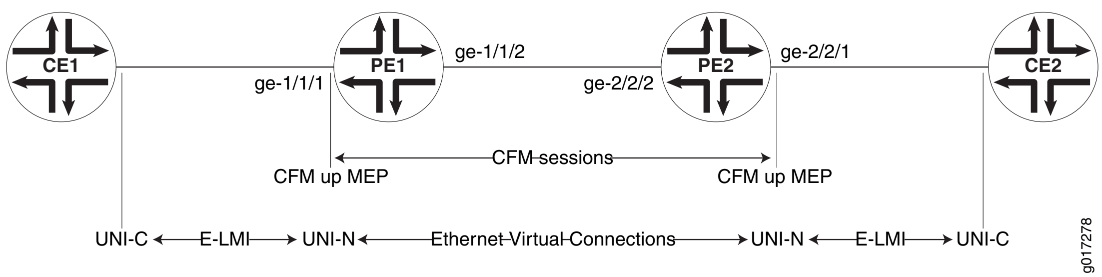
```
lmi {
   status-counter count; # Status Counter (N393), defaults to 4
      polling-verification-timer value; # Polling Verification Timer (T392), defaults to 15
         seconds
      interface name{
         uni-id value; # Optional, defaults to interface-name
```

```
                status-counter count; # Optional, defaults to global value
                polling-verification-time value; # Optional, defaults to global value
                evc-map-type <all-to-one-bundling | bundling | service-multiplexing>;
                evc evc-id {
                    default-evc;
                    vlan-list vlan-id-list;
                }
            }
        }
    }
```

Example E-LMI Configuration

Figure 60 on page 658 illustrates the E-LMI configuration for a point-to-point EVC (SVLAN) monitored by CFM. In this example, VLANs 1 through 2048 are mapped to evc1 (SVLAN 100) and 2049 through 4096 are mapped to evc2 (SVLAN 200). Two CFM sessions are created to monitor these EVCs.

Figure 60: E-LMI configuration for a point to point EVC (SVLAN) monitored by CFM



PE1 Configuration

```
interfaces {
    ge-1/1/1 {
         unit 0 {
             family bridge {
                interface-mode trunk;
                 vlan-id-list [1-2048];
             }
         }
         unit 1 {
             family bridge {
                interface-mode trunk;
                 vlan-id-list [2049-4096];
             }
         }
    }
    ge-1/1/2 {
         unit 0 {
            vlan-id 100;
             family bridge {
                interface-mode trunk;
                 inner-vlan-id-list [1-2048];
             }
```

```
         }
        unit 1 {
            vlan-id 200;
             family bridge {
                interface-mode trunk;
                 inner-vlan-id-list [2049-4096];
             }
         }
     }
}
protocols {
    oam {
       ethernet {
           connectivity-fault-management {
               maintenance-domain md {
                    level 0;
                    maintenance-association 1 {
                      name-format vlan;
                        mep 1 {
                            interface ge-1/1/1.0 vlan 1;
                            direction up;
                        }
                    }
                    maintenance-association 2049 {
                      name-format vlan;
                        mep 1 {
                            interface ge-1/1/1.1 vlan 2049;
                            direction up;
                        }
                    }
                }
            }
           evcs {
              evc1 {
                  evc-protocol cfm management-domain md;
                                 management-association 1;
                   remote-uni-count 1;
                }
              evc2 {
                  evc-protocol cfm management-domain md;
                                 management-association 2049;
                   remote-uni-count 1;
                }

            }
           lmi {
        interface ge-1/1/1 {
                    uni-id uni-ce1;
                    evc-map-type bundling;
          evc evc1 {
             vlan-list 1-2048;
                 }
          evc evc2 {
             vlan-list 2049-4096;
                }
            }
        }
    }
}
```

PE2 Configuration

```
interfaces {
    ge-2/2/1 {
        unit 0 {
            family bridge {
                interface-mode trunk;
                vlan-id-list [1-2048];
            }
        }
        unit 1 {
            family bridge {
                interface-mode trunk;
                vlan-id-list [2049-4096];
            }
        }
    }
    ge-2/2/2 {
        unit 0 {
            vlan-id 100;
            family bridge {
                interface-mode trunk;
                inner-vlan-id-list [1-2048];
            }
        }
        unit 1 {
            vlan-id 200;
            family bridge {
                interface-mode trunk;
                inner-vlan-id-list [2049-4095];
            }
        }
    }
}
protocols {
    oam {
        ethernet {
            connectivity-fault-management {
                maintenance-domain md {
                    level 0;
                    maintenance-association 1 {
                        name-format vlan;
                        mep 1 {
                            interface ge-2/2/1.0 vlan 1;
                            direction up;
                        }
                    }
                    maintenance-association 2049 {
                        name-format vlan;
                        mep 1 {
                            interface ge-2/2/1.1 vlan 2049;
                            direction up;
                        }
                    }
                }
            }
            evcs {
```

```
              evc1 {
                  evc-protocol cfm management-domain md;
                                 management-association 1;
                   remote-uni-count 1;
                }
              evc2 {
                  evc-protocol cfm management-domain md;
                                 management-association 2049;
                   uni-count 2;
                }

            }
           lmi {
              interface ge-2/2/1 {
                    uni-id uni-ce2;
                  evc-map-type bundling;
                  evc evc1 {
                     vlan-list 1-2048;
                   }
                  evc evc2 {
                     vlan-list 2049-4095;
                  }
                }
            }
        }
    }
}
```

Configuring Two UNIs Sharing the Same EVC

```
protocls {
   oam {
       ethernet {
           connectivity-fault-management {....}
           evcs {
               evc1 {
                   evc-protocol cfm management-domain md
                                management-association 1;
                   remote-uni-count 1;
               }
           }
           lmi {
               interface ge-2/2/1 {
                   uni-id uni-ce1;
                   evc-map-type all-to-one-bundling;
                   evc evc1 {
                       vlan-list 0-4095;
                   }
               }
               interface ge-2/3/1 {
                   uni-id uni-ce2;
                   evc-map-type all-to-one-bundling;
                   evc evc1 {
                       vlan-list 0-4095;
                   }
               }
           }
```

```
        }
    }
}
```

Chapter 42

Configuring ITU-T Y.1731 Ethernet Service OAM

This section contains the following topics:

Ethernet Frame Delay Measurements Overview

This topic contains the following information:

ITU-T Y.1731 Frame Delay Measurement Feature

The IEEE 802.3–2005 standard for Ethernet Operations, Administration, and Maintenance (OAM) defines a set of link fault management mechanisms to detect and report link faults on a single point-to-point Ethernet LAN.

JUNOS software supports key OAM standards that provide for automated end-to-end management and monitoring of Ethernet service by service providers:

- *IEEE Standard 802.1ag*, also known as “Connectivity Fault Management (CFM)”.
- *ITU-T Recommendation Y.1731*, which uses different terminology than IEEE 802.1ag and defines Ethernet service OAM features for fault monitoring, diagnostics, and performance monitoring.

These capabilities allow operators to offer binding service-level agreements (SLAs) and generate new revenues from rate- and performance-guaranteed service packages that are tailored to the specific needs of their customers.

Ethernet CFM

The IEEE 802.1ag standard for connectivity fault management (CFM) defines mechanisms to provide for end-to-end Ethernet service assurance over any path, whether a single link or multiple links spanning networks composed of multiple LANs.

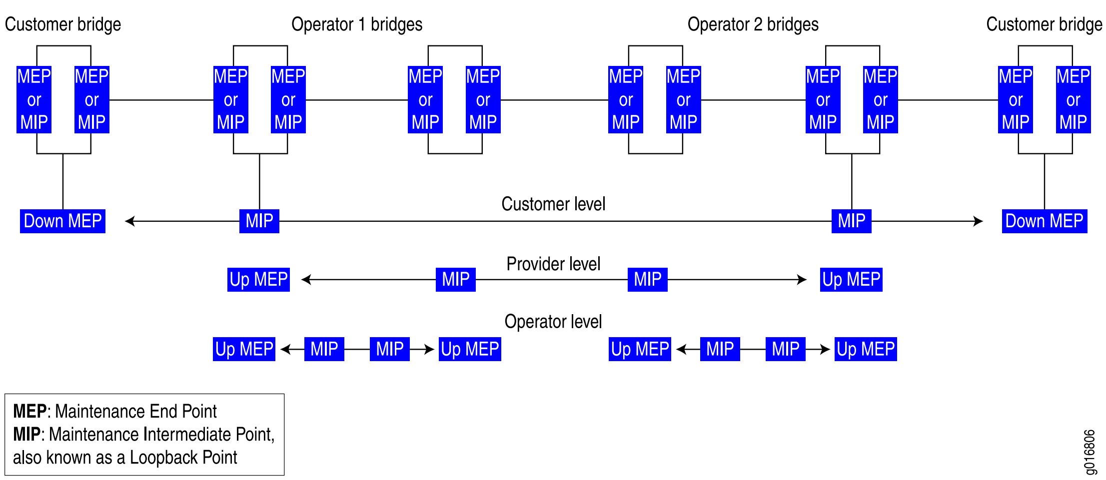
For Ethernet interfaces on M320, MX-series, and T-series routing platforms, JUNOS software supports the following key elements of the Ethernet CFM standard:

- Fault monitoring using the IEEE 802.1ag Ethernet OAM Continuity Check protocol
- Path discovery and fault verification using the IEEE 802.1ag Ethernet OAM Linktrace protocol
- Fault isolation using the IEEE 802.1ag Ethernet OAM Loopback protocol

In a CFM environment, network entities such as network operators, service providers, and customers may be part of different administrative domains. Each administrative domain is mapped into one maintenance domain. Maintenance domains are configured with different level values to keep them separate. Each domain provides enough information for the entities to perform their own management and end-to-end monitoring, and still avoid security breaches.

Figure 61 on page 664 shows the relationships among the customer, provider, and operator Ethernet bridges, maintenance domains, maintenance association end points (MEPs), and maintenance intermediate points (MIPs).

Figure 61: Relationship of MEPs, MIPs, and Maintenance Domain Levels



Ethernet Frame Delay Measurement

Two key objectives of OAM functionality are to measure quality-of-service attributes such as frame delay and frame delay variation (also known as “frame jitter”). Such measurements can enable you to identify network problems before customers are impacted by network defects.

JUNOS software supports Ethernet frame delay measurement between MEPs configured on Ethernet physical or logical interfaces on Dense Port Concentrators (DPCs) in MX-series routers. Ethernet frame delay measurement provides fine control to operators for triggering delay measurement on a given service and can be used to monitor SLAs. Ethernet frame delay measurement also collects other useful information, such as worst and best case delays, average delay, and average delay variation. The JUNOS software implementation of Ethernet frame delay measurement (ETH-DM) is fully compliant with the ITU-T Recommendation Y.1731, *OAM Functions and Mechanisms for Ethernet-based Networks*. The recommendation defines OAM mechanisms for operating and maintaining the network at the Ethernet service layer, which is called the "ETH layer" in ITU-T terminology.

One-Way Ethernet Frame Delay Measurement

In one-way ETH-DM mode, a series of frame delay and frame delay variation values are calculated based on the time elapsed between the time a measurement frame is sent from the initiator MEP at one router and the time when the frame is received at the receiver MEP at the other router.

1DM Transmission

When you start a one-way frame delay measurement, the router sends 1DM frames—frames that carry the protocol data unit (PDU) for a one-way delay measurement—from the initiator MEP to the receiver MEP at the rate and for the number of frames you specify. The router marks each 1DM frame as drop-ineligible and inserts a timestamp of the transmission time into the frame.

1DM Reception

When an MEP receives a 1DM frame, the router that contains the receiver MEP measures the one-way delay for that frame (the difference between the time the frame was received and the timestamp contained in the frame itself) and the delay variation (the difference between the current and previous delay values).

One-Way ETH-DM Statistics

The router that contains the receiver MEP stores each set of one-way delay statistics in the ETH-DM database. The ETH-DM database collects up to 100 sets of statistics for any given CFM session (pair of peer MEPs). You can access these statistics at any time by displaying the ETH-DM database contents.

One-Way ETH-DM Frame Counts

Each router counts the number of one-way ETH-DM frames sent and received:

- For an initiator MEP, the router counts the number of 1DM frames sent.
- For a receiver MEP, the router counts the number of valid 1DM frames received and the number of invalid 1DM frames received.

Each router stores ETH-DM frame counts in the CFM database. The CFM database stores CFM session statistics and, for interfaces that support ETH-DM, any ETH-DM frame counts. You can access the frame counts at any time by displaying CFM database information for Ethernet interfaces assigned to MEPs or for MEPs in CFM sessions.

Synchronization of System Clocks

The accuracy of one-way delay calculations depends on close synchronization of the system clocks at the initiator MEP and receiver MEP.

The accuracy of one-way delay variation is not dependent on system clock synchronization. Because delay variation is simply the difference between consecutive one-way delay values, the out-of-phase period is eliminated from the frame jitter values.

NOTE: For a given one-way Ethernet frame delay measurement, frame delay and frame delay variation values are available only on the router that contains the receiver MEP.

Two-Way Ethernet Frame Delay Measurement

In two-way ETH-DM mode, frame delay and frame delay variation values are based on the time difference between when the initiator MEP transmits a request frame and receives a reply frame from the responder MEP, subtracting the time elapsed at the responder MEP.

DMM Transmission

When you start a two-way frame delay measurement, the router sends delay measurement message (DMM) frames— frames that carry the PDU for a two-way ETH-DM request—from the initiator MEP to the responder MEP at the rate and for the number of frames you specify. The router marks each DMM frame as drop-ineligible and inserts a timestamp of the transmission time into the frame.

DMR Transmission

When an MEP receives a DMM frame, the responder MEP responds with a delay measurement reply (DMR) frame, which carries ETH-DM reply information and a copy of the timestamp contained in the DMM frame.

DMR Reception

When an MEP receives a valid DMR, the router that contains the MEP measures the two-way delay for that frame based on the following sequence of timestamps:

1. TI_{TxDMM}

   Time at which the initiator MEP transmits a two-way ETH-DM DMM frame to the responder MEP.

2. TR_{RxDMM}

   Time at which the responder MEP receives a DMM frame from the initiator MEP.

3. TR_{TxDMR}

   Time at which the responder MEP transmits a two-way ETH-DM DMR) frame, associated with a specific DMM frame, to the initiator MEP.

4. TI_{RxDMR}

   Time at which the initiator MEP receives a DMR frame from the responder MEP.

A two-way frame delay is calculated as follows:

$$[TI_{RxDMR} - TI_{TxDMM}] - [TR_{TxDMR} - TR_{RxDMM}]$$

In other words, frame delay is the difference between the time at which the initiator MEP sends a DMM frame and the time at which the initiator MEP receives the associated DMR frame from the responder MEP, minus the time elapsed at the responder MEP.

The delay variation is the difference between the current and previous delay values.

Two-Way ETH-DM Statistics

The router that contains the initiator MEP stores each set of two-way delay statistics in the ETH-DM database. The ETH-DM database collects up to 100 sets of statistics for any given CFM session (pair of peer MEPs). You can access these statistics at any time by displaying the ETH-DM database contents.

Two-Way ETH-DM Frame Counts

Each router counts the number of two-way ETH-DM frames sent and received:

- For an initiator MEP, the router counts the number DMM frames transmitted, the number of valid DMR frames received, and the number of invalid DMR frames received.
- For a responder MEP, the router counts the number of DMR frames sent.

Each router stores ETH-DM frame counts in the CFM database. The CFM database stores CFM session statistics and, for interfaces that support ETH-DM, any ETH-DM frame counts. You can access the frame counts at any time by displaying CFM database information for Ethernet interfaces assigned to MEPs or for MEPs in CFM sessions.

NOTE: For a given two-way Ethernet frame delay measurement, frame delay and frame delay variation values are available only at the router that contains the initiator MEP.

Choosing Between One-Way and Two-Way ETH-DM

One-way frame delay measurement requires that the system clocks at the initiator MEP and receiver MEP are closely synchronized. Two-way frame delay measurement does not require synchronization of the two systems. If it is not practical for the clocks to be synchronized, two-way frame delay measurements are more accurate.

When two systems are close to each other, their one-way delay values are very high compared to their two-way delay values. This is because one-way delay measurement requires that the timing for the two systems be synchronized at a very granular level, and MX-series routers currently do not support this granular synchronization.

Restrictions for Ethernet Frame Delay Measurement

The following restrictions apply to the Ethernet frame delay measurement feature:

- The Ethernet frame delay measurement feature is supported only for MEPs configured on Ethernet physical or logical interfaces on DPCs in MX-series routers. The ETH-DM feature is not supported on aggregated Ethernet interfaces or label-switched interface (LSI) pseudowires.
- Hardware-assisted timestamping for ETH-DM frames in the reception path is only supported for MEP interfaces on Enhanced DPCs and Enhanced Queuing DPCs in MX-series routers. For information about hardware-assisted timestamping, see “Guidelines for Configuring Routers to Support an ETH-DM Session” on page 669 and “Enabling the Hardware-Assisted Timestamping Option” on page 678.
- Ethernet frame delay measurements can be triggered only when the distributed periodic packet management daemon (ppmd) is enabled. For more information about this limitation, see “Guidelines for Configuring Routers to Support an ETH-DM Session” on page 669 and “Ensuring that Distributed ppmd Is Not Disabled” on page 677.
- You can monitor only one session at a time to the same remote MEP or MAC address. For more information about starting an ETH-DM session, see “Starting an ETH-DM Session” on page 679.
- ETH-DM statistics are collected at only one of the two peer routers in the ETH-DM session. For a one-way ETH-DM session, you can display frame ETH-DM statistics at the receiver MEP only, using ETH-DM-specific show commands. For a two-way ETH-DM session, you can display frame delay statistics at the initiator MEP only, using the same ETH-DM-specific show commands. For more information, see “Managing ETH-DM Statistics and ETH-DM Frame Counts” on page 681.
- ETH-DM frame counts are collected at both MEPs and are stored in the respective CFM databases.
- If graceful Routing Engine switchover (GRES) occurs, any collected ETH-DM statistics are lost, and ETH-DM frame counts are reset to zeroes. GRES enables a routing platform with dual Routing Engines to switch from a master Routing Engine to a backup Routing Engine without interruption to packet forwarding. For more information, see the *JUNOS High Availability Configuration Guide*.
- Accuracy of frame delay statistics is compromised when the system is changing (such as from reconfiguration). We recommend performing Ethernet frame delay measurements on a stable system.

Related Topics

- Guidelines for Configuring Routers to Support an ETH-DM Session on page 669
- Guidelines for Starting an ETH-DM Session on page 670
- Guidelines for Managing ETH-DM Statistics and ETH-DM Frame Counts on page 672
- Example: One-Way Ethernet Frame Delay Measurement on page 684

Guidelines for Configuring Routers to Support an ETH-DM Session

Keep the following guidelines in mind when configuring routers to support an Ethernet frame delay measurement (ETH-DM) session:

Configuration Requirements for ETH-DM

You can obtain ETH-DM information for a link that meets the following requirements:

- The measurements can be performed between peer maintenance association endpoints (MEPs) on two routers.
- The two MEPs must be configured on two Ethernet physical interfaces or on two Ethernet logical interfaces. For more information, see "Creating a Maintenance End Point" on page 651 and "Creating a Remote Maintenance End Point" on page 652.
- The two MEPs must be configured—on their respective routers—under the same maintenance association (MA) identifier. For more information, see "Creating the Maintenance Association" on page 649.
- On both routers, the MA must be associated with the same maintenance domain (MD) name. For more information, see "Creating the Maintenance Domain" on page 647.
- On both routers, periodic packet management (PPM) must be running on the Routing Engine and Packet Forwarding Engine, which is the default configuration. You can disable PPM on the Packet Forwarding Engine only. However, the Ethernet frame delay measurement feature requires that distributed PPM remain enabled on the Packet Forwarding Engine of both routers. For more information about ppmd, see the *JUNOS Routing Protocols Configuration Guide*.
- If the PPM process (ppmd) is disabled on the Packet Forwarding Engine, you must re-enable it. Re-enabling distributed ppmd entails restarting the ethernet-connectivity-fault-management process, which causes all connectivity fault management (CFM) sessions to re-establish. For more information about CFM sessions, see "Configuring Ethernet Local Management Interface" on page 654.

NOTE: The Ethernet frame delay measurement feature is supported only for MEPs configured on Ethernet physical or logical interfaces on DPCs in MX-series routers. The ETH-DM feature is not supported on aggregated Ethernet interfaces or LSI pseudowires.

Configuration Options for ETH-DM

By default, the ETH-DM feature calculates frame delays using software-based timestamping of the ETH-DM PDU frames sent and received by the MEPs in the session. As an option that can increase the accuracy of ETH-DM calculations when the DPC is loaded with heavy traffic in the receive direction, you can enable hardware-assisted timestamping of session frames in the receive direction.

NOTE: Hardware-assisted timestamping for ETH-DM frames is only supported for MEP interfaces on Enhanced DPCs and Enhanced Queuing DPCs in MX-series routers.

Related Topics

- Ethernet Frame Delay Measurements Overview on page 663
- Configuring Routers to Support an ETH-DM Session on page 676

Guidelines for Starting an ETH-DM Session

Keep the following guidelines in mind when preparing to start an Ethernet frame delay measurement (ETH-DM) session:

- ETH-DM Session Prerequisites on page 670
- ETH-DM Session Parameters on page 670
- Restrictions for an ETH-DM Session on page 671

ETH-DM Session Prerequisites

Before you can start an ETH-DM session, you must configure two MX-series routers to support ETH-DM by defining the two CFM-enabled physical or logical Ethernet interfaces on each router. This entails creating and configuring CFM maintenance domains, maintenance associations, and maintenance association end points on each router. For more information about enabling CFM on an Ethernet interface, see “Creating the Maintenance Domain” on page 647.

NOTE: The Ethernet frame delay measurement feature is supported only for maintenance association end points configured on Ethernet physical or logical interfaces on DPCs in MX-series routers. The ETH-DM feature is not supported on aggregated Ethernet interfaces or LSI) pseudowires.

For specific information about configuring routers to support ETH-DM, see “Guidelines for Configuring Routers to Support an ETH-DM Session” on page 669 and “Configuring Routers to Support an ETH-DM Session” on page 676.

ETH-DM Session Parameters

You can initiate a one-way or two-way ETH-DM session by entering the monitor ethernet delay-measurement operational command at a router that contains one end of the service for which you want to measure frame delay. The command options specify the ETH-DM session in terms of the CFM elements:

- The type of ETH-DM measurement (one-way or two-way) to be performed.

- The Ethernet service for which the ETH-DM measurement is to be performed:
  - CFM maintenance domain—Name of the existing maintenance domain (MD) for which you want to measure Ethernet frame delays. For more information, see “Creating the Maintenance Domain” on page 647.
  - CFM maintenance association—Name of an existing maintenance association (MA) within the maintenance domain. For more information, see “Creating the Maintenance Association” on page 649.
  - Remote CFM maintenance association end point—The unicast MAC address or the numeric identifier of the remote maintenance association end point (MEP)—the physical or logical interface on the remote router that resides in the specified MD and is named in the specified MA—with which to perform the ETH-DM session. For more information, see “Creating a Maintenance End Point” on page 651 and “Creating a Remote Maintenance End Point” on page 652.
- Optional specifications:
  - Count—You can specify the number of ETH-DM requests to send for this frame delay measurement session. The range is from 1 through 65,535 frames. The default value is 10 frames.

    NOTE: Although you can trigger frame delay collection for up to 65,535 ETH-DM requests at a time, a router stores only the last 100 frame delay statistics per CFM session (pair of peer MEPs).
  - Frame interval—You can specify the number of seconds to elapse between ETH-DM frame transmittals. The default value is 1 second.

For more detailed information about the parameters you can specify to start an ETH-DM session, see the monitor ethernet delay-measurement operational command description in the *JUNOS System Basics and Services Command Reference*.

Restrictions for an ETH-DM Session

The following restrictions apply to an ETH-DM session:

- You cannot run multiple simultaneous ETH-DM sessions with the same remote MEP or MAC address.
- For a given ETH-DM session, you can collect frame delay information for a maximum of 65,535 frames.
- For a given CFM session (pair of peer MEPs), the ETH-DM database stores a maximum of 100 statistics, with the older statistics being “aged out” as newer statistics are collected for that pair of MEPs.
  - For one-way delay measurements collected within the same CFM session, the 100 most recent ETH-DM statistics can be retrieved at any point of time at the router on which the receiver MEP is defined.
  - For two-way delay measurements collected within the same CFM session, the 100 most recent ETH-DM statistics can be retrieved at any point of time at the router on which the initiator MEP is defined.

Depending on the number of frames exchanged in the individual ETH-DM sessions, the ETH-DM database can contain statistics collected through multiple ETH-DM sessions.

- If graceful Routing Engine switchover (GRES) occurs, any collected ETH-DM statistics are lost, and ETH-DM frame counts are reset to zeroes. GRES enables a routing platform with dual Routing Engines to switch from a master Routing Engine to a backup Routing Engine without interruption to packet forwarding. For more information, see the *JUNOS High Availability Configuration Guide*.
- Accuracy of frame delay data is compromised when the system is changing (such as from reconfiguration). We recommend performing Ethernet frame delay measurements on a stable system.

Related Topics

- Ethernet Frame Delay Measurements Overview on page 663
- Starting an ETH-DM Session on page 679
- Guidelines for Managing ETH-DM Statistics and ETH-DM Frame Counts on page 672

- monitor ethernet delay-measurement operational command

Guidelines for Managing ETH-DM Statistics and ETH-DM Frame Counts

This topic contains the following information:

- ETH-DM Statistics on page 672
- ETH-DM Statistics Retrieval on page 674
- ETH-DM Frame Counts on page 674
- ETH-DM Frame Count Retrieval on page 675

ETH-DM Statistics

Ethernet frame delay statistics are the frame delay and frame delay variation values determined by the exchange of frames containing ETH-DM protocol data units (PDUs).

- For a one-way ETH-DM session, statistics are collected in an ETH-DM database at the router that contains the receiver MEP. For a detailed description of one-way Ethernet frame delay measurement, including the exchange of one-way delay PDU frames, see “Ethernet Frame Delay Measurements Overview” on page 663.
- For a two-way ETH-DM session, statistics are collected in an ETH-DM database at the router that contains the initiator MEP. For a detailed description of two-way Ethernet frame delay measurement, including the exchange of two-way delay PDU frames, see “Ethernet Frame Delay Measurements Overview” on page 663.

A CFM database stores CFM-related statistics and—for Ethernet interfaces that support ETH-DM—the 100 most recently collected ETH-DM statistics for that pair of MEPs. You can view ETH-DM statistics by using the delay-statistics or mep-statistics form of the show oam ethernet connectivity-fault-management command to display the CFM statistics for the MEP that collects the ETH-DM statistics you want to view.

Table 55 on page 673 describes the ETH-DM statistics calculated in an ETH-DM session.

Table 55: ETH-DM Statistics

Field Name	Field Description
One-way delay (μsec)[†]	For a one-way ETH-DM session, the frame delay, in microseconds, collected at the receiver MEP. To display frame delay statistics for a given one-way ETH-DM session, use the delay-statistics or mep-statistics form of the show oam ethernet connectivity-fault-management command at the receiver MEP for that session.
Two-way delay (μsec)	For a two-way ETH-DM session, the frame delay, in microseconds, collected at the initiator MEP. When you start a two-way frame delay measurement, the CLI output displays each DMR frame receipt timestamp and corresponding DMM frame delay and delay variation collected as the session progresses. To display frame delay statistics for a given two-way ETH-DM session, use the delay-statistics or mep-statistics form of the show oam ethernet connectivity-fault-management command at the initiator MEP for that session.
Average delay[†]	When you start a two-way frame delay measurement, the CLI output includes a runtime display of the average two-way frame delay among the statistics collected for the ETH-DM session only. When you display ETH-DM statistics using a show command, the Average delay field displays the average one-way and two- frame delays among all ETH-DM statistics collected at the CFM session level. For example, suppose you start two one-way ETH-DM sessions for 50 counts each, one after the other. If, after both measurement sessions complete, you use a show command to display 100 ETH-DM statistics for that CFM session, the Average delay field displays the average frame delay among all 100 statistics.
Average delay variation[†]	When you start a two-way frame delay measurement, the CLI output includes a runtime display of the average two-way frame delay variation among the statistics collected for the ETH-DM session only. When you display ETH-DM statistics using a show command, the Average delay variation field displays the average one-way and two- frame delay variations among all ETH-DM statistics collected at the CFM session level.
Best-case delay[†]	When you start a two-way frame delay measurement, the CLI output includes a runtime display of the lowest two-way frame delay value among the statistics collected for the ETH-DM session only. When you display ETH-DM statistics using a show command, the Best case delay field displays the lowest one-way and two-way frame delays among all ETH-DM statistics collected at the CFM session level.
Worst-case delay[†]	When you start a two-way frame delay measurement, the CLI output includes a runtime display of the highest two-way frame delay value among the statistics collected for the ETH-DM session only. When you display ETH-DM statistics using a show command, the Worst case delay field displays the highest one-way and two-way frame delays among all statistics collected at the CFM session level.

Table 55: ETH-DM Statistics *(continued)*

Field Name	Field Description

†When you start a one-way frame delay measurement, the CLI output displays NA ("not available") for this field. One-way ETH-DM statistics are collected at the remote (receiver) MEP. Statistics for a given one-way ETH-DM session are available only by displaying CFM statistics for the receiver MEP.

ETH-DM Statistics Retrieval

At the receiver MEP for a one-way session, or at the initiator MEP for a two-way session, you can display all ETH-DM statistics collected at a CFM session level by using the following operational commands:

- show oam ethernet connectivity-fault-management delay-statistics maintenance-domain *md-name* maintenance-association *ma-name* <local-mep *mep-id*> <remote-mep *mep-id*> <count *count*>
- show oam ethernet connectivity-fault-management mep-statistics maintenance-domain *md-name* maintenance-association *ma-name* <local-mep *mep-id*> <remote-mep *mep-id*> <count *count*>

ETH-DM Frame Counts

The number of ETH-DM PDU frames exchanged in a ETH-DM session are stored in the CFM database on each router.

Table 56 on page 674 describes the ETH-DM frame counts collected in an ETH-DM session.

Table 56: ETH-DM Frame Counts

Field Name	Field Description
1DMs sent	Number of one-way delay measurement (1DM) PDU frames sent to the peer MEP in this session. Stored in the CFM database of the MEP initiating a one-way frame delay measurement.
Valid 1DMs received	Number of valid 1DM frames received. Stored in the CFM database of the MEP receiving a one-way frame delay measurement.
Invalid 1DMs received	Number of invalid 1DM frames received. Stored in the CFM database of the MEP receiving a one-way frame delay measurement.
DMMs sent	Number of delay measurement message (DMM) PDU frames sent to the peer MEP in this session. Stored in the CFM database of the MEP initiating a two-way frame delay measurement.
DMRs sent	Number of delay measurement reply (DMR) frames sent (in response to a received DMM). Stored in the CFM database of the MEP responding to a two-way frame delay measurement.

Table 56: ETH-DM Frame Counts *(continued)*

Field Name	Field Description
Valid DMRs received	Number of valid DMR frames received. Stored in the CFM database of the MEP initiating a two-way frame delay measurement.
Invalid DMRs received	Number of invalid DMR frames received. Stored in the CFM database of the MEP initiating a two-way frame delay measurement.

ETH-DM Frame Count Retrieval

Each router counts the number of ETH-DM frames sent or received and stores the counts in a CFM database.

Frame Counts Stored in CFM Databases

You can display ETH-DM frame counts for MEPs assigned to specified Ethernet interfaces or for specified MEPs in CFM sessions by using the following operational commands:

- show oam ethernet connectivity-fault-management interfaces (detail | extensive)
- show oam ethernet connectivity-fault-management mep-database maintenance-domain *md-name* maintenance-association *ma-name* <local-mep *mep-id*> <remote-mep *mep-id*>

One-Way ETH-DM Frame Counts

For a one-way ETH-DM session, delay statistics are collected at the receiver MEP only, but frame counts are collected at both MEPs. As indicated in Table 56 on page 674, one-way ETH-DM frame counts are tallied from the perspective of each router in the session:

- At the initiator MEP, the router counts the number of 1DM frames sent.
- At the receiver MEP, the router counts the number of valid 1DM frames received and the number of invalid 1DM frames received.

You can also view one-way ETH-DM frame counts—for a receiver MEP—by using the show oam ethernet connectivity-fault-management mep-statistics command to display one-way statistics and frame counts together.

Two-Way ETH-DM Frame Counts

For a two-way ETH-DM session, delay statistics are collected at the initiator MEP only, but frame counts are collected at both MEPs. As indicated in Table 56 on page 674, two-way ETH-DM frame counts are tallied from the perspective of each router in the session:

- At the initiator MEP, the router counts the number of DMM frames sent, valid DMR frames received, and invalid DMR frames received.
- At the responder MEP, the router counts the number of DMR frames sent.

You can also view two-way ETH-DM frame counts—for an initiator MEP—by using the show oam ethernet connectivity-fault-management mep-statistics command to display two-way statistics and frame counts together.

Related Topics

- Ethernet Frame Delay Measurements Overview on page 663
- Managing ETH-DM Statistics and ETH-DM Frame Counts on page 681
- Example: One-Way Ethernet Frame Delay Measurement on page 684
- clear oam ethernet connectivity-fault-management statistics command
- show oam ethernet connectivity-fault-management mep-statistics command
- show oam ethernet connectivity-fault-management delay-statistics command
- show oam ethernet connectivity-fault-management interfaces (detail | extensive) command
- show oam ethernet connectivity-fault-management mep-database command

Configuring Routers to Support an ETH-DM Session

This topic contains the following tasks:

Configuring MEP Interfaces

Before you can start an Ethernet frame delay measurement session across an Ethernet service, you must configure two MX-series routers to support ETH-DM.

To configure an Ethernet interface on a DPC in MX-series router to support ETH-DM:

1. On each router, configure two physical or logical Ethernet interfaces connected by a VLAN. The following configuration is typical for single-tagged logical interfaces:

```
[edit interfaces]
interface {
   ethernet-interface-name {
      vlan-tagging;
      unit logical-unit-number {
         vlan-id vlan-id; # Both interfaces on this VLAN
      }
   }
}
```

   Both interfaces will use the same VLAN ID.

2. On each router, attach peer MEPs to the two interfaces. The following configuration is typical:

```
[edit protocols]
oam {
   ethernet {
      connectivity-fault-management {
         maintenance-domain md-name { # On both routers
            level number;
            maintenance-association ma-name { # On both routers
```

```
                        continuity-check {
                            interval 100ms;
                            hold-interval 1;
                        }
                        mep mep-id { # Attach to VLAN interface
                            auto-discovery;
                            direction (up | down);
                            interface interface-name;
                            priority number;
                        }
                    }
                }
            }
        }
    }
```

Ensuring that Distributed ppmd Is Not Disabled

By default, the router's period packet management daemon (ppmd) runs sessions distributed to the Packet Forwarding Engine in addition to the Routing Engine. This daemon is responsible for periodic transmission of packets on behalf of its various client processes, such as Bidirectional Forwarding Detection (BFD), and it also receives packets on behalf of client processes.

In addition, ppmd handles time-sensitive periodic processing and performs such processes as sending process-specific packets and gathering statistics. With ppmd processes running distributed on both the Routing Engine and the Packet Forwarding Engine, you can run such processes as BFD on the Packet Forwarding Engine.

Distributed ppmd Required for ETH-DM

Ethernet frame delay measurement requires that ppmd remains distributed to the Packet Forwarding Engine. Without ppmd distributed to the Packet Forwarding engines of both routers, ETH-DM PDU frame timestamps and ETH-DM statistics are not valid.

Before you start ETH-DM, you must verify that the following configuration statement is *NOT* present:

```
[edit]
routing-options {
    ppm {
        no-delegate-processing;
    }
}
```

If distributed ppmd processing is disabled (as shown in the stanza above) on either router, you must re-enable it in order to use the ETH-DM feature.

Procedure to Ensure that Distributed ppmd is Not Disabled

To ensure that distributed ppmd is not disabled on a router:

1. Display the packet processing management (PPM) configuration to determine whether distributed ppmd has been disabled.
   - In the following example, distributed ppmd is enabled on the router. In this case, you do not need to modify the router configuration:

```
[edit]
user@host# show routing-options
ppm;
```

- In the following example, distributed ppmd is disabled on the router. In this case, you must proceed to Step 2 to modify the router configuration:

```
[edit]
user@host show routing-options
ppm {
   no-delegate-processing;
}
```

2. Modify the router configuration to re-enable distributed ppmd and restart the Ethernet OAM connectivity fault management process *ONLY IF* distributed ppmd is disabled (as determined in the previous step).

   a. Before continuing, make any necessary preparations for the possible loss of connectivity on the router.

      Restarting the ethernet-connectivity-fault-manager process has the following effect on your network:

      - All connectivity fault management (CFM) sessions re-establish.
      - All ETH-DM requests on the router terminate.
      - All ETH-DM statistics and frame counts reset to 0.

   b. Modify the router configuration to re-enable distributed ppmd. For example:

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

   c. Commit the updated router configuration. For example:

```
[edit]
user@host# commit and-quit
commit complete
exiting configuration mode
```

   d. To restart the Ethernet OAM Link-Fault-Management process, enter the restart ethernet-connectivity-fault-management <gracefully | immediately | soft> command from operational mode. For example:

```
user@host> restart ethernet-connectivity-fault-management
Connectivity fault management process started, pid 9893
```

Enabling the Hardware-Assisted Timestamping Option

By default, Ethernet frame delay measurement uses software for timestamping transmitted and received ETH-DM frames. For Ethernet interfaces on Enhanced Dense Port Concentrators (DPCs) and Enhanced Queuing DPCs only, you can optionally use hardware timing to assist in the timestamping of received ETH-DM frames to increase the accuracy of delay measurements.

Enabling hardware-assisted timestamping of received frames can increase the accuracy of ETH-DM calculations when the DPC is loaded with heavy traffic in the receive direction.

To enable Ethernet frame delay measurement hardware assistance on the reception path, include the hardware-assisted-timestamping statement at the [edit protocols oam ethernet connectivity-fault-management performance-monitoring] hierarchy level:

```
[edit protocols]
oam {
    ethernet {
        connectivity-fault-management {
            performance-monitoring {
                hardware-assisted-timestamping;
            }
        }
    }
}
```

Starting an ETH-DM Session

This topic contains the following information:

Using the monitor ethernet delay-measurement Command

After you have configured two MX-series routers to support ITU-T Y.1731Ethernet frame delay measurement (ETH-DM), you can initiate a one-way or two-way Ethernet frame delay measurement session from the CFM maintenance association end point (MEP) on one of the routers to the peer MEP on the other router.

To start an ETH-DM session between the specified local MEP and the specified remote MEP, enter the monitor ethernet delay-measurement command at operational mode. The syntax of the command is as follows:

```
monitor ethernet delay-measurement
(one-way | two-way)
maintenance-domain md-name
maintenance-association ma-name
(remote-mac-address | mep remote-mep-id)
<count frame-count>
<wait interval-seconds>
```

For a one-way frame delay measurement, the command displays a runtime display of the number of 1DM frames sent from the initiator MEP during that ETH-DM session. One-way frame delay and frame delay variation measurements from an ETH-DM session are collected in a CFM database at the router that contains the receiver MEP. You can retrieve ETH-DM statistics from a CFM database at a later time.

For a two-way frame delay measurement, the command displays two-way frame delay and frame delay variation values for each round-trip frame exchange during that ETH-DM session, as well as a runtime display of useful summary information about the session: average delay, average delay variation, best-case delay, and worst-case delay. Two-way frame delay and frame delay variation values measurements from an ETH-DM session are collected in a CFM database at the router that contains the initiator MEP. You can retrieve ETH-DM statistics from a CFM database at a later time.

NOTE: Although you can trigger frame delay collection for up to 65,535 ETH-DM requests at a time, a router stores only the last 100 frame delay statistics per CFM session (pair of peer MEPs).

For a complete description of the monitor ethernet delay-measurement operational command, see the *JUNOS System Basics and Services Command Reference*.

Starting a One-Way ETH-DM Session

To start a one-way Ethernet frame delay measurement session, enter the monitor ethernet delay-measurement one-way command from operational mode, and specify the peer MEP by its MAC address or by its MEP identifier.

For example:

```
user@host> monitor ethernet delay-measurement one-way 00:05:85:73:39:4a
maintenance-domain md6 maintenance-association ma6 count 10
One-way ETH-DM request to 00:05:85:73:39:4a, Interface xe-5/0/0.0
1DM Frames sent : 10
--- Delay measurement statistics ---
Packets transmitted: 10
Average delay: NA, Average delay variation: NA
Best case delay: NA, Worst case delay: NA
```

NOTE: If you attempt to monitor delays to a nonexistent MAC address, you must type **Ctrl** + **C** to explicitly quit the monitor ethernet delay-measurement command and return to the CLI command prompt.

Starting a Two-Way ETH-DM Session

To start a two-way Ethernet frame delay measurement session, enter the monitor ethernet delay-measurement two-way command from operational mode, and specify the peer MEP by its MAC address or by its MEP identifier.

For example:

```
user@host> monitor ethernet delay-measurement two-way 00:05:85:73:39:4a
maintenance-domain md6 maintenance-association ma6 count 10
Two-way ETH-DM request to 00:05:85:73:39:4a, Interface xe-5/0/0.0
DMR received from 00:05:85:73:39:4a Delay: 100 usec Delay variation: 0 usec
DMR received from 00:05:85:73:39:4a Delay: 92 usec Delay variation: 8 usec
```

```
DMR received from 00:05:85:73:39:4a Delay: 92 usec Delay variation: 0 usec
DMR received from 00:05:85:73:39:4a Delay: 111 usec Delay variation: 19 usec
DMR received from 00:05:85:73:39:4a Delay: 110 usec Delay variation: 1 usec
DMR received from 00:05:85:73:39:4a Delay: 119 usec Delay variation: 9 usec
DMR received from 00:05:85:73:39:4a Delay: 122 usec Delay variation: 3 usec
DMR received from 00:05:85:73:39:4a Delay: 92 usec Delay variation: 30 usec
DMR received from 00:05:85:73:39:4a Delay: 92 usec Delay variation: 0 usec
DMR received from 00:05:85:73:39:4a Delay: 108 usec Delay variation: 16 usec

--- Delay measurement statistics ---
Packets transmitted: 10, Valid packets received: 10
Average delay: 103 usec, Average delay variation: 8 usec
Best case delay: 92 usec, Worst case delay: 122 usec
```

NOTE: If you attempt to monitor delays to a nonexistent MAC address, you must type **Ctrl** + **C** to explicitly quit the monitor ethernet delay-measurement command and return to the CLI command prompt.

Related Topics

- Ethernet Frame Delay Measurements Overview on page 663
- Guidelines for Starting an ETH-DM Session on page 670
- monitor ethernet delay-measurement command
- Guidelines for Managing ETH-DM Statistics and ETH-DM Frame Counts on page 672
- Managing ETH-DM Statistics and ETH-DM Frame Counts on page 681

Managing ETH-DM Statistics and ETH-DM Frame Counts

This topic contains the following information:

Displaying ETH-DM Statistics Only

Purpose Display ETH-DM statistics.

By default, the show oam ethernet connectivity-fault-management delay-statistics command displays ETH-DM statistics for MEPs in the specified CFM maintenance association (MA) within the specified CFM maintenance domain (MD).

Action

- To display the ETH-DM statistics collected for MEPs belonging to MA ma1 and within MD md1:

```
user@host> show oam ethernet connectivity-fault-management delay-statistics
maintenance-domain ma1 maintenance-association ma1
```

- To display the ETH-DM statistics collected for ETH-DM sessions for the local MEP 201 belonging to MA ma2 and within MD md2:

```
user@host> show oam ethernet connectivity-fault-management delay-statistics
maintenance-domain md2 maintenance-association ma2 local-mep 201
```

- To display the ETH-DM statistics collected for ETH-DM sessions from local MEPs belonging to MA ma3 and within MD md3 to remote MEP 302:

```
user@host> show oam ethernet connectivity-fault-management delay-statistics
maintenance-domain md3 maintenance-association ma3 remote-mep 302
```

Displaying ETH-DM Statistics and Frame Counts

Purpose Display ETH-DM statistics and ETH-DM frame counts.

By default, the show oam ethernet connectivity-fault-management mep-statistics command displays ETH-DM statistics and frame counts for MEPs in the specified CFM maintenance association (MA) within the specified CFM maintenance domain (MD).

Action

- To display the ETH-DM statistics and ETH-DM frame counts for MEPs in MA ma1 and within MD md1:

```
user@host> show oam ethernet connectivity-fault-management mep-statistics
maintenance-domain md1 maintenance-association ma1
```

- To display the ETH-DM statistics and ETH-DM frame counts for the local MEP 201 in MA ma2 and within MD md2:

```
user@host> show oam ethernet connectivity-fault-management mep-statistics
maintenance-domain md2 maintenance-association ma2 local-mep 201
```

- To display the ETH-DM statistics and ETH-DM frame counts for the local MEP in MD md3 and within MA ma3 that participates in an ETH-DM session with the remote MEP 302:

```
user@host> show oam ethernet connectivity-fault-management mep-statistics
maintenance-domain ma3 maintenance-association ma3 remote-mep 302
```

Displaying ETH-DM Frame Counts for MEPs by Enclosing CFM Entity

Purpose Display ETH-DM frame counts for CFM maintenance association end points (MEPs).

By default, the show oam ethernet connectivity-fault-management mep-database command displays CFM database information for MEPs in the specified CFM maintenance association (MA) within the specified CFM maintenance domain (MD).

NOTE: At the router attached to the initiator MEP for a one-way session, or at the router attached to the receiver MEP for a two-way session, you can only display ETH-DM frame counts.

Action

- To display CFM database information (including ETH-DM frame counts) for all MEPs in MA ma1 within MD md1:

```
user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain ma1 maintenance-association ma1
```

- To display CFM database information (including ETH-DM frame counts) only for local MEP 201 in MA ma1 within MD md1:

```
user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md2 maintenance-association ma2 local-mep 201
```

- To display CFM database information (including ETH-DM frame counts) only for remote MEP 302 in MD md3 within MA ma3:

```
user@host> show oam ethernet connectivity-fault-management mep-database
maintenance-domain ma3 maintenance-association ma3 remote-mep 302
```

Displaying ETH-DM Frame Counts for MEPs by Interface or Domain Level

Purpose Display ETH-DM frame counts for CFM maintenance association end points (MEPs).

By default, the show oam ethernet connectivity-fault-management interfaces command displays CFM database information for MEPs attached to CFM-enabled Ethernet interfaces on the router or at a maintenance domain level. For Ethernet interfaces that support ETH-DM, any frame counts are also displayed when you specify the detail or extensive command option.

NOTE: At the router attached to the initiator MEP for a one-way session, or at the router attached to the receiver MEP for a two-way session, you can only display ETH-DM frame counts.

Action

- To display CFM database information (including ETH-DM frame counts) for all MEPs attached to CFM-enabled Ethernet interfaces on the router:

```
user@host> show oam ethernet connectivity-fault-management interfaces
detail
```

- To display CFM database information (including ETH-DM frame counts) only for the MEPs attached to CFM-enabled router interface ge-5/2/9.0:

```
user@host> show oam ethernet connectivity-fault-management interfaces
ge-5/2/9.0 detail
```

- To display CFM database information (including ETH-DM frame counts) only for MEPs enclosed within CFM maintenance domains (MDs) at level 6:

```
user@host> show oam ethernet connectivity-fault-management interfaces
level 6 detail
```

Clearing ETH-DM Statistics and Frame Counts

Purpose Clear the ETH-DM statistics and ETH-DM frame counts.

By default, statistics and frame counts are deleted for all MEPs attached to CFM-enabled interfaces on the router. However, you can filter the scope of the command by specifying an interface name.

Action

- To clear the ETH-DM statistics and ETH-DM frame counts for all MEPs attached to CFM-enabled interfaces on the router:

```
user@host> clear oam ethernet connectivity-fault-management statistics
```

- To clear the ETH-DM statistics and ETH-DM frame counts only for MEPs attached to the logical interface ge-0/5.9.0:

```
user@host> clear oam ethernet connectivity-fault-management statistics
ge-0/5/9.0
```

Related Topics

- clear oam ethernet connectivity-fault-management statistic command
- show oam ethernet connectivity-fault-management delay-statistics command
- show oam ethernet connectivity-fault-management interfaces (detail | extensive) command
- show oam ethernet connectivity-fault-management mep-statistics command
- show oam ethernet connectivity-fault-management mep-database command

Example: One-Way Ethernet Frame Delay Measurement

This topic contains the following information:

Description of the Example One-Way Frame Delay Measurement

This example shows how you can configure two MX-series routers (MX-PE1 and MX-PE2) to support an ETH-DM session between two peer MEPs (MEP 201 and MEP 101), initiate a one-way ETH-DM session (from MEP 101 to MEP 201), and then display the ETH-DM statistics and frame counts collected. To increase the accuracy of the ETH-DM statistics, enable optional hardware-assisted timestamping of received ETH-DM frames on the router that contains the receiver MEP.

Routers Used in This Example

To support one-way ETH-DM with optional hardware timestamping of frames on the reception path, the routers used in this example are described as follows:

- Routers MX-PE1 and MX-PE2 are MX-series routers.
- The system clocks of routers MX-PE1 and MX-PE2 are closely synchronized.
- On router MX-PE1, interface ge-5/2/9 is an Ethernet port on an Enhanced or Enhanced Queuing Dense Port Concentrator (DPC). The traffic load received on this DPC is heavy.
- On router MX-PE2, interface ge-0/2/5 is an Ethernet port on a DPC.

ETH-DM Frame Counts for this Example

Both routers count the number of ETH-DM frames sent and received by the peer MEPs in the session and store the frame counts in the CFM databases as follows:

- At router MX-PE2, which contains the initiator MEP 101, the CFM database stores the ETH-DM frame counts for a one-way ETH-DM initiator (the count of 1DM frames sent).
- At router MX-PE1, which contains the receiver MEP 201, the CFM database stores the ETH-DM frame counts for a one-way ETH-DM receiver (the count of valid 1DM frames received and the count of invalid 1DM frames received).

ETH-DM Statistics for this Example

For a one-way frame delay measurement, only the router that contains the receiver MEP measures and stores frame delay statistics. In this example, ETH-DM statistics collected for the session are available only at router MX-PE1.

Steps for the Example One-Way Frame Delay Measurement

The following steps describe an example one-way Ethernet frame delay measurement:

1. At router MX-PE1, configure MEP 201 as a CFM maintenance association end point in CFM maintenance domain md6 as follows:
   a. Define the maintenance domain md6 by associating it with maintenance domain level 6 and maintenance association identifier ma6.
   b. Configure the maintenance association by specifying continuity protocol options and specifying MEP identifier 201.
   c. Configure MEP 201 by attaching it to logical interface ge-5/2/9.0, which is a single-tag interface on VLAN 512.

   The following configuration is only a partial example of a complete and functional router configuration:

```
[edit]
interfaces { # Configure a single-tag logical interface on VLAN 512
  ge-5/2/9 { # Interface must be on a DPC
    vlan-tagging;
    unit 0 {
      vlan-id 512;
    }
  }
}
protocols {
  oam {
    ethernet {
      connectivity-fault-management {
        traceoptions {
          file eoam_cfm.log size 1g files 2 world-readable;
          flag all;
        }
        maintenance-domain md6 { # Define MD 'md6' on router MX-PE1
          level 6;
          maintenance-association ma6 { # Configure MA 'ma6' on router MX-PE1
            continuity-check {
              interval 100ms;
              hold-interval 1;
            }
            mep 201 { # Configure MEP 201 on router MX-PE1
              interface ge-5/2/9.0; # Attach to logical interface on VLAN 512
              direction down;
              auto-discovery;
            }
          }
        }
      }
    }
  }
}
```

2. At router MX-PE2, configure MEP 101 as a CFM maintenance association end point in CFM maintenance domain md6 as follows:

   a. Define the maintenance domain md6 by associating it with maintenance domain level 6 and maintenance association identifier ma6.

   b. Configure the maintenance association by specifying continuity protocol options and specifying MEP identifier 101.

   c. Configure MEP 101 by attaching it to logical interface ge-0/2/5.0, which is a single-tag interface on VLAN 512.

   The following configuration is only a partial example of a complete and functional configuration for router MX-PE2:

```
[edit]
interfaces { # Configure a single-tag logical interface on VLAN 512
  ge-0/2/5 { # Interface must be on a DPC
    vlan-tagging;
    unit 0 {
      vlan-id 512;
    }
  }
}
protocols {
  oam {
    ethernet {
      connectivity-fault-management {
        traceoptions {
          file eoam_cfm.log size 1g files 2 world-readable;
          flag all;
        }
        maintenance-domain md6 { # Define MD 'md6' on router MX-PE2
          level 6;
          maintenance-association ma6 { # Configure MA 'ma6' on router MX-PE2
            continuity-check {
              interval 100ms;
              hold-interval 1;
            }
            mep 101 { # Configure MEP 101 on router MX-PE2
              interface ge–0/2/5.0; # Attach to logical interface on VLAN 512
              direction down;
              auto-discovery;
            }
          }
        }
      }
    }
  }
```

3. (Optional) To increase the accuracy of the ETH-DM statistics, modify the configuration of router MX-PE1, which contains the receiver MEP, by enabling hardware-assisted timestamping of 1DM frames received on the router.

```
[edit protocols]
oam {
```

```
        ethernet {
            connectivity-fault-management {
                performance-monitoring {
                    hardware-assisted-timestamping;
                }
            }
        }
    }
```

NOTE: The hardware-assisted timestamping option for ETH-DM is available for Ethernet interfaces on Enhanced or Enhanced Queuing DPCs only.

---

4. At router MX-PE2, start a one-way frame delay measurement session from local MEP 101 to remote MEP 201 on router MX-PE1:

```
user@MX-PE2> monitor ethernet delay-measurement one-way mep 201
maintenance-domain md6 maintenance-association ma6 count 10

One-way ETH-DM request to 00:90:69:0a:43:94, Interface ge-0/2/5.0
1DM Frames sent : 10
--- Delay measurement statistics ---
Packets transmitted: 10
Average delay: NA, Average delay variation: NA
Best case delay: NA, Worst case delay: NA
```

5. At router MX-PE2, which contains the initiator MEP, only the ETH-DM frame counts are available. Furthermore, the only frame count tallied for the initiator of a one-way frame delay measurement is the count of 1DM frames transmitted.

   ETH-DM frame counts (the number of 1DM, DMM, and DMR frames exchanged during an ETH-DM session) are stored in the CFM database of both the initiator and receiver MEPs. When you display CFM database information, you can also display the ETH-DM frame counts. You can display CFM database information for all interfaces on the router, or you can limit the output to MEPs associated with certain CFM MDs and MAs.

   - To display CFM database information for MEPs specified by enclosing CFM entities, use the mep-database form of the show oam ethernet connectivity-fault-management command. A CFM database also stores any ETH-DM frame counts.

     In the example configuration for router MX-PE2, MEP 101 is the only MEP defined in MA ma6 within MD md6. Therefore, the show oam ethernet connectivity-fault management mep-database command output displays CFM database information for MEP 101 only, even though you do not filter the command output by including the local-mep or remote-mep command options.

```
user@MX-PE2> show oam ethernet connectivity-fault-management mep-database
maintenance-domain md6 maintenance-association ma6

Maintenance domain name: md6, Format: string, Level: 6
  Maintenance association name: ma6, Format: string
  Continuity-check status: enabled, Interval: 100ms, Loss-threshold: 3
```

```
frames
  MEP identifier: 101, Direction: down, MAC address: 00:90:69:0a:48:57
  Auto-discovery: enabled, Priority: 0
  Interface name: ge-0/2/5.0, Interface status: Active, Link status: Up
  Defects:
    Remote MEP not receiving CCM                 : no
    Erroneous CCM received                       : no
    Cross-connect CCM received                   : no
    RDI sent by some MEP                         : no
  Statistics:
    CCMs sent                                    : 1590
    CCMs received out of sequence                : 0
    LBMs sent                                    : 0
    Valid in-order LBRs received                 : 0
    Valid out-of-order LBRs received             : 0
    LBRs received with corrupted data            : 0
    LBRs sent                                    : 0
    LTMs sent                                    : 0
    LTMs received                                : 0
    LTRs sent                                    : 0
    LTRs received                                : 0
    Sequence number of next LTM request          : 0
    1DMs sent                                    : 10
    Valid 1DMs received                          : 0
    Invalid 1DMs received                        : 0
    DMMs sent                                    : 0
    DMRs sent                                    : 0
    Valid DMRs received                          : 0
    Invalid DMRs received                        : 0
  Remote MEP count: 1
    Identifier    MAC address        State    Interface
      201     00:90:69:0a:43:94       ok    ge-0/2/5.0
```

- To display CFM database information for MEPs specified by interface name, use the interfaces detail form of the show oam ethernet connectivity-fault-management command. A CFM database also stores any ETH-DM frame counts.

  In the example configuration for router MX-PE2, MEP 101 is the only MEP assigned to an interface on the router. Therefore, the show oam ethernet connectivity-fault-management interfaces (detail | extensive) command output displays CFM database information for MEP 101 only, even though you do not filter the command output by including the *ethernet-interface-name* or level *md-level* command options.

```
user@MX-PE2> show oam ethernet connectivity-fault-management interfaces
detail

Interface name: ge-0/2/5.0, Interface status: Active, Link status: Up
  Maintenance domain name: md6, Format: string, Level: 6
    Maintenance association name: ma6, Format: string
    Continuity-check status: enabled, Interval: 100ms, Loss-threshold: 3
 frames
    MEP identifier: 101, Direction: down, MAC address: 00:90:69:0a:48:57
    MEP status: running
    Defects:
      Remote MEP not receiving CCM                 : no
      Erroneous CCM received                       : no
```

```
    Cross-connect CCM received                    : no
    RDI sent by some MEP                          : no
  Statistics:
    CCMs sent                                     : 1590
    CCMs received out of sequence                 : 0
    LBMs sent                                     : 0
    Valid in-order LBRs received                  : 0
    Valid out-of-order LBRs received              : 0
    LBRs received with corrupted data             : 0
    LBRs sent                                     : 0
    LTMs sent                                     : 0
    LTMs received                                 : 0
    LTRs sent                                     : 0
    LTRs received                                 : 0
    Sequence number of next LTM request           : 0
    1DMs sent                                     : 10
    Valid 1DMs received                           : 0
    Invalid 1DMs received                         : 0
    DMMs sent                                     : 0
    DMRs sent                                     : 0
    Valid DMRs received                           : 0
    Invalid DMRs received                         : 0
  Remote MEP count: 1
    Identifier    MAC address        State    Interface
      201     00:90:69:0a:43:94       ok    ge-0/2/5.0
```

NOTE: You can use these same commands—show oam ethernet connectivity-fault-management mep-database and show oam ethernet connectivity-fault-management interfaces (detail | extensive)—at router MX-PE1 to display the CFM database information (which includes any ETH-DM frame counts) for receiver MEP 201.

6. At router MX-PE1, which contains the receiver MEP, you can use two different show oam ethernet connectivity-fault-management commands to display ETH-DM statistics and ETH-DM frame counts.

   a. To display only the delay statistics, use the delay-statistics form of the show oam ethernet connectivity-fault-management command:

```
user@MX-PE1> show oam ethernet connectivity-fault-management
delay-statistics maintenance-domain md6

MEP identifier: 201, MAC address: 00:90:69:0a:43:94
Remote MEP count: 1

  Remote MAC address: 00:90:69:0a:48:57
    Delay measurement statistics:
    Index  One-way delay  Two-way delay
              (usec)         (usec)
      1        370
      2        357
      3        344
      4        332
      5        319
      6        306
      7        294
      8        281
      9        269
      10       255
    Average one-way delay          : 312 usec
    Average one-way delay variation: 11 usec
    Best case one-way delay        : 255 usec
    Worst case one-way delay       : 370 usec
```

   b. To display both the ETH-DM statistics and the CFM database information (which includes any ETH-DM frame counts), use the mep-statistics form of the show oam ethernet connectivity-fault-management command:

```
user@MX-PE1> show oam ethernet connectivity-fault-management mep-statistics
maintenance-domain md6

MEP identifier: 201, MAC address: 00:90:69:0a:43:94
Remote MEP count: 1
  CCMs sent                                     : 3240
  CCMs received out of sequence                 : 0
  LBMs sent                                     : 0
  Valid in-order LBRs received                  : 0
  Valid out-of-order LBRs received              : 0
  LBRs received with corrupted data             : 0
  LBRs sent                                     : 0
  LTMs sent                                     : 0
```

```
LTMs received                              : 0
LTRs sent                                  : 0
LTRs received                              : 0
Sequence number of next LTM request        : 0
1DMs sent                                  : 0
Valid 1DMs received                        : 10
Invalid 1DMs received                      : 0
DMMs sent                                  : 0
DMRs sent                                  : 0
Valid DMRs received                        : 0
Invalid DMRs received                      : 0

Remote MEP identifier: 101
Remote MAC address: 00:90:69:0a:48:57
  Delay measurement statistics:
  Index  One-way delay  Two-way delay
            (usec)         (usec)
    1        370
    2        357
    3        344
    4        332
    5        319
    6        306
    7        294
    8        281
    9        269
    10       255
  Average one-way delay          : 312 usec
  Average one-way delay variation: 11 usec
  Best case one-way delay        : 255 usec
  Worst case one-way delay       : 370 usec
```

Related Topics

- Guidelines for Configuring Routers to Support an ETH-DM Session on page 669
- Guidelines for Starting an ETH-DM Session on page 670
- Guidelines for Managing ETH-DM Statistics and ETH-DM Frame Counts on page 672

Chapter 43

Configuring IEEE 802.1x Port-Based Network Access Control

This section contains the following topics:

IEEE 802.1x Port-Based Network Access Control Overview

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

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

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

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

NOTE: On the MX–series platform, 802.1x can be enabled on bridged ports only and not on routed ports.

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

Administrative State of the Authenticator Port

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

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

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

Administrative Mode of the Authenticator Port

JUNOS software supports the supplicant mode of “Single” and not the “Single Secure” or “Multiple” modes. The “Single” mode option authenticates only the first client that connects to a port. All other clients that connect later (802.1x compliant or noncompliant) are allowed free access on that port without any further authentication. If the first authenticated client logs out, all other users are locked out until a client authenticates again.

Configuring the Authenticator

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

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

```
        retries integer;
        server-timeout seconds;
        supplicant (single);
        supplicant-timeout seconds;
        transmit-period seconds;
    }
}
```

Viewing the dot1x Configuration

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

Chapter 44

Configuring IEEE 802.3ah OAM Link-Fault Management

This section includes the following topics:

IEEE 802.3ah OAM Link-Fault Management Overview

Ethernet interfaces capable of running at 100 Mbps or faster on MX-series, M-series (except M10 and M7 routers), and T-series routing platforms support the IEEE 802.3ah standard for Operation, Administration, and Management (OAM). You can configure IEEE 802.3ah OAM on Ethernet point-to-point direct links or links across Ethernet repeaters. The IEEE 802.3ah standard meets the requirement for OAM capabilities as Ethernet moves from being solely an enterprise technology to being a WAN and access technology, as well as being backward-compatible with existing Ethernet technology. JUNOS software supports IEEE 802.3ah link-fault management.

The features of link-fault management are:

- Discovery
- Link monitoring
- Remote fault detection
- Remote loopback

NOTE: Ethernet running on top of a Layer 2 protocol, such as Ethernet over ATM, is not supported in OAM configurations.

Configuring IEEE 802.3ah OAM Link-Fault Management

You can configure threshold values for fault events that trigger the sending of link event TLVs when the values exceed the threshold. To set threshold values for fault events on an interface, include the event-thresholds statement at the [edit protocols oam ethernet link-fault-management interface] hierarchy level.

You can also configure OAM threshold values within an action profile and apply the action profile to multiple interfaces. To create an action profile, include the action-profile statement at the [edit protocols oam ethernet link-fault-management] hierarchy level.

To view OAM statistics, use the show oam ethernet link-fault-management operational mode command. To clear OAM statistics, use the clear oam ethernet link-fault-management statistics operational mode command. To clear link-fault management state information and restart the link discovery process on Ethernet interfaces, use the operational clear oam ethernet link-fault-management state mode command. For more information about these commands, see the *JUNOS Interfaces Command Reference*.

Enabling IEEE 802.3ah OAM Support

To enable IEEE 802.3ah OAM support, include the interface statement at the [edit protocols oam ethernet link-fault-management] hierarchy level:

```
[edit protocols oam ethernet link-fault-management interface interface-name]
```

When you enable IEEE 802.3ah OAM on a physical interface, the discovery process is automatically triggered.

Configuring Link Discovery

When the IEEE 802.3ah OAM protocol is enabled on a physical interface, the discovery process is automatically triggered. The discovery process permits Ethernet interfaces to discover and monitor the peer on the link if it also supports the IEEE 802.3ah standard.

You can specify the discovery mode used for IEEE 802.3ah OAM support. The discovery process is triggered automatically when OAM IEEE 802.3ah functionality is enabled on a port. Link monitoring is done when the interface sends periodic OAM PDUs.

To configure the discovery mode, include the link-discovery statement at the [edit protocol oam ethernet link-fault-management interface *interface-name*] hierarchy level:

```
[edit protocol oam ethernet link-fault-management interface interface-name]
link-discovery (active | passive);
```

In active mode, the interface discovers and monitors the peer on the link if the peer also supports IEEE 802.3ah OAM functionality. In passive mode, the peer initiates the discovery process. After the discovery process has been initiated, both sides participate in discovery.

Configuring the OAM PDU Interval

Periodic OAM PDUs are sent to perform link monitoring.

You can specify the periodic OAM PDU sending interval for fault detection.

To configure the sending interval, include the pdu-interval statement at the [edit protocol oam ethernet link-fault-management interface *interface-name*] hierarchy level:

```
[edit protocol oam ethernet link-fault-management interface interface-name]
pdu-interval interval;
```

The periodic OAM PDU interval range is from 100 through 1000 milliseconds. The default sending interval is 1000 milliseconds.

Configuring the OAM PDU Threshold

You can specify the number of OAM PDUs that an interface can miss before the link between peers is considered down.

To configure the number of PDUs that can be missed from the peer, include the pdu-threshold statement at the [edit protocol oam ethernet link-fault-management interface *interface-name*] hierarchy level:

```
[edit protocol oam ethernet link-fault-management interface interface-name]
pdu-threshold threshold-value;
```

The threshold value range is from 3 through 10. The default is three PDUs.

Configuring Threshold Values for Local Fault Events on an Interface

You can configure threshold values on an interface for the local errors that trigger the sending of link event TLVs.

To set the error threshold values for sending event TLVs, include the frame-error, frame-period, frame-period-summary, and symbol-period statements at the [edit protocols oam ethernet link-fault-management interface *interface-name* event-thresholds] hierarchy level:

```
[edit protocol oam ethernet link-fault-management interface interface-name]
event-thresholds {
    frame-error count;
    frame-period count;
    frame-period-summary count;
    symbol-period count;
}
```

Disabling the Sending of Link Event TLVs

You can disable the sending of link event TLVs.

To disable the monitoring and sending of PDUs containing link event TLVs in periodic PDUs, include the no-allow-link-events statement at the [edit protocols oam ethernet link-fault-management interface *interface-name* negotiation-options] hierarchy level:

```
[edit protocol oam ethernet link-fault-management interface interface-name
    negotiation-options]
no-allow-link-events;
```

Detecting Remote Faults

Fault detection is either based on flags or fault event type length values (TLVs) received in OAM protocol data units (PDUs). Flags that trigger a link fault are:

- Critical Event
- Dying Gasp
- Link Fault

The link event TLVs are sent by the remote DTE by means of event notification PDUs. Link event TLVs are:

- Errored Symbol Period Event
- Errored Frame Event
- Errored Frame Period Event
- Errored Frame Seconds Summary Event

Configuring an OAM Action Profile

You can create an action profile to define event fault flags and thresholds and the action to be taken. You can then apply the action profile to one or more interfaces.

To configure an action profile, include the action-profile statement at the [edit protocols oam ethernet link-fault-management] hierarchy level:

```
action-profile profile-name {
```

```
    action {
        syslog;
        link-down;
        send-critical-event;
    }
    event {
        link-adjacency-loss;
        link-event-rate {
            frame-error count;
            frame-period count;
            frame-period-summary count;
            symbol-period count;
        }
        protocol-down;
    }
}
```

Specifying the Actions to Be Taken for Link-Fault Management Events

You can specify the action to be taken by the system when the configured link-fault event occurs. Multiple action profiles can be applied to a single interface. For each action-profile, at least one event and one action must be specified. The actions are taken only when all of the events in the action profile are true. If more than one action is specified, all the actions are executed.

You might want to set a lower threshold for a specific action such as logging the error and set a higher threshold for another action such as sending a critical event TLV.

To specify the action, include the action statement at the [edit protocols oam ethernet link-fault-management action-profile *profile-name*] hierarchy level:

```
[edit protocol oam ethernet link-fault-management action-profile profile-name]
event {
    link-adjacency-loss;
    protocol-down;
}
action {
    syslog;
    link-down;
    send-critical-event;
}
```

To create a system log entry when the link-fault event occurs, include the syslog statement.

To administratively disable the link when the link-fault event occurs, include the link-down statement.

To send IEEE 802.3ah link event TLVs in the OAM PDU when a link-fault event occurs, include the send-critical-event statement.

NOTE: If multiple actions are specified in the action profile, all of the actions are executed in no particular order.

Monitoring the Loss of Link Adjacency

You can specify actions be taken when link adjacency is lost. When link adjacency is lost, the system takes the action defined in the action statement of the action profile.

To configure the system to take action when link adjacency is lost, include the link-adjacency-loss statement at the [edit protocols oam ethernet link-fault-management action-profile *profile-name* event] hierarchy level:

```
[edit protocol oam ethernet link-fault-management action-profile profile-name]
link-adjacency-loss;
```

Monitoring Protocol Status

When a higher level protocol has signaled a down status to the IEEE 802.3ah protocol, the system takes the action defined in the action statement of the action profile.

To monitor the IEEE 802.3ah protocol, include the protocol-down statement at the [edit protocols oam ethernet link-fault-management action-profile *profile-name* event] hierarchy level:

```
[edit protocol oam ethernet link-fault-management action-profile profile-name]
protocol-down;
```

NOTE: If multiple events are specified in the action profile, all the events must occur before the specified action is taken.

Configuring Threshold Values for Fault Events in an Action Profile

You can configure link event thresholds for received error events that trigger the action specified in the action statement. You can then apply the action profile to one or more interfaces.

To configure link event thresholds, include the link-event-rate statement at the [edit protocols oam ethernet link-fault-management action-profile *profile-name* event] hierarchy level:

```
link-event-rate {
    frame-error count;
    frame-period count;
    frame-period-summary count;
    symbol-period count;
}
```

Applying an Action Profile

You can apply an action profile to one or more interfaces.

To apply an action profile to an interface, include the apply-action-profile statement at the [edit protocols oam ethernet link-fault-management action-profile interface *interface-name*] hierarchy level:

```
[edit protocol oam ethernet link-fault-management interface interface-name]
apply-action-profile profile-name;
```

Setting a Remote Interface into Loopback Mode

You can configure the software to set the remote DTE into loopback mode on the following interfaces:

- IQ2 and IQ2-E Gigabit Ethernet interfaces
- Ethernet interfaces on the MX-series routers

JUNOS software can place a remote DTE into loopback mode (if remote-loopback mode is supported by the remote DTE). When you place a remote DTE into loopback mode, the interface receives the remote-loopback request and puts the interface into remote-loopback mode. When the interface is in remote-loopback mode, all frames except OAM PDUs are looped back without any changes made to the frames. OAM PDUs continue to be sent to the management plane and processed.

To configure remote loopback, include the remote-loopback statement at the [edit protocol oam ethernet link-fault-management interface *interface-name*] hierarchy level:

```
[edit protocol oam ethernet link-fault-management interface interface-name]
remote-loopback;
```

To take the remote DTE out of loopback mode, remove the remote-loopback statement from the configuration.

Enabling Remote Loopback Support on the Local Interface

You can allow a remote DTE to set a local interface into remote loopback mode on IQ2 and IQ2-E Gigabit Ethernet interfaces and all Ethernet interfaces on the MX-series routers. When a remote-loopback request is sent by a remote DTE, the JUNOS software places the local interface into loopback mode. When an interface is in loopback mode, all frames except OAM PDUs are looped back without any changes to the frames. OAM PDUs continue to be sent to the management plane and processed. By default, the remote loopback feature is not enabled.

To enable remote loopback, include the allow-remote-loopback statement at the [edit protocol oam ethernet link-fault-management interface *interface-name* negotiation-options] hierarchy level:

```
[edit protocol oam ethernet link-fault-management interface interface-name
   negotiation-options]
allow-remote-loopback;
```

NOTE: Activation of OAM remote loopback may result in data frame loss.

Example: Configuring IEEE 802.3ah OAM Support on an Interface

Configure 802.3ah OAM support on an MX-series 10-Gigabit Ethernet interface:

```
[edit]
protocols {
   oam {
      ethernet {
         link-fault-management {
            interface xe-0/0/0 {
               link-discovery active;
               pdu-interval 800;
               pdu-threshold 4;
               remote-loopback;
               negotiation-options {
                  allow-remote-loopback;
               }
               event-thresholds {
                  frame-error 30;
                  frame-period 50;
                  frame-period summary 40;
                  symbol-period 20;
               }
            }
         }
      }
   }
}
```

Chapter 45

Configuring VRRP and VRRP for IPv6

This section contains the following topics:

VRRP and VRRP for IPv6 Overview

For Ethernet, Fast Ethernet, Tri-Rate Ethernet copper, Gigabit Ethernet, 10-Gigabit Ethernet, and Ethernet logical interfaces, you can configure the Virtual Router Redundancy Protocol (VRRP) and VRRP for IPv6. VRRP and VRRP for IPv6 allow hosts on a LAN to make use of redundant routing platforms on that LAN without requiring more than the static configuration of a single default route on the hosts. The VRRP routing platforms share the IP address corresponding to the default route configured on the hosts. At any time, one of the VRRP routing platforms is the master (active) and the others are backups. If the master fails, one of the backup routers becomes the new master router, thus always providing a virtual default routing platform and allowing traffic on the LAN to be routed without relying on a single routing platform.

VRRP is defined in RFC 3768, *Virtual Router Redundancy Protocol*.

For VRRP and VRRP for IPv6 overview information, configuration guidelines, and statement summaries, see the *JUNOS High Availability Configuration Guide*.

Configuring VRRP and VRRP for IPv6

To configure VRRP or VRRP for IPv6, include the vrrp-group or vrrp-inet6-group statement, respectively. These statements are available at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address*]

The VRRP and VRRP IPv6 configuration statements are as follows:

```
(vrrp-group | vrrp-inet-group) group-number {
    (accept-data | no-accept-data);
    advertise-interval seconds;
```

```
    authentication-key key;
    authentication-type authentication;
    fast-interval milliseconds;
    (preempt | no-preempt) {
        hold-time seconds;
    }
    priority-number number;
    track {
        priority-hold-time;
        interface interface-name {
            priority-cost priority;
            bandwidth-threshold bits-per-second {
                priority-cost;
            }
        }
    }
    virtual-address [ addresses ];
}
```

To trace VRRP and VRRP for IPv6 operations, include the traceoptions statement at the [edit protocols vrrp] hierarchy level:

```
[edit protocols vrrp traceoptions]
file {
    filename filename;
    files number;
    size size;
    (world-readable | no-world-readable);
}
flag flag;
```

When there are multiple VRRP groups, there is a few seconds delay between the time the first gratuitous ARP is sent out and the rest of the gratuitous ARP are sent. Configuring failover-delay compensates for this delay. To configure the failover delay from 500 to 2000 milliseconds for VRRP and VRRP for IPv6 operations, use the set failover-delay *milliseconds* statement at the [edit protocols vrrp] hierarchy level:

```
[edit protocols vrrp]
set failover-delay milliseconds;
```

To configure the startup period for VRRP and VRRP for IPv6 operations, include the startup-silent-period statement at the [edit protocols vrrp] hierarchy level:

```
[edit protocols vrrp]
startup-silent-period seconds;
```

Chapter 46

Configuring Gigabit Ethernet Accounting and Policing

This section contains the following topics:

Gigabit Ethernet Accounting and Policing Overview

For Gigabit Ethernet IQ PICs and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform), you can configure granular per-VLAN class-of-service (CoS) capabilities and extensive instrumentation and diagnostics on a per-VLAN and per-MAC address basis.

VLAN rewrite, tagging, and deleting enables you to use VLAN address space to support more customers and services.

VPLS allows you to provide a point-to-multipoint LAN between a set of sites in a VPN. Ethernet IQ PICs and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform) are combined with VPLS to deliver metro Ethernet service.

For Gigabit Ethernet IQ2 and IQ2-E and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces, you can apply Layer 2 policing to logical interfaces in the egress or ingress direction. Policers are configured at the [edit firewall] hierarchy.

Table 57 on page 707 lists the capabilities of Gigabit Ethernet IQ PICs and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform).

Table 57: Capabilities of Gigabit Ethernet IQ and Gigabit Ethernet with SFPs

Capability	Gigabit Ethernet IQ (SFP)	Gigabit Ethernet (SFP)
Layer 2		
802.3ad link aggregation	Yes	Yes

Table 57: Capabilities of Gigabit Ethernet IQ and Gigabit Ethernet with SFPs *(continued)*

Capability	Gigabit Ethernet IQ (SFP)	Gigabit Ethernet (SFP)
Maximum VLANs per port	384	1023
Maximum transmission unit (MTU) size	9192	9192
MAC learning	Yes	Yes
MAC accounting	Yes	Yes
MAC filtering	Yes	Yes
Destinations per port	960	960
Sources per port	64	64
Hierarchical MAC policers	Yes, premium and aggregate	No, aggregate only
Multiple TPID support and IP service for nonstandard TPIDs	Yes	Yes
Multiple Ethernet encapsulations	Yes	Yes
Dual VLAN tags	Yes	No
VLAN rewrite	Yes	No
Layer 2 VPNs		
VLAN CCC	Yes	Yes
Port-based CCC	Yes	Yes
Extended VLAN CCC Virtual Metropolitan Area Network (VMAN) Tag Protocol	Yes	Yes
CoS		
PIC-based egress queues	Yes	Yes
Queued VLANs	Yes	No
VPLS	Yes	Yes

For more information about configuring VPLS, see the *JUNOS VPNs Configuration Guide* and the *JUNOS Feature Guide*.

You can also configure CoS on logical IQ interfaces. For more information, see the *JUNOS Class of Service Configuration Guide*.

Configuring Gigabit Ethernet Policers

On Gigabit Ethernet IQ and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform), you can define rate limits for premium and aggregate traffic received on the interface. These policers allow you to perform simple traffic policing without configuring a firewall filter. First you configure the Ethernet policer profile, next you classify ingress and egress traffic, then you can apply the policer to a logical interface.

For Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform), the policer rates you configure can be different than the rates on the Packet Forward Engine. The difference results from Layer 2 overhead. The PIC accounts for this difference.

This section contains the following topics:

Configuring a Policer

To configure an Ethernet policer profile, include the ethernet-policer-profile statement at the [edit interfaces *interface-name* gigether-options ethernet-switch-profile] hierarchy level:

```
[edit interfaces interface-name gigether-options ethernet-switch-profile]
ethernet-policer-profile {
    policer cos-policer-name {
        aggregate {
            bandwidth-limit (ethernet) bps;
            burst-size-limit (ethernet) bytes;
        }
        premium {
            bandwidth-limit (ethernet) bps;
            burst-size-limit (ethernet) bytes;
        }
    }
}
```

In the Ethernet policer profile, the aggregate-priority policer is mandatory; the premium-priority policer is optional.

For aggregate and premium policers, you specify the bandwidth limit in bits per second. You can specify the value as a complete decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000). There is no absolute minimum value for bandwidth limit, but any value below 61,040 bps will result in an effective rate of 30,520 bps. The maximum bandwidth limit is 4.29 Gbps.

The maximum burst size controls the amount of traffic bursting allowed. To determine the burst-size limit, you can multiply the bandwidth of the interface on which you are applying the filter by the amount of time you allow a burst of traffic at that bandwidth to occur:

burst size = *bandwidth* x *allowable time for burst traffic*

If you do not know the interface bandwidth, you can multiply the maximum MTU of the traffic on the interface by 10 to obtain a value. For example, the burst size for an MTU of 4700 would be 47,000 bytes. The burst size should be at least 10 interface MTUs. The maximum value for the burst-size limit is 100 MB.

Specifying an Input Priority Map

An input priority map identifies ingress traffic with specified IEEE 802.1p priority values, and classifies that traffic as premium.

If you include a premium-priority policer, you can specify an input priority map by including the ieee802.1 premium statement at the [edit interfaces *interface-name* gigether-options ethernet-policer-profile input-priority-map] hierarchy level:

```
[edit interfaces interface-name gigether-options ethernet-policer-profile input-priority-map]
ieee802.1p premium [ values ];
```

The priority values can be from 0 through 7. The remaining traffic is classified as nonpremium (or aggregate). For a configuration example, see “Example: Configuring Gigabit Ethernet Policers” on page 713.

NOTE: On IQ2 and IQ2-E interfaces and MX-series interfaces, when a VLAN tag is pushed, the inner VLAN IEEE 802.1p bits are copied to the IEEE bits of the VLAN or VLANs being pushed. If the original packet is untagged, the IEEE bits of the VLAN or VLANs being pushed are set to 0.

Specifying an Output Priority Map

An output priority map identifies egress traffic with specified queue classification and packet loss priority (PLP), and classifies that traffic as premium.

If you include a premium-priority policer, you can specify an output priority map by including the classifier statement at the [edit interfaces *interface-name* gigether-options ethernet-policer-profile output-priority-map] hierarchy level:

```
[edit interfaces interface-name gigether-options ethernet-policer-profile
  output-priority-map]
classifier {
  premium {
    forwarding-class class-name {
      loss-priority (high | low);
```

```
        }
    }
}
```

You can define a forwarding class, or you can use a predefined forwarding class. Table 58 on page 711 shows the predefined forwarding classes and their associated queue assignments.

Table 58: Default Forwarding Classes

Forwarding Class Name	Queue
best-effort	Queue 0
expedited-forwarding	Queue 1
assured-forwarding	Queue 2
network-control	Queue 3

For more information about CoS forwarding classes, see the *JUNOS Class of Service Configuration Guide*. For a configuration example, see "Example: Configuring Gigabit Ethernet Policers" on page 713.

Applying a Policer

On Gigabit Ethernet IQ and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform), you can apply input and output policers that define rate limits for premium and aggregate traffic received on the logical interface. Aggregate policers are supported on Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform).

These policers allow you to perform simple traffic policing without configuring a firewall filter. For information about defining these policers, see "Configuring Gigabit Ethernet Policers" on page 709.

To apply policers to specific source MAC addresses, include the accept-source-mac statement:

```
accept-source-mac {
    mac-address mac-address {
        policer {
            input cos-policer-name;
            output cos-policer-name;
        }
    }
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]

- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

You can specify the MAC address as *nn:nn:nn:nn:nn:nn* or *nnnn.nnnn.nnnn*, where *n* is a hexadecimal number. You can configure up to 64 source addresses. To specify more than one address, include multiple mac-address statements in the logical interface configuration.

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

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

NOTE: If the remote Ethernet card is changed, the interface does not accept traffic from the new card because the new card has a different MAC address.

The MAC addresses you include in the configuration are entered into the routing platform's MAC database. To view the routing platform's MAC database, enter the show interfaces mac-database *interface-name* command:

user@host> **show interfaces mac-database *interface-name***

In the input statement, list the name of one policer template to be evaluated when packets are received on the interface.

In the output statement, list the name of one policer template to be evaluated when packets are transmitted on the interface.

NOTE: On IQ2 and IQ2-E PIC interfaces, the default value for maximum retention of entries in the MAC address table has changed, for cases in which the table is not full. The new holding time is 12 hours. The previous retention time of 3 minutes is still in effect when the table is full.

You can use the same policer one or more times.

If you apply both policers and firewall filters to an interface, input policers are evaluated before input firewall filters, and output policers are evaluated after output firewall filters.

Configuring MAC Address Filtering

You cannot explicitly define traffic with specific source MAC addresses to be rejected; however, for Gigabit Ethernet IQ and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform), you can block all incoming packets that do not have a source address specified in the accept-source-mac statement. For more information about the accept-source-mac statement, see "Applying a Policer" on page 711.

To enable this blocking, include the source-filtering statement at the [edit interfaces *interface-name* gigether-options] hierarchy level:

```
[edit interfaces interface-name gigether-options]
source-filtering;
```

For more information about the source-filtering statement, see "Enabling Ethernet MAC Address Filtering" on page 561.

To accept traffic even though it does not have a source address specified in the accept-source-mac statement, include the no-source-filtering statement at the [edit interfaces *interface-name* gigether-options] hierarchy level:

```
[edit interfaces interface-name gigether-options]
no-source-filtering;
```

For more information about the accept-source-mac statement, see "Applying a Policer" on page 711.

Example: Configuring Gigabit Ethernet Policers

Configure interface ge-6/0/0 to treat priority values 2 and 3 as premium. On ingress, this means that IEEE 802.1p priority values 2 and 3 are treated as premium. On egress, it means traffic that is classified into queue 0 or 1 with PLP of low and queue 2 or 3 with PLP of high, is treated as premium.

Define a policer that limits the premium bandwidth to 100 Mbps and burst size to 3 k, and the aggregate bandwidth to 200 Mbps and burst size to 3 k.

Specify that frames received from the MAC address 00:01:02:03:04:05 and the VLAN ID 600 are subject to the policer on input and output. On input, this means frames received with the source MAC address 00:01:02:03:04:05 and the VLAN ID 600 are subject to the policer. On output, this means frames transmitted from the routing platform with the destination MAC address 00:01:02:03:04:05 and the VLAN ID 600 are subject to the policer.

```
[edit interfaces]
ge-6/0/0 {
    gigether-options {
        ether-switch-profile {
```

```
                ether-policer-profile {
                    input-priority-map {
                        ieee-802.1p {
                            premium [ 2 3 ];
                        }
                    }
                    output-priority-map {
                        classifier {
                            premium {
                                forwarding-class best-effort {
                                    loss-priority low;
                                }
                                forwarding-class expedited-forwarding {
                                    loss-priority low;
                                }
                                forwarding-class assured-forwarding {
                                    loss-priority high;
                                }
                                forwarding-class network-control {
                                    loss-priority high;
                                }
                            }
                        }
                    }
                    policer policer-1 {
                        premium {
                            bandwidth-limit 100m;
                            burst-size-limit 3k;
                        }
                        aggregate {
                            bandwidth-limit 200m;
                            burst-size-limit 3k;
                        }
                    }
                }
            }
        }
        unit 0 {
            accept-source-mac {
                mac-address 00:01:02:03:04:05 {
                    policer {
                        input policer-1;
                        output policer-1;
                    }
                }
            }
        }
    }
```

Configuring Gigabit Ethernet Two-Color and Tricolor Policers

For Gigabit Ethernet and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces on M-series and T-series routing platforms, you can configure two-color and tricolor marking policers and apply them to logical interfaces to prevent traffic on the interface from consuming bandwidth inappropriately.

Networks police traffic by limiting the input or output transmission rate of a class of traffic on the basis of user-defined criteria. Policing traffic allows you to control the maximum rate of traffic sent or received on an interface and to partition a network into multiple priority levels or classes of service.

Policers require you to apply a burst size and bandwidth limit to the traffic flow, and set a consequence for packets that exceed these limits—usually a higher loss priority, so that packets exceeding the policer limits are discarded first.

Juniper Networks routing platform architectures support three types of policer:

- Two-color policer—A two-color policer (or "policer" when used without qualification) meters the traffic stream and classifies packets into two categories of packet loss priority (PLP) according to a configured bandwidth and burst-size limit. You can mark packets that exceed the bandwidth and burst-size limit in some way, or simply discard them. A policer is most useful for metering traffic at the port (physical interface) level.
- Single-rate tricolor marking (srTCM)—A single-rate tricolor marking policer is defined in RFC 2697, *A Single Rate Three Color Marker*, as part of an assured forwarding (AF) per-hop-behavior (PHB) classification system for a Differentiated Services (DiffServ) environment. This type of policer meters traffic based on the configured committed information rate (CIR), committed burst size (CBS), and excess burst size (EBS). Traffic is marked as belonging to one of three categories (green, yellow, or red) based on whether the packets arriving are below the CBS (green), exceed the CBS (yellow) but not the EBS, or exceed the EBS (red). Single-rate TCM is most useful when a service is structured according to packet length and not peak arrival rate.
- Two-rate Tricolor Marking (trTCM)—This type of policer is defined in RFC 2698, *A Two Rate Three Color Marker*, as part of an assured forwarding (AF) per-hop-behavior (PHB) classification system for a Differentiated Services (DiffServ) environment. This type of policer meters traffic based on the configured CIR and peak information rate (PIR), along with their associated burst sizes, the CBS and EBS. Traffic is marked as belonging to one of three categories (green, yellow, or red) based on whether the packets arriving are below the CIR (green), exceed the CIR (yellow) but not the PIR, or exceed the PIR (red). Two-rate TCM is most useful when a service is structured according to arrival rates and not necessarily packet length.

Unlike policing (described in "Configuring Gigabit Ethernet Policers" on page 709), configuring two-color policers and tricolor marking policers requires that you configure a firewall filter.

This section contains the following topics:

Configuring a Policer

Two-color and tricolor marking policers are configured at the [edit firewall] hierarchy level.

A tricolor marking policer polices traffic on the basis of metering rates, including the CIR, the PIR, their associated burst sizes, and any policing actions configured for the traffic.

To configure tricolor policer marking, include the three-color-policer statement with options at the [edit firewall] hierarchy level:

```
[edit firewall]
three-color-policer name {
    action {
        loss-priority high {
            then discard;
        }
    }
    single-rate {
        (color-aware | color-blind);
        committed-information-rate bps;
        committed-burst-size bytes;
        excess-burst-size bytes;
    }
    two-rate {
        (color-aware | color-blind);
        committed-information-rate bps;
        committed-burst-size bytes;
        peak-information-rate bps;
        peak-burst-size bytes;
    }
}
```

For more information about configuring tricolor policer markings, see the *JUNOS Policy Framework Configuration Guide* and the *JUNOS Class of Service Configuration Guide*.

Applying a Policer

Apply a two-color policer or tricolor policer to a logical interface to prevent traffic on the interface from consuming bandwidth inappropriately. To apply two-color or tricolor policers, include the layer2-policer statement:

```
layer2-policer {
    input-policer policer-name;
    input-three-color policer-name;
    output-policer policer-name;
    policer-name;
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Use the input-policer statement to apply a two-color policer to received packets on a logical interface and the input-three-color statement to apply a tricolor policer. Use the output-policer statement to apply a two-color policer to transmitted packets on a logical interface and the output-three-color statement to apply a tricolor policer. The specified policers must be configured at the [edit firewall] hierarchy level. For each interface, you can configure a three-color policer or two-color input policer or output policers—you cannot configure both a three-color policer and a two-color policer.

Example: Configuring and Applying a Policer

Configure tricolor policers and apply them to an interface:

```
[edit firewall]
three-color-policer three-color-policer-color-blind {
    logical-interface-policer;
    two-rate {
        color-blind;
        committed-information-rate 1500000;
        committed-burst-size 150;
        peak-information-rate 3;
        peak-burst-size 300;
    }
}
three-color-policer three-color-policer-color-aware {
    logical-interface-policer;
    two-rate {
        color-aware;
        committed-information-rate 1500000;
        committed-burst-size 150;
        peak-information-rate 3;
        peak-burst-size 300;
    }
}
[edit interfaces ge-1/1/0]
unit 1 {
    layer2-policer {
        input-three-color three-color-policer-color-blind;
        output-three-color three-color-policer-color-aware;
    }
}
```

Configure a two-color policer and apply it to an interface:

```
[edit firewall]
policer two-color-policer {
    logical-interface-policer;
    if-exceeding {
        bandwidth-percent 90;
        burst-size-limit 300;
    }
    then loss-priority-high;
}
[edit interfaces ge-1/1/0]
unit 2 {
    layer2-policer {
        input-policer two-color-policer;
        output-policer two-color-policer;
```

```
    }
}
```

Configuring MAC Address Accounting

For Gigabit Ethernet IQ and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform), you can configure whether source and destination MAC addresses are dynamically learned. To configure MAC address accounting, include the mac-learn-enable statement at the [edit interfaces *interface-name* gigether-options ethernet-switch-profile] hierarchy level:

```
[edit interfaces interface-name gigether-options ethernet-switch-profile]
mac-learn-enable;
```

To prohibit the interface from dynamically learning source and destination MAC addresses, include the no-mac-learn-enable statement at the [edit interfaces *interface-name* gigether-options ethernet-switch-profile] hierarchy level:

```
[edit interfaces interface-name gigether-options ethernet-switch-profile]
no-mac-learn-enable;
```

MAC address learning is based on source addresses. You can start accounting for traffic after it has been sent from the MAC address. Once the MAC address is learned, the frames and bytes transmitted to or received from the MAC address can be tracked.

Chapter 47

Configuring Gigabit Ethernet Autonegotiation

This section contains the following topics:

Gigabit Ethernet Autonegotiation Overview

Autonegotiation is enabled by default on all Gigabit Ethernet and Tri-Rate Ethernet copper interfaces. However, you can explicitly enable autonegotiation to configure remote fault options manually.

NOTE: For Gigabit Ethernet interfaces installed in J4350 and J6350 Services Routers, when you manually configure either the link mode or speed settings, the system ignores the configuration and generates a system log message. When autonegotiation is enabled and you specify the link mode and speed, the link autonegotiates with the manually configured settings. When autonegotiation is disabled and you configure both the link mode and speed, the link operates with the manually configured settings. If you disable autonegotiation and do not manually configure the link mode and speed, the link operates at 1000 Mbps full duplex.

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

Configuring Gigabit Ethernet Autonegotiation

Configuring Gigabit Ethernet Autonegotiation with Remote Fault

To configure explicit autonegotiation and remote fault, include the auto-negotiation statement and the remote-fault option at the [edit interfaces ge-*fpc/pic/port* gigether-options] hierarchy level.

[edit interfaces ge-*fpc/pic/port* gigether-options]

(auto-negotiation | no-auto-negotiation) remote-fault <local-interface-online |
local-interface-offline>

Configuring Flow Control

To enable flow control, include the flow-control statement at the [edit interfaces ge-*fpc/pic*>/*port* gigether-options] hierarchy level.

Configuring Autonegotiation Speed on MX-series Routers

MX-series routers with Combo Line Rate DPCs and Tri-Rate Copper SFPs support autonegotiation of speed. The autonegotiation specified interface speed is propagated to CoS, routing protocols, and other system components. Half-duplex mode is not supported.

To specify the autonegotiation speed, use the speed <(auto | 1Gbps | 100Mbps | 10Mbps)> statement at the [edit interface ge-*fpc/pic*>/*port*] hierarchy level.

To set port speed negotiation to a specific rate, set the port speed to 1Gbps, 100Mbps, or 10Mbps. If the negotiated speed and the interface speed do not match, the link will not be brought up.

If you set the autonegotiation speed auto option, then the port speed is negotiated.

You can disable auto MDI/MDIX using the no-auto-mdix statement at the [edit interface ge-*fpc/pic*>/*port* gigether-options] hierarchy level.

Use the show interfaces ge-*fpc/pic*>/*port* brief command to display the auto negotiation of speed and auto MDI/MDIX states.

Displaying Autonegotiation Status

To display Gigabit Ethernet interface details, including the autonegotiation status, use the operational mode command show interfaces ge- *fpc/pic/port* extensive.

Table 59 on page 720 and Table 60 on page 723 provide information about the autonegotiation status on local and remote routers with fiber interfaces. The status of the link and LED can vary depending on the level of autonegotiation set and the transmit and receive fiber status.

Table 59: Mode and Autonegotiation Status (Local)

Transmit	Receive	Mode	LED	Link	Autonegotiation Status
ON	ON	Default	Green	UP	Complete
ON	OFF	Default	Red	DOWN	
OFF	ON	Default	Red	DOWN	

Table 59: Mode and Autonegotiation Status (Local) *(continued)*

Transmit	Receive	Mode	LED	Link	Autonegotiation Status
OFF	OFF	Default	Red	DOWN	
ON	ON	Default	Red	DOWN	
ON	ON	Default	Green	UP	No-autonegotiation
ON	OFF	Default	Red	DOWN	
OFF	OFF	Default	Red	DOWN	
ON	ON	Default	Green	UP	
ON	ON	Default	Red	DOWN	
ON	ON	No-autonegotiation	Green	UP	Incomplete
ON	OFF	No-autonegotiation	Red	DOWN	
OFF	ON	No-autonegotiation	Green	UP	
OFF	OFF	No-autonegotiation	Red	DOWN	
ON	ON	No-autonegotiation	Red	DOWN	
ON	ON	Explicit	Green	UP	Complete
ON	OFF	Explicit	Red	DOWN	
OFF	ON	Explicit	Red	DOWN	
OFF	OFF	Explicit	Red	DOWN	
ON	ON	Explicit	Red	DOWN	
ON	OFF	Explicit + RFI-Offline	Red	DOWN	
ON	ON	Explicit	Green	UP	No-autonegotiation
ON	OFF	Explicit	Red	DOWN	
OFF	ON	Explicit	Green	UP	
OFF	OFF	Explicit	Red	DOWN	
ON	ON	Explicit	Red	DOWN	
ON	ON	Explicit + RFI-Offline	Green	UP	Complete
OFF	ON	Explicit + RFI-Offline	Red	DOWN	
OFF	OFF	Explicit + RFI-Offline	Red	DOWN	
ON	ON	Explicit + RFI-Offline	Red	DOWN	

Table 59: Mode and Autonegotiation Status (Local) *(continued)*

Transmit	Receive	Mode	LED	Link	Autonegotiation Status
ON	ON	Explicit + RFI-Offline	Green	UP	No-autonegotiation
ON	OFF	Explicit + RFI-Offline	Red	DOWN	
OFF	ON	Explicit + RFI-Offline	Green	UP	
OFF	OFF	Explicit + RFI-Offline	Red	DOWN	
ON	ON	Explicit + RFI-Offline	Red	DOWN	
ON	ON	Explicit + RFI-Offline	Red	DOWN	Complete
ON	OFF	Explicit + RFI-Offline	Red	DOWN	
OFF	ON	Explicit + RFI-Online	Red	DOWN	
OFF	OFF	Explicit + RFI-Online	Red	DOWN	
ON	ON	Explicit + RFI-Online	Red	DOWN	
ON	ON	Explicit + RFI-Online	Green	UP	No-autonegotiation*
ON	OFF	Explicit + RFI-Online	Red	DOWN	
OFF	ON	Explicit + RFI-Online	Green	UP	
OFF	OFF	Explicit + RFI-Online	Red	DOWN	
ON	ON	Explicit + RFI-Online	Green	UP	
ON	ON	Explicit + RFI-Online	Red	DOWN	
ON	ON	Explicit + RFI-Online	Red	DOWN	Complete
ON	OFF	Explicit + RFI-Online	Red	DOWN	
OFF	ON	Explicit + RFI-Online	Red	DOWN	
OFF	OFF	Explicit + RFI-Online	Red	DOWN	
ON	ON	Explicit + RFI-Online	Red	DOWN	
ON	ON	Explicit + RFI-Online	Green	UP	Complete

Table 60: Mode and Autonegotiation Status (Remote)

Transmit	Receive	Mode	LED	Link	Autonegotiation Status
ON	ON	Default	Green	UP	Complete
ON	ON	Default	Red	DOWN	
ON	OFF	Default	Red	DOWN	
OFF	ON	Default	Red	DOWN	
OFF	OFF	Default	Red	DOWN	
ON	ON	No-autonegotiation	Green	UP	Incomplete
ON	ON	No-autonegotiation	Red	DOWN	
ON	OFF	No-autonegotiation	Red	DOWN	
OFF	ON	No-autonegotiation	Green	UP	
OFF	OFF	No-autonegotiation	Red	DOWN	
ON	ON	No-autonegotiation	Green	UP	Incomplete
ON	ON	No-autonegotiation	Red	DOWN	
ON	ON	No-autonegotiation	Red	DOWN	
ON	OFF	No-autonegotiation	Red	DOWN	
OFF	ON	No-autonegotiation	Green	UP	
OFF	OFF	No-autonegotiation	Red	DOWN	
ON	ON	Default	Green	UP	Complete
ON	ON	Default	Red	DOWN	
ON	OFF	Default	Red	DOWN	
OFF	ON	Default	Red	DOWN	
OFF	OFF	Default	Red	DOWN	
ON	ON	Explicit	Green	UP	Complete
ON	ON	Explicit	Red	DOWN	
ON	OFF	Explicit	Red	DOWN	
OFF	ON	Explicit	Red	DOWN	
OFF	OFF	Explicit	Red	DOWN	
ON	ON	No-autonegotiation	Green	UP	Incomplete

Table 60: Mode and Autonegotiation Status (Remote) *(continued)*

Transmit	Receive	Mode	LED	Link	Autonegotiation Status
ON	ON	No-autonegotiation	Red	DOWN	
ON	OFF	No-autonegotiation	Red	DOWN	
OFF	ON	No-autonegotiation	Green	UP	
OFF	OFF	No-autonegotiation	Red	DOWN	
ON	ON	Explicit	Red	DOWN	Complete
ON	OFF	Explicit	Red	DOWN	
OFF	ON	Explicit	Red	DOWN	
OFF	OFF	Explicit	Red	DOWN	
ON	ON	Default	Green	UP	Complete
ON	ON	Default	Red	DOWN	
ON	OFF	Default	Red	DOWN	
OFF	ON	Default	Red	DOWN	
OFF	OFF	Default	Red	DOWN	
ON	ON	No-autonegotiation	Green	UP	Incomplete
ON	ON	No-autonegotiation	Green	UP	
ON	ON	No-autonegotiation	Red	DOWN	
ON	ON	No-autonegotiation	Red	DOWN	
ON	OFF	No-autonegotiation	Red	DOWN	
OFF	ON	No-autonegotiation	Green	UP	
OFF	OFF	No-autonegotiation	Red	DOWN	
ON	ON	Explicit + RFI-Offline	Red	DOWN	Complete
ON	ON	Explicit + RFI-Offline	Red	DOWN	
ON	ON	Explicit + RFI-Offline	Red	DOWN	
ON	ON	Explicit + RFI-Offline	Red	DOWN	
ON	OFF	Explicit + RFI-Offline	Red	DOWN	
OFF	ON	Explicit + RFI-Offline	Red	DOWN	
OFF	OFF	Explicit + RFI-Offline	Red	DOWN	

Table 60: Mode and Autonegotiation Status (Remote) *(continued)*

Transmit	Receive	Mode	LED	Link	Autonegotiation Status
ON	ON	Explicit	Green	UP	Complete
ON	ON	Explicit	Red	DOWN	
ON	ON	Explicit	Red	DOWN	
ON	ON	Explicit	Red	DOWN	
ON	OFF	Explicit	Red	DOWN	
OFF	ON	Explicit	Red	DOWN	
OFF	OFF	Explicit	Red	DOWN	
ON	ON	Default	Green	UP	Complete
ON	ON	Default	Red	DOWN	
ON	ON	Default	Red	DOWN	
ON	ON	Default	Red	DOWN	
ON	OFF	Default	Red	DOWN	
OFF	ON	Default	Red	DOWN	
OFF	OFF	Default	Red	DOWN	
ON	ON	No-autonegotiation	Green	UP	Incomplete
ON	ON	No-autonegotiation	Green	UP	
ON	ON	No-autonegotiation	Red	DOWN	
ON	ON	No-autonegotiation	Red	DOWN	
ON	OFF	No-autonegotiation	Red	DOWN	
OFF	ON	No-autonegotiation	Green	UP	
OFF	OFF	No-autonegotiation	Red	DOWN	
ON	ON	Explicit + RFI-Offline	Green	UP	Complete
ON	ON	Explicit + RFI-Offline	Red	DOWN	
ON	ON	Explicit + RFI-Offline	Red	DOWN	
ON	ON	Explicit + RFI-Offline	Red	DOWN	
ON	OFF	Explicit + RFI-Offline	Red	DOWN	
OFF	ON	Explicit + RFI-Offline	Red	DOWN	

Table 60: Mode and Autonegotiation Status (Remote) *(continued)*

Transmit	Receive	Mode	LED	Link	Autonegotiation Status
OFF	OFF	Explicit + RFI-Offline	Red	DOWN	
ON	ON	Explicit + RFI-Online	Green	UP	Complete
ON	ON	Explicit + RFI-Online	Red	DOWN	
ON	ON	Explicit + RFI-Online	Red	DOWN	
ON	ON	Explicit + RFI-Online	Red	DOWN	
ON	OFF	Explicit + RFI-Online	Red	DOWN	
OFF	ON	Explicit + RFI-Online	Red	DOWN	
OFF	OFF	Explicit + RFI-Online	Red	DOWN	

Chapter 48
Configuring Gigabit Ethernet OTN Options

This section contains the following topics:

Gigabit Ethernet OTN Options Configuration Overview

M120, M320, T320, T640, and T1600 router platforms support Optical Transport Network (OTN) interfaces, including the 10-Gigabit Ethernet DWDM OTN PIC, and provide ITU-G.709 support. Use the set otn-options statement at the [edit interface if-fpc/pic/port] hierarchy level to configure the OTN options.

Gigabit Ethernet OTN Options

The following example shows the configuration settings for Gigabit Ethernet OTN options:

```
[edit interfaces ge-fpc/pic/port]
otn-options {
  fec (efec | gfec | none);
  (laser-enable | no-laser-enable);
  (line-loopback | no-line-loopback);
  pass-thru;
  rate (fixed-stuff-bytes | no-fixed-stuff-bytes | pass-thru);
  trigger (oc-lof | oc-lom | oc-los | oc-wavelength-lock | odu-ais | odu-bbe-th | odu-bdi |
    odu-es-th | odu-lck | odu-oci | odu-sd | odu-ses-th | odu-ttim | odu-uas-th | opu-ptm
    | otu-ais | otu-bbe-th | otu-bdi | otu-es-th | otu-fec-deg | otu-fec-exe | otu-iae | otu-sd
    | otu-ses-th | otu-ttim | otu-uas-th);
  tti;
}
```

NOTE: The Gigabit Ethernet interface and the XENPAK interface support the read/write overhead bytes only for the APS/PPC (bytes 0 through 3).

You can use the following show commands to view the OTN configuration:

- show interfaces extensive—See the *JUNOS Interfaces Command Reference* for command details.

- show chassis hardware—See the *JUNOS System Basics and Services Command Reference* for command details.
- show chassis pic—See the *JUNOS System Basics and Services Command Reference* for command details.

Chapter 49
Configuring the Management Ethernet Interface

This section contains the following topics:

Management Ethernet Interface Overview

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

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

Configuring a Consistent Management IP Address

On platforms with multiple Routing Engines, each Routing Engine is configured with a separate IP address for the management interface (fxp0). To access the master Routing Engine, you must know which Routing Engine is active and use the appropriate IP address.

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

On routers with dual Routing Engines, include the master-only statement at the [edit groups] hierarchy level.

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

```
[edit groups re0 interfaces fxp0]
unit 0 {
   family inet {
      address 10.17.40.131/25 {
         master-only;
      }
      address 10.17.40.132/25;
   }
}
[edit groups re1 interfaces fxp0]
unit 0 {
   family inet {
      address 10.17.40.131/25 {
         master-only;
      }
      address 10.17.40.133/25;
   }
}
```

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

Configuring the MAC Address on the Management Ethernet Interface

By default, the routing platform's management Ethernet interface (fxp0) uses as its MAC address the MAC address that is burned into the Ethernet card. To display this address, enter the show interface fxp0 operational mode command.

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

```
[edit interfaces fxp0]
mac mac-address;
```

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

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

Chapter 50

Configuring the 10-Gigabit Ethernet DWDM Interface Wavelength

This section contains the following topics:

10-Gigabit Ethernet DWDM Interface Wavelength Overview

For M320, M120, T320, and T640 routing platforms, the 10-Gigabit Ethernet DWDM PIC enables you to configure 10-Gigabit Ethernet DWDM interfaces with full C-band International Telecommunication Union (ITU)-Grid tunable optics, as defined in the following specifications:

- *Intel TXN13600 Optical Transceiver I2C Interface and Customer EEPROM Preliminary Specification*, July 2004.
- *I2C Reference Document for 300 Pin MSA 10G and 40G Transponder*, Edition 4, August 04, 2003.

By default, the wavelength is 1550.12 nanometers (nm), which corresponds to 193.40 terahertz (THz).

Configuring the 10-Gigabit Ethernet DWDM Interface Wavelength

To configure the wavelength on a 10-Gigabit Ethernet DWDM interface, include the wavelength statement at the [edit interfaces ge- *fpc/pic/port* optics-options] hierarchy level:

```
[edit interfaces ge-0/0/0 optics-options]
wavelength nm;
```

For interface diagnostics, you can issue the show interfaces diagnostics optics ge-*fpc/pic/port* operational mode command.

Table 61 on page 734 shows configurable wavelengths and the corresponding frequency for each configurable wavelength.

Table 61: Wavelength-to-Frequency Conversion Matrix

Wavelength (nm)	Frequency (THz)	Wavelength (nm)	Frequency (THz)	Wavelength (nm)	Frequency (THz)
1528.77	196.10	1540.56	194.60	1552.52	193.10
1529.55	196.00	1541.35	194.50	1553.33	193.00
1530.33	195.90	1542.14	194.40	1554.13	192.90
1531.12	195.80	1542.94	194.30	1554.94	192.80
1531.90	195.70	1543.73	194.20	1555.75	192.70
1532.68	195.60	1544.53	194.10	1556.56	192.60
1533.47	195.50	1545.32	194.00	1557.36	192.50
1534.25	195.40	1546.12	193.90	1558.17	192.40
1535.04	195.30	1546.92	193.80	1558.98	192.30
1535.82	195.20	1547.72	193.70	1559.79	192.20
1536.61	195.10	1548.52	193.60	1560.61	192.10
1537.40	195.00	1549.32	193.50	1561.42	192.00
1538.19	194.90	1550.12	193.40	1562.23	191.90
1538.98	194.80	1550.92	193.30	1563.05	191.80
1539.77	194.70	1551.72	193.20	1563.86	191.70

Chapter 51
Configuring 10-Gigabit Ethernet Framing

This section contains the following topics:

10-Gigabit Ethernet Framing Overview

The 10-Gigabit Ethernet IQ2 and IQ2-E PIC for the M120, M320, and T-series routing platforms operates with Type 3 FPCs. The 10-Gigabit Ethernet IQ2 and IQ2-E PIC supports all features of the IQ2 and IQ2-E family PICs. Additionally, it provides one external interface running at 10 Gbps that operates in two modes:

- 10GBASE-R, LAN Physical Layer Device (LAN PHY)
- 10GBASE-W, WAN Physical Layer Device (WAN PHY)

When the external interface is running in LAN PHY mode, it bypasses the WIS sublayer to directly stream block-encoded Ethernet frames on a 10-Gigabit Ethernet serial interface. When the external interface is running in WAN PHY mode, it uses the WIS sublayer to transport 10-Gigabit Ethernet frames in an OC192c SONET payload.

Although the external interface provides a lower throughput when running in WAN PHY mode because of the extra SONET overhead, it can interoperate with SONET section or line level repeaters. This creates an advantage when the interface is used for long-distance, point-to-point 10-Gigabit Ethernet links. When the external interface is running in WAN PHY mode, some SONET options are supported. For information about SONET options supported on this interface, see "Configuring SONET Options for 10-Gigabit Ethernet Interfaces" on page 826.

Configuring 10-Gigabit Ethernet Framing

The 10-Gigabit Ethernet IQ2 and IQ2-E PIC uses the interface type xe-*fpc/pic/port*. On this single-port PIC, the port number is always zero.

The xe-*fpc/pic/port* interface inherits all the configuration commands that are used for gigabit Ethernet (ge-*fpc/pic/port*) interfaces.

To configure LAN PHY or WAN PHY operating mode, include the framing statement with the lan-phy or wan-phy option at the [edit interfaces xe-*fpc* /*pic*/0] hierarchy level.

```
[edit interfaces xe-fpc/pic/0 framing]
framing (lan-phy | wan-phy);
```

To display interface information, use the operational mode command show interfaces xe-*fpc*/*pic*/*port* extensive.

NOTE: If you configure the WAN PHY mode on an aggregated Ethernet interface, you must set the aggregated Ethernet link speed to OC192.

Chapter 52

Configuring 10-Gigabit Ethernet Notification of Link Down Alarm

This section contains the following topics:

10-Gigabit Ethernet Notification of Link Down Alarm Overview

Notification of link down alarm generation and transfer is supported for all 10-Gigabit Ethernet PIC interfaces, M120, M320. and T-series routing platforms.

Configuring 10-Gigabit Ethernet Notification of Link Down Alarm

To configure this option, include the asynchronous-notification statement at the [edit interfaces ge- *fpc/pic/port* gigether-options] hierarchy level:

```
[edit interfaces]
ge-fpc/pic/port {
    gigether-options {
        asynchronous-notification;
    }
}
```

Chapter 53

Configuring Point-to-Point Protocol over Ethernet

This chapter includes the following topics:

PPPoE Overview

The Point-to-Point Protocol over Ethernet (PPPoE) connects multiple hosts on an Ethernet LAN to a remote site through a single customer premises equipment (CPE) device. Hosts share a common digital subscriber line (DSL), a cable modem, or a wireless connection to the Internet.

A J-series Services Router can be configured as the CPE device for PPPoE connections. To use PPPoE, you must configure the Services Router as a PPPoE client, encapsulate PPP packets over Ethernet, and initiate a PPPoE session.

NOTE: J4300 and J6300 Services Routers with asymmetrical DSL (ADSL) Physical Interface Modules (PIMs) and symmetrical high-speed DSL (SHDSL) PIMs can use PPPoE over Asynchronous Transfer Mode (ATM) to connect through DSL lines only, not for direct ATM connections. For information about configuring ADSL and SHDSL interfaces, see “Configuring ATM-over-ADSL Interfaces” on page 341 and “Configuring ATM-over-SHDSL Interfaces” on page 347.

M120 and M320 Internet routers can be configured as a PPPoE access concentrator server. To configure a PPPoE server on an M120 or M320 Ethernet logical interface, specify PPPoE encapsulation, include the pp0 statement for the pseudo PPPoE physical interface, and include the server statement in the PPPoE options under the logical interface.

NOTE: PPPoE encapsulation is not supported on M120 or M320 routers on an ATM2 IQ interface.

On the J-series Services Router, PPPoE establishes a point-to-point connection between the client (the Services Router) and the server, also called an access concentrator. Multiple hosts can be connected to the Services Router, and their data can be authenticated, encrypted, and compressed before the traffic is sent to the PPPoE session on the Services Router's Fast Ethernet or ATM-over-ADSL interface. PPPoE is easy to configure and enables services to be managed on a per-user basis rather than on a per-site basis.

This overview contains the following topics:

- PPPoE Interfaces on page 740
- PPPoE Stages on page 741
- Optional CHAP Authentication on page 742

PPPoE Interfaces

The PPPoE interface to the access concentrator can be a Fast Ethernet interface on any Services Router, a Gigabit Ethernet interface on J4350 and J6350 Services Routers, an ATM-over-ADSL or ATM-over-SHDSL interface on all J-series Services Routers except the J2300, or an ATM-over-SHDSL interface on a J2300 Services Router. The PPPoE configuration is the same for both interfaces. The only difference is the encapsulation for the underlying interface to the access concentrator:

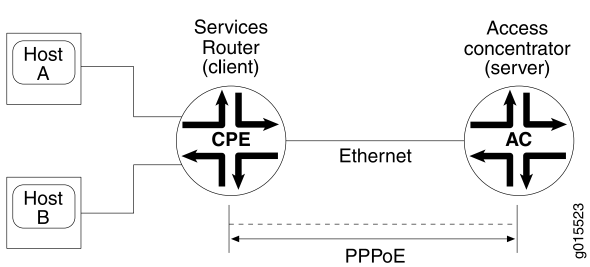
- If the interface is Fast Ethernet, use a PPPoE encapsulation.
- If the interface is ATM over ADSL, use a PPPoE over ATM encapsulation.

The PPPoE interface on M120 or M320 routers acting as a access concentrator can be a Gigabit Ethernet or 10-Gigabit Ethernet interface.

Ethernet Interface

The Services Router encapsulates each PPP frame in an Ethernet frame and transports the frames over an Ethernet loop. Figure 62 on page 740 shows a typical PPPoE session between a Services Router and an access concentrator on the Ethernet loop.

Figure 62: PPPoE Session on an Ethernet Loop



PPPoE Stages

PPPoE has two stages, the discovery stage and the PPPoE session stage. In the discovery stage, the client discovers the access concentrator by identifying the Ethernet media access control (MAC) address of the access concentrator and establishing a PPPoE session ID. In the PPPoE session stage, the client and the access concentrator build a point-to-point connection over Ethernet, based on the information collected in the discovery stage.

PPPoE Discovery Stage

A Services Router initiates the PPPoE discovery stage by broadcasting a PPPoE active discovery initiation (PADI) packet. To provide a point-to-point connection over Ethernet, each PPPoE session must learn the Ethernet MAC address of the access concentrator and establish a session with a unique session ID. Because the network might have more than one access concentrator, the discovery stage allows the client to communicate with all of them and select one.

NOTE: A Services Router cannot receive PPPoE packets from two different access concentrators on the same physical interface.

The PPPoE discovery stage consists of the following steps:

1. PPPoE active discovery initiation (PADI)—The client initiates a session by broadcasting a PADI packet on the LAN to request a service.
2. PPPoE active discovery offer (PADO)—Any access concentrator that can provide the service requested by the client in the PADI packet replies with a PADO packet that contains it own name, the unicast address of the client, and the service requested. An access concentrator can also use the PADO packet to offer other services to the client.
3. PPPoE active discovery request (PADR)—From the PADOs it receives, the client selects one access concentrator based on its name or the services offered and sends it a PADR packet to indicate the service or services needed.
4. PPPoE active discovery session-Confirmation (PADS)—When the selected access concentrator receives the PADR packet, it accepts or rejects the PPPoE session.

- To accept the session, the access concentrator sends the client a PADS packet with a unique session ID for a PPPoE session and a service name that identifies the service under which it accepts the session.
- To reject the session, the access concentrator sends the client a PADS packet with a service name error and resets the session ID to zero.

PPPoE Session Stage

The PPPoE session stage starts after the PPPoE discovery stage is over. The access concentrator can start the PPPoE session after it sends the PADS packet to the client, or the client can start the PPPoE session after it receives a PADS packet from the access concentrator. A Services Router supports multiple PPPoE sessions on each interface, but no more than 256 PPPoE sessions on all interfaces on the Services Router.

Each PPPoE session is uniquely identified by the Ethernet address of the peer and the session ID. After the PPPoE session is established, data is sent as in any other PPP encapsulation. The PPPoE information is encapsulated within an Ethernet frame and is sent to a unicast address. In this stage, both the client and the server must allocate resources for the PPPoE logical interface.

After a session is established, the client or the access concentrator can send a PPPoE active discovery termination (PADT) packet anytime to terminate the session. The PADT packet contains the destination address of the peer and the session ID of the session to be terminated. After this packet is sent, the session is closed to PPPoE traffic.

Optional CHAP Authentication

For interfaces with PPPoE encapsulation, you can configure interfaces to support the PPP Challenge Handshake Authentication Protocol (CHAP). When you enable CHAP on an interface, the interface can authenticate its peer and be authenticated by its peer.

If you configure an interface to handle incoming CHAP packets only (by including the passive statement at the [edit interfaces *interface-name* ppp-options chap] hierarchy level), the interface does not challenge its peer. However, if the interface is challenged, it responds to the challenge. If you do not include the passive statement, the interface always challenges its peer.

For more information about CHAP, see "Configuring the PPP Challenge Handshake Authentication Protocol" on page 106.

Configuring the PPPoE Interfaces MTU

You can configure the maximum transmission unit (MTU) of the interface by including the mtu statement at the [edit interfaces pp0] hierarchy level:

```
[edit interfaces pp0]
mtu bytes;
```

The default media MTU size used and the range of available sizes on a physical interface depends on the encapsulation used on that interface.

Disabling the Sending of PPPoE Keepalive Messages

When configuring the client, you can disable the sending of keepalive messages on a logical interface by including the no-keepalives statement:

```
no-keepalives;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces pp0.0]
- [edit logical-systems *logical-system-name* interfaces pp0 unit *logical-unit-number*]

Configuring PPPoE

To configure PPPoE on a J-series Services Router, perform the following tasks:

1. Configure PPPoE encapsulation for an Ethernet interface or Ethernet over ATM encapsulation for an ATM-over-ADSL interface.
2. If you are configuring ATM over ADSL, configure LLC encapsulation on the logical interface.
3. Specify the logical Ethernet interface or the logical ATM interface as the underlying interface for the PPPoE session.
4. Configure the operational mode as client.
5. Identify the access concentrator by a unique name.
6. Optionally, specify how many seconds to wait before attempting to reconnect.
7. Provide a name for the type of service provided by the access concentrator.
8. Optionally, configure the maximum transmission unit (MTU) of the interface.
9. Configure the PPPoE interface address.
10. Configure the destination PPPoE interface address.
11. Optionally, configure the MTU size for the protocol family.
12. Optionally, disable the sending of keepalive messages on the logical interface.

To configure PPPoE on an M120 or M320 Internet Router operating as an access concentrator, perform the following tasks:

1. Configure PPPoE encapsulation for an Ethernet interface.
2. Specify the logical Ethernet interface as the underlying interface for the PPPoE session.
3. Optionally, configure the maximum transmission unit (MTU) of the interface.
4. Configure the operational mode as server.
5. Configure the PPPoE interface address.
6. Configure the destination PPPoE interface address.
7. Optionally, configure the MTU size for the protocol family.

Setting the Appropriate Encapsulation on the PPPoE Interface

For PPPoE on an Ethernet interface, you must configure encapsulation on the logical interface and use PPP over Ethernet encapsulation.

For PPPoE on an ATM-over-ADSL interface, you must configure encapsulation on both the physical and logical interfaces. To configure encapsulation on an

ATM-over-ADSL physical interface, use Ethernet over ATM encapsulation. To configure encapsulation on an ATM-over-ADSL logical interface, use PPPoE over AAL5 LLC encapsulation. LLC encapsulation allows a single ATM virtual connection to transport multiple protocols.

NOTE: PPPoE encapsulation is not supported on an M120 or M320 router on an ATM2 IQ interface.

When you configure a point-to-point encapsulation such as PPP on a physical interface, the physical interface can have only one logical interface (only one unit statement) associated with it.

To configure physical interface properties, include the encapsulation statement at the [edit interfaces *interface-name*] hierarchy level:

[edit interfaces *interface-name*]
encapsulation ethernet-over-atm;

To configure logical interface encapsulation properties, include the encapsulation statement:

encapsulation ppp-over-ether;

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Perform the task appropriate for the interface on which you are using PPPoE:

- Configuring PPPoE Encapsulation on an Ethernet Interface on page 744
- Configuring PPPoE Encapsulation on an ATM-over-ADSL Interface on page 744

Configuring PPPoE Encapsulation on an Ethernet Interface

Both the client and the server must be configured to support PPPoE. To configure PPPoE encapsulation on an Ethernet interface, include the encapsulation statement:

encapsulation ppp-over-ether;

You can include this statement at the following hierarchy levels:

- [edit interfaces pp0 unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces pp0 unit *logical-unit-number*]

Configuring PPPoE Encapsulation on an ATM-over-ADSL Interface

To configure the PPPoE encapsulation on a ATM-over-ADSL interface, perform the following steps:

1. Include the encapsulation statement at the [edit interfaces *interface-name*] hierarchy level, and specify ethernet-over-atm:

```
[edit interfaces pp0]
encapsulation ethernet-over-atm;
```

2. Configure LLC encapsulation on the logical interface by including the encapsulation statement and specifying ppp-over-ether-over-atm-llc:

```
encapsulation ppp-over-ether-over-atm-llc;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces pp0 unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces pp0 unit *logical-unit-number*]

Configuring a PPPoE Interface

The following sections describe how to configure a PPPoE interface:

Configuring the PPPoE Underlying Interface

To configure the underlying Fast Ethernet, Gigabit Ethernet, 10-Gigabit Ethernet, or ATM interface, include the underlying-interface statement at the [edit interfaces pp0 unit *logical-unit-number* pppoe-options] hierarchy level:

```
[edit interfaces pp0]
unit logical-unit-number {
   pppoe-options {
      underlying-interface interface-name;
   }
}
```

You can include this statement at the following hierarchy levels:

- [edit interfaces pp0 unit *logical-unit-number* pppoe-options]
- [edit logical-systems *logical-system-name* interfaces pp0 unit *logical-unit-number* pppoe-options]

Specify the logical Ethernet, Fast Ethernet, Gigabit Ethernet, 10-Gigabit Ethernet, or ATM interface as the underlying interface—for example, at-0/0/1.0 (ATM VC), fe-1/0/1.0 (Fast Ethernet interface), or ge-2/0/0 (Gigabit Ethernet interface).

Identifying the Access Concentrator

When configuring a PPPoE client, identify the access concentrator by a unique name by including the access-concentrator statement at the [edit interfaces *interface-name* unit *logical-unit-number* pppoe-options] hierarchy level:

```
[edit interfaces pp0]
unit logical-unit-number{
   pppoe-options {
      access-concentrator name;
   }
}
```

Specify the access concentrator name.

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* pppoe-options]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* pppoe-options]

Configuring the PPPoE Automatic Reconnect Wait Timer

By default, after a PPPoE session is terminated, the session attempts to reconnect immediately. When configuring a PPPoE client, you can specify how many seconds to wait before attempting to reconnect, by including the auto-reconnect statement at the [edit interfaces *interface-name* unit *logical-unit-number* pppoe-options] hierarchy level:

```
[edit interfaces pp0]
unit logical-unit-number {
   pppoe-options {
      auto-reconnect seconds;
   }
}
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* pppoe-options]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* pppoe-options]

You can configure the reconnection attempt to occur in 0 through 4,294,967,295 seconds after the session terminates.

Configuring the PPPoE Service Name

When configuring a PPPoE client, identify the type of service provided by the access concentrator—such as the name of the Internet service provider (ISP), class, or quality of service—by including the service-name statement at the [edit interfaces *interface-name* unit *logical-unit-number* pppoe-options] hierarchy level:

```
[edit interfaces pp0]
unit logical-unit-number {
   pppoe-options {
      service-name name;
   }
}
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* pppoe-options]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* pppoe-options]

Configuring the PPPoE Server Mode

When configuring a PPPoE server, identify the mode by including the server statement at the [edit interfaces *interface-name* unit *logical-unit-number* pppoe-options] hierarchy level:

```
[edit interfaces pp0]
unit logical-unit-number {
   pppoe-options {
      server;
   }
}
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* pppoe-options]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* pppoe-options]

Configuring the PPPoE Client Mode

When configuring a PPPoE client, identify the mode by including the client statement at the [edit interfaces *interface-name* unit *logical-unit-number* pppoe-options] hierarchy level:

```
[edit interfaces pp0]
unit logical-unit-number {
   pppoe-options {
      client;
   }
}
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* pppoe-options]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* pppoe-options]

Configuring the PPPoE Source and Destination Addresses

When configuring a PPPoE client or server, assign source and destination addresses—for example, 192.168.1.1/32 and 192.168.1.2. To assign the source and destination address, include the address and destination statements:

```
address address {
   destination address;
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces pp0.0 family inet]
- [edit logical-systems *logical-system-name* interfaces pp0.0 family inet]

Deriving the PPPoE Source Address From a Specified Interface

For a router supporting PPPoE, you can derive the source address from a specified interface—for example, the loopback interface, lo0.0—and assign a destination address—for example, 192.168.1.2. The specified interface must include a logical unit number and have a configured IP address. To derive the source address and assign the destination address, include the unnumbered-address and destination statements:

```
unnumbered-address interface-name destination address;
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces pp0.0 family inet]
- [edit logical-systems *logical-system-name* interfaces pp0.0 family inet]

Configuring the PPPoE IP Address by Negotiation

You can have the PPPoE client router obtain an IP address by negotiation with the remote end. This method might require the access concentrator to use a RADIUS authentication server. To obtain an IP address from the remote end by negotiation, include the negotiate-address statement:

```
negotiate-address;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces pp0.0 family (inet | inet6 | mpls)]
- [edit logical-systems *logical-system-name* interfaces pp0.0 family (inet | inet6 | mpls)]

Configuring the Protocol MTU PPPoE

You can configure the maximum transmission unit (MTU) size for the protocol family. Specify a range from 0 through 5012 bytes. Ensure that the size of the media MTU is equal to or greater than the sum of the protocol MTU and the encapsulation overhead. To set the MTU, include the mtu statement:

```
mtu bytes;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces pp0.0 family (inet | inet6 | mpls)]
- [edit logical-systems *logical-system-name* interfaces pp0.0 family (inet | inet6 | mpls)]

Example: Configuring a PPPoE Client Interface on a J-Series Services Router

Configure a PPPoE over ATM-over-ADSL interface:

```
[edit interfaces]
at-2/0/0 {
    encapsulation ethernet-over-atm;
    atm-options {
        vpi 0;
    }
    dsl-options {
        operating-mode auto;
    }
    unit 0 {
        encapsulation ppp-over-ether-over-atm-llc;
        vci 0.120;
    }
}
pp0 {
    mtu 1492;
    unit 0 {
        ppp-options {
```

```
            chap {
                access-profile A-ppp-client;
                local-name A-at-2/0/0.0;
            }
        }
        pppoe-options {
            underlying-interface at-2/0/0;
            client;
            access-concentrator ispl.com;
            service-name "video@ispl.com";
            auto-reconnect 100;
        }
        no-keepalives;
        family inet {
            negotiate-address;
            mtu 100;
        }
        family inet6 {
            negotiate-address;
            mtu 200;
        }
        family mpls {
            negotiate-address;
            mtu 300;
        }
    }
}
```

Example: Configuring a PPPoE Server Interface on an M120 or M320 Router

Configure a PPPoE server over a Gigabit Ethernet interface:

```
[edit interfaces]
ge-1/0/0 {
    vlan-tagging;
    unit 1 {
        encapsulation ppp-over-ether;
        vlan-id 10;
    }
}
pp0 {
    unit 0 {
        pppoe-options {
            underlying-interface ge-1/0/0.0;
            server;
        }
        ppp-options {
        }
        family inet {
            address 22.2.2.1/32 {
                destination 22.2.2.2;
            }
        }
    }
```

```
}
```

Verifying a PPPoE Configuration

To verify a PPPoE configuration, you can issue the following operational mode commands:

- show interfaces at-*fpc/pic/port* extensive
- show interfaces pp0
- show pppoe interfaces
- show pppoe version
- show pppoe statistics

For more information about these operational mode commands, see the *J-series Services Router Basic LAN and WAN Access Configuration Guide* and the *JUNOS Interfaces Command Reference*.

Chapter 54

Configuring Ethernet Ring Protection Switching

Ethernet Ring Protection Switching Overview

MX-series routers support *Ethernet ring protection switching*, which helps achieve high reliability and network stability. Links in the ring will never form loops that fatally affect the network operation and services availability. The basic idea of an Ethernet ring is to use one specific link to protect the whole ring. This special link is called a *ring protection link (RPL)*. If no failure happens in other links of the ring, the RPL blocks the traffic and is not used. RPL is controlled by a special node called an *RPL owner*. There is only one RPL owner in a ring. The RPL owner is responsible for blocking traffic over the RPL. Under ring failure conditions, the RPL owner is responsible for unblocking traffic over the RPL. A ring failure results in protection switching of the RPL traffic. An APS protocol is used to coordinate the protection actions over the ring. Protection switching blocks traffic on the failed link and unblocks the traffic on the RPL. When the failure clears, revertive protection switching blocks traffic over the RPL and unblocks traffic on the link on which the failure is cleared.

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

- IEEE 802.1Q - 1998
- IEEE 802.1D - 2004
- IEEE 802.1Q - 2003
- Draft ITU-T Recommendation G.8032/Y.1344, *Ethernet Ring protection switching*
- ITU-T Y.1731, *OAM functions and mechanisms for Ethernet-based networks*

For additional information on configuring Ethernet ring protection switching on MX-series routers, see the *MX Solutions Guide* for a complete example of Ethernet rings, and the *Layer 2 Configuration Guide* for information about STP loop avoidance and prevention.

Ethernet Ring Protection Switching Functionality

This section includes the following topics:

Acronyms

The following acronyms are used in this section:

- MA—maintenance association
- MEP—maintenance association end point
- OAM—connectivity fault management daemon
- FDB—MAC forwarding database
- STP—Spanning Tree Protocol
- RAPS—ring automatic protection switching
- WTR—wait to restore
- RPL—ring protection link

Ring Nodes

Multiple nodes are used to form a ring. For each ring node. There are two different node types:

- Normal node—The node has no special role on the ring.
- RPL owner node—The node owns the RPL and blocks or unblocks traffic over the RPL. This node also initiates the RAPS message.

Ring Node States

There are three different states for each node of a specific ring:

- init—Not a participant of a specific ring.
- idle—No failure on the ring, the node is performing normally. For normal node, traffic is unblocked on both ring ports. For the RPL owner, traffic is blocked on the ring port that connects to the RPL and unblocked on the other ring port.
- protection—A failure occurred on the ring. For normal node, traffic is blocked on the ring port that connects to the failing link and unblocked on working ring ports. For the RPL owner, traffic is unblocked on both ring ports if they connect to non-failure links.

There can only one RPL owner for each ring. The user configuration must guarantee this, because the APS protocol cannot check this.

Failure Detection

Ethernet ring operation depends on quick and accurate failure detection. The failure condition *signal failure (SF)* is supported. For SF detection, an Ethernet continuity check MEP must be configured for each ring link. For fast protection switching, a 10 ms transmission period for this MEP group is supported. OAM monitors the MEP group's MA and reports SF or SF clear events to the Ethernet ring control module. For this MEP group, the action profile must be configured to update the interface device IFF_LINKDOWN flag. OAM updates the IFF_LINKDOWN flag to notify the Ethernet ring control module.

Logical Ring

This feature currently supports only the physical ring, which means that two adjacent nodes of a ring must be physically connected and the ring operates on the physical interface, not the VLAN.

FDB Flush

When ring protection switching occurs, normally an *FDB flush* should be executed. The Ethernet ring control module should use the same mechanism as the STP to trigger the FDB flush. The Ethernet ring control module controls the ring port physical interface's default STP index to execute the FDB flush.

Traffic Blocking and Forwarding

The Ethernet ring control module uses the same mechanism as the STP to control forwarding or discarding of user traffic. The Ethernet ring control module sets the ring port physical interface default STP index state to forwarding or discarding in order to to control user traffic.

RAPS Message Blocking and Forwarding

The router treats the RAPS message the same as user traffic for forwarding RAPS messages between two ring ports. The ring port physical interface default STP index state also controls forwarding RAPS messages between the two ring ports. Other than forwarding RAPS between the two ring ports, as shown in Figure 63 on page 756, the system also needs to forward the RAPS message between the CPU (Ethernet ring control module) and the ring port. This type of forwarding does not depend on the ring port physical interfaces STP index state. The RAPS message is always sent by the router through the ring ports, as shown in Figure 64 on page 756. An RAPS message received from a discarding ring port is sent to the Ethernet ring control module but is not sent to the other ring port.

Figure 63: Protocol Packets from the Network to the Router

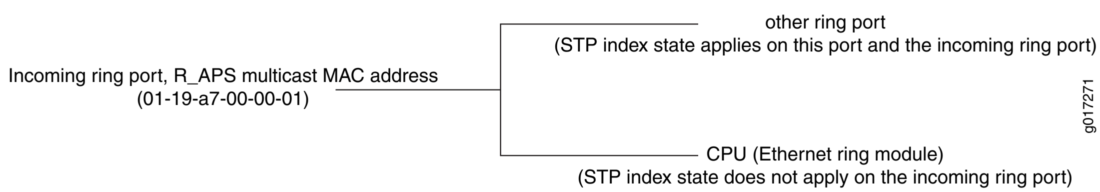
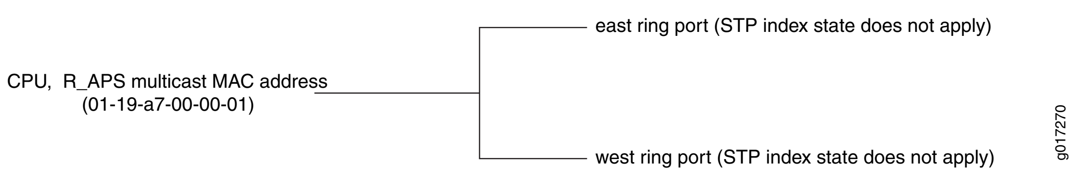


Figure 64: Protocol Packets from the Router to the Network



Juniper Networks routers use an implicit filter to achieve these routes. Each implicit filter binds to a bridge domain. Therefore, the east ring port control channel and the west ring port control channel of a particular ring instance must be configured to the same bridge domain. For each ring port control channel, a filter term is generated to control RAPS message forwarding. The filter number is the same as the number of bridge domains that contain the ring control channels. If a bridge domain contains control channels from multiple rings, the filter related to this bridge domain will have multiple terms and each term will relate to a control channel. The filter has command parts and control-channel related parts, as follows:

- Common terms:
  - term 1: if [Ethernet type is not OAM Ethernet type (0x8902)
    ] { accept packet }
  - term 2: if [source MAC address belongs to this bridge]
    { drop packet, our packet loop through the ring and come back
    to home}
  - term 3: if [destination is the RAPS PDU multicast address(0x01,0x19,0xa7,
    0x00,0x00,0x01] AND[ring port STP status is DISCARDING]
    { send to CPU }

- Control channel related terms:
  - if [destination is the RAPS PDU multicast address(0x01,0x19,0xa7,0x00,0x00,
    0x01] AND[ring port STP status is FORWARDING] AND [Incoming interface
    IFL equal to control channel IFL]
    { send packet to CPU and send to the other ring port }
    default term: accept packet.

Dedicated Signaling Control Channel

For each ring port, a dedicated signaling control channel with a dedicated VLAN ID must be configured. In Ethernet ring configuration, only this control logical interface is configured and the underlying physical interface is the physical ring port. Each ring requires that two control physical interfaces be configured. These two logical interfaces must be configured in a bridge domain in order to forward RAPS PDUs between the two ring control physical interfaces. If the control channel logical interface is not a trunk port, only control logical interfaces will be configured in ring port configuration. If this control channel logical interface is a trunk port, in addition to the control channel logical interfaces, a dedicated VLAN ID must be configured.

RAPS Message Termination

The RAPS message starts from the originating node, travels through the entire ring, and terminates in the originating node unless a failure is present in the ring. The originating node must drop the RAPS message if the source MAC address in the RAPS message belongs to itself. The source MAC address is the node's node ID.

Manual Switch

Manual switch is not supported in this release.

Non-Revertive Switch

In revertive operation, once the condition causing a switch has cleared, traffic is blocked on the RPL and restored to the working transport entity. In non-revertive operation, traffic is allowed to use the RPL if it has not failed, even after a switch condition has cleared. Non-revertive switching is not supported in this release.

Multiple Rings

The Ethernet ring control module supports multiple rings in each node, (two logical interfaces are part of each ring). However, interconnection of multiple rings is not supported in this release. The interconnection of two rings means that two rings may share the same link or share the same node.

Node ID

For each node in the ring, a unique *node ID* identifies each node. The node ID is the node's MAC address. You can configure this node ID when configuring the ring on the node or automatically select an ID such as STP. In most cases, you will not configure this and the router will select a node ID, like STP does. It should be the manufacturing MAC address. The ring node ID should not be changed, even if you change the manufacturing MAC address. Any MAC address can be used if you make sure each node in the ring has a different node ID.

Bridge Domains with the Ring Port

From the router point of view, the protection group is seen as an abstract logical port that can be configured to any bridge domain. Therefore, if you configure one ring port or its logical interface in a bridge domain; you must configure the other related ring port or its logical interface to the same bridge domain. The bridge domain that includes the ring port acts as any other bridge domain and supports the IRB layer 3 interface.

Configuring Ethernet Ring Protection Switching

The inheritance model follows:

```
protection-group {
  ethernet-ring ring-name {
    east-interface {
      control-channel channel-name{
        vlan number;
      }
    }
    guard-interval number;
    node-id mac-address;
    restore-interval number;
    ring-protection-link-owner;
    west-interface {
      control-channel channel-name {
        vlan number;
      }
    }
  }
}
```

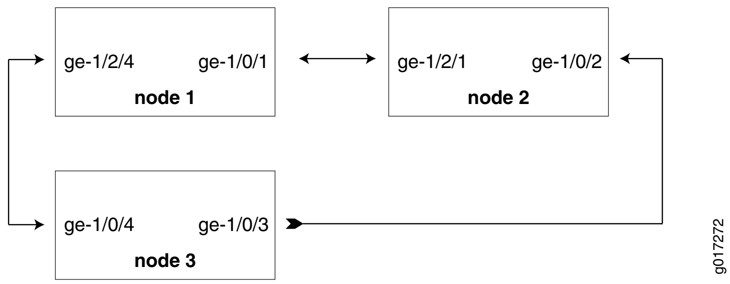
For each ring, a protection group must be configured. There may be several rings in each node, so there should be multiple protection groups corresponding to the related Ethernet rings.

Three interval parameters (restore-interval, guard-interval and hold-interval) can be configured at the protection group level. These configurations are global configurations and apply to all Ethernet rings if the Ethernet ring doesn't have a more specific configuration for these values. If no parameter is configured at the protection group level, the global configuration of this parameter uses the default value.

Ethernet Ring Protection Switching Configuration Example

In this section, a configuration example of a three node ring is given. The ring topology is shown in Figure 65 on page 759.

Figure 65: Example of a Three Node Ring



The configuration in this section is only for the RAPS channel. The bridge domain for user traffic is the same as the normal bridge domain. The only exception is if a bridge domain includes a ring port; then it must also include the other ring port of the same ring.

Configuration for Node 1

```
interfaces {
    ge-1/0/1 {
        vlan-tagging;
        encapsulation flexible-ethernet-services;
        unit 1 {
            encapsulation vlan-bridge;
            vlan-id 100;
        }
    }
    ge-1/2/4 {
        vlan-tagging;
        encapsulation flexible-ethernet-services;
        unit 1 {
            encapsulation vlan-bridge;
            vlan-id 100;
        }
    }
}
bridge-domains {
    bd1 {
        domain-type bridge;
        interface ge-1/2/4.1;
        interface ge-1/0/1.1;
    }
}
                    protocols {
    protection-group {
        ethernet-ring pg101 {
            node-id 00:01:01:00:00:01;
            ring-protection-link-owner;
            east-interface {
```

```
                control-channel ge-1/0/1.1;
                ring-protection-link-end;
            }
            west-interface {
                control-channel ge-1/2/4.1;
            }
        }
    }
}
  protocols {
    oam {
        ethernet {
            connectivity-fault-management {
                action-profile rmep-defaults {
                    default-action {
                        interface-down;
                    }
                }
                maintenance-domain d1 {
                    level 0;
                    maintenance-association 100 {
                        mep 1 {
                            interface ge-1/0/1;
                            remote-mep 2 {
                                action-profile rmep-defaults;
                            }
                        }
                    }
                }
                maintenance-domain d2 {
                    level 0;
                    maintenance-association 100 {
                        mep 1 {
                            interface ge-1/2/4;
                            remote-mep 2 {
                                action-profile rmep-defaults;
                            }
                        }
                    }
                }
            }
        }
    }
}
```

Configuration for Node 2

```
interfaces {
    ge-1/0/2 {
        vlan-tagging;
        encapsulation flexible-ethernet-services;
        unit 1 {
            encapsulation vlan-bridge;
            vlan-id 100;
        }
    }
```

```
    ge-1/2/1 {
        vlan-tagging;
        encapsulation flexible-ethernet-services;
        unit 1 {
            encapsulation vlan-bridge;
            vlan-id 100;
        }
    }
}

bridge-domains {
    bd1 {
        domain-type bridge;
        interface ge-1/2/1.1;
        interface ge-1/0/2.1;
    }
}


protocols {
    protection-group {
        ethernet-ring pg102 {
            east-interface {
                control-channel ge-1/0/2.1;
            }
            west-interface {
                control-channel ge-1/2/1.1;
            }
        }
    }
}


protocols {
    oam {
        ethernet {
            connectivity-fault-management {
                action-profile rmep-defaults {
                    default-action {
                        interface-down;
                    }
                }
                maintenance-domain d1 {
                    level 0;
                    maintenance-association 100 {
                        mep 2 {
                            interface ge-1/2/1;
                            remote-mep 1 {
                                action-profile rmep-defaults;
                            }
                        }
                    }
                }
                maintenance-domain d3 {
                    level 0;
                    maintenance-association 100 {
```

```
                        mep 1 {
                            interface ge-1/0/2;
                            remote-mep 2 {
                                action-profile rmep-defaults;
                            }
                        }
                    }
                }
            }
        }
    }
}
```

Configuration for Node 3

```
interfaces {
    ge-1/0/4 {
        vlan-tagging;
        encapsulation flexible-ethernet-services;
        unit 1 {
             encapsulation vlan-bridge;
             vlan-id 100;
        }
    }

    ge-1/0/3 {
        vlan-tagging;
        encapsulation flexible-ethernet-services;
        unit 1 {
            encapsulation vlan-bridge;
            vlan-id 100;
        }
    }
}

bridge-domains {
    bd1 {
        domain-type bridge;
        interface ge-1/0/4.1;
        interface ge-1/0/3.1;
    }
}


protocols {
    protection-group {
        ethernet-ring pg103 {
            east-interface {
                control-channel ge-1/0/3.1;
            }
            west-interface {
                control-channel ge-1/0/4.1;
            }
        }
    }
}
```

```
protocols {
    oam {
        ethernet {
            connectivity-fault-management {
                action-profile rmep-defaults {
                    default-action {
                        interface-down;
                    }
                }
                maintenance-domain d2 {
                    level 0;
                    maintenance-association 100 {
                        mep 2 {
                            interface ge-1/0/4;
                            remote-mep 1 {
                                action-profile rmep-defaults;
                            }
                        }
                    }
                }
                maintenance-domain d3 {
                    level 0;
                    maintenance-association 100 {
                        mep 2 {
                            interface ge-1/0/3;
                            remote-mep 1 {
                                action-profile rmep-defaults;
                            }
                        }
                    }
                }
            }
        }
    }
}
```

Examples: Ethernet RPS Output

This section provides output examples based on the configuration shown in "Ethernet Ring Protection Switching Configuration Example" on page 759. The show commands used in these examples can help verify configuration and correct operation. The following situations are shown:

- Normal Situation on page 763
- Failure Situation on page 765

Normal Situation

RPL Owner Node

If ring has no failure, the show command will have the following output for node 1:

```
user@node1> show protection-group ethernet-ring aps

Ethernet Ring Name  Request/state  No Flush  Ring Protection Link Blocked
```

```
pg101              NR             No        Yes

Originator  Remote Node ID
Yes
user@node1> show protection-group ethernet-ring interface
Ethernet ring port parameters for protection group pg101

Interface    Control Channel  Forward State  Ring Protection Link End
ge-1/0/1     ge-1/0/1.1       discarding     Yes
ge-1/2/4     ge-1/2/4.1       forwarding     No

Signal Failure  Admin State
Clear          IFF ready
Clear          IFF ready
user@node1> show protection-group ethernet-ring node-state
Ethernet ring    APS State    Event         Ring Protection Link Owner
pg101            idle         NR-RB         Yes

Restore Timer  Quard Timer  Operation state
disabled       disabled    operational
user@node1> show protection-group ethernet-ring statistics group-name pg101
Ethernet Ring statistics for PG pg101
RAPS sent                       : 1
RAPS received                   : 0
Local SF happened:              : 0
Remote SF happened:             : 0
NR event happened:              : 0
NR-RB event happened:           : 1
```

Other Nodes For Node 2 and Node 3, the outputs should be same:

```
user@node2> show protection-group ethernet-ring aps
Ethernet Ring Name  Request/state  No Flush  Ring Protection Link Blocked
pg102              NR             No        Yes

Originator  Remote Node ID
No          00:01:01:00:00:01
user@node2> show protection-group ethernet-ring interface
Ethernet ring port parameters for protection group pg102

Interface    Control Channel  Forward State  Ring Protection Link End
ge-1/2/1     ge-1/2/1.1       forwarding     No
ge-1/0/2     ge-1/0/2.1       forwarding     No

Signal Failure  Admin State
Clear          IFF ready
Clear          IFF ready
user@node2> show protection-group ethernet-ring node-state
Ethernet ring    APS State    Event         Ring Protection Link Owner
pg102            idle         NR-RB         No

Restore Timer  Quard Timer  Operation state
disabled       disabled    operational
user@node2> show protection-group ethernet-ring statistics group-name pg102
Ethernet Ring statistics for PG pg101
RAPS sent                       : 0
RAPS received                   : 1
Local SF happened:              : 0
Remote SF happened:             : 0
```

```
NR event happened:              : 0
NR-RB event happened:           : 1
```

Failure Situation

RPL Owner Node

If ring has a link failure between Node2 and Node 3, the show command will have the following outputs for Node 1:

```
user@node1> show protection-group ethernet-ring aps
Ethernet Ring Name  Request/state  No Flush  Ring Protection Link Blocked
pg101               SF             NO        No

Originator  Remote Node ID
No          00:01:02:00:00:01
user@node1> show protection-group ethernet-ring interface
Ethernet ring port parameters for protection group pg101

Interface    Control Channel  Forward State  Ring Protection Link End
ge-1/0/1     ge-1/0/1.1       forwarding     Yes
ge-1/2/4     ge-1/2/4.1       forwarding     No

Signal Failure  Admin State
Clear           IFF ready
Clear           IFF ready
user@node1> show protection-group ethernet-ring node-state
Ethernet ring    APS State    Event         Ring Protection Link Owner
pg101            protected    SF            Yes

Restore Timer  Quard Timer  Operation state
disabled       disabled     operational
user@node1> show protection-group ethernet-ring statistics group-name pg101
Ethernet Ring statistics for PG pg101
RAPS sent                       : 1
RAPS received                   : 1
Local SF happened:              : 0
Remote SF happened:             : 1
NR event happened:              : 0
NR-RB event happened:           : 1
```

Other Nodes

For Node 2 and Node 3, the outputs should be same:

```
user@node2> show protection-group ethernet-ring aps
Ethernet Ring Name  Request/state  No Flush  Ring Protection Link Blocked
pg102               SF             No        No

Originator  Remote Node ID
Yes         00:00:00:00:00:00
user@node2> show protection-group ethernet-ring interface
Ethernet ring port parameters for protection group pg102

Interface    Control Channel  Forward State  Ring Protection Link End
ge-1/2/1     ge-1/2/1.1       forwarding     No
ge-1/0/2     ge-1/0/2.1       discarding     No

Signal Failure  Admin State
Clear           IFF ready
set             IFF ready
user@node2> show protection-group ethernet-ring node-state
```

```
Ethernet ring    APS State    Event         Ring Protection Link Owner
pg102            idle         NR-RB         No

Restore Timer  Quard Timer  Operation state
disabled       disabled     operational
user@node2> show protection-group ethernet-ring statistics group-name pg102
Ethernet Ring statistics for PG pg101
RAPS sent                        : 1
RAPS received                    : 1
Local SF happened:               : 1
Remote SF happened:              : 0
NR event happened:               : 0
NR-RB event happened:            : 1
```

Chapter 55

Example Ethernet Configurations

This section contains the following example configurations for Ethernet interfaces:

Example: Configuring Fast Ethernet Interfaces

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

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

Example: Configuring Gigabit Ethernet Interfaces

The following configuration is sufficient to get a Gigabit Ethernet, Tri-Rate Ethernet copper, or 10-Gigabit Ethernet interface up and running. By default, IPv4 Gigabit Ethernet interfaces on MX-series, M-series, and T-series routing platforms use 802.3 encapsulation. J-series Gigabit Ethernet interfaces do not support 802.3 encapsulation.

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

```
                address local-address;
            }
        }
    }
}
```

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

Each of the two interfaces on the PIC is named:

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

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

Example: Configuring Aggregated Ethernet Interfaces

Aggregated Ethernet interfaces can use interfaces from different FPCs, DPCs, or PICs. The following configuration is sufficient to get an aggregated Gigabit Ethernet interface up and running.

```
[edit interfaces]
ge-1/3/0 {
    gigether-options {
        802.3ad ae0;
    }
}
ge-2/0/1 {
    gigether-options {
        802.3ad ae0;
    }
}
ae0 {
    aggregated-ether-options {
        link-speed 1g;
        minimum-links 1;
    }
    vlan-tagging;
    unit 0 {
        vlan-id 1;
        family inet {
            address 14.0.100.50/24;
        }
    }
    unit 1 {
        vlan-id 1024;
        family inet {
            address 14.0.101.50/24;
        }
    }
    unit 2 {
        vlan-id 1025;
        family inet {
            address 14.0.102.50/24;
```

```
        }
    }
    unit 3 {
        vlan-id 4094;
        family inet {
            address 14.0.103.50/24;
        }
    }
}

[edit chassis]
aggregated-devices {
    ethernet {
        device-count 15;
    }
}
```

Example: Configuring Aggregated Ethernet Link Protection

The following configuration enables link protection on the ae0 interface, and specifies the ge-1/0/0 interface as the primary link and ge-1/0/1 as the secondary link.

```
[edit interfaces]
ae0 {
    aggregated-ether-options {
        link protection;
    }
}
[edit interfaces]
ge-1/0/0 {
    gigether-options {
        802.3ad ae0 primary;
    }
}
[edit interfaces]
ge-1/0/1 {
    gigether-options {
        802.3ad ae0 backup;
    }
}
```

Part 10
Configuring ISDN Interfaces

Chapter 56

Configuring ISDN Interfaces

This section contains the following topics:

ISDN Interfaces Overview

ISDN is a set of standards for digital transmission over different media created by the Consultative Committee for International Telegraphy and Telephony (CCITT) and the International Telecommunication Union (ITU). ISDN is a dial-on-demand service that provides fast call setup, low latency, and the ability to carry high-quality voice, data, and video transmissions. ISDN is also a circuit-switched service that can be used on both multipoint and point-to-point connections.

You configure two types of interfaces for ISDN service: a physical interface and a logical interface called the *dialer interface*.

Four types of Physical Interface Modules (PIMs) provide ISDN connectivity on J-series Services Routers:

- 1-port S/T interface supporting ITU-T I.430, ETSI TS 101080, and GR-1089-Core Type III
- 1-port U interface supporting ANSI T.601 and GR-1089-Core
- 4-port S/T interface supporting ITU-T I.430, ETSI TS 101080, and GR-1089-Core Type III as a field-replaceable unit (FRU)
- 4-port U interface supporting ANSI T.601 and GR-1089-Core

For information about installing hardware, see the *J-series Services Router Getting Started Guide*.

For information about installing ISDN service over an ISDN line, contact your telecommunications service provider.

Configuring ISDN Services Physical and Logical Interface Properties

To configure ISDN services physical interface properties, include the isdn-options statement at the [edit interfaces br-*pim*/0/*port*] hierarchy level:

```
[edit interfaces br-pim/0/port]
isdn-options {
    calling-number number;
    incoming-called-number number <reject>;
    pool pool-name <priority priority>;
    spid1 spid-string;
    spid2 spid-string;
    static-tei-val value;
    switch-type (att5e | etsi | ni1 | ntdms100 | ntt);
    t310 seconds;
    tei-option (first-call | power-up);
}
dialer-options {
    pool pool-name <priority priority>;
}
```

To configure ISDN services logical interface properties, include the following statements:

```
[edit interfaces dln unit logical-unit-number]
dialer-options {
    activation-delay seconds;
    callback;
    callback-wait-period time;
    deactivation-delay seconds;
    dial-string dial-string-numbers;
    idle-timeout seconds;
    incoming-map {
        caller (caller-id| accept-all);
        initial-route-check seconds;
            load-interval seconds;
            load-threshold percent;
            pool pool-name;
            redial-delay time;
            watch-list {
                [ routes ];
            }
        }
        encapsulation [
        (cisco-hdlc | multilink-ppp | ppp);
    }
}
```

To configure a primary interface to use an ISDN logical interface as a backup or “failover” interface when the primary connection experiences interruptions in Internet connectivity, include the backup-options statement to specify the ISDN interface at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces interface-name unit logical-unit-number]
backup-options {
    interface dln.0;
}
```

You can include these statements at the following hierarchy levels:

- [edit interfaces]
- [edit logical-systems *logical-system-name* interfaces]

To configure the Services Router to reject incoming ISDN calls (supported when dial-in is configured), include the reject-incoming statement at the [edit system processes isdn-signaling] hierarchy level:

```
[edit system processes isdn-signaling]
reject-incoming;
}
```

To disable ISDN, include the disable statement at the [edit system processes isdn-signaling] hierarchy level:

```
[edit system processes isdn-signaling]
disable;
}
```

To disable the dial-out on demand process, include the disable statement at the [edit system processes dialer-services] hierarchy level:

```
[edit system processes dialer-services]
disable;
}
```

Configuring ISDN Physical Interface Properties

You specify the physical ISDN interface in the form br-*pim*/0/*port*. *pim* is the slot in which the PIM is installed. The second number is always 0. *port* is the configured port number.

You specify the B-channel in the form bc-*pim*/0/*port*:*n*. *n* is the B-channel ID and can be 1 or 2. You specify the D-channel in the form dc-*pim*/0/*port*:0.

NOTE: The B- and D-channel interfaces do not have any configurable parameters. However, when interface statistics are displayed, B- and D-channel interfaces have statistical values.

To enable ISDN interfaces installed on your Services Router to work properly, you must configure the interface properties. To configure physical interface properties, include the isdn-options statement at the [edit interfaces br-*pim*/0/*port*] hierarchy level:

```
[edit interfaces br-pim/0/port]
```

```
isdn-options {
    calling-number number;
    incoming-called-number number <reject>;
    spid1 spid-string;
    spid2 spid-string;
    static-tei-val value;
    switch-type (att5e | etsi | ni1 | ntdms100 | ntt);
    t310 seconds;
    tei-option (first-call | power-up);
}
dialer-options {
    pool pool-name <priority priority>;
}
```

You can configure the following ISDN options:

- calling-number—The calling number included in outgoing calls.
- incoming-called-number—Screening of incoming calls. If the incoming number of the incoming call is configured, the call is accepted. If the reject option is specified with the number, the call is rejected. If no numbers are configured, all calls are accepted. See "Configuring an ISDN Interface to Screen Incoming Calls" on page 777.
- pool—The dial pool for logical and physical ISDN interfaces. The dial pool allows logical (dialer) and physical (br-*pim*/0/*port*) interfaces to be bound together dynamically on a per-call basis. On a dialer interface, pool directs the dialer interface to a dial pool. On a br-*pim*/0/*port* interface, pool defines the pool to which the interface belongs. Specify a priority value from 0 (lowest) to 255 (highest) for the interface.
- spid1—The Service Profile Identifier (SPID). *spid-string* is a numeric value. If your service provider requires SPIDs, you cannot place calls until the interface sends a valid, assigned SPID to the service provider when accessing the ISDN connection. A single SPID must be configured as spid1.
- spid2—A second SPID, used for DMS-100 and NI1switch types.
- static-tei-val—A static Terminal Endpoint Identifier (TEI) value. The TEI value represents any ISDN-capable device attached to an ISDN network that is the terminal endpoint. TEIs are used to distinguish between different devices using the same ISDN links. Specify a value from 0 through 63. You cannot configure a TEI value with multiple SPIDs—dynamic TEI assignment is required.

NOTE: TEI assignment is usually done dynamically instead of statically using the TEI management protocol. When the TEI management protocol is used, values 64-126 are assigned to terminal endpoints. TEI value 127 is used for group assignment.

- switch-type—The ISDN switch type. The following switches are compatible:
    - att5e—AT&T 5ESS
    - etsi—NET3 for United Kingdom and Europe
    - ni1—National ISDN-1

  - ntdms100—Northern Telecom DMS-100
  - ntt—NTT Group switch for Japan
- tei-option—When the Terminal Endpoint Identifier (TEI) negotiates with the ISDN provider. Specify first-call (activation does not occur until the call setup is sent) or power-up (activation occurs when the Services Router is powered on). The default value is power-up.
- t310—Q.931-specific timer for T310, in seconds. Specify the number of seconds from 1 through 65536. The default value is 10 seconds.

Configuring an ISDN Interface to Screen Incoming Calls

By default, an ISDN interface is configured to accept all incoming calls. If multiple devices are connected to the same ISDN line, you can configure an ISDN interface to screen incoming calls based on the incoming called number.

You can specify the incoming called numbers that an ISDN interface accepts. You can use the reject option to specify a number that the ISDN interface can ignore. The reject option is useful when an incoming called number is specified on one device connected to an ISDN line, and you want the incoming called number rejected on a second ISDN device connected to the same ISDN line. For example, if the first ISDN device has the called number 4085321901, you can configure the called number 4085321901 with the reject option on the second ISDN device.

When an incoming ISDN call is received, the Services Router matches the incoming called number against the called numbers configured on its ISDN interfaces. If an exact match is not found, or if the called number is configured with the reject option, the incoming call is ignored. Each ISDN interface accepts only the calls whose called number are configured on it.

To specify that an incoming called number be rejected by the interface, include the incoming-called-number statement with the reject option at the [edit interfaces br-*pim*/0/*port* isdn-options] hierarchy level:

```
[edit interfaces br-pim/0/port]
isdn-options {
   incoming-called-number number reject;
}
```

You can configure up to 30 incoming called numbers.

Configuring ISDN Logical Interface Properties

You configure ISDN services interface properties at the logical unit level. For information about default settings for ISDN logical interface properties, see the *JUNOS Services Interfaces Configuration Guide*.

The dialer interface, dl*n*, is a logical interface for configuring dialing properties for a backup ISDN connection. The interface can be configured in two modes:

- Multilink mode using multilink-ppp encapsulation. This mode is used when the router supports B-channel bundling (two B-channels connected to provide a 128-Kbps connection) and runs Multilink Point-to-Point Protocol (MLPPP). When the dialer interface (dl*n*) is in multilink mode, the value of *n* is from 0 through 149. However, you can only configure one dialer interface with multilink-ppp encapsulation. For example, you cannot have both dl1 and dl2 as multilink dialers simultaneously. If you need to have multiple multilink dialers, then the values should be dl*n*.1, dl*n*.2, and so forth.
- Normal mode using ppp or cisco-hdlc encapsulation. This mode is used when the router is using one B-channel. When the dialer interface (dl*n*) is in normal mode, the value of *n* is always is from 0 through 149.

NOTE: Ensure that the same IP subnet address is not configured on different dialer interfaces. Configuring the same IP subnet address on different dialer interfaces can result in inconsistency in the route and packet loss. Packets may be routed through any of the dialer interfaces that have the same IP subnet address, instead of being routed through the dialer interface to which the ISDN call is connected.

You can configure the following ISDN services logical interface properties:

- Configuring an ISDN Dialer Interface as a Backup Interface on page 780
- Applying the Dial-on-Demand Dialer Filter to the Dialer Interfaces on page 782
- Configuring Bandwidth on Demand on page 783
- Configuring Dial-In and Callback on page 786
- Configuring Dialer Watch on page 789

The dialer interface cannot be configured:

- As a backup interface and as a dialer filter simultaneously.
- As a backup interface and as a dialer watch simultaneously.
- As a dialer watch interface and as a dialer filter simultaneously.
- As a backup interface for more than one primary interface.

For specific ISDN configuration information for dial-on-demand routing (DDR) and adding Open Shortest Path First (OSPF) demand circuits to a Services Router, see the *JUNOS Routing Protocols Configuration Guide*.

For general information about logical unit properties, see "Configuring Logical Interface Properties" on page 135. For general information about family inet properties, see "Configuring Protocol Family and Interface Address Properties" on page 161.

To configure logical interface properties, include the encapsulation statement at the [edit interfaces dl*n*] hierarchy level and the dialer-options statement at the [edit interfaces dl*n* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces dln]
encapsulation (cisco-hdlc | multilink-ppp | ppp);
```

```
[edit interfaces dln unit logical-unit-number]
dialer-options {
    activation-delay seconds;
    callback;
    callback-wait-period time;
    deactivation-delay seconds;
    dial-string dial-string-numbers;
    idle-timeout seconds;
    incoming-map {
        caller (caller-id | accept-all);
        initial-route-check seconds;
            load-interval seconds;
            load-threshold percent;
            pool pool-name;
            redial-delay time;
            watch-list {
                [ routes ];
            }
        }
    }
}
```

You can configure the following options:

- activation-delay—ISDN activation delay, in seconds. Specify a number from 1 through 4294967295.
- callback—Configure the dialer to terminate the incoming call and call back the originator after the callback wait period.
- callback-wait-period—For interfaces configured for ISDN with callback, specify the amount of time the dialer waits before calling back the caller. The default is 5 seconds.
- caller—Specify the dialer to accept a specified caller number or accept all incoming calls.
- deactivation-delay—ISDN deactivation delay, in seconds. Specify from 1 through 4294967295.
- encapsulation—Logical link-layer encapsulation type. For normal mode, specify cisco-hdlc for Cisco-compatible High-Level Data Link control (HDLC) or ppp for Point-to-Point Protocol. For multilink mode, specify multilink-ppp.
- dial-string—Phone number to be dialed. Do not include hyphens in number.
- idle-timeout—Number of seconds the link is idle before losing connectivity. The default is 120 seconds.
- incoming-map—Specify the dialer to accept incoming calls.

CAUTION: Changing the caller incoming map when a call is connected can create inconsistencies in the route and prevent traffic on a subnet from being transmitted. This is seen when two dialer interfaces are configured and the association of the caller incoming-map from one interface to the other is changed when a call is connected on one of the interfaces. The cause of the inconsistency is that dialer interfaces are pseudo interfaces that are always up, even if not actually connected.

- initial-route-check—Allows the router to check whether the primary route is up after the initial startup of the router is complete and the timer expires.
- load-interval—Interval used to calculate the average load on the network. By default, the average interface load is calculated every 60 seconds. You can specify an interval from 20 through 180 seconds, configurable in intervals of 10 seconds. For more information about the load interval, see "Configuring Bandwidth on Demand" on page 783.
- load-threshold—Bandwidth threshold percentage used for adding interfaces. Another link is added to the multilink bundle when the bandwidth reaches the threshold value you set. Specify a percentage between 0 and 100. When the value is set to 0, all available channels are dialed. The default value is 100.
- pool—For logical and physical ISDN interfaces, specify the dial pool. The dial pool allows logical (dialer) and physical (br-*pim*/0/*port*) interfaces to be bound together dynamically on a per-call basis. On a dialer interface, pool directs the dialer interface which dial pool to use. On a br-*pim*/0/*port* interface, pool defines the pool to which the interface belongs.
- redial-delay—Specify the delay (in seconds) between two successive calls made by the dialer (for dialout). The default is 3 seconds.
- watch-list—IP prefix of one or more routes. The primary route is considered up if there is at least one valid route for any of the addresses in the watch list to an interface other than the backup interface.

Changing the caller incoming map when a call is connected can create inconsistencies in the route and prevent traffic on a subnet from being transmitted. This is seen when two dialer interfaces are configured and the association of the caller incoming-map from one interface to the other is changed when a call is connected on one of the interfaces.

The cause of the inconsistency is that dialer interfaces are pseudo interfaces that are always up, even if not actually connected.

Configuring an ISDN Dialer Interface as a Backup Interface

Configuring the ISDN interface as a backup interface ensures continuous network connectivity. The Services Router can be configured to fail over to the ISDN interface if the primary connection experiences interruptions in Internet connectivity.

To configure an ISDN interface as the backup interface, include the backup-options statement at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces interface-name unit logical-unit-number]
backup-options {
   interface dln.0;
}
```

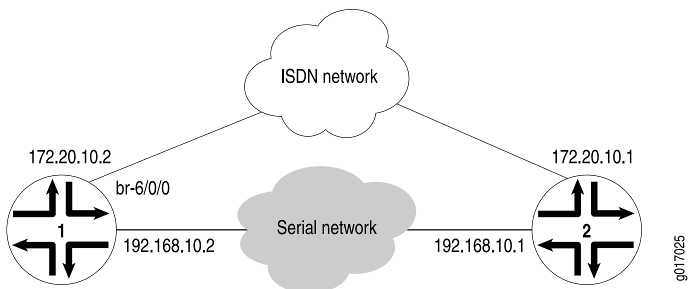
interface-name is the primary interface. The backup interface is specified as dl*n*.

Example: Configuring an ISDN Interface as the Backup Interface

The following example illustrates a backup configuration using a primary serial interface, two dialer interfaces, and a physical ISDN interface.

See Figure 66 on page 781 for the topology used for this example.

Figure 66: ISDN Backup Topology



Configure dialer interface dl0 as the backup interface on the primary serial interface t1-4/0/1:

Configuration on the Primary Serial Interface

```
[edit interfaces]
t1-4/0/1 {
    encapsulation ppp;
    backup-options {
        interface dl0.0;
    }
    unit 0 {
        family inet {
            address 192.168.10.2;
        }
    }
}
```

Configuration on the Dialer Interface

```
[edit interfaces]
dl0 {
    encapsulation ppp;
    unit 0 {
        dialer-options {
            pool 10;
            dial-string 5552222;
            activation-delay 10;
            deactivation-delay 10;
        }
        family inet {
            address 172.20.10.2 {
                destination 172.20.10.1;
            }
        }
    }
}
```

Configuration on the Physical ISDN Interface

```
[edit interfaces]
br-1/0/0 {
    isdn-options {
        calling-number 5558888;
        spid1 51255511110101 5551111;
        spid2 51255511120101 5551112;
        switch-type ni1;
        t310 70;
    }
    dialer-options {
        pool 10 priority 3;
        pool 2 priority 25;
    }
}
```

Applying the Dial-on-Demand Dialer Filter to the Dialer Interfaces

Dial-on-demand routing (DDR) links two sites over a public network and provides bandwidth. An ISDN connection allows an ISDN line to be activated only when there is network traffic configured as an “interesting” packet. An interesting packet is defined using the firewall filter feature of the Services Router.

To configure DDR, you configure the dialer interface as a passive static route with a lower priority than dynamic routes. If the dynamic route is lost, and a packet destined for that IP address is received, the dialer interface initiates an ISDN connection and sends the packet over it. When no new packets are sent to the destination, the dialer interface initiates an inactivity timer. The ISDN connection is terminated when the timer expires.

There are three steps to configuring dial-on-demand connectivity:

- Define the dialer filter.
- Configure the firewall rule.
- Apply the dialer filter to the dialer interface.

To define the filter, include the dialer-filter interesting-traffic statement at the [edit firewall family inet] hierarchy level.

To configure the firewall rule, include the term and from statements at the [edit firewall family inet dialer-filter *filter-name*] hierarchy level.

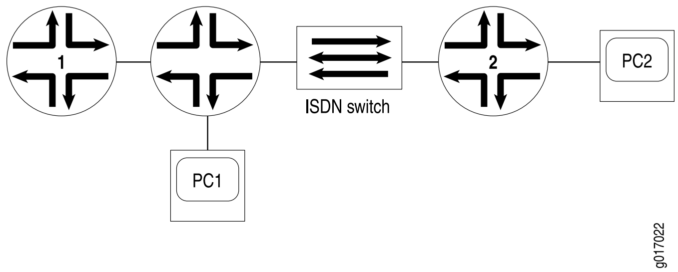
To apply the filter to the dialer interface, include the filter dialer statement at the [edit interfaces dl*n* unit *logical-unit-number* family *family*] hierarchy level.

Example: Applying the Dialer Filter

The following example illustrates a dialer filter configuration configured at the [edit firewall family inet] hierarchy level and applied to a physical interface and a dialer interface.

See Figure 67 on page 783 for the topology used for this example.

Figure 67: Dialer Filter Topology



Configuration for the Dialer Filter

```
[edit firewall family inet]
dialer-filter interesting-traffic {
   term 1 {
      from {
         destination-address {
            100.0.0.50/32;
         }
      }
      then note;
   }
}
```

Configuration on the Dialer Interface

```
[edit interfaces]
dl0 {
   encapsulation ppp;
   unit 0 {
      dialer-options {
         pool 1;
         dial-string 350100;
      }
   }
   family inet {
      filter {
         dialer interesting-traffic;
      }
      address 50.2.0.1/24;
   }
}
```

Configuring Bandwidth on Demand

You can define a bandwidth threshold for network traffic on the Services Router using the dialer interface and ISDN interfaces. Initially, only one ISDN link is active and all packets are sent through this interface. When a predefined bandwidth threshold is reached on this interface, the dialer interface activates another ISDN link and initiates a data connection.

To configure bandwidth on demand, perform the steps in the following sections to configure the dialer interface and the physical ISDN interfaces:

- Configuring the Dialer Interface on page 784
- Configuring the ISDN Interface on page 785
- Example: Configuring Bandwidth on Demand on page 785

Configuring the Dialer Interface

To configure the dialer interface for bandwidth on demand, include the encapsulation multilink-ppp statement at the [edit interfaces dl*n*] hierarchy level:

```
[edit interfaces]
dln {
   encapsulation multilink-ppp;
}
```

To configure dialer options, include the dialer-options statement at the [edit interfaces dl*n* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces dln unit logical-unit-number]
dialer-options {
   dial-string dial-string-numbers;
   load-interval seconds;
   load-threshold percent;
   pool pool-name;
}
```

To configure unit properties, include the unit *logical-unit-number* statement at the [edit interfaces dl*n*] hierarchy level:

```
[edit interfaces dln unit logical-unit-number]
family family {
   mtu bytes;
   negotiate-address;
   filter {
      filter-name;
         fragment-threshold bytes;
            mrru bytes;
            ppp-options {
               chap {
                  access-profile name;
               }
            }
         }
      }
   }
}
```

You can configure the following unit properties:

- family—Protocol family information for the logical interface. For *family*, specify inet (for Internet Protocol version 4 [IPv4]) suite.
- filter—Dialer filter name. The dialer filter applied here is configured at the [edit firewall family inet] hierarchy level and also applied to the physical ISDN interface.
- fragment-threshold—Maximum size, in bytes, for multilink packet fragments. Any nonzero value must be a multiple of 64 bytes. The value can be between 128 and 16320. The default is 0 bytes (no fragmentation).
- mrru—Maximum received reconstructed unit (MRRU), in bytes. The value can be between 1500 and 4500. The default is 1500 bytes.
- negotiate-address—For interfaces with Point-to-Point Protocol (PPP) encapsulation, enable the interface to be assigned an IP address by the remote end.

Configuring the ISDN Interface

To configure the ISDN interface for bandwidth on demand, include the pool statement at the [edit interfaces br-*pim*/0/*port* dialer-options] hierarchy level:

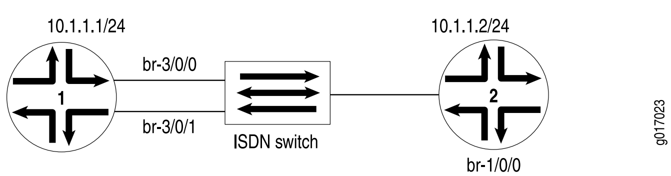
```
[edit interfaces br-pim/0/port]
dialer-options {
   pool pool-name;
}
```

Each ISDN interface must use the same dialer pool name to participate in the bandwidth-on-demand configuration.

Example: Configuring Bandwidth on Demand

Figure 68 on page 785 illustrates a bandwidth-on-demand configuration using multiple physical ISDN interfaces.

Figure 68: Bandwidth-on-Demand Topology



Configuration for the Dialer Interface

```
[edit interfaces]
dl0 {
   encapsulation multilink-ppp;
   unit 0 {
      dialer-options {
         pool 10;
         dial-string 5552222; #Phone number to be dialed
         load-threshold 95;#Dial more ISDN if load exceeds 95% of
         #current capacity
      }
```

```
        fragment-threshold 1024; #Allowed only when dialer is in multilink mode
        mrru 1500; #Allowed only when dialer is in multilink mode
        encapsulation multilink-ppp;
        rtp {
            f-max-period 100;
            queues q3;
        }
    }
    family inet {
        negotiate-address;
    }
}
```

Configuration for the First Physical ISDN Interface

```
[edit interfaces]
br-1/0/0 {
    isdn-options {
        switch-type ni1;
    }
    dialer-options {
        pool 1;
    }
}
```

Configuration for the Second Physical ISDN Interface

```
[edit interfaces]
br-1/0/1 {
    isdn-options {
        switch-type ni1;
    }
    dialer-options {
        pool dialer-pool1;
    }
}
```

Configuring Dial-In and Callback

You can configure dial-in on the dialer interface to permit incoming calls. Using dial-in, all incoming calls on a BRI interface are mapped to a dialer interface based on a caller ID. The incoming call's caller ID is compared against all caller IDs configured on all dialers to find the valid match. Multiple caller IDs can be configured on a dialer interface. The same caller IDs cannot be configured on different dialers.

Instead of accepting incoming calls, you can configure the dialer interface to call back the caller. When callback is configured, the call is rejected, and after a brief delay the caller is called back using the dial-string configured on the dialer interface. Multiple dial-strings cannot be configured on a dialer when callback is configured.

To configure dial-in or callback, perform the steps in the following sections to configure the dialer interface and the physical ISDN interfaces:

- Configuring Dial-In on page 787
- Disabling Dial-In on page 787

Configuring Dial-In

To configure the dialer interface for dial-in operation, include the incoming-map statement with options at the [edit interfaces dl*n* unit *logical-unit-number* dialer-options] hierarchy level:

```
[edit interfaces dln unit logical-unit-number]
dialer-options {
   incoming-map {
      caller (caller-id | accept-all);
      }
   }
}
```

NOTE: The incoming-map statement is mandatory for the router to accept any incoming ISDN calls.

Include the option accept-all to accept all incoming calls. You can configure the accept-all option for only one of the dialer interfaces associated with an ISDN physical interface. The dialer interface with the accept-all option configured will be used only if the incoming call's caller ID does not match against the caller IDs configured on other dialer interfaces.

Include the caller *caller-id* statement to configure the dialer interface to accept calls from a specific caller ID. You can configure a maximum of 15 caller IDs per dialer interface.

The same caller ID cannot be configured on different dialer interfaces. However, you can configure a subset of the caller ID configured on another dialer interface. For example, you can configure the caller IDs 14085551515, 4085551515, and 5551515 on different dialer interfaces.

Disabling Dial-In

When dial-in is configured on the Services Router, incoming ISDN calls are accepted by the Services Router. However, you can configure the Services Router to reject all incoming ISDN calls when dial-in is configured.

To configure the Services Router to reject incoming ISDN calls, include the reject-incoming statement at the [edit system processes isdn-signaling] hierarchy level:

```
[edit system processes isdn-signaling]
reject-incoming;
```

For more information about disabling dial-in, see the *JUNOS System Basics Configuration Guide* and the *J-series Services Router Basic LAN and WAN Access Configuration Guide*.

Configuring Callback

To configure the dialer interface to call back a specific caller, include the caller *caller-id* statement and the callback statement at the [edit interfaces dl*n* unit *logical-unit-number* dialer-options] hierarchy level:

```
[edit interfaces dln unit logical-unit-number]
dialer-options {
   incoming-map {
      caller caller-id;
      callback;
      callback-wait-period time;
   }
}
```

Include the optional callback-wait-period statement to change the time at which the dialer interface calls back the caller. The default period is 5 seconds.

Before configuring the callback on a dialer interface, ensure that:

- The dialer interface is not configured as a backup for a primary interface.
- The dialer interface does not have a watch list configured.
- Only one dial string is configured for the dialer interface.
- Dial-in is configured on the dialer interface of the remote router that is dialing in.

Example: Configuring Dial-In and Callback

The following illustrates configurations for dial-in and callback operations.

Configuration to Accept All Incoming Calls

```
[edit interfaces]
dl0 {
   encapsulation ppp;
   unit 0 {
      dialer-options {
         dial-string 7031231282;
         incoming-map;
         accept-all;
      }
      pool 2;
      family inet {
         address 10.1.1.2;
      }
   }
}
```

Configuration to Accept Calls from a Specific Caller ID

```
[edit interfaces]
dl0 {
   encapsulation ppp;
   unit 0 {
      dialer-options {
         incoming-map {
```

```
            caller 14082711234;
          }
          pool 1;
          family inet {
            address 20.1.1.1;
          }
        }
      }
    }
```

Configuration to Call Back Calls from a Specific Caller ID

```
[edit interfaces]
dl0 {
  encapsulation ppp;
  unit 0 {
    dialer-options {
      incoming-map {
        caller 14082711234;
      }
      callback;
      callback-wait-period 2;
      pool 1;
      family inet {
        address 20.1.1.1;
      }
    }
  }
}
```

Configuring Dialer Watch

Dialer watch is a feature that integrates backup dialing with routing capabilities and provides reliable connectivity without relying on “interesting” packets to trigger outgoing ISDN connections. With dialer watch, the Services Router monitors the existence of a specified route and if the route fails, the dialer interface initiates the ISDN connection as a backup connection.

To configure dialer watch, perform the steps in the following sections to configure the dialer interface and the physical ISDN interface:

- Configuring the Dialer Interface on page 789
- Configuring the Physical Interface on page 790
- Example: Configuring Dialer Watch on page 790
- Example: Complete ISDN Called-Calling Router Configuration on page 791

Configuring the Dialer Interface

To configure the dialer interface for dialer watch, include the following statements at the [edit interfaces dl*n*] and the [edit interfaces dl*n* unit *logical-unit-number*] hierarchy levels:

```
[edit interfaces]
dln {
```

```
        encapsulation (cisco-hdlc | multilink-ppp | ppp);
        hold-time (up | down) milliseconds;
        unit logical-unit-number {
            dialer-options {
                activation-delay seconds;
                deactivation-delay seconds;
                dial-string dial-string-numbers;
                hold-time seconds;
                initial-route-check seconds
                pool pool-name;
                watch-list {
                    [ routes ];
                }
                family family {
                    ip-address;
                }
            }
        }
    }
```

Configuring the Physical Interface

To configure the physical interface for dialer watch, include the pool statement at the [edit interfaces br-*pim*/0/*port* dialer-options] hierarchy level:

```
[edit interfaces]
br-pim/0/port {
    dialer-options {
        pool name;
    }
}
```

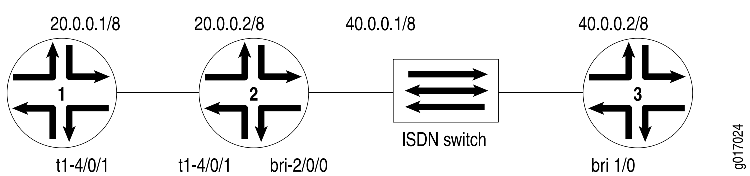
Each physical interface must use the same pool to participate in dialer watch.

Example: Configuring Dialer Watch

The following example illustrates a dialer watch configuration using one physical interface and one dialer interface.

See Figure 69 on page 790 for the topology used in this example.

Figure 69: Dialer Watch Topology



Configuration for the Physical Interface

```
[edit interfaces]
br-2/0/0 {
    isdn-options {
        switch-type ntdms100;
    }
```

```
    dialer-options {
        pool 1 priority 1;
    }
}
```

Configuration for the Dialer Interface

```
[edit interfaces]
dl0 {
    unit 0 {
        dialer-options {
            pool 1;
            dial-string 384030;
            watch-list {
                2.2.2.2/24;
                3.3.3.3/24;
            }
        }
        family inet {
            address 40.0.0.1/8;
        }
    }
}
```

Example: Complete ISDN Called-Calling Router Configuration

This example configures the calling J-series router (R1) and the calling J-series router (R2). The routers are both directly connected to an ISDN switch.

Configuration of Calling Router (R1)

```
[edit]
system {
    login {
        user isdn {
            uid 2000;
            class super-user;
            authentication {
                encrypted-password "$1$IS8Vkg3V$tzySvfBSZhI1vYHSZQ6fM1";
                    ## SECRET-DATA
            }
        }
    }
    services {
        web-management {
            http;
        }
    }
}

interfaces {
    fe-0/0/0 {
        unit 0 {
            family inet {
                address 192.168.1.1/24;
            }
        }
    }
```

```
    br-3/0/0 {
        traceoptions {
            flag q921;
            flag q931;
            file {
                isdn_logg;
            }
        }
        isdn-options {
            switch-type etsi;
            spid1 116;
        }
        dialer-options {
            pool 100;
        }
    }
    dl100 {
        encapsulation ppp;
        unit 0 {
            dialer-options {
                pool 100;
                dial-string 119;
            }
            family inet {
                filter {
                    dialer nss;
                }
                address 10.1.1.1/24;
            }
        }
    }
}

firewall {
    family inet {
        dialer-filter nss {
            term 1 {
                from {
                    destination-address {
                        10.1.1.0/24;
                    }
                }
                then note;
            }
        }
    }
}

access {
    profile isdn {
        client isdn chap-secret "$9$Lpax7VsYoGUHwsP5F39C"; ## SECRET-DATA
    }
}
```

Configuration of Called Router (R1)

```
[edit]
system {
   root-authentication {
      encrypted-password "$1$UfcFhjcm$ftfgaLjMgRvFHrT3obrHu."; ## SECRET-DATA
   }
   services {
      web-management {
         http {
            interface [ fe-0/0/0.0 fe-0/0/1.0 ];
         }
      }
   }
   syslog {
      user * {
         any emergency;
      }
      file messages {
         any any;
         authorization info;
      }
      file interactive-commands {
         interactive-commands any;
      }
   }
}

interfaces {
   br-0/0/4 {
      isdn-options {
         switch-type etsi;
         spid1 119;
         tei-option power-up;
      }
      dialer-options {
         pool 100;
      }
   }
   dl100 {
      encapsulation ppp;
      unit 0 {
         dialer-options {
            pool 100;
            dial-string 116;
            incoming-map {
               caller 116;
            }
         }
         family inet {
            filter {
               dialer nss;
            }
            address 10.1.1.2/24;
         }
      }
   }
```

```
}

firewall {
    family inet {
        dialer-filter nss {
            term 1 {
                from {
                    address {
                        10.1.1.0/24;
                    }
                }
                then note;
            }
        }
    }
}
```

Disabling ISDN Processes

You can disable ISDN entirely or disable certain processes at the system process level.

To disable ISDN entirely, include the disable statement at the [edit system processes isdn-signaling] hierarchy level:

```
[edit system processes isdn-signaling]
disable;
```

To disable the dial-out on demand process, include the disable statement at the [edit system processes dialer-services] hierarchy level:

```
[edit system processes dialer-services]
disable;
```

To disable dial-in and force the Services Router to reject incoming ISDN calls, include the reject-incoming statement at the [edit system processes isdn-signaling] hierarchy level:

```
[edit system processes isdn-signaling]
reject-incoming;
```

Part 11

Configuring SONET Interfaces

Chapter 57

Configuring SONET/SDH Interfaces

This chapter discusses configuration of the SONET/SDH interface properties and provides configuration examples in the following sections:

SONET/SDH Interfaces Overview

Synchronous Digital Hierarchy (SDH) is a CCITT standard for a hierarchy of optical transmission rates. Synchronous Optical Network (SONET) is a USA standard that is largely equivalent to SDH. Both are widely used methods for very high speed transmission of voice and data signals across the numerous world-wide fiber-optic networks.

SDH and SONET use light-emitting diodes or lasers to transmit a binary stream of light-on and light-off sequences at a constant rate. At the far end optical sensors convert the pulses of light back to electrical representations of the binary information.

In wavelength-division multiplexing (WDM), light at several different wavelengths (colors to a human eye) is transmitted on the same fiber segment, greatly increasing the throughput of each fiber cable.

In dense wavelength-division multiplexing (DWDM), many optical data streams at different wavelengths are combined into one fiber.

The basic building block of the SONET/SDH hierarchy in the optical domain is an OC1; in the electrical domain, it is an STS-1. An OC1 operates at 51.840 Mbps. OC3 operates at 155.520 Mbps.

A SONET/SDH stream can consist of discrete lower-rate traffic flows that have been combined using time-division multiplexing (TDM) techniques. This method is useful, but a portion of the total bandwidth is consumed by the TDM overhead. When a SONET/SDH stream consists of only a single, very high speed payload, it is referred to as operating in concatenated mode. A SONET/SDH interface operating in this mode has a "c" added to the rate descriptor. For example, a concatenated OC48 interface is referred to as OC48c.

SONET and SDH traffic streams exhibit very few differences in behavior that are significant to Juniper Networks SONET/SDH interfaces; in general, this chapter uses *SONET/SDH* to indicate behavior that is identical for the two standards. However, there is one important difference that requires you to configure the interface specifically for SONET or SDH mode. That difference is in the setting of two bits (the ss-bits) in the pointer. SONET equipment ignores these bits, but SDH equipment uses them to distinguish a VC-4 payload from other types. When configured in SDH mode, Juniper Networks SONET/SDH PICs set the ss-bits to s1s0 2 (binary 10). For more information, see the *JUNOS System Basics Configuration Guide*.

CAUTION: To extend the life of the laser, when a SONET/SDH PIC is not being actively used with any valid links, take the PIC offline until you are ready to establish a link to another device. To do this, issue the request chassis pic offline fpc-slot *slot-number* pic-slot *slot-number* operational mode command:

user@host> request chassis pic offline fpc-slot *slot-number* pic-slot *slot-number*

After you have connected the PIC to another device, bring the PIC back online by issuing the request chassis pic online fpc-slot *slot-number* pic-slot *slot-number* operational mode command.

user@host> request chassis pic online fpc-slot *slot-number* pic-slot *slot-number*

For information about taking a PIC offline or online, see the request chassis pic offline command and the request chassis pic online command in the *JUNOS System Basics and Services Command Reference*.

Configuring SONET/SDH Physical Interface Properties

To configure SONET/SDH physical interface properties, include the sonet-options statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces so-fpc/pic/port]
framing (sdh | sonet);
sonet-options {
    aggregate asx;
    aps {
        advertise-interval milliseconds;
        annex-b
        authentication-key key;
        force;
        hold-time milliseconds;
        lockout;
```

```
        neighbor address;
        paired-group group-name;
        protect-circuit group-name;
        request;
        revert-time seconds;
        switching-mode (bidirectional | unidirectional);
        working-circuit group-name;
      }
      bytes {
        e1-quiet value;
        f1 value;
        f2 value;
        s1 value;
        z3 value;
        z4 value;
      }
      fcs (16 | 32);
      loopback (local | remote);
      mpls {
        pop-all-labels {
          required-depth number;
        }
      }
      path-trace trace-string;
      (payload-scrambler | no-payload-scrambler);
      rfc-2615;
      trigger {
        defect ignore;
        defect hold-time up milliseconds down milliseconds;
      }
    }
    vtmapping (itu-t | klm);
    (z0-increment | no-z0-increment);
    speed (oc3 | oc12 | oc48);
```

Note that when you configure SONET/SDH OC48 interfaces for channelized (multiplexed) mode (by including the no-concatenate statement at the [edit chassis fpc *slot-number* pic *pic-number*] hierarchy level), the bytes f1 statement has no effect. Currently, the bytes e1-quiet statement is ignored if you include it in the configuration. The bytes f2, bytes z3, bytes z4, and path-trace options work correctly on channel 0 and work in the transmit direction only on channels 1, 2, and 3. When using no-concatenate, you must specify a channel. For more information, see the *JUNOS System Basics Configuration Guide*.

For DS3 channels on a channelized OC12 interface, the bytes f1, bytes f2, bytes z3, and bytes z4 options have no effect. The bytes s1 option is supported only for channel 0; it is ignored if configured on channels 1 through 11. The bytes s1 value configured on channel 0 applies to all channels on the interface.

You can also include some of the statements in the sonet-options statement to set SONET/SDH parameters on ATM interfaces.

You can configure the following SONET/SDH physical interface properties:

Configuring SONET/SDH Framing

The 4-port OC48 PIC with SFP installed, the next-generation SONET/SDH PICs with SFP, and the 4-port OC192 PIC on M-series, MX-series, and T-series routing platforms, support SONET or SDH framing on a per-port basis. This functionality allows you to mix SONET and SDH modes on interfaces on a single PIC. You can use the framing statement to configure incoming SDH links from Europe and outgoing SONET links to the US on the same PIC. Traffic flowing through other ports of the same PIC will not be affected.

When you change SONET/SDH mode on a port, only the port's framing type is changed. The PIC does not go offline.

To configure framing on a per-port basis, include the framing (sdh | sonet) statement at the [edit interfaces so-*fpc/pic/port*] hierarchy level:

```
[edit interfaces]
so-fpc/pic/port {
   framing (sdh | sonet);
}
```

NOTE: Per-port framing configuration is applicable for SONET interfaces in concatenated mode (default mode) only. When you configure a PIC to operate in nonconcatenated mode, the individual channels inherit framing configuration from the [edit chassis fpc *number* pic *number* framing (sonet | sdh)] hierarchy level.

NOTE: Automatic Protection Switching (APS) is used by SONET add/drop multiplexers (ADMs) to protect against circuit failures. If APS is configured, and you do not change the SONET/SDH mode on both the working and protection port, APS support will not function properly. Both the working and protection ports must have the same mode configuration.

To view interface information, use the operational mode command show interfaces so-*fpc/pic/port*.

Configuring SONET/SDH Interface Speed

You can configure the speed of SONET/SDH interfaces on next-generation SONET/SDH Type 1 and Type 2 PICs with SFP. The speed you select is dependent upon whether the PIC is in concatenated or nonconcatenated mode. In concatenated mode, the bandwidth of the interface is in a single channel. In nonconcatenated mode, the PIC operates in channelized (multiplexed) mode.

Table 62 on page 801 shows the mode combinations for the next-generation SONET/SDH Type 1 PICs with SFP.

Table 62: Type 1 PIC Mode Combinations

PIC	Mode	Speed Configuration	Default Mode
2-port OC3	2xOC3 concatenated	*fpc/pic/*0 speed oc3	Concatenated
4-port OC3	1xOC12 concatenated	*fpc/pic/*0 speed oc12	
	1xOC12 nonconcatenated	*fpc/pic/*0:0 speed oc3	Nonconcatenated
	4xOC3 concatenated	*fpc/pic/port* speed oc3	Concatenated
1-port OC12	1xOC12 concatenated	*fpc/pic/*0 speed oc12	Concatenated
	1xOC12 nonconcatenated	*fpc/pic/*0:0 speed oc3	Nonconcatenated
	1xOC3 concatenated	*fpc/pic/*0 speed oc3	

Table 63 on page 802 shows the mode combinations for the next-generation SONET/SDH Type 2 PICs with SFP.

Table 63: Type 2 PIC Mode Combinations

PIC	Mode	Speed Configuration	Default Mode
1-port OC48	1xOC48 concatenated	*fpc/pic/*0 speed oc48	Concatenated
	1xOC48 nonconcatenated	*fpc/pic/*0:0 speed oc12	Nonconcatenated
	1xOC12 concatenated	*fpc/pic/*0 speed oc12	
	1xOC12 nonconcatenated	*fpc/pic/*0 0 speed oc3	
	1xOC3 concatenated	*fpc/pic/*0 speed oc3	
4-port OC12	1xOC48 concatenated	*fpc/pic/*0 speed oc48	
	1xOC48 nonconcatenated	*fpc/pic/*0:0 speed	Nonconcatenated
	1xOC12 nonconcatenated	*fpc/pic/*0 speed oc3	
	4xOC12 concatenated	*fpc/pic/port* speed oc3|oc12	Concatenated
4-port OC3	1xOC12 concatenated	*fpc/pic/*0 speed oc12	
	1xOC12 nonconcatenated	*fpc/pic/*0:0 speed oc3	Nonconcatenated
	4xOC3 concatenated	*fpc/pic/port* speed oc3	Concatenated

By default, SONET/SDH PICs operate in concatenated mode. To specify interface speed in concatenated mode, include the speed statement with options at the [edit interfaces so-*fpc*/*pic*/*port*] hierarchy level:

```
[edit interfaces so-fpc/pic/port
speed (oc3 | oc12 | oc48);
```

For example, each port of 4-port OC12 PIC can be configured to be in OC3 or OC12 speed independently when this PIC is in 4xOC12 concatenated mode.

To specify interface speed in nonconcatenated mode, include the speed statement at the [edit interfaces so-*fpc/pic/port.channel*] hierarchy level:

```
[edit interfaces so-fpc/pic/port.channel]
speed (oc3 | oc12);
```

To configure the PIC to operate in channelized (multiplexed) mode, include the no-concatenate statement at the [edit chassis fpc *slot-number* pic *pic-number*] hierarchy level.

For more information about using the non-concatenate statement, see the *JUNOS System Basics Configuration Guide*.

Configuring SONET/SDH Header Byte Values

To configure values in SONET/SDH header bytes, include the bytes statement at the [edit interfaces *interface-name* sonet-options] hierarchy level:

```
[edit interfaces so-fpc/pic/port sonet-options]
bytes {
  c2 value;
  e1-quiet value;
  f1 value;
  f2 value;
  s1 value;
  z3 value;
  z4 value;
}
```

You can configure the following SONET/SDH header bytes:

- c2—Path signal label SONET/SDH overhead byte. SONET/SDH frames use the C2 byte to indicate the contents of the payload inside the frame. SONET/SDH interfaces use the C2 byte to indicate whether the payload is scrambled. For the c2 byte, *value* can be from 0 through 255. The default value is 0xCF.
- e1-quiet—Default idle byte sent on the orderwire SONET/SDH overhead bytes. The routing platform does not support the orderwire channel, and hence sends this byte continuously.
- f1, f2, z3, z4—SONET/SDH overhead bytes. For these bytes, *value* can be from 0 through 255. The default value is 0x00.
- s1—Synchronization message SONET/SDH overhead byte. This byte is normally controlled as a side effect of the system reference clock configuration and the state of the external clock coming from an interface if the system reference clocks have been configured to use an external reference. For the s1 byte, *value* can be from 0 through 255.

Table 64 on page 803 displays JUNOS software framing bytes for several specific speeds.

Table 64: SONET/SDH Framing Bytes for Specific Speeds

Overhead Bytes	STM4	STM16	STM64	OC12	OC48	OC192
A1	F6	F6	F6	F6	F6	F6
A2	28	28	28	28	28	28
C1	—	—	—	1..12	1..48	1..192
H1/H2	6A0A	6A0A	6A0A	620A	620A	620A
Z0	01/CC	01/CC	01/CC	—	—	—

Table 64: SONET/SDH Framing Bytes for Specific Speeds *(continued)*

Overhead Bytes	STM4	STM16	STM64	OC12	OC48	OC192
Concatenated mode	93FF	93FF	93FF	93FF	93FF	93FF

When you configure SONET/SDH header bytes, note the following:

- The C2 byte is the path signal label. If the C2 byte value on an interface does not match the C2 byte value on the remote interface, the path label mismatch (PLM-P) or unequipped (UNEQ-P) alarm might occur.
- When you configure SONET/SDH OC48 interfaces for channelized (multiplexed) mode (by including the no-concatenate statement at the [edit chassis fpc *slot-number* pic *pic-number*] hierarchy level), the bytes f1 statement has no effect.
- Currently, the bytes e1-quiet statement is ignored if you include it in the configuration.
- The bytes f2, bytes z3, bytes z4, and path-trace options work correctly on channel 0 and work in the transmit direction only on channels 1, 2, and 3.
- For DS3 channels on a channelized OC12 interface, the bytes f1, bytes f2, bytes z3, and bytes z4 options have no effect.
- The bytes s1 option is supported only for channel 0; it is ignored if configured on channels 1 through 11. The bytes s1 value configured on channel 0 applies to all channels on the interface.
- Embedded operations channel (EOC) D1, D2, and D3 bytes are not supported.
- For channelized OC12 IQE and channelized OC48 IQE PICs with SFPs:
  - Only C2 (Path signal label) and S1 byte setting is supported.
  - Following header bytes are not supported. The router will syslog an INFO message if a command for an unsupported header byte is received.

    F1—Section user channel byte

    F2—Path user channel byte

    Z3, Z4—SONET/SDH overhead bytes

    E1—quiet default idle byte

Configuring an Incrementing STM ID

When configured in SDH framing mode, SONET/SDH interfaces on a Juniper Networks routing platform might not interoperate with some older versions of ADMs or regenerators that require an incrementing STM ID.

Current SDH standards specify a set of 3**n* overhead bytes in an STM*n* that includes the J0 section trace byte. The rest are essentially unused (spare Z0) and contain hexadecimal values (0x01, 0xCC, 0xCC ... 0xCC). The older version of the standard specified that the same set of bytes should contain an incrementing sequence: 1, 2, 3, ..., 3*n. Their use was still unspecified although they might have been used to assist in frame alignment. You can configure an incrementing STM ID to enable your Juniper Networks routing platform to interoperate with older equipment that relies on these bytes for frame alignment.

The STM identifier has a precise definition in the SDH specifications. In ITU-T Recommendation G.707, *Network node interface for the synchronous digital hierarchy (SDH)* (03/96), Section 9.2.2.2.

You can explicitly configure an incrementing STM ID rather than a static one in the SDH overhead by including the z0-increment statement at the [edit interfaces *interface-name* sonet-options] hierarchy level. You should include this statement only for SDH mode; do not use it for SONET mode.

```
[edit interfaces so-fpc/pic/port sonet-options]
z0-increment;
```

To explicitly disable incrementing of the STM ID, include the following statement:

```
[edit interfaces so-fpc/pic/port sonet-options]
no-z0-increment;
```

Configuring the SONET/SDH Frame Checksum

By default, SONET/SDH interfaces use a 16-bit frame checksum. You can configure a 32-bit checksum, which provides more reliable packet verification. However, some older equipment might not support 32-bit checksums.

To configure a 32-bit checksum, include the fcs statement at the [edit interfaces *interface-name* sonet-options] hierarchy level:

```
[edit interfaces so-fpc/pic/port sonet-options]
fcs 32;
```

To return to the default 16-bit frame checksum, delete the fcs 32 statement from the configuration:

```
[edit]
user@host# delete interfaces so-fpc/pic/port sonet-options fcs 32
```

To explicitly configure a 16-bit checksum, include the fcs statement at the [edit interfaces *interface-name* sonet-options] hierarchy level:

```
[edit interfaces so-fpc/pic/port sonet-options]
fcs 16;
```

On a channelized OC12 interface, the sonet-options fcs statement is not supported. To configure the frame checksum sequence (FCS) on each DS3 channel, you must include the t3-options fcs statement in the configuration for each channel.

Configuring Channelized IQ and IQE SONET/SDH Loop Timing

By default, internal clocking (line timing) is used on channelized IQ and IQE interfaces. To configure SONET/SDH or DS3-level clocking, include the loop-timing statement:

```
loop-timing;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces ct3-*fpc/pic/port* t3-options]
- [edit interfaces stm1-*fpc/pic/port* sonet-options]

To explicitly configure the default line timing, include the no-loop-timing statement in the configuration:

```
no-loop-timing;
```

The loop-timing and no-loop-timing statements apply only to E1 and T1 interfaces you configure on channelized IQ and IQE PICs. If you attempt to include these statements on any other interface type, they are ignored.

For all channelized IQ and IQE PICs, the clocking statement is supported on all channels. To configure clocking on individual interfaces, include the clocking statement at the [edit interfaces *type-fpc/pic/port*:*channel*] hierarchy level. If you do not include the clocking statement, the individual interfaces use internal clocking by default.

For more information, see “Configuring the Clock Source” on page 121 and “Clock Sources on Channelized Interfaces” on page 376.

Configuring SONET/SDH Loopback Capability

To configure loopback capability on a SONET/SDH interface, include the loopback statement at the [edit interfaces *interface-name* sonet-options] hierarchy level:

```
[edit interfaces so-fpc/pic/port sonet-options]
loopback (local | remote);
```

To exchange BERT patterns between a local routing platform and a remote routing platform, include the loopback remote statement in the interface configuration at the remote end of the link. From the local routing platform, issue the test interface command.

For more information about configuring BERT, see “Interface Diagnostics” on page 127. For more information about using operational mode commands to test interfaces, see the *JUNOS System Basics and Services Command Reference*.

To turn off the loopback capability, remove the loopback statement from the configuration:

```
[edit]
user@host# delete interfaces so-fpc/pic/port sonet-options loopback
```

For channel 0 on channelized interfaces only, you can include the loopback statement at the [edit interfaces *interface-name interface-type*-options] hierarchy level. The loopback setting configured for channel 0 applies to all channels on the channelized interface. The loopback statement is ignored if you include it at this hierarchy level in the configuration of other channels. To configure loopbacks on individual channels, you must include the *channel-type*-options loopback statement in the configuration for each channel. This allows each channel to be put in loopback mode independently.

For example, for DS3 channels on a channelized OC12 interface, the sonet-options loopback statement is supported only for channel 0; it is ignored if included in the configuration for channels 1 through 11. The SONET/SDH loopback configured for channel 0 applies to all 12 channels equally. To configure loopbacks on the individual DS3 channels, you must include the t3-options loopback statement in the configuration for each channel. This allows each DS3 channel can be put in loopback mode independently.

You can determine whether there is an internal problem or an external problem by checking the error counters in the output of the show interface *interface-name* extensive command:

```
user@host> show interfaces so-fpc/pic/port extensive
```

Example: Configuring SONET/SDH Loopback Capability

To determine whether a problem is internal or external, loop packets on both the local and the remote routing platform. To do this, include the no-keepalives and encapsulation cisco-hdlc statements at the [edit interfaces *interface-name*] hierarchy level, and the loopback local statement at the [edit interfaces *interface-name* sonet-options] hierarchy level. With this configuration, the link stays up, so you can loop ping packets to a remote routing platform. The loopback local statement causes the interface to loop within the PIC just before the data reaches the transceiver.

```
[edit interfaces]
so-1/0/0 {
    no-keepalives;
    encapsulation cisco-hdlc;
    sonet-options {
        loopback local;
    }
    unit 0 {
        family inet {
            address 10.100.100.1/24;
        }
    }
}
```

Configuring the SONET/SDH Path Trace Identifier

The SONET/SDH *path trace identifier* is a text string that identifies the circuit. If the string contains spaces, enclose it in quotation marks.

By default, the JUNOS software uses the router and interface names for the path trace identifier. Depending on the router and interface names, the default path trace identifier might be longer then 16 bytes. The SDH standards define a maximum 16-byte path trace. For this reason, the default path trace identifier might be truncated in SDH mode. You can prevent the path trace identifier from being truncated in SDH mode by configuring a path trace identifier that is under 16-bytes long. In SONET mode, a path trace identifier can be up to 64-bytes long.

For DS3 channels on a channelized OC12 interface, you can configure a unique path trace for each of the 12 channels. Each path trace can be up to 16 bytes. For channels on a channelized OC12 intelligent queuing (IQ and IQE) interface, each path trace can be up to 64 bytes.

To configure a path trace identifier, include the path-trace statement at the [edit interfaces *interface-name* sonet-options] hierarchy level:

```
[edit interfaces interface-name sonet-options]
path-trace trace-string;
```

A common convention is to use the circuit identifier as the path trace identifier.

To display the local router's path trace identifier, issue the show interfaces command on the remote router.

Configuring SONET/SDH HDLC Payload Scrambling

SONET/SDH HDLC payload scrambling, which is enabled by default, provides better link stability. Both sides of a connection must either use or not use scrambling.

NOTE: HDLC payload scrambling conflicts with traffic shaping configured using leaky bucket properties. If you configure leaky bucket properties, you must disable payload scrambling, because the JUNOS software rejects configurations that have both features enabled. For more information, see "Configuring Receive and Transmit Leaky Bucket Properties on SONET/SDH Interfaces" on page 830.

On a channelized OC12 interface, the sonet-options payload-scrambler statement is ignored. To configure scrambling on the DS3 channels on the interface, include the t3-options payload-scrambler statement in the configuration for each DS3 channel.

To disable HDLC payload scrambling, include the no-payload-scrambler statement at the [edit interfaces *interface-name* sonet-options] hierarchy level:

```
[edit interfaces so-fpc/pic/port sonet-options]
no-payload-scrambler;
```

To return to the default, that is, to re-enable payload scrambling, delete the no-payload-scrambler statement from the configuration:

```
[edit]
user@host# delete interfaces so-fpc/pic/port sonet-options no-payload-scrambler
```

To explicitly enable payload scrambling, include the payload-scrambler statement at the [edit interfaces *interface-name* sonet-options] hierarchy level:

```
[edit interfaces so-fpc/pic/port sonet-options]
payload-scrambler;
```

Configuring SONET/SDH RFC 2615 Support

RFC 2615, *PPP over SONET/SDH*, requires certain C2 header byte and FCS settings that vary from the default values configured in accordance with RFC 1619 (the previous version of RFC 2615). The newer values are optimized for stronger error detection, especially when combined with payload scrambling at higher bit rate links.

Table 65 on page 809 shows the older (RFC 1619) and newer (RFC 2615) values, together with the Juniper Networks default values.

Table 65: SONET/SDH Default Settings

Value	RFC 1619	Default	RFC 2615
SONET/SDH C2 header byte	0XCF	0XCF	0X16
Frame checksum (bit)	16	16	32
Payload scrambling	n/a	Enabled	Enabled

To enable support for the RFC 2615 features, include the rfc-2615 statement at the [edit interfaces *interface-name* sonet-options] hierarchy level:

```
[edit interfaces so-fpc/pic/port sonet-options]
rfc-2615;
```

Configuring SONET/SDH Defect Triggers to Be Ignored

A trigger is a defect alarm that causes a physical interface to be marked down. By default, all defects are honored with no hold time. For SONET/SDH and ATM over SONET/SDH interfaces only, you can configure individual triggers to ignore a defect, honor a defect, and apply up and down hold timers to the defect.

Table 66 on page 809 lists the defects you can configure.

Table 66: SONET/SDH and ATM Active Alarms and Defects

Alarm	Description
Physical	
pll	Phase-locked loop out of lock
lol	Loss of light
Section	
lof	Loss of frame
los	Loss of signal

Table 66: SONET/SDH and ATM Active Alarms and Defects *(continued)*

Alarm	Description
Line	
ais-l	Alarm indication signal—line
rfi-l	Remote failure indication—line
ber-sd	Bit error rate defect-signal degrade
ber-sf	Bit error rate fault-signal fail
Path	
ais-p	Alarm indication signal—path
locd (ATM only)	Loss of cell delineation
lop-p	Loss of pointer—path
plm-p	Payload label mismatch
rfi-p	Remote failure indication—path
uneq-p	Path unequipped

To configure defects to be ignored, include the trigger statement at the [edit interfaces *interface-name* sonet-options] hierarchy level:

```
[edit interfaces interface-name sonet-options]
trigger {
    defect ignore;
}
```

If you configure a defect to be ignored, that defect does not contribute to the interface being marked down or up.

After you configure a defect to be ignored, the JUNOS software reevaluates the state of the defect on the interface. If the defect is outstanding and has caused the interface to be marked down, the interface is marked up.

When you configure a trigger on a low-level defect—for example, an LOS—only the low-level defect is affected. Higher-level defects that might result from the lower-level defect are not affected by the low-level trigger configuration. Therefore, you must configure higher-level defects as well.

Configuring SONET/SDH Defect Hold Times

By default, an interface is marked down as soon as a defect is detected, and is marked up as soon as the defect is absent. You might want to apply hold times to defects for the following reasons:

- To prevent route flaps from happening before a defect has been outstanding for a longer period than would be expected for an Automatic Protection Switching (APS) cutover
- To reduce the number of interface transitions

NOTE: On M-series and T-series platforms with Channelized SONET IQ PICs and Channelized SONET IQE PICs, the SONET defect alarm trigger hold-time statement is not supported.

When you apply a “down” hold time to a defect, the defect must be present for at least the hold-time period before the interface is marked down. When you apply an “up” hold time to a defect, the defect must remain absent for at least the hold-time period before the interface is marked up, assuming no other defect is outstanding.

When you configure hold timers and the interface goes from up to down, the interface transition is not advertised to the rest of the system until the interface has remained down for the hold-time period. Similarly, when an interface goes from down to up, the interface transition is not advertised until the interface has remained up for the hold-time period.

To configure hold timers, include the hold-time statement at the [edit interfaces *interface-name* sonet-options trigger *defect*] hierarchy level:

```
[edit interfaces interface-name sonet-options trigger defect]
hold-time up milliseconds down milliseconds;
```

The time can be a value from 1 through 65,534 milliseconds.

When you configure defect hold times, you should note the following:

- You can configure an up hold time, a down hold time, or both.
- Each interface on a SONET/SDH PIC controls certain aspects of the SONET/SDH overhead. For example, when you configure an OC48 PIC to be nonconcatenated, four interfaces are created. Each interface has its own path overhead. However, all four path interfaces share the same physical, section, and line overhead. This means the following:
  - Each interface’s path trigger configuration is honored.
  - The physical, section, and line trigger configuration for the primary interface (so-*fpc/pic/slot*:0) is applied to all four interfaces.

Therefore, if you configure the so-*fpc/pic/slot*:0 interface to have a hold time for the LOS trigger, when an LOS event occurs, all four interfaces remain up until the trigger expires, and then all four interfaces are marked down.

- The hold timers on the SONET/SDH defects are applied in addition to any other hold timers you configure on the interface. For example, if an interface is up and you configure a SONET/SDH trigger down hold time of 100 milliseconds and an interface down hold time of 250 milliseconds, when the SONET/SDH defect occurs, the SONET/SDH trigger timer starts. After 100 milliseconds, assuming the defect is still present, the SONET/SDH defect starts the 250 millisecond down timer. After this has expired and again assuming the defect is still outstanding, the interface will be marked down. For more information about interface hold timers, see "Damping Interface Transitions" on page 131.

- Some defects are reported through a periodic poll (once every second). For these defects, there could be up to one second lost before the defect is detected and the hold timer is started. The hold timer expires in precisely the amount of time configured. At that point, the existence of the defect is checked again and the interface is marked up or down accordingly. These defects are as follows:
  - lol
  - pll
  - ber-sf
  - ber-sd
- We recommend the following settings:
  - Configure SONET/SDH defect timers on no more than 64 interfaces per FPC.
  - Configure a combined up hold time and down hold time for a SONET/SDH defect to be at least 100 milliseconds.

Example: Configuring SONET/SDH Defects to Be Ignored

Prevent an LOS from bringing down an interface. An LOS can lead to the following defects:

- AIS-L
- LOF
- PLL
- RFI-L
- RFI-P

```
[edit interfaces sonet-options trigger]
ais-l ignore;
lof ignore;
los ignore;
pll ignore;
rfi-l ignore;
rfi-p ignore;
```

Configuring Virtual Tributary Mapping

You can configure virtual tributary mapping to use KLM mode or ITU-T mode. By default, virtual tributary mapping uses KLM mode.

For the Channelized STM1 IQ and IQE PICs, you can configure virtual tributary mapping by including the vtmapping statement at the [edit interfaces cau4-*fpc/pic/port* sonet-options] hierarchy level:

```
[edit interfaces cau4-fpc/pic/port sonet-options]
vtmapping (klm | itu-t);
```

For the STM1 PIC, you can configure virtual tributary mapping by including the vtmapping statement at the [edit chassis fpc *slot-number* pic *pic-number*] hierarchy level:

```
[edit chassis fpc slot-number pic pic-number]
vtmapping (klm | itu-t);
```

Table 38 on page 457 lists the KLM mappings used by the Channelized STM1-to-E1 PIC interfaces.

Configuring APS and MSP

Automatic Protection Switching (APS) is used by SONET add/drop multiplexers (ADMs) to protect against circuit failures. The JUNOS implementation of APS allows you to protect against circuit failures between an ADM and one or more routing platforms, and between multiple interfaces in the same routing platform. When a circuit or routing platform fails, a backup immediately takes over.

NOTE: For SDH interfaces, the JUNOS software supports multiplex section protection (MSP). You configure MSP with the same CLI statements you use to configure APS.

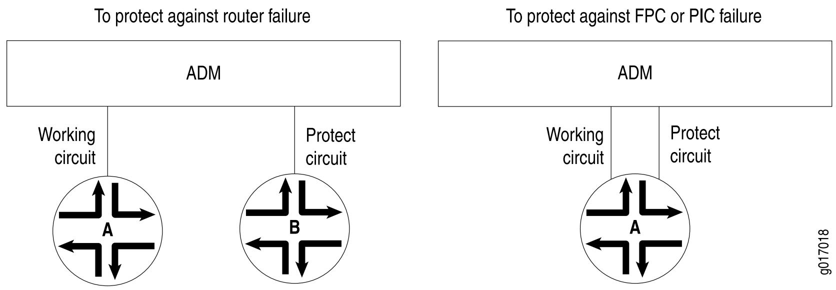
The JUNOS software supports APS 1 + 1 switching, either revertive or nonrevertive mode, and bidirectional mode only (although you can configure interoperation with line-terminating equipment [LTE] provisioned for unidirectional mode). The JUNOS software does not transmit identical data on the working and protect circuits, as the APS specification requires for 1 + 1 switching, but this causes no operational impact.

For DS3 channels on a channelized OC12 interface, you can configure APS on channel 0 only. If you configure APS on channels 1 through 11, it is ignored.

With APS and MSP, you configure two circuits, a *working circuit* and a *protect circuit*. Normally, traffic is carried on the working circuit (that is, the working circuit is the active circuit), and the protect circuit is disabled. If the working circuit fails or degrades, or if the working router fails, the ADM and the protect router switch the traffic to the protect circuit, and the protect circuit becomes the active circuit.

To configure APS or MSP, you configure a working and a protect circuit, as shown in Figure 70 on page 814. To protect against a routing platform failure, you connect two routing platforms to the ADM, configuring one of them as the working router and the second as the protect router. To protect against a PIC or FPC failure, you connect one routing platform to the ADM through both the working and protect circuits, configuring one of the PICs or FPCs as the working circuit and the second as the protect circuit.

Figure 70: APS/MSP Configuration Topologies



To configure APS or MSP, include the aps statement at the [edit interfaces *interface-name* sonet-options] hierarchy level:

```
[edit interfaces interface-name sonet-options]
aps {
    advertise-interval milliseconds;
    annex-b
    authentication-key key;
    force;
    hold-time milliseconds;
    lockout;
    neighbor address;
    paired-group group-name;
    protect-circuit group-name;
    request;
    revert-time seconds;
    switching-mode (bidirectional | unidirectional);
    working-circuit group-name;
}
```

This section includes the following topics:

NOTE: This implementation of APS is not supported on Layer 2 circuits. For Layer 2 circuits, configure APS by including the protect-interface statement. You can include this statement at the following hierarchy levels:

- [edit logical-systems *logical-system-name* protocols l2circuit neighbor *neighbor-id* interface *interface-name*]
- [edit protocols l2circuit neighbor *neighbor-id* interface *interface-name*]

For more information and a configuration example, see the *JUNOS VPNs Configuration Guide*.

When configuring the APS annex-b option, the APS options *must* be configured as follows:

- switching-mode *cannot* be uni-directional
- revert-time *cannot* be configured
- manual-request *cannot* be configured
- excercise-request *cannot* be configured
- lockout-request *cannot* be configured
- wait-to-restore-time is allowed *only* when Annex-B is configured
- protect-circuit *must* be configured
- working-circuit *must* be configured

Configuring Basic APS Support

To set up a basic APS configuration, configure one interface to be the working circuit and a second to be the protect circuit. If you are using APS to protect against routing platform failure, configure one interface on each routing platform. If you are using APS to protect against FPC failure, configure two interfaces on the routing platform, one on each FPC.

For each working–protect circuit pair, configure the following:

- Group name—Creates the association between the two circuits. Configure the same group name for both the working and protect routers.
- Authentication key—You configure this on both interfaces. Configure the same key for both the working and protect routers.
- Address of the other interface on the other routing platform—If you are configuring one routing platform to be the working router and a second to be the protect router, you must configure the address of the remote interface. You configure this on one or both of the interfaces.

The address you specify for the neighbor must never be routed through the interface on which APS is configured, or instability will result. APS neighbor only applies to inter-routing platform configurations. We strongly recommend that you directly connect the working and protect routers and that you configure the interface address of this shared network as the neighbor address.

The working and protect configurations on the routing platforms must match the circuit configurations on the ADM; that is, the working router must be connected to the ADM's working circuit and the protect router must be connected to the protect circuit.

To set up a basic APS configuration, include the following statements at the [edit interfaces *interface-name* sonet-options] hierarchy level:

On the Working Circuit

```
[edit interfaces so-fpc/pic/port sonet-options]
aps {
   working-circuit group-name;
   authentication-key key;
   neighbor address; # Include if protect circuit is on a different routing platform
}
```

On the Protect Circuit

```
aps {
   protect-circuit group-name;
   authentication-key key;
   neighbor address; # Include if working circuit is on a different routing platform
}
```

Example: Configuring Basic APS Support

Configure Router A to be the working router and Router B to be the protect router.

On Router A (the Working Router)

```
[edit interfaces so-6/1/1 sonet-options]
aps {
   working-circuit San-Jose;
   authentication-key " $9$B2612345" ;
}
```

On Router B (the Protect Circuit)

```
[edit interfaces so-0/0/0 sonet-options]
aps {
   protect-circuit San-Jose;
   authentication-key " $9$B2612345" ;
   neighbor 192.168.1.2;# Address of Router A on the link between A and B
}
```

On a Single Platform, One Interface as the Working Circuit and Another Interface as the Protect Circuit

```
[edit interfaces so-2/1/1 sonet-options]
aps {
   working-circuit bayward;
   authentication-key blarney;
}
[edit interfaces so-3/0/2 sonet-options]
aps {
   protect-circuit bayward;
   authentication-key blarney;
}
```

Configuring Container Interfaces

JUNOS supports container interfaces for APS on SONET links. Physical interfaces and logical interfaces remain up on switchover, and their APS parameters are auto-copied from the container interface to the member links. See "Container Interfaces" on page 34 for more information.

Container interfaces support the following features:

- Cisco HDLC or PPP encapsulation methods.
- Unpaired groups.
- Bidirectional APS.
- Non-container and container-based APS on the same system.
- Use of any combination of (nonchannelized) SONET interfaces installed on the same router.

To configure a container interface, you must first create the number of container devices that you require. You can create up to a maximum of 128 container interfaces per router using the device-count statement at the [edit chassis container-devices] hierarchy level. You can create more container interfaces later if required, up to 128 (total). The resulting container interfaces are designated sequentially from ci0 up to a maximum of ci127, depending on the device-count *number* specified. SONET interfaces can be assigned to any container interface ci*n*.

To configure each container interface, you must assign two SONET interfaces (so-*fpc/pic/port*) using the container-list ci*n* statement, and specify the member-interface-speed *speed* and container-options for each SONET interface.

Within each of the two SONET interfaces' container options, you must set one container-type as primary (corresponding to an APS working circuit) and the other as standby (corresponding to an APS protect circuit). For each SONET interface, you can also use the allow-configuration-override statement to allow the physical configuration of a member link to override the container configuration.

The following configuration steps are required:

1. Specify the total number of container interfaces (up to 128) to create using the device-count *number* statement at the [edit chassis container-devices] hierarchy level:

    ```
    [edit chassis container-devices]
    user@host# set device-count number
    ```

2. Configure the container interface parameters for a specified container ci*n* as follows:

    a. Specify the container interface using the numbered identifier ci*n*:

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

b. Specify the container interface encapsulation as cisco-hdlc or ppp:

```
[edit interfaces cin]
user@host# set encapsulation (cisco-hdlc | ppp)
```

c. Specify the container options container-type as aps; a SONET interface is required for APS selection:

```
[edit interfaces cin]
user@host# set container-options container-type aps
```

d. Specify the container interface member-interface type as sonet:

```
[edit interfaces cin]
user@host# set interfaces cin container-options member-interface-type
   sonet
```

e. Specify the container member-interface-speed *speed* to match the specified installed SONET interface links; the available values are *OC3, OC12, OC48, OC192, OC768,* or *mixed*. The member-interface-speed *speed* statement setting applies to all SONET member interfaces of the specified container ci*n*.

```
[edit interfaces cin]
user@host# set interfaces cin container-options member-interface-type
   sonet member-interface-speed speed
```

f. Specify the container interface's unit number, family, IP address, and mask:

```
[edit interfaces cin]
user@host# set interfaces cin unit number family inet address
   ip-address/mask
```

3. Configure each of the required two SONET interfaces as follows:

   a. Specify the SONET interfaces and their container options; including the container-list, identified by its ci*n*.

   b. Specify the container-type as *primary* (corresponding to an APS working-circuit) or *standby* (corresponding to an APS protect-circuit).

   For example, setting so-0/0/0 as the primary and so-0/0/1 as the standby SONET interfaces for container interface ci0:

```
[edit]
user@host#edit interfaces so-0/0/0 # Enter config mode for interface
   so-0/0/0
[edit interfaces so-0/0/0]
user@host# set container-options container-list ci0 primary # Set so-0/0/0
   as APS primary interface
[edit interfaces so-0/0/0]
user@host# top
[edit]
user@host#edit interfaces so-0/0/1 # Enter config mode for interface
   so-0/0/1
[edit interfaces so-0/0/1]
```

user@host# **set container-options container-list ci0 standby** # Set so-0/0/1 as APS standby interface

Optionally, you can set the allow-configuration-override statement to allow the physical configuration of a member link to override the container configuration:

[edit interfaces so-0/0/1]
user@host# **set container-options container-list ci0 standby allow-configuration-override**

Example Container Interface Configuration

The following is a sample container interface configuration:

```
[edit chassis]
container-devices {
   device-count 1;
}
[edit interfaces]
so-1/0/2 {
   container-options {
      container-list ci0;
      primary;
   }
}
so-1/0/3 {
   container-options {
      container-list ci0;
      standby;
   }
}
ci0 {
   encapsulation cisco-hdlc;
   container-options {
      container-type aps {
         member-interface-type sonet {
            member-interface-speed mixed;
         }
      }
   }
   unit 0 {
      family inet {
         address 192.168.11.1/24;
      }
   }
}
```

You can run the show aps command to display the APS container interface configuration, as follows:

```
user@host> show aps
Interface    Group                          Circuit    Intf state
ci0           CONTAINER_ci0                 Container  enabled, up
```

```
so-1/2/2      MEMBER_OF_ci0                 Working    enabled, up
so-1/2/3      MEMBER_OF_ci0                 Protect    disabled, up
```

Configuring Switching Between the Working and Protect Circuits

When there are multiple reasons to switch between the working and protect circuits, a priority scheme is used to decide which circuit to use. The routing platforms and the ADM might automatically switch traffic between the working and protect circuits because of circuit and routing platform failures. You can also choose to switch traffic manually between the working and protect circuits.

When an ATM2 PIC is configured for APS, and the protect circuit comes online for the first time, there are no open VCs and the PIC discards the input traffic received on the protect circuit. The show interface extensive or show monitor interface traffic commands display the statistics as zero since the PIC drops the packets at the VC.

When the APS switches from the working circuit to the protect circuit, VCs are created on the protect circuit to accept traffic. However, the VCs on the working circuit remain open to support any future APS switches even though the interface is down or disabled. The input traffic received on the working circuit (current backup) is accepted by the PIC but discarded in the PFE. The show interface extensive or show monitor interface traffic commands displays live statistics for the traffic since it is accepted by the PIC.

When APS switches from the protect circuit to the working circuit again, the VCs on the protect circuit remain open to support a future APS switch even though the interface is down or disabled. The input traffic received on the current backup protect circuit is accepted by the PIC but discarded in the PFE. The show interface extensive or the show monitor interface traffic command displays live statistics for this traffic since it is accepted by the PIC.

There are three priority levels of manual configuration, listed here in order from lowest to highest priority:

- Request (also known as manual switch)—Overridden by signal failures, signal degradations, or any higher-priority reasons.
- Force (also known as forced switch)—Overrides manual switches, signal failures, and signal degradation.
- Lockout (also known as lockout of protection)—Do not switch between the working and protect circuits.

NOTE: Do not use the disable statement at the [edit interfaces *interface-name* aps] hierarchy level to switch between interface working and protect circuits; it can cause loss of traffic on the disabled interface. Use only the request statement or the force statement at the [edit interfaces interface-name aps] hierarchy level to modify interface status.

A routing platform failure is considered to be equivalent to a signal failure on a circuit.

To perform a manual switch, include the request statement at the [edit interfaces *interface-name* sonet-options aps] hierarchy level. This statement is honored only if there are no higher-priority reasons to switch.

```
[edit interfaces so-fpc/pic/port sonet-options aps]
request (protect | working);
```

When the working circuit is operating in nonrevertive mode, use the request working statement to switch the circuit manually to being the working circuit or to override the revert timer.

To perform a forced switch, include the force statement at the [edit interfaces *interface-name* sonet-options aps] hierarchy level. This statement is honored only if there are no higher-priority reasons to switch. This configuration can be overridden by a signal failure on the protect circuit, thus causing a switch to the working circuit.

```
[edit interfaces so-fpc/pic/port sonet-options aps]
force (protect | working);
```

To configure a lockout of protection, forcing the use of the working circuit and locking out the protect circuit regardless of anything else, include the lockout statement at the [edit interfaces *interface-name* sonet-options aps] hierarchy level:

```
[edit interfaces so-fpc/pic/port sonet-options aps]
lockout;
```

Configuring Revertive Mode

By default, APS is nonrevertive, which means that if the protect circuit becomes active, traffic is not switched back to the working circuit unless the protect circuit fails or you manually configure a switch to the working circuit. In revertive mode, traffic is automatically switched back to the working circuit.

You should configure the ADM and routing platforms consistently with regard to revertive or nonrevertive mode.

To configure revertive mode, include the revert-time statement, specifying the amount of time to wait after the working circuit has again become functional before making the working circuit active again:

```
[edit interfaces so-fpc/pic/port sonet-options aps]
revert-time seconds;
```

If you are using nonrevertive APS, you can use the request working statement to switch the circuit manually to being the working circuit or to override the revert timer (configured with the revert-time statement).

Configuring Unidirectional Switching Mode Support

You can configure interoperation with SONET/SDH Line Terminating Equipment (LTE) that is provisioned for unidirectional linear APS in 1 + 1 architecture on the following interfaces:

- Unchannelized OC3, OC12, and OC48 SONET/SDH interfaces on T-series platforms
- SONET/SDH interfaces on the M40e routing platform
- ATM over SONET interfaces

By default, APS supports only SONET/SDH LTE that is provisioned for bidirectional mode.

In bidirectional switching mode, the working interface switches to the protect interface for both receipt and transmission of data, regardless of whether the signal failure is in the transmit or receive direction.

In true unidirectional mode, the working interface switches to the protect interface only for the direction in which signal failure occurs; for example, if there is a signal failure in the transmit direction, the working interface switches over to the protect interface for transmission but not receipt of data. When the protect interface operates in unidirectional mode, the working and protect interfaces must cooperate to operate the transmit and receive interfaces in a bidirectional fashion.

The JUNOS software does not support true unidirectional mode. Instead the software supports interoperation with SONET/SDH LTE provisioned for unidirectional switching. This means that the SONET/SDH LTE on the router receives and transmits on one interface, even when you configure unidirectional support. The JUNOS implementation of unidirectional mode support allows the router to do the following:

- Accept a unidirectional mode as valid
- Trigger the peer (ADM) selector to switch receive from working interface to protect interface or the reverse
- Not send reverse requests to the far end (ADM)

To configure unidirectional mode support, include the switching-mode unidirectional statement, at the [edit interfaces *interface-name* sonet-options aps] hierarchy level:

```
[edit interfaces interface-name sonet-options aps]
switching-mode unidirectional;
```

NOTE: On interfaces with unidirectional APS support configured, revertive mode and load sharing between circuits are not supported.

To restore the default behavior, include the switching-mode bidirectional statement, at the [edit interfaces *interface-name* sonet-options aps] hierarchy level:

```
[edit interfaces interface-name sonet-options aps]
switching-mode bidirectional;
```

Configuring APS Timers

The protect and working routers periodically send packets to their neighbors to advertise that they are operational. By default, these advertisement packets are sent every 1000 milliseconds. A routing platform considers its neighbor to be operational for a period, called the hold time, that is, by default, three times the advertisement interval. If the protect router does not receive an advertisement packet from the working router within the hold time configured on the protect router, the protect router assumes that the working router has failed and becomes active.

APS is symmetric; either side of a circuit can time out the other side (for example, when detecting a crash of the other). Under normal circumstances, the failure of the protect router does not cause any changes because the traffic is already moving on the working router. However, if you had configured request protect and the protect router failed, the working router would enable its interface.

To modify the advertisement interval, include the advertise-interval at the [edit interfaces *interface-name* sonet-options aps] hierarchy level:

```
[edit interfaces so-fpc/pic/port sonet-options aps]
advertise-interval milliseconds;
```

To modify the hold time, include the hold-time at the [edit interfaces *interface-name* sonet-options aps] hierarchy level:

```
[edit interfaces so-fpc/pic/port sonet-options aps]
hold-time milliseconds;
```

The advertisement intervals and hold times on the protect and working routers can be different.

Configuring Link PIC Redundancy

Link state replication, also called interface preservation, is an addition to the SONET Automatic Protection Switching (APS) functionality that helps promote redundancy of link PICs used in LSQ configurations, providing MLPPP link redundancy at the port level.

Link state replication provides the ability to add two sets of links, one from the active SONET PIC and the other from the standby SONET PIC, to the same bundle. If the active SONET PIC fails, links from the standby PIC are used without link renegotiation. All the negotiated state is replicated from the active links to the standby links to prevent link renegotiation. For more information about LSQ configurations, see the *JUNOS Services Interfaces Configuration Guide*.

To configure link state replication, include the preserve-interface statement at the [edit interfaces *interface-name* sonet-options aps] hierarchy level on the interfaces on both PICs:

```
preserve-interface;
```

APS functionality must be available on the SONET PICs and the interface configurations must be identical on both ends of the link. Any configuration mismatch causes the commit operation to fail.

This feature is supported with SONET APS and the following link PICs:

- Channelized OC3 IQ and IQE PICs

- Channelized OC12 IQ and IQE PICs
- Channelized STM1 IQ and IQE PICs

Link state replication supports MLPPP and PPP over Frame Relay (frame-relay-ppp) encapsulation, and fully supports GRES.

Example: Configuring Link PIC Redundancy

Configure link state replication configuration between the ports coc3-1/0/0 and coc3-2/0/0.

```
interfaces {
  coc3-1/0/0 {
    sonet-options {
      aps {
        preserve-interface;
        working-circuit aps-group-1;
      }
    }
  }
  coc3-2/0/0 {
    sonet-options {
      aps {
        preserve-interface;
        working-circuit aps-group-1;
      }
    }
  }
}
```

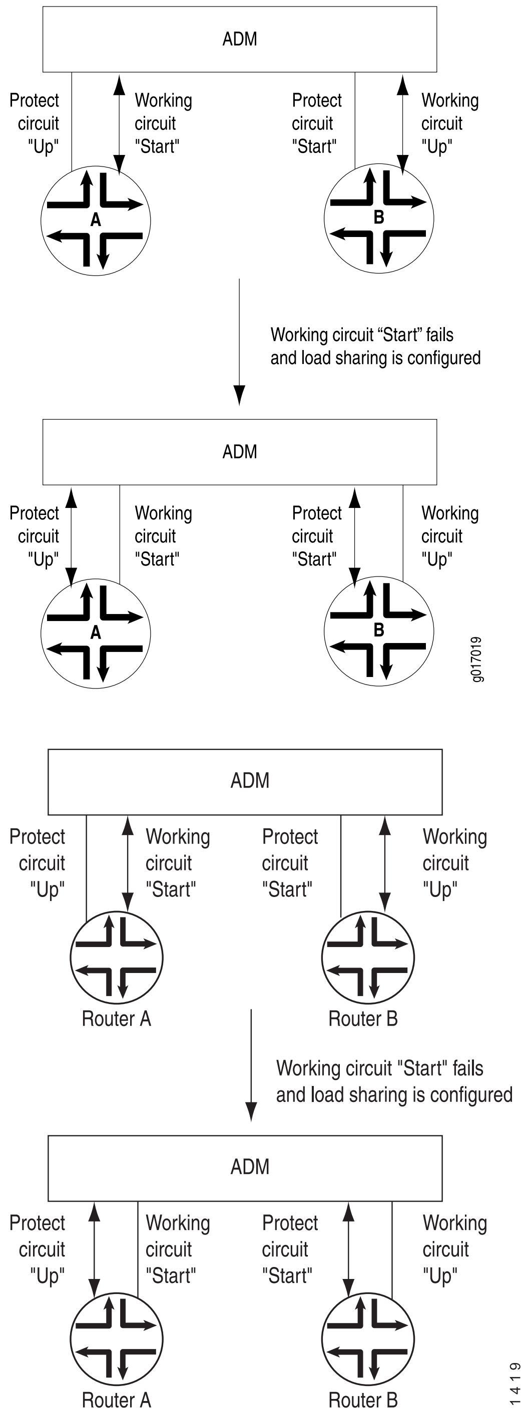
Configuring APS Load Sharing Between Circuit Pairs

When two routing platforms are connected to a single ADM, you can have them back up each other on two different pairs of circuits. This arrangement provides load balancing between the routing platforms if one of the working circuits fails.

Figure 71 on page 825 illustrates load sharing between circuits on two routing platforms. Router A has a working circuit “Start” and a protect circuit “Up,” and Router B has a working circuit “Up” and a protect circuit “Start.” Under normal circumstances, Router A carries the “Start” circuit traffic and Router B carries the “Up” circuit traffic. If the working circuit “Start” were to fail, Router B would end up carrying all the traffic for both the “Start” and “Up” circuits.

To balance the load between the circuits, you pair the two circuits. In this case, you pair the “Start” and “Up” circuits. Then, if the working circuit “Start” fails, the two routing platforms automatically switch the “Up” traffic from the working to the protect circuit so that each routing platform is still carrying only one circuit’s worth of traffic. That is, the working circuit on Router A would be “Up” and the working circuit on Router B would be “Start.”

Figure 71: APS Load Sharing Between Circuit Pairs



To configure load sharing between two working–protect circuit pairs, include the paired-group statement when configuring one of the circuits on one of the routing platforms. In this statement, the *group-name* is the name of the group you assigned to one of the circuits with the working-circuit and protect-circuit statements. The JUNOS software automatically configures the remainder of the load-sharing setup based on the group name.

[edit interfaces so-*fpc/pic/port* sonet-options aps]
paired-group *group-name*;

Example: Configuring APS Load Sharing Between Circuit Pairs

Configure APS load sharing to match the configuration shown in Figure 71 on page 825:

On Router A

[edit interfaces so-7/0/0 sonet-options aps]
user@host# **set working-circuit start**
[edit interfaces so-7/0/0 sonet-options aps]
user@host# **set authentication-key linsey**
[edit interfaces so-7/0/0 sonet-options aps]
user@host# **set paired-group "Router A-Router B"**
...
[edit interfaces so-0/0/0 sonet-options aps]
user@host# **set protect-circuit up**
[edit interfaces so-0/0/0 sonet-options aps]
user@host# **set authentication-key woolsey**
[edit interfaces so-0/0/0 sonet-options aps]
user@host# **set paired-group "Router A-Router B"**

On Router B

[edit interfaces so-1/0/0 sonet-options aps]
user@host# **set working-circuit up**
[edit interfaces so-1/0/0 sonet-options aps]
user@host# **set authentication-key woolsey**
[edit interfaces so-1/0/0 sonet-options aps]
user@host# **set paired-group "Router A-Router B"**
...
[edit interfaces so-6/0/0 sonet-options aps]
user@host# **set protect-circuit start**
[edit interfaces so-6/0/0 sonet-options aps]
user@host# **set authentication-key linsey**
[edit interfaces so-6/0/0 sonet-options aps]
user@host# **set paired-group "Router A-Router B"**

Configuring SONET Options for 10-Gigabit Ethernet Interfaces

The 10-Gigabit Ethernet IQ2 and IQ2-E PIC is supported on the M120, M320, and T-series routing platforms. The PIC provides one external interface running at 10 Gbps. The interface operates in either LAN PHY or WAN PHY mode. When the external interface is running in WAN PHY mode, it uses the WIS sublayer to transport 10-Gigabit Ethernet frames in an OC192c SONET payload, and can interoperate with SONET section or line level repeaters. This creates an advantage when the interface is used for long-distance, point-to-point 10-Gigabit Ethernet links.

When the external interface is running in WAN PHY mode, you can configure specific physical SONET options. To configure SONET options, include the loopback, mpls, path-trace, and trigger statements at the [edit interfaces *interface-name* sonet-options] hierarchy level:

```
[edit interfaces]
xe-0/0/0 {
    sonet-options {
        loopback (local | remote);
        mpls {
            pop-all-labels {
                required-depth number;
            }
        }
        path-trace trace-string;
        trigger {
            defect ignore {
                defect hold-time up milliseconds down milliseconds;
            }
        }
    }
}
```

For information about using the loopback statement, see "Configuring SONET/SDH Loopback Capability" on page 806. For information about using the mpls statement, see "Removing MPLS Labels from Incoming Packets" on page 828. For information about using the path-trace statement, see "Configuring the SONET/SDH Path Trace Identifier" on page 807. For information about using the trigger statement, see "Configuring SONET/SDH Defect Triggers to Be Ignored" on page 809.

Configuring the Media MTU on SONET/SDH interfaces

The default media MTU size used on a physical interface depends on the encapsulation being used on that interface. For a listing of MTU sizes for each encapsulation type, see "Configuring the Media MTU" on page 92. For information about configuring the encapsulation on an interface, see "Configuring Interface Encapsulation on SONET/SDH Interfaces" on page 832.

To modify the default media MTU size for a physical interface, include the mtu statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
mtu bytes;
```

If you change the size of the media MTU, you must ensure that the size is equal to or greater than the sum of the protocol MTU and the encapsulation overhead. You configure the protocol MTU by including the mtu statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number* family *family*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

For more information, see "Setting the Protocol MTU" on page 181.

Enabling Passive Monitoring on SONET/SDH Interfaces

The Monitoring Services I and Monitoring Services II PICs are designed to enable IP services. If you have a Monitoring Services PIC and a SONET/SDH PIC installed in an M160, M40e, or T-series routing platform, you can monitor IPv4 traffic from another routing platform.

On SONET/SDH interfaces, you enable packet flow monitoring by including the passive-monitor-mode statement:

```
passive-monitor-mode;
```

You can include this statement at the following hierarchy levels:

- [edit interfaces so-*fpc/pic/port* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces so-*fpc/pic/port* unit *logical-unit-number*]

If you include the passive-monitor-mode statement in the configuration, the SONET/SDH interface does not send keepalives or alarms, and does not participate actively on the network.

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

```
[edit interfaces mo-fpc/pic/port unit logical-unit-number]
family inet;
```

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

```
[edit interfaces mo-fpc/pic/port unit logical-unit-number family inet]
receive-options-packets;
receive-ttl-exceeded;
```

For the monitoring services interface, you can configure multiservice physical interface properties. For more information, see “Configuring Multiservice Physical Interface Properties” on page 132 and the *JUNOS Services Interfaces Configuration Guide*.

Removing MPLS Labels from Incoming Packets

The JUNOS software can forward only IPv4 packets to a Monitoring Services PIC. IPv4 packets with MPLS labels cannot be forwarded to a Monitoring Services PIC. By default, if packets with MPLS labels are forwarded to the Monitoring Services PIC, they are discarded. To monitor packets with MPLS labels, you must remove the MPLS labels as the packets arrive on the interface.

You can remove up to two MPLS labels from an incoming packet by including the pop-all-labels statement at the [edit interfaces *interface-name* sonet-options mpls] hierarchy level:

```
[edit interfaces interface-name sonet-options mpls]
pop-all-labels {
    required-depth number;
}
```

By default, the pop-all-labels statement takes effect for incoming packets with one or two labels. You can specify the number of MPLS labels an incoming packet must have for the pop-all-labels statement to take effect by including the required-depth statement at the [edit interfaces *interface-name* atm-options mpls pop-all-labels] hierarchy level:

```
[edit interfaces interface-name atm-options mpls pop-all-labels]
required-depth number;
```

The required depth can be 1, 2, or [1 2]. If you include the required-depth 1 statement, the pop-all-labels statement takes effect for incoming packets with one label only. If you include the required-depth 2 statement, the pop-all-labels statement takes effect for incoming packets with two labels only. If you include the required-depth [1 2] statement, the pop-all-labels statement takes effect for incoming packets with one or two labels. A required depth of [1 2] is equivalent to the default behavior of the pop-all-labels statement.

When you remove MPLS labels from incoming packets, note the following:

- The pop-all-labels statement has no effect on IP packets with three or more MPLS labels.
- When you enable MPLS label removal, you must configure all ports on a PIC with the same label popping mode and required depth.
- You use the pop-all-labels statement to enable passive monitoring applications, not active monitoring.
- You cannot apply MPLS filters or accounting to the MPLS labels because the labels are removed as soon as the packet arrives on the interface.

Configuring the Clock Source on SONET/SDH Interfaces

For interfaces such as SONET/SDH that can use different clock sources, you can configure the source of the transmit clock on each interface. The source can be internal or external. The default source is internal, which means that each interface uses the routing platform’s internal Stratum 3 clock.

For DS3 channels on a channelized OC12 interface, the clocking statement is supported only for channel 0; it is ignored if included in the configuration of channels 1 through 11. The clock source configured for channel 0 applies to all channels on the channelized OC12 interface. The individual DS3 channels use a gapped 45-MHz clock as the transmit clock. For more information, see “Clock Sources on Channelized Interfaces” on page 376.

NOTE: On channelized STM1 interfaces, you should configure the clock source at one side of the connection to be internal (the default JUNOS configuration) and configure the other side of the connection to be external.

To configure loop timing on an interface, include the clocking external statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
clocking external;
```

To explicitly configure line timing on an interface, include the clocking internal statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
clocking internal;
```

Configuring Receive and Transmit Leaky Bucket Properties on SONET/SDH Interfaces

Congestion control is particularly difficult in high-speed networks with high volumes of traffic. When congestion occurs in such a network, it is usually too late to react. You can avoid congestion by regulating the flow of packets into your network. Smoother flows prevent bursts of packets from arriving at (or being transmitted from) the same interface and causing congestion.

For all interface types except ATM, Fast Ethernet, Gigabit Ethernet, and channelized IQ and IQE, you can configure leaky bucket properties, which allow you to limit the amount of traffic received on and transmitted by a particular interface. You effectively specify what percentage of the interface's total capacity can be used to receive or transmit packets. You might want to set leaky bucket properties to limit the traffic flow from a link that is known to transmit high volumes of traffic.

NOTE: Instead of configuring leaky bucket properties, you can limit traffic flow by configuring policers. Policers work on all interfaces. For more information, see the *JUNOS Policy Framework Configuration Guide*.

The leaky bucket is used at the host-network interface to allow packets into the network at a constant rate. Packets might be generated in a bursty manner, but after they pass through the leaky bucket, they enter the network evenly spaced. In some cases, you might want to allow short bursts of packets to enter the network without smoothing them out. By controlling the number of packets that can accumulate in the bucket, the threshold property controls burstiness. The maximum number of packets entering the network in t time units is threshold + rate * t.

By default, leaky buckets are disabled and the interface can receive and transmit packets at the maximum line rate.

For each DS3 channel on a channelized OC12 interface, you can configure unique receive and transmit buckets.

NOTE: HDLC payload scrambling conflicts with traffic shaping configured using leaky bucket properties. If you configure leaky bucket properties, you must disable payload scrambling, because the JUNOS software rejects configurations that have both features enabled. For more information, see "Configuring SONET/SDH HDLC Payload Scrambling" on page 808.

To configure leaky bucket properties, include one or both of the receive-bucket and transmit-bucket statements at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
receive-bucket {
    overflow (discard | tag);
    rate percentage;
    threshold bytes;
}
transmit-bucket {
    overflow discard;
    rate percentage;
    threshold bytes;
}
```

In the rate statement, specify the percentage of the interface line rate that is available to receive or transmit packets. The percentage can be a value from 0 (none of the interface line rate is available) to 100 (the maximum interface line rate is available). For example, when you set the line rate to 33, the interface receives or transmits at one third of the maximum line rate.

In the threshold statement, specify the bucket threshold, which controls the burstiness of the leaky bucket mechanism. The larger the value, the more bursty the traffic, which means that over a very short amount of time the interface can receive or transmit close to line rate, but the average over a longer time is at the configured bucket rate. The threshold can be a value from 0 through 65,535 bytes. For ease of entry, you can enter *number* either as a complete decimal number or as a decimal number followed by the abbreviation k (1,000). For example, the entry threshold 2k corresponds to a threshold of 2,000 bytes.

In the overflow option, specify how to handle packets that exceed the threshold:

- tag—(receive-bucket only) Tag, count, and process received packets that exceed the threshold.
- discard—Discard received packets that exceed the threshold. No counting is done.

Damping Interface Transitions on SONET/SDH Interfaces

By default, when an interface changes from being up to being down, or from down to up, this transition is advertised immediately to the hardware and the JUNOS software. In some situations—for example, when an interface is connected to an add-drop multiplexer (ADM) or wavelength-division multiplexer (WDM), or to protect against SONET/SDH framer holes—you might want to damp interface transitions.

This means not advertising the interface's transition until a certain period of time has transpired.

When you have damped interface transitions and the interface goes from up to down, the interface is not advertised to the rest of the system as being down until it has remained down for the hold-time period. Similarly when an interface goes from down to up, it is not advertised as being up until it has remained up for the hold-time period.

To damp interface transitions, include the hold-time statement at the [edit interfaces *interface-name*] hierarchy level:

hold-time up *milliseconds* down *milliseconds*;

The time can be a value from 0 through 65,534 milliseconds. The default value is 0, which means that interface transitions are not damped. The JUNOS software advertises the transition within 100 milliseconds of the time value you specify.

Configuring Interface Encapsulation on SONET/SDH Interfaces

Point-to-Point Protocol (PPP) encapsulation is the default encapsulation type for physical interfaces. You need not configure encapsulation for any physical interfaces that support PPP encapsulation. If you do not configure encapsulation, PPP is used by default. For physical interfaces that do not support PPP encapsulation, you must configure an encapsulation to use for packets transmitted on the interface. You can optionally configure an encapsulation on a logical interface, which is the encapsulation used within certain packet types.

Configuring the Encapsulation on a Physical SONET/SDH Interface

For SONET/SDH interfaces, the physical interface encapsulation can be one of the following:

- Point-to-Point Protocol (PPP)—PPP encapsulation is defined in RFC 1661, *The Point-to-Point Protocol (PPP) for the Transmission of Multiprotocol Datagrams over Point-to-Point Links*. PPP is the default encapsulation type for physical interfaces. Two related versions are supported:
  - Circuit cross-connect (CCC) version (ppp-ccc)—The logical interfaces do not require an encapsulation statement. When you use this encapsulation type, you can configure the ccc family only.
  - Translational cross-connect (TCC) version (ppp-tcc)—Similar to CCC and has the same configuration restrictions, but used for circuits with different media on either side of the connection.
- Cisco HDLC—E1, E3, SONET/SDH, T1, and T3 interfaces can use Cisco HDLC encapsulation. Two related versions are supported:
  - CCC version (cisco-hdlc-ccc)—The logical interfaces do not require an encapsulation statement. When you use this encapsulation type, you can configure the ccc family only.

    - TCC version (cisco-hdlc-tcc)—Similar to CCC and has the same configuration restrictions, but used for circuits with different media on either side of the connection.

- Frame Relay—Defined in RFC 1490, *Multiprotocol Interconnect over Frame Relay*. E1, E3, SONET/SDH, T1, and T3 interfaces can use Frame Relay encapsulation. Two related versions are supported:
    - CCC version (frame-relay-ccc)—The same as standard Frame Relay for DLCIs 0 through 511. DLCIs 512 through 1022 are dedicated to CCC. This numbering restriction does not apply to IQ and IQE interfaces. The logical interface must also have frame-relay-ccc encapsulation.
    - TCC version (frame-relay-tcc)—Similar to Frame Relay CCC and has the same configuration restrictions, but used for circuits with different media on either side of the connection.
- Frame Relay Ether Type (frame-relay-ether-type)—Physical interfaces can use Frame Relay ether type encapsulation for compatibility with Cisco Frame Relay. IETF Frame Relay encapsulation identifies the payload format using NLPID and SNAP formats. Cisco-compatible Frame Relay encapsulation uses the Ethernet type to identify the type of payload. Two related versions are supported:
    - TCC version (frame-relay-ether-type-tcc)—Cisco-compatible Frame Relay for DLCIs 0 through 511. DLCIs 512 through 1022 are dedicated to TCC. This numbering restriction does not apply to IQ and IQE interfaces. This encapsulation is used for circuits with different media on either side of the connection.
    - Extended TCC version (extended-frame-relay-ether-type-tcc)—This encapsulation allows you to dedicate Cisco-compatible Frame Relay TCC for DLCIs 1 through 1022. This encapsulation is used for circuits with different media on either side of the connection. All ether type TCC encapsulation is supported on the same PICs as non-ether type Frame Relay TCC encapsulation.

NOTE: When the encapsulation type is set to Cisco-compatible Frame Relay encapsulation, ensure that the LMI type is set to ANSI or Q933-A.

To configure the encapsulation on a physical interface, include the encapsulation statement at the [edit interfaces *interface-name*] hierarchy level:

```
[edit interfaces interface-name]
encapsulation (cisco-hdlc | cisco-hdlc-ccc | cisco-hdlc-tcc | frame-relay | frame-relay-ccc |
   frame-relay-tcc | frame-relay-tcc | ppp | ppp-ccc | ppp-tcc);
```

When you configure a point-to-point encapsulation (such as PPP or Cisco HDLC) on a physical interface, the physical interface can have only one logical interface (that is, only one unit statement) associated with it. When you configure a multipoint encapsulation (such as Frame Relay), the physical interface can have multiple logical units, and the units can be either point to point or multipoint. Use PPP if you are running Cisco IOS Release 12.0 or later. If you need to run Cisco HDLC, the JUNOS software automatically configures an ISO family MTU of 4469 in the routing platform. This is due to an extra byte of padding used by Cisco.

For more information about physical interface encapsulation, see “Configuring the Encapsulation on a Physical Interface” on page 100.

Example: Configuring the Encapsulation on a Physical SONET/SDH Interface

Configure PPP encapsulation on a SONET/SDH interface. The second two family statements allow IS-IS and MPLS to run on the interface.

```
[edit interfaces]
so-7/0/0 {
   encapsulation ppp;
   unit 0 {
      point-to-point;
      family inet {
         address 192.168.1.113/32 {
            destination 192.168.1.114;
         }
      }
      family iso;
      family mpls;
   }
}
```

Configuring the Encapsulation on a Logical SONET/SDH Interface

Generally, you configure an interface’s encapsulation at the [edit interfaces *interface-name*] hierarchy level. However, for Frame Relay encapsulation, you can also configure the encapsulation type that is used inside the Frame Relay packet itself. To do this, include the encapsulation statement, specifying the frame-relay-ccc frame-relay-tcc, frame-relay-ether-type, or frame-relay-ether-type-tcc option:

```
encapsulation (frame-relay-ccc | frame-relay-tcc | frame-relay-ether-type |
   frame-relay-ether-type-tcc);
```

You can include this statement at the following hierarchy levels:

- [edit interfaces *interface-name* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

The ATM encapsulations are defined in RFC 2684, *Multiprotocol Encapsulation over ATM Adaptation Layer 5*.

With the atm-nlpid, atm-cisco-nlpid, and atm-vc-mux encapsulations, you can configure the inet family only. With the circuit cross-connect (CCC) encapsulations, you cannot configure a family on the logical interface. A logical interface cannot have frame-relay-ccc encapsulation unless the physical device also has frame-relay-ccc encapsulation. A logical interface cannot have frame-relay-tcc encapsulation unless the physical device also has frame-relay-tcc encapsulation. In addition, you must assign this logical interface a DLCI from 512 through 1022. This numbering restriction does not apply to IQ and IQE interfaces. You must configure the logical interface as point-to-point.

For more information about logical interface encapsulation, see "Configuring the Encapsulation on a Logical Interface" on page 151.

Example: Configuring SONET/SDH Interfaces

SONET/SDH interfaces can use either PPP or Cisco HDLC encapsulation. Use PPP if you are running Cisco IOS Release 12.0 or later. If you need to run Cisco HDLC, the JUNOS software automatically configures an ISO family MTU of 4469 in the routing platform. This is due to an extra byte of padding used by Cisco. The following configuration, which uses PPP encapsulation, is sufficient to get a SONET/SDH OC3 or OC12 interface up and running:

```
[edit interfaces]
so-fpc/pic/port {
    encapsulation ppp;
    unit 0 {
        family inet {
            address local-address {
                destination remote-address;
            }
        }
    }
}
```

Configuring Aggregated SONET/SDH Interfaces

The JUNOS software enables link aggregation of SONET/SDH interfaces; this is similar to Ethernet link aggregation, but is not defined in a public standard. The JUNOS software balances traffic across the member links within an aggregated SONET/SDH bundle based on the Layer 3 information carried in the packet. This implementation uses the same load balancing algorithm used for per-packet load balancing. For information about per-packet load balancing, see the *JUNOS Routing Protocols Configuration Guide*.

You configure an aggregated SONET/SDH virtual link by specifying the link number as a physical device and then associating a set of physical interfaces that have the same speed. Channelized OC IQ and IQE PICs do not support SONET aggregation.

By default, no aggregated SONET/SDH interfaces are created. You must define the number of aggregated SONET/SDH interfaces by including the device-count statement at the [edit chassis aggregated-devices sonet] hierarchy level:

```
[edit chassis aggregated-devices sonet]
device-count number;
```

The maximum number of aggregated interfaces is 16. The aggregated SONET/SDH interfaces are numbered from as0 through as15. For more information, see the *JUNOS Services Interfaces Configuration Guide*.

NOTE: SONET/SDH aggregation is proprietary to the JUNOS software and might not work with other software.

To configure aggregated SONET/SDH interfaces, assign a number for the aggregated SONET/SDH interface as*x* at the [edit interfaces] hierarchy level:

```
[edit interfaces]
asx {
   ...
}
```

The following example shows an aggregated SONET/SDH configuration:

```
[edit interfaces]
as0 {
   aggregated-sonet-options {
      minimum-links 1;
      link-speed oc3;
   }
   unit 0 {
      family inet {
         address 10.2.11.1/32 {
            destination 10.2.11.3;
         }
      }
   }
}
```

You also need to specify the constituent physical interfaces by including the aggregate statement at the [edit interfaces *interface-name* sonet-options] hierarchy level; for more information, see "Configuring SONET/SDH Link Aggregation" on page 837. You can optionally specify other physical properties that apply specifically to the aggregated SONET/SDH interfaces; for details, see "Configuring SONET/SDH Physical Interface Properties" on page 798. For a sample configuration, see "Example: Configuring Aggregated SONET/SDH Interfaces" on page 840.

To remove the configuration statements related to as*x* and set the aggregated SONET/SDH interface to down state, delete the interface from the configuration:

```
[edit]
user@host# delete interfaces asx
```

However, the aggregated SONET/SDH interface is not deleted until you delete the chassis aggregated-devices sonet device-count configuration statement.

You can configure the following aggregated SONET/SDH properties:

- Configuring SONET/SDH Link Aggregation on page 837
- Configuring Aggregated SONET/SDH Link Speed on page 837
- Configuring Aggregated SONET/SDH Minimum Links on page 837
- Configuring Filters or Sampling on Aggregated SONET/SDH Links on page 838
- Example: Configuring Aggregated SONET/SDH Interfaces on page 840

Configuring SONET/SDH Link Aggregation

On SONET/SDH interfaces, you can associate a physical interface with an aggregated SONET/SDH interface. To associate the interface with an aggregated SONET/SDH link, include the aggregate statement at the [edit interfaces *interface-name* sonet-options] hierarchy level:

```
[edit interfaces interface-name sonet-options]
aggregate asx;
```

x is the interface instance number and can be from 0 through 15, for a total of 16 aggregated interfaces. You should not mix SONET and SDH mode on the same aggregated interface. You must also include a statement configuring as*x* at the [edit interfaces] hierarchy level. For a sample configuration, see "Example: Configuring Aggregated SONET/SDH Interfaces" on page 840.

Configuring Aggregated SONET/SDH Link Speed

On aggregated SONET/SDH interfaces, you can set the required link speed for all interfaces included in the bundle, or specify that the bundle contains interfaces with mixed interface speeds.

NOTE: For nonconcatenated interfaces on aggregated SONET/SDH interfaces, you can configure the link speed of the aggregate to match the speed of the nonconcatenated interface. For example, an OC12 PIC can have nonconcatenated interfaces with a link speed of OC3.

To set the required link speed or specify mixed interface speeds, include the link-speed statement at the [edit interfaces *interface-name* aggregated-sonet-options] hierarchy level:

```
[edit interfaces interface-name aggregated-sonet-options]
link-speed (speed | mixed);
```

The link speed can be one of the following values:

- oc3—Links are OC3c or STM1c.
- oc12—Links are OC12c or STM4c.
- oc48—Links are OC48c or STM16c.
- oc192—Links are OC192c or STM64c.
- oc768—Links are OC768c or STM256c.

Configuring Aggregated SONET/SDH Minimum Links

On aggregated SONET/SDH interfaces, you can configure the minimum number of links that must be up for the bundle as a whole to be labeled up. By default, only one link must be up for the bundle to be labeled up.

To configure the minimum number of links, include the minimum-links statement at the [edit interfaces *interface-name* aggregated-sonet-options] hierarchy level:

```
[edit interfaces interface-name aggregated-sonet-options]
minimum-links number;
```

On a T-series, TX matrix routing platform with SONET interfaces, the valid range for minimum-links *number* is from 1 through 16. When the maximum value (16) is specified, all configured links of a bundle must be up for the bundle to be labeled up.

On all other router platforms, the range of valid values for minimum-links *number* is 1 through 8 and the maximum number of links supported in an aggregate is eight. When the maximum value (8) is specified, all configured links of a bundle must be up for the bundle to be labeled up.

Configuring Filters or Sampling on Aggregated SONET/SDH Links

To set up firewall filters or sampling on aggregated SONET/SDH interfaces, you must configure the as*x* interface with these properties. The filters function in the same manner as on other interfaces.

To configure a filter, include the filter statement:

```
filter {
    input input-filter-name;
    output output-filter-name;
}
```

You can include this statement at the following hierarchy levels:

- [edit interfaces as *x* unit *logical-unit-number*]
- [edit logical-systems *logical-system-name* interfaces as*x* unit *logical-unit-number*]

You must also configure separate statements that define the properties of the filter. For more information, see the *JUNOS Policy Framework Configuration Guide* and “Examples: Configuring Filters or Sampling on Aggregated SONET/SDH Links” on page 838.

Examples: Configuring Filters or Sampling on Aggregated SONET/SDH Links

Configure filtering on aggregated SONET/SDH interfaces:

```
[edit interfaces]
asx {
    unit 0 {
        family inet {
            address 10.2.11.1/32 {
                destination 10.2.11.3;
            }
            filter {
                input input-filter-name;
```

```
            output output-filter-name;
         }
      }
   }
}
```

Defining the Filter

```
[edit firewall]
filter input-filter-name {
   term match-any-input {
      then {
         accept;
      }
   }
}
filter output-filter-name {
   term match-any-output {
      then {
         accept;
      }
   }
}
```

Configuring Sampling on an Aggregated SONET/SDH Interface

```
[edit interfaces]
asx {
   unit 0 {
      family inet {
         address 10.2.11.1/32 {
            destination 10.2.11.3;
         }
         filter {
            input input-sampler-name;
         }
      }
   }
}
```

Defining the Sampling Filter and the Forwarding Action

```
[edit firewall]
filter input-sampler-name {
   term match-any-input {
      then {
         sample;
         accept;
      }
   }
}
[edit forwarding-options]
sampling {
   input {
      family inet {
         rate 10000;
         run-length 1;
      }
   }
}
```

Example: Configuring Aggregated SONET/SDH Interfaces

The following configuration is sufficient to get an aggregated SONET/SDH interface up and running:

```
[edit interfaces]
as0 {
    aggregated-sonet-options {
        minimum-links 1;
        link-speed oc3;
    }
    unit 0 {
        family inet {
            address 10.2.11.1/32 {
                destination 10.2.11.3;
            }
        }
    }
}
[edit chassis]
aggregated-devices {
    sonet {
        device-count 15;
    }
}
[edit interfaces]
so-1/3/0 {
    sonet-options {
        aggregate as0;
    }
}
```

Part 12

Interface Configuration Statements

Chapter 58
Summary of Interface Configuration Statements

The following descriptions explain each of the interface configuration statements. The statements are organized alphabetically.

802.3ad

Syntax

```
802.3ad {
   aex (primary | backup);
   lacp {
      port-priority;
   }
}
```

Hierarchy Level [edit interfaces *interface-name* fastether-options],
[edit interfaces *interface-name* gigether-options]

Release Information Statement introduced before JUNOS Release 7.4.
primary and backup options added in JUNOS Release 8.3.

Description Specify aggregated Ethernet logical interface number.

Options aex—Aggregated Ethernet logical interface number.

Range: 0 through 15

primary—For link protection configurations, specify the primary link for egress traffic.

backup—For link protection configurations, specify the backup link for egress traffic.

Usage Guidelines See "Configuring Ethernet Link Aggregation" on page 595 and "Configuring Aggregated Ethernet Link Protection" on page 595.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics link-protection

accept

See the following sections:

- accept on page 845
- accept on page 845

accept

Syntax accept (inet);

Hierarchy Level [edit interfaces *interface-name* auto-configure vlan-ranges dynamic-profile *profile-name*]

Release Information Statement introduced in JUNOS Release 9.5.

Description Configure the Ethernet packet type acceptable when creating VLAN interfaces.

Options inet—The inet (IPv4) Ethernet packet type. The inet option includes both inet (IPv4) Ethernet and ARP packet types.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics
- Configuring the VLAN Ethernet Packet Type for Single-Tag VLAN Dynamic Profiles

accept

Syntax accept (inet);

Hierarchy Level [edit interfaces *interface-name* auto-configure stacked-vlan-ranges dynamic-profile *profile-name*]

Release Information Statement introduced in JUNOS Release 9.5.

Description Configure the Ethernet packet type acceptable when creating stacked VLAN interfaces.

Options inet—The inet (IPv4) Ethernet packet type. The inet option includes both inet (IPv4) Ethernet and ARP packet types.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics
- Configuring the VLAN Ethernet Packet Type for Stacked VLAN Dynamic Profiles

accept-source-mac

Syntax

```
accept-source-mac {
    mac-address mac-address {
        policer {
            input cos-policer-name;
            output cos-policer-name;
        }
    }
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Gigabit Ethernet intelligent queuing (IQ) interfaces only, accept traffic from and to the specified remote media access control (MAC) address.

The accept-source-mac statement is equivalent to the source-address-filter statement, which is valid for aggregated Ethernet, Fast Ethernet, and Gigabit Ethernet interfaces only.

On untagged Gigabit Ethernet interfaces you should not configure the source-address-filter statement and the accept-source-mac statement simultaneously. On tagged Gigabit Ethernet interfaces you should not configure the source-address-filter statement and the accept-source-mac statement with an identical MAC address specified in both filters.

The statements are explained separately.

Usage Guidelines See "Configuring MAC Address Filtering" on page 713.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics source-filtering

access-concentrator

Syntax access-concentrator *name*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* pppoe-options],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* pppoe-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For J-series Services Routers with Point-to-Point Protocol over Ethernet (PPPoE) interfaces, configure the name of the access concentrator (AC).

Options *name*—Name of the AC.

Usage Guidelines See “Identifying the Access Concentrator” on page 746.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

access-profile

Syntax access-profile *name*;

Hierarchy Level [edit interfaces *interface-name* ppp-options chap],
[edit interfaces *interface-name* ppp-options pap],
[edit interfaces *interface-name* unit *logical-unit-number* ppp-options chap],
[edit interfaces *interface-name* unit *logical-unit-number* ppp-options pap],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* ppp-options chap],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* ppp-options pap]

Release Information Statement introduced before JUNOS Release 7.4.
Support for PAP added in JUNOS Release 8.3.

Description For CHAP authentication, the mapping between peer names (or “clients”) and the secrets associated with their respective links. For PAP authentication, the peer's username and password.

For Asynchronous Transfer Mode 2 (ATM2) IQ interfaces only, you can configure a Challenge Handshake Authentication Protocol (CHAP) access profile on the logical interface unit if the logical interface is configured with one of the following PPP over ATM encapsulation types:

- atm-ppp-llc—PPP over AAL5 logical link control (LLC) encapsulation.
- atm-ppp-vc-mux—PPP over AAL5 multiplex encapsulation.

Options *name*—Name of the access profile.

Usage Guidelines See “Configuring the PPP Challenge Handshake Authentication Protocol” on page 106 and “Configuring the PPP Password Authentication Protocol” on page 108.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics default-chap-secret, *JUNOS System Basics Configuration Guide*

accounting

Syntax

```
accounting {
    destination-class-usage;
    source-class-usage {
        direction;
    }
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet]

Release Information Statement introduced before JUNOS Release 7.4.

Description Enable IP packet counters on an interface.

The statements are explained separately.

Usage Guidelines See "Enabling Source Class and Destination Class Usage" on page 204.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

accounting-profile

Syntax accounting-profile *name*;

Hierarchy Level [edit interfaces *interface-name*],
[edit interfaces *interface-name* unit *logical-unit-number*],

Release Information Statement introduced before JUNOS Release 7.4.

Description Enable collection of accounting data for the specified physical or logical interface.

Options *name*—Name of the accounting profile.

Usage Guidelines See "Applying an Accounting Profile to the Physical Interface" on page 124 and "Applying an Accounting Profile to the Logical Interface" on page 149.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

acfc

Syntax acfc;

Hierarchy Level [edit interfaces *interface-name* ppp-options compression],
[edit interfaces *interface-name* unit *logical-unit-number* ppp-options compression],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* ppp-options compression]

Release Information Statement introduced before JUNOS Release 7.4.

Description For interfaces with PPP encapsulation, configure compression of the Data Link Layer address and control fields. The acfc option is not supported with frame-relay-ppp encapsulation.

On M320, M120, and T-series routing platforms, address and control field compression (ACFC) is not supported for any ISO family protocols. Do not include the acfc statement at the [edit interfaces *interface-name* ppp-options compression] hierarchy level when you include the family iso statement at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level.

Usage Guidelines See "Configuring PPP Address and Control Field Compression" on page 114.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

ack-delay-time

Syntax ack-delay-time *time*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family llc2],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family llc2]

Release Information Statement introduced in JUNOS Release 7.4.

Description For J-series Services Routers only. On Ethernet interfaces configured for DLSw, configure the maximum time allowed for incoming Information-frames (I-frames) to remain unacknowledged.

Options *time*—Number of milliseconds.
Range: 1 through 60,000 milliseconds
Default: 100 milliseconds

Usage Guidelines See "Configuring LLC2 Options" on page 171.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Advanced WAN Access Configuration Guide*

ack-max

Syntax ack-max *count*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family llc2],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family llc2]

Release Information Statement introduced in JUNOS Release 7.4.

Description For J-series Services Routers only. On Ethernet interfaces configured for DLSw, configure the maximum number of Information-frames (I-frames) received before acknowledgment is sent.

Options *count*—Number of I-frames.
Range: 1 through 127 I-frames
Default: 3 I-frames

Usage Guidelines See “Configuring LLC2 Options” on page 171.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Advanced WAN Access Configuration Guide*

acknowledge-retries

Syntax acknowledge-retries *number*;

Hierarchy Level [edit interfaces *interface-name* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For link services and voice services interfaces only, configure the number of retransmission attempts to be made for consecutive hello or remove link messages following the expiration of the acknowledgment timer.

Options *number*—Number of retransmission attempts to be made following the expiration of the acknowledgment timer.
Range: 1 through 5
Default: 2

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics action-red-differential-delay, hello-timer

acknowledge-timer

Syntax acknowledge-timer *milliseconds*;

Hierarchy Level [edit interfaces *interface-name* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For link services and voice services interfaces only, configure the maximum time, in milliseconds, to wait for an add link acknowledgment, hello acknowledgment, or remove link acknowledgment message.

Options milliseconds—Time, in milliseconds, to wait for an add link acknowledgment, hello acknowledgment, or remove link acknowledgment message.

Range: 1 through 10 milliseconds

Default: 4 milliseconds

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics address, hello-timer

action

See the following sections:

- action (OAM) on page 853
- action (Policer) on page 853

action (OAM)

Syntax

```
action {
    syslog (OAM Action);
    link-down;
    send-critical-event;
}
```

Hierarchy Level [edit protocols oam ethernet link-fault-management action-profile]

Release Information Statement introduced in JUNOS Release 8.5.

Description Define the action or actions to be taken when the OAM fault event occurs.

Usage Guidelines See "Specifying the Actions to Be Taken for Link-Fault Management Events" on page 701.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

action (Policer)

Syntax

```
action {
    loss-priority high then discard;
}
```

Hierarchy Level [edit firewall three-color-policer *policer-name*]

Release Information Statement introduced in JUNOS Release 8.2.

Description This statement discards high loss priority traffic as part of a configuration using tricolor marking on a logical interface.

Usage Guidelines See the *JUNOS Class of Service Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics logical-interface-policer

action-profile

See the following sections:

action-profile (Applying to CFM)

Syntax action-profile *profile-name*;

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name* mep *mep-id* remote-mep *mep-id*]

Release Information Statement introduced in JUNOS Release 8.4.

Description Identify the action profile to use.

Options *profile-name*—Name of the action profile to use.

Usage Guidelines See "Configuring the Remote Maintenance End Point Action Profile" on page 652.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

action-profile (Defining for CFM)

Syntax

```
action-profile profile-name {
   default-action {
      interface-down;
   }
}
```

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management]

Release Information Statement introduced in JUNOS Release 8.4.

Description Configure a name and default action for an action profile.

Options *profile-name*—Name of the action profile.

The remaining statements are explained separately.

Usage Guidelines See "Creating a Connectivity-Fault Management Action Profile" on page 652.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

action-profile (Defining for LFM)

Syntax

```
action-profile profile-name {
    action {
        syslog;
        link-down;
        send-critical-event;
    }
    event {
        link-adjacency-loss;
        link-event-rate {
            frame-error count;
            frame-period count;
            frame-period-summary count;
            symbol-period count;
        }
        protocol-down;
    }
}
```

Hierarchy Level [edit protocols oam ethernet link-fault-management]

Release Information Statement introduced in JUNOS Release 8.5.

Description Configure a name, one or more actions, and the events that trigger the action for an action profile.

Options *profile-name*—Name of the action profile.

The remaining statements are explained separately.

Usage Guidelines See “Configuring an OAM Action Profile” on page 700.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

action-red-differential-delay

Syntax action-red-differential-delay (disable-tx | remove-link);

Hierarchy Level [edit interfaces *interface-name* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For link services and voice services interfaces only, configure the action to be taken when the differential delay exceeds the red limit.

Options disable-tx—Disable transmission on the bundle link.

remove-link—Remove bundle link from service.

Default: disable-tx

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics remote, yellow-differential-delay

activation-delay

Syntax activation-delay *seconds*;

Hierarchy Level [edit interface dl*n* unit *logical-unit-number* dialer-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description (J-series Services Routers) For ISDN interfaces, configure the ISDN dialer activation delay. Used only for dialer backup and dialer watch cases.

Options *seconds*—Interval before the backup interface is activated after the primary interface has gone down.

Range: 1 through 4,294,967,295 seconds

Usage Guidelines See "Configuring the Dialer Interface" on page 789.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

activation-priority

Syntax activation-priority *priority*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* dynamic-call-admission-control]
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* dynamic-call-admission-control]

Release Information Statement introduced in JUNOS Release 8.2.

Description (J4350 and J6350 Services Routers supporting voice over IP with the TGM550 media gateway module) For Fast Ethernet and Gigabit Ethernet interfaces, ISDN BRI interfaces, and serial interfaces with PPP or Frame Relay encapsulation, configure the dynamic call admission control (dynamic CAC) activation priority value.

Options *priority*—The activation priority in which the interface is used for providing call bandwidth. The interface with the highest activation priority value is used as the primary link for providing call bandwidth. If the primary link becomes unavailable, the TGM550 switches over to the next active interface with the highest activation priority value, and so on.
Range: 0 through 255
Default: 50

Usage Guidelines See “Configuring Dynamic Call Admission Control” on page 157.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS Services Interfaces Configuration Guide*, *J-series Services Router Basic LAN and WAN Access Configuration Guide*

address

Syntax

```
address address {
    arp ip-address (mac | multicast-mac) mac-address <publish>;
    broadcast address;
    destination address;
    destination-profile name;
    eui-64;
    master-only;
    multipoint-destination address dlci dlci-identifier;
    multipoint-destination address {
        epd-threshold cells;
        inverse-arp;
        oam-liveness {
            up-count cells;
            down-count cells;
        }
        oam-period (disable | seconds);
        shaping {
            (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained
                rate burst length);
            queue-length number;
        }
        vci vpi-identifier.vci-identifier;
    }
    primary;
    preferred;
    (vrrp-group | vrrp-inet6-group) group-number {
        (accept-data | no-accept-data);
        advertise–interval seconds;
        authentication-type authentication;
        authentication-key key;
        fast-interval milliseconds;
        (preempt | no-preempt) {
            hold-time seconds;
        }
        priority-number number;
        track {
            priority-cost seconds;
            priority-hold-time interface-name {
                interface priority;
                bandwidth-threshold bits-per-second {
                    priority;
                }
            }
            route ip-address/mask routing-instance instance-name priority-cost cost;
        }
        virtual-address [ addresses ];
    }
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family *family*],

[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure the interface address.

Options *address*—Address of the interface.

The remaining statements are explained separately.

Usage Guidelines See “Configuring the Protocol Family” on page 164.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics negotiate-address, unnumbered-address, *JUNOS System Basics Configuration Guide*

advertise-interval

See the following sections:

- advertise-interval (APS) on page 860
- advertise-interval (DLSw) on page 861

NOTE: For information about the advertise-interval statement at the [edit interfaces *interface-name* unit *unit-number* family inet address *address* (vrrp-group | vrrp-inet6-group) *group-number*] or [edit logical-systems *logical-system-name* interfaces *interface-name* unit *unit-number* family (inet | inet6) address *address* (vrrp-group | vrrp-inet6-group) *group-number*] hierarchy level, see the *JUNOS High Availability Configuration Guide*.

advertise-interval (APS)

Syntax advertise-interval *milliseconds*;

Hierarchy Level [edit interfaces *interface-name* sonet-options aps]

Release Information Statement introduced before JUNOS Release 7.4.

Description Modify the Automatic Protection Switching (APS) interval at which the protect and working routers send packets to their neighbors to advertise that they are operational. A router considers its neighbor to be operational for a period, called the hold time, that is, by default, three times the advertisement interval.

Options *milliseconds*—Interval between advertisement packets.
Range: 1 through 65,534 milliseconds
Default: 1000 milliseconds

Usage Guidelines See "Configuring APS Timers" on page 822.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics hold-time

advertise-interval (DLSw)

Syntax advertise-interval *seconds*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family llc2 redundancy-group *group-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family llc2 redundancy-group *group-number*]

Release Information Statement introduced in JUNOS Release 7.5.

Description For J-series Services Routers only. On Ethernet interfaces configured for DLSw Ethernet redundancy, configure the advertisement interval of DLSw neighbors on the network.

All routers in the redundancy group must use the same advertisement interval.

Options *seconds*—Interval between advertisement packets.

Range: 1 through 255 seconds

Default: 1 second

Usage Guidelines See "Configuring DLSw Ethernet Redundancy Using LLC2 Properties" on page 172.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS Services Interfaces Configuration Guide*

age

Syntax age (30m | 10m | 1m | 30s | 10s);

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management linktrace]

Release Information Statement introduced in JUNOS Release 8.5.

Description Time to wait (in minutes or seconds) for a response. If no response is received, the request and response entry is deleted from the linktrace database.

Default 10 minutes

Usage Guidelines See "Configuring the Linktrace Path Age Timer" on page 654.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

aggregate

See the following sections:

aggregate (firewall)

Syntax

```
aggregate {
   if-exceeding {
      bandwidth-limit bandwidth;
      burst-size-limit burst;
   }
   then {
      discard;
   }
}
```

Hierarchy Level [edit firewall hierarchical-policer]

Release Information Statement introduced in JUNOS Release 9.5.

Description On M40e, M120, and M320 (with FFPC and SFPC) edge routers and T320, T640, and T1600 core routers with Enhanced Intelligent Queuing (IQE) PICs, to specify an aggregate hierarchical policer, use the aggregate statement at the [edit firewall hierarchical-policer] hierarchy level.

Options Options are described separately.

Usage Guidelines See "Applying Policers" on page 185 and *Class of Service*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

aggregate (Gigabit Ethernet CoS Policer)

Syntax

```
aggregate {
   bandwidth-limit (ethernet) bps;
   burst-size-limit (ethernet) bytes;
}
```

Hierarchy Level [edit interfaces *interface-name* gigether-options ethernet-switch-profile ethernet-policer-profile policer *cos-policer-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Define a policer to apply to nonpremium traffic.

The statements are explained separately.

Usage Guidelines See "Configuring Gigabit Ethernet Policers" on page 709.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics premium, ieee802.1p

aggregate (SONET/SDH)

Syntax aggregate as*x*;

Hierarchy Level [edit interfaces *interface-name* sonet-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Specify aggregated SONET/SDH logical interface number.

Options as*x*—Aggregated SONET/SDH logical interface number.
Range: 0 through 15

Usage Guidelines See "Configuring Aggregated SONET/SDH Interfaces" on page 835.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

aggregate-ports

Syntax aggregate-ports;

Hierarchy Level [edit chassis fpc *slot-number* pic *pic-number*]

Release Information Statement introduced in JUNOS Release 8.1.

Description For T-series routers only, specify OC768-over-OC192 mode on the 4-port OC192C PIC. Four OC192 links are aggregated into one OC768 link with one logical interface.

Usage Guidelines See “Specifying OC768-over-OC192 Mode” on page 89.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

aggregated-ether-options

Syntax

```
aggregated-ether-options {
    ethernet-switch-profile {
        ethernet-policer-profile {
            input-priority-map {
                ieee802.1p premium [ values ];
            }
            output-priority-map {
                classifier {
                    premium {
                        forwarding-class class-name {
                            loss-priority (high | low);
                        }
                    }
                }
            }
            policer cos-policer-name {
                aggregate {
                    bandwidth-limit (ethernet) bps;
                    burst-size-limit (ethernet) bytes;
                }
                premium {
                    bandwidth-limit (ethernet) bps;
                    burst-size-limit (ethernet) bytes;
                }
            }
        }
        (mac-learn-enable | no-mac-learn-enable);
    }
    (flow-control | no-flow-control);
    lacp {
        (active | passive);
        link-protection {
            disable;
        (revertive | non-revertive);
        periodic interval;
        system-priority priority;
    }
    link-protection;
    link-speed speed;
    (loopback | no-loopback);
    minimum-links number;
    source-address-filter {
        mac-address;
        (source-filtering | no-source-filtering);
    }
}
```

Hierarchy Level [edit interfaces aex]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure aggregated Ethernet-specific interface properties.

The statements are explained separately.

Usage Guidelines See “Configuring Ethernet Interfaces” on page 555.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

aggregated-sonet-options

Syntax

```
aggregated-sonet-options {
   link-speed speed;
   minimum-links number;
}
```

Hierarchy Level [edit interfaces asx]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure aggregated SONET/SDH-specific interface properties.

The statements are explained separately.

Usage Guidelines See “Configuring Aggregated SONET/SDH Interfaces” on page 835.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

allow-any-vci

Syntax allow-any-vci;

Hierarchy Level [edit interfaces *interface-name* unit 0],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit 0]

Release Information Statement introduced before JUNOS Release 7.4.

Description Dedicate entire ATM device to ATM cell relay circuit.

Usage Guidelines See “Configuring an ATM1 Cell-Relay Circuit” on page 318.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

allow-fragmentation

Syntax allow-fragmentation;

Hierarchy Level [edit interfaces gr-*fpc/pic/port* unit *logical-unit-number* tunnel],
[edit logical-systems *logical-system-name* interfaces gr-*fpc/pic/port* unit *logical-unit-number* tunnel]

Release Information Statement introduced in JUNOS Release 9.2.

Description Enable fragmentation of generic routing encapsulation (GRE) encapsulated packets regardless of maximum transmission unit (MTU) value.

Default By default, the GRE encapsulated packets are dropped if the packet size exceeds the MTU setting of the egress interface.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics reassemble-packets

allow-remote-loopback

Syntax allow-remote-loopback;

Hierarchy Level [edit protocols oam link-fault-management interface *interface-name* negotiation-options]

Release Information Statement introduced in JUNOS Release 8.4.

Description Enable the remote loopback on IQ2 and IQ2-E Gigabit Ethernet interfaces, and all Ethernet interfaces on the MX-series routers.

Usage Guidelines See “Enabling Remote Loopback Support on the Local Interface” on page 703.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

annex

Syntax annex (annex-a | annex-b);

Hierarchy Level [edit interfaces *interface-name* shdsl-options];
[edit interfaces *interface-name* sonet-options aps];
[edit logical-systems *logical-system-name* interfaces *interface-name* shdsl-options]

Release Information Statement introduced in JUNOS Release 7.4.

Description For J-series Services Routers only, configure the type of SHDSL annex.

For M320 and M120 routers only, for Multiplex Section Protection (MSP) switching on SDH interfaces, set annex-b. You must also configure the working protection circuit under the [edit interfaces so-*fpc/pic/port* sonet-options aps] hierarchy level.

Default annex-b

Options annex-a—Use for North American SHDSL network implementations.

annex-b—Use for European SHDSL network implementations.

Usage Guidelines See "Configuring ATM-over-SHDSL Interfaces" on page 347.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

apply-action-profile

Syntax apply-action-profile *profile-name*;

Hierarchy Level [edit protocols oam ethernet link-fault-management interface]

Release Information Statement introduced in JUNOS Release 8.5.

Description Apply the specified action profile to the interface for link-fault management.

Usage Guidelines See "Applying an Action Profile" on page 703.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

aps

Syntax

```
aps {
    advertise-interval milliseconds;
    annex-b
    authentication-key key;
    force;
    hold-time milliseconds;
    lockout;
    neighbor address;
    paired-group group-name;
    preserve-interface;
    protect-circuit group-name;
    request;
    revert-time seconds;
    switching-mode (bidirectional | unidirectional);
    working-circuit group-name;
}
```

Hierarchy Level [edit interfaces *interface-name* sonet-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure Automatic Protection Switching (APS) on the router.

For DS3 channels on a channelized OC12 interface, configure APS on channel 0 only. If you configure APS on channels 1 through 11, it is ignored.

The statements are explained separately.

Usage Guidelines See “Configuring APS and MSP” on page 813.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

arp

Syntax arp *ip-address* (mac | multicast-mac) *mac-address* <publish>;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Ethernet, Fast Ethernet, and Gigabit Ethernet interfaces only, configure Address Resolution Protocol (ARP) table entries, mapping IP addresses to MAC addresses.

Options *ip-address*—IP address to map to the MAC address. The IP address specified must be part of the subnet defined in the enclosing address statement.

mac *mac-address*—MAC address to map to the IP address. Specify the MAC address as six hexadecimal bytes in one of the following formats: *nnnn*.*nnnn*.*nnnn* or *nn*:*nn*:*nn*:*nn*:*nn*:*nn*. For example, 0011.2233.4455 or 00:11:22:33:44:55.

multicast-mac—Multicast MAC address to map to the IP address. Specify the multicast MAC address as six hexadecimal bytes in one of the following formats: *nnnn*.*nnnn*.*nnnn* or *nn*:*nn*:*nn*:*nn*:*nn*:*nn*. For example, 0011.2233.4455 or 00:11:22:33:44:55.

publish—(Optional) Have the routing platform reply to ARP requests for the specified IP address. If you omit this option, the routing platform uses the entry to reach the destination but does not reply to ARP requests.

Usage Guidelines See “Configuring Static ARP Table Entries” on page 635.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

asynchronous-notification

Syntax (asynchronous-notification | no-asynchronous-notification);

Hierarchy Level [edit interfaces ge-*fpc/pic/port* gigether-options]

Release Information Statement introduced in JUNOS Release 8.3.

Description For all 10-Gigabit Ethernet interfaces, M120, M320, and T-series routing platforms, configure support for notification of link down alarm generation and transfer.

- asynchronous-notification—Support notification of link down alarm generation and transfer.
- no-asynchronous-notification—Prohibit notification of link down alarm generation and transfer.

Default Support for notification of link down alarm generation and transfer is not enabled.

Usage Guidelines See "Configuring 10-Gigabit Ethernet Notification of Link Down Alarm" on page 737.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

atm-encapsulation

Syntax atm-encapsulation (direct | plcp);

Hierarchy Level [edit interfaces at-*fpc/pic/port* e3-options],
[edit interfaces at-*fpc/pic/port* t3-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure encapsulation for E3 and T3 traffic over ATM interfaces.

Default Physical Layer Convergence Protocol (PLCP) encapsulation is the default for T3 traffic and for E3 traffic using G.751 framing.

Options direct—Use direct encapsulation. G.832 framing on E3 interfaces requires direct encapsulation.

plcp—Use PLCP encapsulation.

Usage Guidelines See "Configuring E3 and T3 Parameters on ATM Interfaces" on page 323.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics encapsulation

atm-options

Syntax

```
atm-options {
  cell-bundle-size cells;
  ilmi;
  linear-red-profiles profile-name {
    high-plp-max-threshold percent;
    low-plp-max-threshold percent;
    queue-depth cells high-plp-threshold percent low-plp-threshold percent;
  }
  mpls {
    pop-all-labels {
      required-depth number;
    }
  }
  pic-type (atm1 | atm2);
  plp-to-clp;
  promiscuous-mode {
    vpi vpi-identifier;
  }
  scheduler-maps map-name {
    forwarding-class class-name {
      epd-threshold cells plp1 cells;
      linear-red-profile profile-name;
      priority (high | low);
      transmit-weight (cells number | percent number);
    }
    vc-cos-mode (alternate | strict);
  }
  vpi vpi-identifier {
    maximum-vcs maximum-vcs;
    oam-liveness {
      up-count cells;
      down-count cells;
    }
    oam-period (disable | seconds);
    shaping {
      (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained
        rate burst length);
      queue-length number;
    }
  }
}
```

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure ATM-specific physical interface properties.

The statements are explained separately.

Usage Guidelines See “Configuring ATM Interfaces” on page 267.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics multipoint-destination, shaping, vci

atm-scheduler-map

Syntax atm-scheduler-map (*map-name* | default);

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Associate a scheduler map with a virtual circuit on a logical interface.

Options *map-name*—Name of scheduler map that you define at the [edit interfaces *interface-name* atm-options scheduler-maps] hierarchy level.

default—The default scheduler mapping.

Usage Guidelines See "Configuring ATM2 IQ VC Tunnel CoS Components" on page 325.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics scheduler-maps

authentication-key

Syntax authentication-key *key*;

Hierarchy Level [edit interfaces *interface-name* sonet-options aps]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure the Automatic Protection Switching (APS) authentication key (password).

Options *key*—Authentication password. It can be 1 through 8 characters long. Configure the same key for both the working and protect routers.

Usage Guidelines See "Configuring Basic APS Support" on page 815.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics For information about the authentication-key statement at the [edit interfaces *interface-name* unit *unit-number* family inet address *address* (vrrp-group | vrrp-inet6-group) *group-number*] or [edit logical-systems *logical-system-name* interfaces *interface-name* unit *unit-number* family (inet | inet6) address *address* (vrrp-group | vrrp-inet6-group) *group-number*] hierarchy level, see the *JUNOS High Availability Configuration Guide*.

authentication-profile-name

Syntax authentication-profile-name *access-profile-name*;

Hierarchy Level [edit protocols dot1x authenticator]

Release Information Statement introduced in JUNOS Release 9.3.

Description Specify the RADIUS authentication profile to use for user authentication when establishing an IEEE 802.1x Port-Based Network Access Control (dot1x) connection.

Usage Guidelines See “Configuring IEEE 802.1x Port-Based Network Access Control” on page 693.

Required Privilege Level interface—To view this statement in the configuration.
interface control—To add this statement to the configuration.

Related Topics dot1x, authenticator

authenticator

Syntax

```
authenticator {
  authentication-profile-name access-profile-name;
  interface interface-id {
    maximum-requests integer;
    quiet-period seconds;
    reauthentication (disable | interval seconds);
    retries integer;
    server-timeout seconds;
    supplicant (single);
    supplicant-timeout seconds;
    transmit-period seconds;
  }
}
```

Hierarchy Level [edit protocols dot1x]

Release Information Statement introduced in JUNOS Release 9.3.

Description Specify an authentication profile for user or client authentication and configure the Ethernet interface for 802.1x protocol operation.

Options authentication-profile-name *access-profile-name*—Specifies the RADIUS authentication profile for user or client authentication.

interface *interface-ids*—Configures the Ethernet interface for 802.1x protocol operation. See interface (IEEE 802.1x) for descriptions of interface statement subordinate options.

Usage Guidelines See “Configuring IEEE 802.1x Port-Based Network Access Control” on page 693.

Required Privilege Level protocols—To view this statement in the configuration.
protocols-control—To add this statement to the configuration.

Related Topics authentication-profile-name, dot1x, interface (IEEE 802.1x)

auto-configure

Syntax

```
auto-configure {
    vlan-ranges {
        dynamic-profile profile-name {
            accept (inet);
            ranges (any | low-tag) - (any | high-tag);
        }
    }
    stacked-vlan-ranges {
        dynamic-profileprofile-name {
            accept (inet);
            ranges (any | low-tag - high-tag) , (any | low-tag - high-tag);
        }
    }
}
```

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced in JUNOS Release 9.5.

Description Enables the configuration of dynamic, auto-sensed VLANs.

The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics

auto-discovery

Syntax auto-discovery;

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name* mep *mep-id*]

Release Information Statement introduced in JUNOS Release 8.4.

Description Enable the MEP to accept continuity check messages from all remote MEPs.

Usage Guidelines See "Enabling Maintenance End Point Automatic Discovery" on page 651.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

auto-negotiation

See the following sections:

- auto-negotiation (Gigabit Ethernet) on page 877
- auto-negotiation (J-series uPIM) on page 878

auto-negotiation (Gigabit Ethernet)

Syntax
(auto-negotiation | no-auto-negotiation) remote-fault <local-interface-online |
local-interface-offline>;

Hierarchy Level
[edit interfaces *interface-name* gigether-options]

Release Information
Statement introduced in JUNOS Release 7.6.

Description
For Gigabit Ethernet interfaces only, explicitly enable autonegotiation and remote fault. In this mode, you can manually configure remote fault options. Include the no-auto-negotiation statement to disable autonegotiation. When you configure the Tri-Rate Ethernet copper interface to operate at 1 Gbps, autonegotiation must be enabled.

Default
Autonegotiation is automatically enabled. No explicit action is taken after the autonegotiation is complete or if the negotiation fails.

Options
no-auto-negotiation—Disables explicit autonegotiation.

remote-fault local-interface-online | local-interface-offline—(Optional) Manually configure remote fault on an interface. Specify remote fault as online or offline.
Default: online

Usage Guidelines
See “Configuring Gigabit Ethernet Autonegotiation” on page 719.

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

auto-negotiation (J-series uPIM)

Syntax (auto-negotiation | no-auto-negotiation);

Hierarchy Level [edit interfaces ge-*pim*/0/0 switch-options switch-port *port-number*]

Release Information Statement introduced in JUNOS Release 8.4.

Description For universal Physical Interface Modules (uPIMs) on J-series Services Routers only, explicitly enable autonegotiation. If the link speed and duplex are also configured, the interfaces use the values configured as the desired values in the negotiation. Include the no-auto-negotiation statement to disable autonegotiation.

If autonegotiation is disabled, the link speed and link mode must be configured.

Default Autonegotiation is enabled by default.

Options auto-negotiation—Enables autonegotiation.

no-auto-negotiation—Disables autonegotiation.

Usage Guidelines See "Configuring J-series Services Router Switching Interfaces" on page 559.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

auto-reconnect

Syntax auto-reconnect *seconds*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* pppoe-options],
[edit logical-systems *logical-system-name* interfaces *interface-name*
unit *logical-unit-number* pppoe-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For J-series Services Routers with PPP over Ethernet interfaces, configure the amount of time to wait before reconnecting after a session has terminated.

Options *seconds*—Time to wait before reconnecting after a session has terminated.
Range: 0 through 4,294,967,295 seconds
Default: 0 (immediately)

Usage Guidelines See "Configuring the PPPoE Automatic Reconnect Wait Timer" on page 746.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

backup-destination

Syntax backup-destination *address*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* tunnel],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* tunnel]

Release Information Statement introduced before JUNOS Release 7.4.

Description For tunnel interfaces, specify the remote address of the backup tunnel.

Options *address*—Address of the remote side of the connection.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics destination

backup-interface

Syntax backup-interface es-*fpc/pic/port*;

Hierarchy Level [edit interfaces es-*fpc/pic/port* es-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure a backup ES Physical Interface Card (PIC). If the primary ES PIC fails, the backup becomes active, inherits all the tunnels and security associations (SAs), and acts as the new next hop for IP Security (IPsec) traffic.

Options es-*fpc/pic/port*—Name of ES interface to serve as the backup.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

backup-options

Syntax

```
backup-options {
   interface interface-name;
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure an interface to be used as a backup interface if the primary interface goes down. This is used to support ISDN dial backup operation.

The remaining statement is explained separately.

Usage Guidelines See "Configuring an ISDN Dialer Interface as a Backup Interface" on page 780.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

bandwidth

Syntax bandwidth *rate*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure an informational-only bandwidth value for an interface. This statement is valid for all logical interface types, except multilink and aggregated interfaces.

Options *rate*—Peak rate, in bits per second (bps) or cells per second (cps). You can specify a value in bits per second either as a complete decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000). You can also specify a value in cells per second by entering a decimal number followed by the abbreviation c; values expressed in cells per second are converted to bits per second by means of the formula 1 cps = 384 bps.
Range: Not limited.

Usage Guidelines See "Configuring the Interface Bandwidth" on page 150.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

bandwidth-limit (firewall)

Syntax bandwidth-limit *bandwidth*;

Hierarchy Level [edit firewall hierarchical-policer aggregate if-exceeding]
[edit firewall hierarchical-policer premium if-exceeding]

Release Information Statement introduced in JUNOS Release 9.5.

Description On M40e, M120, and M320 (with FFPC and SFPC) edge routers and T320, T640, and T1600 core routers with Enhanced Intelligent Queuing (IQE) PICs, to define a policer to apply to nonpremium traffic in a hierarchical policer, use the bandwidth-limit statement at the [edit firewall hierarchical-policer aggregate if-exceeding] or [edit firewall hierarchical-policer premium if-exceeding] hierarchy level.

Options

Usage Guidelines See "Applying Policers" on page 185 and *Class of Service*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

bandwidth-limit (ethernet)

Syntax bandwidth-limit *bps*;

Hierarchy Level [edit interfaces *interface-name* gigether-options ethernet-switch-profile ethernet-policer-profile policer *cos-policer-name* aggregate],
[edit interfaces *interface-name* gigether-options ethernet-switch-profile ethernet-policer-profile policer *cos-policer-name* premium]

Release Information Statement introduced before JUNOS Release 7.4.

Description Define a policer to apply to nonpremium traffic.

Options *bps*—Bandwidth limit, in bits per second. Specify either as a complete decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000).
Range: 32 Kbps through 32 gigabits per second (Gbps). For IQ2 and IQ2-E interfaces 65,536 bps through 1 Gbps. For 10-Gigabit IQ2 and IQ2-E interfaces 65,536 bps through 10 Gbps.

Usage Guidelines See "Configuring Gigabit Ethernet Policers" on page 709.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics burst-size-limit (ethernet)

bchannel-allocation

Syntax bchannel-allocation (ascending | descending);

Hierarchy Level [edit interfaces *interface-name* isdn-options]

Release Information Statement introduced in JUNOS Release 8.3.

Description (J-series Services Routers equipped with a Dual-Port Channelized T1/E1 PIM) For Integrated Services Digital Network Primary Rate Interfaces (ISDN PRI), allocate PRI dialout B-channels in ascending or descending order.

Options (ascending | descending)—Allocate the B-channels in ascending (from low to high) or descending (from high to low) order.
Default: Descending order

Usage Guidelines See “Allocating B-Channels for Dialout” on page 497.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

bearer-bandwidth-limit

Syntax bearer-bandwidth-limit *kilobits-per-second*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* dynamic-call-admission-control],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* dynamic-call-admission-control]

Release Information Statement introduced in JUNOS Release 8.2.

Description (J4350 and J6350 Services Routers supporting voice over IP with the TGM550 media gateway module) For Fast Ethernet and Gigabit Ethernet interfaces, ISDN BRI interfaces, and serial interfaces with PPP or Frame Relay encapsulation, configure the bearer bandwidth limit (BBL). BBL is used for dynamic call admission control (dynamic CAC) to provide enhanced control over WAN bandwidth.

Options *kilobits-per-second*—The bearer bandwidth limit to be reported to a TGM550 media gateway module, in kilobits per second (kbps).
Range: 0 through 9999 kbps
Default: 1 (dynamic CAC is not enabled on the interface)

Usage Guidelines See “Configuring Dynamic Call Admission Control” on page 157.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS Services Interfaces Configuration Guide*, *J-series Services Router Basic LAN and WAN Access Configuration Guide*

bert-algorithm

Syntax bert-algorithm *algorithm*;

Hierarchy Level [edit interface ce1-*fpc/pic/port*]
[edit interface ct1-*fpc/pic/port*]
[edit interfaces *interface-name* ds0-options],
[edit interfaces *interface-name* e1-options],
[edit interfaces *interface-name* e3-options],
[edit interfaces *interface-name* t1-options],
[edit interfaces *interface-name* t3-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure the pattern to send in the bit stream during a bit error rate test (BERT). Applies to T1, E3, T3, and multichannel DS3 interfaces, the channelized interfaces (DS3, OC12, STM1), and channelized IQ and IQE interfaces (E1, E3 and DS3).

NOTE: When configuring CE1 interfaces on the 10-port Channelized E1/T1 IQE PIC, bert-algorithm must be set at the [edit interface ce1-fpc/pic/port] hierarchy level.

When configuring CT1 interfaces on the 10-port Channelized E1/T1 IQE PIC, bert-algorithm must be set at the [edit interface ct1-fpc/pic/port] hierarchy level.

Options *algorithm*—Pattern to send in the bit stream. There are two categories of test patterns: pseudorandom and repetitive. Both patterns conform to CCITT/ITU O.151, O.152, O.153, and O.161 standards. The algorithm can be one of the following patterns:

- all-ones-repeating—Pattern is all ones.
- all-zeros-repeating—Pattern is all zeros.
- alternating-double-ones-zeros—Pattern is alternating pairs of ones and zeros.
- alternating-ones-zeros—Pattern is alternating ones and zeros.
- pseudo-2e3—Pattern is $2^3 - 1$.
- pseudo-2e4—Pattern is $2^4 - 1$.
- pseudo-2e5—Pattern is $2^5 - 1$.
- pseudo-2e6—Pattern is $2^6 - 1$.
- pseudo-2e7—Pattern is $2^7 - 1$.
- pseudo-2e9-o153—Pattern is $2^9 - 1$, as defined in the O153 standard.
- pseudo-2e10—Pattern is $2^{10} - 1$.
- pseudo-2e11-o152—Pattern is $2^{11} - 1$, as defined in the O152 standard.
- pseudo-2e15-o151—Pattern is $2^{15} - 1$, as defined in the O151 standard.

- pseudo-2e17—Pattern is $2^{17} - 1$.
- pseudo-2e18—Pattern is $2^{18} - 1$.
- pseudo-2e20-o151—Pattern is $2^{20} - 1$, as defined in the O151 standard.
- pseudo-2e20-o153—Pattern is $2^{20} - 1$, as defined in the O153 standard.
- pseudo-2e21—Pattern is $2^{21} - 1$.
- pseudo-2e22—Pattern is $2^{22} - 1$.
- pseudo-2e23-o151—Pattern is $2^{23} - 1$, as defined in the O151 standard.
- pseudo-2e25—Pattern is $2^{25} - 1$.
- pseudo-2e28—Pattern is $2^{28} - 1$.
- pseudo-2e29—Pattern is $2^{29} - 1$.
- pseudo-2e31—Pattern is $2^{31} - 1$.
- pseudo-2e32—Pattern is $2^{32} - 1$.
- repeating-1-in-4—One bit in four is set to 1; the others are set to 0.
- repeating-1-in-8—One bit in eight is set to 1; the others are set to 0.
- repeating-3-in-24—Three bits in twenty four are set to 1; the others are set to 0.

Default: pseudo-2e3

Usage Guidelines See “Interface Diagnostics” on page 127, “Configuring E3 BERT Properties” on page 522, “Configuring T1 BERT Properties” on page 530, “Configuring T3 BERT Properties” on page 540, and “Examples: Configuring T3 Interfaces” on page 549.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics bert-error-rate, bert-period

bert-error-rate

Syntax bert-error-rate *rate*;

Hierarchy Level [edit interface ce1-*fpc*/*pic*/*port*]
[edit interface ct1-*fpc*/*pic*/*port*]
[edit interfaces *interface-name* ds0-options],
[edit interfaces *interface-name* e1-options],
[edit interfaces *interface-name* e3-options],
[edit interfaces *interface-name* t1-options],
[edit interfaces *interface-name* t3-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure the bit error rate to use in a BERT procedure. Applies to E1, E3, T1, or T3 interfaces, and to the channelized interfaces (DS3, OC3, OC12, STM1).

NOTE: When configuring CE1 interfaces on the 10-port Channelized E1/T1 IQE PIC, bert-error-rate must be set at the [edit interface ce1-fpc/pic/port] hierarchy level.

When configuring CT1 interfaces on the 10-port Channelized E1/T1 IQE PIC, bert-error-rate must be set at the [edit interface ct1-fpc/pic/port] hierarchy level.

Options *rate*—Bit error rate.

Range: 0 through 7, which corresponds to 10^{-1} (1 error per bit) to 10^{-7} (1 error per 10 million bits)

Default: 0

Usage Guidelines See “Interface Diagnostics” on page 127, “Configuring E3 BERT Properties” on page 522, “Configuring T1 BERT Properties” on page 530, “Configuring T3 BERT Properties” on page 540, and “Examples: Configuring T3 Interfaces” on page 549.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics bert-algorithm, bert-period

bert-period

Syntax bert-period *seconds*;

Hierarchy Level [edit interface ce1-*fpc/pic/port*],
[edit interface ct1-*fpc/pic/port*],
[edit interfaces *interface-name* ds0-options],
[edit interfaces *interface-name* e1-options],
[edit interfaces *interface-name* e3-options],
[edit interfaces *interface-name* t1-options],
[edit interfaces *interface-name* t3-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure the duration of a BERT test. Applies to E1, E3, T1, and T3 interfaces, and to E1, E3, T1, and T3 partitions on the channelized interfaces (CE1, CT1, DS3, OC3, OC12, OC48, STM1, STM4, and STM16).

E1 and T1 IQ, IQE, and standard interfaces support an extended BERT period range, up to 86,400 seconds (24 hours).

NOTE: When configuring CE1 interfaces on the 10-port Channelized E1/T1 IQE PIC, bert-period must be set at the [edit interface ce1-fpc/pic/port] hierarchy level.

When configuring CT1 interfaces on the 10-port Channelized E1/T1 IQE PIC, bert-period must be set at the [edit interface ct1-fpc/pic/port] hierarchy level.

Options **Range:**

seconds—Test duration. Range and default values vary by interface type.

- PIC-dependent—Normal BERT period: either 1 through 239 seconds or 1 through 240 seconds
- PIC-dependent—Extended BERT period: from 1 through 86,400 seconds

Default:

- Normal BERT period: 10 seconds
- Extended BERT period (on supported E1 interfaces): 10 seconds
- Extended BERT period (on supported T1 interfaces): 240 seconds

Usage Guidelines See “Interface Diagnostics” on page 127, “Configuring E1 BERT Properties” on page 514, “Configuring E3 BERT Properties” on page 522, “Configuring T1 BERT Properties” on page 530, and “Configuring T3 BERT Properties” on page 540.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics bert-algorithm, bert-error-rate

bridge-domain

Syntax bridge-domain *name*;

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management maintenance-domain routing-instances *name*]

Release Information Statement introduced in JUNOS Release 9.4.

Description Specify the OAM Ethernet CFM maintenance domain bridge domain.

Options *name*—Specify the name of the bridge domain.

Usage Guidelines See “Configuring Maintenance Intermediate Points” on page 648.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics maintenance-domain

broadcast

Syntax broadcast *address*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family *family* address *address*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family* address *address*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Set the broadcast address on the network or subnet. On a subnet you cannot specify a host address of 0, nor can you specify a broadcast address.

Default The default broadcast address has a host portion of all ones.

Options *address*—Broadcast address. The address must have a host portion of either all ones or all zeros. You cannot specify the addresses 0.0.0.0 or 255.255.255.255.

Usage Guidelines See “Configuring the Interface Address” on page 166.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

buildout

See the following sections:

- buildout (E3 or T3 over ATM Interfaces) on page 888
- buildout (T1 Interfaces) on page 889

buildout (E3 or T3 over ATM Interfaces)

Syntax buildout *feet*;

Hierarchy Level [edit interfaces at-*fpc/pic/port* e3-options],
[edit interfaces at-*fpc/pic/port* t3-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For E3 and T3 traffic over ATM interfaces, set the buildout value.

Options *feet*—The buildout value in feet.
Range: 0 through 450 feet (137 meters)
Default: 10 feet (3 meters)

Usage Guidelines See "Configuring E3 and T3 Parameters on ATM Interfaces" on page 323.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

buildout (T1 Interfaces)

Syntax buildout *value*;

Hierarchy Level [edit interface ct1-*fpc/pic/port*]
[edit interfaces *interface-name* t1-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For T1 interfaces, set the buildout value.

NOTE: When configuring CT1 interfaces on the 10-port Channelized E1/T1 IQE PIC, buildout must be set at the [edit interface ct1-fpc/pic/port] hierarchy level.

Default The default buildout value is 0 through 132 feet.

Options You can set the buildout value to one of the following:

- 0-132—0 through 132 feet (0 through 40 meters)
- 133-265—133 through 265 feet (40 through 81 meters)
- 266-398—266 through 398 feet (81 through 121 meters)
- 399-531—399 through 531 feet (121 through 162 meters)
- 532-655—532 through 655 feet (162 through 200 meters)
- long-0db—For J-series Services Routers only, long buildout with 0 decibel (dB) transmit attenuation
- long-7.5db—For J-series Services Routers only, long buildout with 7.5 dB transmit attenuation
- long-15db—For J-series Services Routers only, long buildout with 15 dB transmit attenuation
- long-22.5db—For J-series Services Routers only, long buildout with 22.5 dB transmit attenuation

Usage Guidelines See "Configuring the T1 Buildout" on page 531.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

bundle

Syntax bundle (ml-*fpc/pic/port* | ls-*fpc/pic/port*);

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family *family*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Associate the multilink interface with the logical interface it is joining. You can include this statement for the mlfr-end-to-end and mlfr-uni-nni protocol families only.

Options ml-*fpc/pic/port*—Name of the multilink interface you are linking.

ls-*fpc/pic/port*—Name of the link services interface you are linking.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

burst-size-limit (firewall)

Syntax bandwidth-limit *bandwidth*;

Hierarchy Level [edit firewall hierarchical-policer aggregate if-exceeding]
[edit firewall hierarchical-policer premium if-exceeding]

Release Information Statement introduced in JUNOS Release 9.5.

Description On M40e, M120, and M320 (with FFPC and SFPC) edge routers and T320, T640, and T1600 core routers with Enhanced Intelligent Queuing (IQE) PICs, to define a policer to apply to nonpremium traffic in a hierarchical policer, use the burst-size-limit statement at the [edit firewall hierarchical-policer aggregate if-exceeding] or [edit firewall hierarchical-policer premium if-exceeding] hierarchy level.

Options

Usage Guidelines See “Applying Policers” on page 185 and *Class of Service*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

burst-size-limit (ethernet)

Syntax burst-size-limit *bytes*;

Hierarchy Level [edit interfaces *interface-name* gigether-options ethernet-switch-profile ethernet-policer-profile policer *cos-policer-name* aggregate],
[edit interfaces *interface-name* gigether-options ethernet-switch-profile ethernet-policer-profile policer *cos-policer-name* premium]

Release Information Statement introduced before JUNOS Release 7.4.

Description Define a policer to apply to nonpremium traffic.

Options *bytes*—Burst length.

Range: 1500 through 100,000,000 bytes

Usage Guidelines See “Configuring Gigabit Ethernet Policers” on page 709.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics bandwidth-limit (ethernet)

byte-encoding

Syntax byte-encoding (nx56 | nx64);

Hierarchy Level [edit interface t1-*fpc/pic/port*]
[edit interfaces *interface-name* ds0-options],
[edit interfaces *interface-name* t1-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Set the byte encoding on a DS0 or T1 interface to use 7 bits per byte or 8 bits per byte.

NOTE: When configuring T1 interfaces on the 10-port Channelized E1/T1 IQE PIC, byte-encoding must be set at the [edit interface t1-fpc/pic/port] hierarchy level.

Default The default byte encoding is 8 bits per byte (nx64).

Options nx56—Use 7 bits per byte.

nx64—Use 8 bits per byte.

Usage Guidelines See “Configuring T1 Byte Encoding” on page 531.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

bytes

Syntax

```
bytes {
   c2 value;
   e1-quiet value;
   f1 value;
   f2 value;
   s1 value;
   z3 value;
   z4 value;
}
```

Hierarchy Level [edit interfaces *interface-name* sonet-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Set values in some SONET/SDH header bytes.

Options

c2 *value*—Path signal label SONET/SDH overhead byte. SONET/SDH frames use the C2 byte to indicate the contents of the payload inside the frame. SONET/SDH interfaces use the C2 byte to indicate whether the payload is scrambled.
Range: 0 through 255
Default: 0xCF

e1-quiet *value*—Default idle byte sent on the orderwire SONET/SDH overhead bytes. The routing platform does not support the orderwire channel, and hence sends this byte continuously.
Range: 0 through 255
Default: 0x7F

f1 *value*, f2 *value*, z3 *value*, z4 *value*—SONET/SDH overhead bytes.
Range: 0 through 255
Default: 0x00

s1 *value*—Synchronization message SONET overhead byte. This byte is normally controlled as a side effect of the system reference clock configuration and the state of the external clock coming from an interface if the system reference clocks have been configured to use an external reference.
Range: 0 through 255
Default: 0xCC

Usage Guidelines See “Configuring SONET/SDH Header Byte Values” on page 803.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics no-concatenate in the *JUNOS System Basics Configuration Guide*

callback

Syntax callback;

Hierarchy Level [edit interfaces dl*n* unit *logical-unit-number* dialer-options incoming-map],
[edit logical-systems *logical-system-name* interfaces dl*n* unit *logical-unit-number* dialer-options incoming-map]

Release Information Statement introduced in JUNOS Release 7.5.

Description (J-series Services Routers) For interfaces configured for ISDN, configure the dialer to terminate the incoming call and call back the originator after the callback wait period. The default wait time is 5 seconds. To configure the wait time, include the callback-wait-period statement at the [edit interfaces dl *n* unit *logical-unit-number* dialer-options] hierarchy level.

NOTE: The incoming-map statement is mandatory for the router to accept any incoming ISDN calls.

If the callback statement is configured, you cannot use the caller *caller-id* statement at the [edit interfaces dl*n* unit *logical-unit-number* dialer-options] hierarchy level.

Usage Guidelines See "Configuring Dial-In and Callback" on page 786.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

callback-wait-period

Syntax callback-wait-period *time*;

Hierarchy Level [edit interfaces dl*n* unit *logical-unit-number* dialer-options],
[edit logical-systems *logical-system-name* interfaces dl*n* unit *logical-unit-number* dialer-options]

Release Information Statement introduced in JUNOS Release 7.5.

Description (J-series Services Routers) For interfaces configured for ISDN with callback, specify the amount of time the dialer waits before calling back the caller. The default wait time is 5 seconds. The wait time is necessary because, when a call is rejected, the switch waits for up to 4 seconds on point-to-multipoint connections to ensure no other device accepts the call before sending the DISCONNECT message to the originator of the call. However, the default time of 5 seconds may not be sufficient for different switches or may not be needed on point-to-point connections.

To configure callback mode, include the callback statement at the [edit interfaces dl*n* unit *logical-unit-number* dialer-options] hierarchy level.

If the callback statement is configured, you cannot use the caller *caller-id* statement at the [edit interfaces dl*n* unit *logical-unit-number* dialer-options] hierarchy level.

Options *time*—Time the dialer waits before calling back the caller.

Usage Guidelines See "Configuring Dial-In and Callback" on page 786.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

caller

Syntax caller (*caller-id* | accept-all);

Hierarchy Level [edit interfaces dl*n* unit *logical-unit-number* dialer-options incoming-map],
[edit logical-systems *logical-system-name* interfaces dl*n* unit *logical-unit-number* dialer-options incoming-map]

Release Information Statement introduced in JUNOS Release 7.5.

Description (J-series Services Routers) For interfaces configured for ISDN, specify the dialer to accept a specified caller number or accept all incoming calls.

Options *caller-id*—Incoming caller number. You can configure multiple caller IDs on a dialer. The caller ID of the incoming call is matched against all caller IDs configured on all dialers. The dialer matching the caller ID is looked at for further processing. Only a precise match is a valid match, For example, the configured caller ID 1-222-333-4444 or 222-333-4444 will match the incoming caller ID 1-222-333-4444.

If the incoming caller ID has fewer digits than the number configured, it is not a valid match. Duplicate caller IDs are not allowed on different dialers; however, for example, the numbers 1-408-532-1091, 408-532-1091, and 532-1091 can still be configured on different dialers.

Only one B-channel can map to one dialer. If one dialer is already mapped, any other call mapping to the same dialer is rejected (except in the case of a multilink dialer). If no dialer caller is configured on a dialer, that dialer will not accept any calls.

accept-all—Any incoming call in an associated interface is accepted.

Usage Guidelines See “Configuring ISDN Interfaces” on page 773.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

calling-number

Syntax calling-number *number*;

Hierarchy Level [edit interfaces br-*pim*/0/*port* isdn-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For J-series Services Routers only. For ISDN interfaces, configure the calling number to include in outgoing calls.

Options *number*—Calling number.

Usage Guidelines See “Configuring ISDN Physical Interface Properties” on page 775.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

cbit-parity

Syntax (cbit-parity | no-cbit-parity);

Hierarchy Level [edit interfaces *interface-name* t3-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For T3 interfaces only, enable or disable C-bit parity mode, which controls the type of framing that is present on the transmitted T3 signal. When C-bit parity mode is enabled, the C-bit positions are used for the far-end block error (FEBE), far-end alarm and control (FEAC), terminal data link, path parity, and mode indicator bits, as defined in ANSI T1.107a-1989. For ATM and ATM2 IQ2 and IQ2-E interfaces, M23 framing is used when the no-cbit-parity statement is included. For all other interfaces, M13 framing is used when the no-cbit-parity statement is included.

Default C-bit parity mode is enabled.

Usage Guidelines See “Configuring E3 and T3 Parameters on ATM Interfaces” on page 323 and “Disabling T3 C-Bit Parity Mode” on page 541.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

cbr

Syntax cbr *rate*;

Hierarchy Level [edit interfaces at-*fpc/pic/port* atm-options vpi *vpi-identifier* shaping],
[edit interfaces at-*fpc/pic/port* unit *logical-unit-number* address *address* family *family* multipoint-destination *address* shaping],
[edit interfaces at-*fpc/pic/port* unit *logical-unit-number* shaping],
[edit logical-systems *logical-system-name* interfaces at-*fpc/pic/port* unit *logical-unit-number* address *address* family *family* multipoint-destination *address* shaping],
[edit logical-systems *logical-system-name* interfaces at-*fpc/pic/port* unit *logical-unit-number* shaping]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM encapsulation only, define a constant bit rate bandwidth utilization in the traffic-shaping profile.

Default Unspecified bit rate (UBR); that is, bandwidth utilization is unlimited.

Options *rate*—Peak rate, in bits per second (bps) or cells per second (cps). You can specify a value in bits per second either as a complete decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000). You can also specify a value in cells per second by entering a decimal number followed by the abbreviation c; values expressed in cells per second are converted to bits per second by means of the formula 1 cps = 384 bps.

For ATM1 OC3 interfaces, the maximum available rate is 100 percent of *line-rate*, or 135,600,000 bps. For ATM1 OC12 interfaces, the maximum available rate is 50 percent of *line-rate*, or 271,263,396 bps. For ATM2 IQ interfaces, the maximum available rate is 542,526,792 bps.

Usage Guidelines See “Defining the ATM Traffic-Shaping Profile” on page 305.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics rtvbr, shaping, vbr

cell-bundle-size

Syntax cell-bundle-size *cells*;

Hierarchy Level [edit interfaces at-*fpc/pic/port* atm-options],
[edit interfaces at-*fpc/pic/port* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces at-*fpc/pic/port* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM2 IQ interfaces using ATM Layer 2 circuit cell-relay transport mode only, you can configure the maximum number of ATM cells per frame.

Options *cells*—Maximum number of cells.

Default: 1 cell

Range: 1 through 176 cells

Usage Guidelines See "Configuring the Layer 2 Circuit Cell-Relay Cell Maximum" on page 299.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

chap

Syntax

```
chap {
   access-profile name;
   default-chap-secret name;
   local-name name;
   passive;
}
```

Hierarchy Level [edit interfaces *interface-name* ppp-options],
[edit interfaces *interface-name* unit *logical-unit-number* ppp-options],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* ppp-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Allows each side of a link to challenge its peer, using a “secret” known only to the authenticator and that peer. The secret is not sent over the link.

By default, PPP CHAP is disabled. If CHAP is not explicitly enabled, the interface makes no CHAP challenges and denies all incoming CHAP challenges.

For ATM2 IQ interfaces only, you can configure CHAP on the logical interface unit if the logical interface is configured with one of the following PPP over ATM encapsulation types:

- atm-ppp-llc—PPP over AAL5 LLC encapsulation.
- atm-ppp-vc-mux—PPP over AAL5 multiplex encapsulation.

The statements are explained separately.

Usage Guidelines See “Configuring the PPP Challenge Handshake Authentication Protocol” on page 106.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS System Basics Configuration Guide*

chap-secret

Syntax chap-secret *chap-secret*;

Hierarchy Level [edit access profile *profile-name* client *client-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For interfaces with PPP encapsulation on which the PPP Challenge Handshake Authentication Protocol (CHAP) is configured, configure the shared secret, as defined in RFC 1994.

Options *chap-secret*—The secret key associated with a peer.

Usage Guidelines See "Configuring PPP CHAP Authentication" on page 155.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Topics pap-password and the *JUNOS System Basics Configuration Guide*

cisco-interoperability

Syntax cisco-interoperability send-lip-remove-link-for-link-reject;

Hierarchy Level [edit interfaces *interface-name* mlfr-uni-nni-bundle-options]

Release Information Statement introduced in JUNOS Release 7.4.

Description FRF.16 interoperability settings.

Options send-lip-remove-link-for-link-reject—Send Link Integrity Protocol remove link when an add-link rejection message is received.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

classifier

Syntax

```
classifier {
  per-unit-scheduler {
    forwarding-class class-name {
      loss-priority (high | low);
    }
  }
}
```

Hierarchy Level [edit interfaces *interface-name* gigether-options ethernet-switch-profile ethernet-policer-profile output-priority-map]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Gigabit Ethernet IQ and 10-Gigabit Ethernet interfaces only, define the classifier for the output priority map to be applied to outgoing frames on this interface.

The statements are explained separately.

Usage Guidelines See “Specifying an Output Priority Map” on page 710.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics input-priority-map

clear-dont-fragment-bit

Syntax clear-dont-fragment-bit;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Clear the don’t-fragment (DF) bit on all IP version 4 (IPv4) packets entering a generic routing encapsulation (GRE) tunnel. If the encapsulated packet’s size exceeds the tunnel’s maximum transmission unit (MTU), the packet is fragmented before encapsulation.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

client

Syntax client;

Hierarchy Level [edit interfaces pp0 unit *logical-unit-number* pppoe-options],
[edit logical-systems *logical-system-name* interfaces pp0 unit *logical-unit-number* pppoe-options]

Release Information Statement introduced in JUNOS Release 8.5.

Description Configure the router to operate in the PPPoE client mode. Supported on J-series Services Routers.

Usage Guidelines See “Configuring the PPPoE Client Mode” on page 748.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

clocking

Syntax clocking (external [interface *interface-name*] | internal);

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.
interface option added in JUNOS Release 8.2.

Description For interfaces that can use various clock sources, configure the source of the transmit clock on each interface.

Options external—The clock source is provided by the data communication equipment (DCE).

interface *interface-name*—For interfaces operating on T1/E1 PIMs for J-series Services Routers only, configure clocking for the drop-and insert feature. When configuring this feature, both ports must use the same clock source: either the router's internal clock or an external clock on one of the interfaces. If an external clock source is required, one interface must specify clocking external and the other must specify the same clock.

internal—Use the internal stratum 3 clock as the reference clock.

Default: internal

Usage Guidelines See "Configuring the Clock Source" on page 121 or "Configuring the Clock Source on SONET/SDH Interfaces" on page 829 and "Clock Sources on Channelized Interfaces" on page 376, and "Configuring a Channelized T1/E1 Interface to Drop and Insert Time Slots" on page 494.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics loop-timing

clocking-mode

Syntax clocking-mode (dce | internal | loop);

Hierarchy Level [edit interfaces *interface-name* serial-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For EIA-530 and V.35 interfaces, configure the clock mode. You cannot configure clocking-mode dce on a DTE router using an X.21 serial line protocol (detected automatically when an X.21 cable is plugged into the serial interface).

Options dce—DCE timing (DTE mode only, not valid for X.21).

internal—Internal baud timing.

loop—Loop timing.

Default: loop

Usage Guidelines See “Configuring the Serial Clocking Mode” on page 255.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration

Related Topics Configuring the DTE Clock Rate on page 256

clock-rate

Syntax clock-rate *rate*;

Hierarchy Level [edit interfaces *interface-name* serial-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For EIA-530 and V.35 interfaces, configure the interface speed, in megahertz (MHz).

Options *rate*—You can specify one of the following rates:

- 2.048 MHz
- 2.341 MHz
- 2.731 MHz
- 3.277 MHz
- 4.096 MHz
- 5.461 MHz
- 8.192 MHz
- 16.384 MHz

Default: 16.384mhz

Usage Guidelines See “Configuring the Serial Clocking Mode” on page 255.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

compatibility-mode

Syntax compatibility-mode (adtran | digital-link | kentrox | larscom | verilink) <subrate *value*>;

Hierarchy Level [edit interfaces *interface-name* e3-options],
[edit interfaces *interface-name* t3-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure the E3 or T3 interface to be compatible with the channel service unit (CSU) at the remote end of the line.

Default If you omit this option, the full E3 or T3 rate is used.

Options adtran—For T3 IQ interfaces only, configure compatibility with Adtran CSUs.

digital-link—Configure compatibility with Digital Link CSUs. If you include this option on an E3 interface, you must also disable payload scrambling.

kentrox—Configure compatibility with Kentrox CSUs. Kentrox subrate is valid for E3 IQ and T3 IQ interfaces only.

larscom—For T3 and T3 IQ interfaces only, configure compatibility with Larscom CSUs.

verilink—For T3 IQ and T3 IQE interfaces only, configure compatibility with Verilink CSUs

NOTE: Verilink configuration is not functional if an IQ interface is paired with an IQE interface.

subrate *value*—Subrate of the E3 or T3 line.
Range: For Kentrox CSUs on E3 IQ interfaces and T3 IQ interfaces the subrate value must match the value configured on the CSU. Each increment of the subrate value corresponds to a rate increment of about 0.5 Mbps.

Usage Guidelines See “Configuring the E3 CSU Compatibility Mode” on page 523 and “Configuring the T3 CSU Compatibility Mode” on page 542.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics payload-scrambler

compression

See the following sections:

- compression (PPP Properties) on page 908
- compression (Voice Services) on page 909

compression (PPP Properties)

Syntax

```
compression {
   acfc;
   pfc;
}
```

Hierarchy Level

[edit interfaces *interface-name* ppp-options],
[edit interfaces *interface-name* unit *logical-unit-number* ppp-options],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* ppp-options]

Release Information

Statement introduced before JUNOS Release 7.4.

Description

For interfaces with PPP encapsulation, set Link Control Protocol (LCP) compression options.

The statements are explained separately.

Usage Guidelines

See "Configuring PPP Address and Control Field Compression" on page 114 and "Configuring the PPP Protocol Field Compression" on page 115.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

compression (Voice Services)

Syntax

```
compression {
  rtp {
    f-max-period number;
    queues [ queue-numbers ];
    port {
      minimum port-number;
      maximum port-number;
    }
  }
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure the compression properties for voice services traffic.

The remaining statements are described separately.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

compression-device

Syntax compression-device *interface-name*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Specify the compression interface for voice services traffic.

Options *interface-name*—Logical interface used for compression.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

connections

Syntax

```
connections {
    interface-switch connection-name {
        interface interface-name.unit-number;
        interface interface-name.unit-number;
    }
}
```

Hierarchy Level [edit protocols]

Release Information Statement introduced before JUNOS Release 7.4.

Description Define the connection between two circuits in a circuit cross-connect (CCC) connection.

The statements are explained separately.

Usage Guidelines See “Defining the Connection for Switching Cross-Connects” on page 218.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Topics *JUNOS MPLS Applications Configuration Guide*

connectivity-fault-management

Syntax

```
connectivity-fault-management {
  action-profile profile-name {
    default-action {
      interface-down;
    }
  }
  performance-monitoring {
    hardware-assisted-timestamping;
  }
  linktrace {
    age (30m | 10m | 1m | 30s | 10s);
    path-database-size path-database-size;
  }
  maintenance-domain domain-name {
    level number;
    name-format (character-string | none | dns | mac+2oct);
    maintenance-association ma-name {
      short-name-format (character-string | vlan | 2octet | rfc-2685-vpn-id);
      continuity-check {
        hold-interval (OAM) minutes;
        interval (10m | 10s | 1m | 1s| 100ms);
        loss-threshold number;
      }
      mep mep-id {
        auto-discovery;
        direction (up | down);
        interface interface-name;
        priority number;
        remote-mep mep-id {
          action-profile profile-name;
        }
      }
    }
  }
}
```

Hierarchy Level [edit protocols oam ethernet]

Release Information Statement introduced in JUNOS Release 8.4.

Description For Ethernet interfaces on M320, MX-series, and T-series routing platforms, specify connectivity fault management for IEEE 802.1ag Operation, Administration, and Management (OAM) support.

The remaining statements are explained separately.

Usage Guidelines See “Configuring IEEE 802.1ag OAM Connectivity-Fault Management” on page 645.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

container-devices

Syntax

```
container-devices {
   device-count number;
}
```

Hierarchy Level [edit chassis]

Release Information Statement introduced in JUNOS Release 9.2.

Description Specify the container devices configuration. The number option specifies the number of sequentially numbered container interfaces, from ci0 to ci127 maximum.

Options number—Number of container devices.

Range: 1 through 128

Usage Guidelines See "Configuring Container Interfaces" on page 817.

Required Privilege Level chassis—To view this statement in the configuration.
chassis-control—To add this statement to the configuration.

container-list

Syntax container-list [*container-interface-names*];

Hierarchy Level [edit interfaces container-options]

Release Information Statement introduced in JUNOS Release 9.2.

Description Specify a list of container interfaces; for example: ci*0*, ci*1*, and up to ci*127*.

Options *container-interface-names*—Name of each container interface.

Usage Guidelines See "Configuring Container Interfaces" on page 817.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics container-options

container-options

Syntax

```
container-options {
   container-list [ container-interface-names ];
   container-type aps;
   member-interface-type sonet {
      member-interface-speed [ speed ];
   }
}
```

Hierarchy Level [edit interfaces]

Release Information Statement introduced in JUNOS Release 9.2.

Description Specify the container interface options.

Options interface-name—Name of the SONET or the container interface.

aps—Specify the member link interface type of the container as APS.

sonet—Protocol type of the container interface.

speed—Set interface speed to OC3, OC12, OC48, OC192, OC768, or mixed.

Usage Guidelines See "Configuring Container Interfaces" on page 817.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

container-type

Syntax container-type *aps*;

Hierarchy Level [edit interfaces container-options]

Release Information Statement introduced in JUNOS Release 9.2.

Description Specify the container-options interface type.

Options aps—Configure the interface type to be Automatic Protection Switching (APS).

Usage Guidelines See "Configuring Container Interfaces" on page 817

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

continuity-check

Syntax

```
continuity-check {
    hold-interval (OAM) minutes;
    interval (10m | 10s | 1m | 1s| 100ms | 10ms);
    loss-threshold number;
}
```

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name*]

Release Information Statement introduced in JUNOS Release 8.4.

Description Specify continuity check protocol options.

Options The remaining statements are explained separately.

Usage Guidelines See “Configuring the Continuity Check” on page 650.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

control-channel

Syntax

```
control-channel channel-name {
    vlan vlan-id;
}
```

Hierarchy Level [edit protocols protection-group ethernet-ring *name* (east-interface | west-interface)]

Release Information Statement introduced in JUNOS Release 9.4.

Description Configure the Ethernet RPS control channel logical interface to carry the RAPS PDU. The related physical interface is the physical ring port.

Options vlan *vlan-id*—If the control channel logical interface is a trunk port, then a dedicated vlan *vlan-id* defines the dedicated VLAN channel to carry the RAPS traffic. Only configure the *vlan-id* when the control channel logical interface is the trunk port.

Usage Guidelines See “Configuring Ethernet Ring Protection Switching” on page 753.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

control-polarity

Syntax control-polarity (negative | positive);

Hierarchy Level [edit interfaces *interface-name* serial-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For X.21 interfaces only, configure the control signal polarity.

Options positive—Positive signal polarity.

negative—Negative signal polarity.

Default: positive

Usage Guidelines See “Configuring Serial Signal Polarities” on page 260.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

control-signal

Syntax control-signal (assert | de-assert | normal);

Hierarchy Level [edit interfaces *interface-name* serial-options dce-options],
[edit interfaces *interface-name* serial-options dte-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For X.21 interfaces only, configure the to-DCE signal.

Options assert—The to-DCE signal must be asserted.

de-assert—The to-DCE signal must be deasserted.

normal—Normal request-to-send (RTS) signal handling, as defined by ITU-T Recommendation X.21.

Default: normal

Usage Guidelines See “Configuring the Serial Signal Handling” on page 257.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

copy-tos-to-outer-ip-header

Syntax copy-tos-to-outer-ip-header;

Hierarchy Level [edit interfaces at-*fpc/pic/port* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces at-*fpc/pic/port* unit *logical-unit-number*]

Release Information Statement introduced in JUNOS Release 8.2.

Description For GRE tunnel interfaces only, enable the inner IP header's TOS bits to be copied to the outer IP packet header.

Default If you omit this statement, the TOS bits in the outer IP header are set to 0.

Usage Guidelines See the *JUNOS Class of Service Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

core-dump

Syntax (core-dump | no-core-dump);

Hierarchy Level [edit interfaces mo-*fpc/pic/port* multiservice-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For monitoring services interfaces only, a useful tool for isolating the cause of a problem. Core dumping is enabled by default. The directory /var/tmp contains core files. The JUNOS software saves the current core file (0) and the four previous core files, which are numbered 1 through 4 (from newest to oldest):

- core-dump—Enable the core dumping operation.
- no-core-dump—Disable the core dumping operation.

Usage Guidelines See "Configuring Multiservice Physical Interface Properties" on page 132 or the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

crc-major-alarm-threshold

Syntax crc-major-alarm-threshold (1e-3 | 5e-4 | 1e-4 | 5e-5 | 1e-5);

Hierarchy Level [edit interfaces *interface-name* t1-options]

Release Information Statement introduced in JUNOS Release 8.5.

Description Major alarm error thresholds for T1 CRC errors. When the threshold is exceeded for one second, a defect condition is declared. If the defect condition continues for the monitoring period, an alarm condition is declared.

Default 10-second monitoring period for all settings except 1e-5. The 1e-5 value uses a 50-second monitoring period.

Options rate—Error rate expressed as the number of errors per number of bits. The value 1e-3 is one error in 10^{-3} bits and 5e-4 is five errors in 10^{-4} bits.
Default: 5e-5

Usage Guidelines See “Configuring T1 CRC Error Major Alarm Thresholds” on page 532.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

crc-minor-alarm-threshold

Syntax crc-minor-alarm-threshold (1e-3 | 5e-4 | 1e-4 | 5e-5 | 1e-5 | 5e-6 | 1e-6);

Hierarchy Level [edit interfaces *interface-name* t1-options]

Release Information Statement introduced in JUNOS Release 8.5.

Description Minor alarm error thresholds for T1 CRC errors. When the threshold is exceeded for one second, a defect condition is declared. If the defect condition continues for the monitoring period, an alarm condition is declared.

Default 10-second monitoring period for values 1e-3, 5e-4, 1e-4, and 5e-5. The 1e-5 value uses a 50-second monitoring period. The 5e-6 value uses a 100-second monitoring period. The 1e-6 value uses a 500-second monitoring period.

Options rate—Error rate expressed as the number of errors per number of bits. The value 1e-3 is one error in 10^{-3} bits and 5e-4 is five errors in 10^{-4} bits.
Default: 5e-6

Usage Guidelines See “Configuring T1 CRC Error Minor Alarm Thresholds” on page 532.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

cts

Syntax cts (ignore | normal | require);

Hierarchy Level [edit interfaces *interface-name* serial-options dce-options],
[edit interfaces *interface-name* serial-options dte-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For EIA-530 and V.35 interfaces only, configure the from-DCE signal, clear-to-send (CTS).

Options ignore—The from-DCE signal is ignored.

normal—Normal CTS signal handling as defined by the TIA/EIA Standard 530.

require—The from-DCE signal must be asserted.

Default: normal

Usage Guidelines See "Configuring the Serial Signal Handling" on page 257.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

cts-polarity

Syntax cts-polarity (negative | positive);

Hierarchy Level [edit interfaces *interface-name* serial-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure CTS signal polarity.

Options positive—Positive signal polarity.

negative—Negative signal polarity.

Default: positive

Usage Guidelines See "Configuring Serial Signal Polarities" on page 260.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

current

Syntax current *margin*;

Hierarchy Level [edit interfaces *interface-name* shdsl-options snr-margin],
[edit logical-systems *logical-system-name* interfaces *interface-name* shdsl-options snr-margin]

Release Information Statement introduced in JUNOS Release 7.4.

Description For J-series Services Routers only, configure the current target signal-to-noise ratio (SNR) margin to be used when training the SHDSL line. The current margin is the difference between desired SNR and the actual SNR. When configured, the line trains at higher than the current margin plus SNR threshold.

Options *margin*—Desired current SNR margin. Specify either disabled or a value from 0 dB through 10 dB.
Default: 0 dB

Usage Guidelines See "Configuring ATM-over-SHDSL Interfaces" on page 347.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

data-input

Syntax data-input (system | interface *interface-name*);

Hierarchy Level [edit interfaces ds-*pim*/0/*port*:*channel*]

Release Information Statement introduced in JUNOS Release 8.2.

Description For interfaces operating on T1/E1 PIMs for J-series Services Routers only, configure whether an interface should send and receive data from the Routing Engine or from a given interface name. On channelized T1/E1 interfaces partitioned into channels, you can insert time slots from one port directly into the other port on the same PIM, to replace time slots coming through the Routing Engine.

To avoid slips, both ports must use the same clock source: either the router's internal clock or an external clock on one of the interfaces. If an external clock source is required, one interface must specify clocking external and the other must specify the same clock by including the clocking external interface *interface-name* statement at the [edit interface *interface-name*] hierarchy level.

Options system—Interface sends and receives data from the Routing Engine.

interface *interface-name*—Interface sends and receives data from a specific interface.

Default: Data is sent and received from the Routing Engine (system).

Usage Guidelines See "Configuring a Channelized T1/E1 Interface to Drop and Insert Time Slots" on page 494 and the *J-series Services Router Basic LAN and WAN Access Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics clocking

dcd

Syntax dcd (ignore | normal | require);

Hierarchy Level [edit interfaces *interface-name* serial-options dce-options],
[edit interfaces *interface-name* serial-options dte-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For EIA-530 and V.35 interfaces only, configure the from-DCE signal, data-carrier-detect (DCD).

Options ignore—The from-DCE signal is ignored.

normal—Normal DCD signal handling as defined by the TIA/EIA Standard 530.

require—The from-DCE signal must be asserted.

Default: normal

Usage Guidelines See "Configuring the Serial Signal Handling" on page 257.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

dcd-polarity

Syntax dcd-polarity (negative | positive);

Hierarchy Level [edit interfaces *interface-name* serial-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure DCD signal polarity.

Options positive—Positive signal polarity.

negative—Negative signal polarity.

Default: positive

Usage Guidelines See "Configuring Serial Signal Polarities" on page 260.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

dce

Syntax dce;

Hierarchy Level [edit interfaces *interface-name*],
[edit interfaces *interface-name* serial-options clocking-mode]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Frame Relay only, respond to status enquiry message keepalives.

When you configure the routing platform to be a DCE, keepalives are disabled by default.

Default The routing platform operates in DTE mode.

Usage Guidelines See “Configuring the Router as a DCE with Frame Relay Encapsulation” on page 366.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

dce-options

Syntax

```
dce-options {
    control-signal (assert | de-assert | normal);
    cts (ignore | normal | require);
    dcd (ignore | normal | require);
    dsr (ignore | normal | require);
    dtr signal-handling-option;
    ignore-all;
    indication (ignore | normal | require);
    rts (assert | de-assert | normal);
    tm (ignore | normal | require);
}
```

Hierarchy Level [edit interfaces *interface-name* serial-options]

Release Information Statement introduced in JUNOS Release 8.3.
Statement previously known as control-leads

Description For J-series Services Routers, configure the serial interface signal characteristics.

The statements are explained separately.

Usage Guidelines See “Configuring the Serial Signal Handling” on page 257.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

deactivation-delay

Syntax deactivation-delay *seconds*;

Hierarchy Level [edit interface dl*n* unit *logical-unit-number* dialer-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description (J-series Services Routers) For ISDN interfaces, configure the ISDN deactivation delay. Used only for dialer backup and dialer watch cases.

Options *seconds*—Interval before the backup interface is deactivated after the primary interface has comes up.

Range: 1 through 4294967295 seconds

Default: 0 (zero)

Usage Guidelines See "Configuring ISDN Logical Interface Properties" on page 777.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

default-action

Syntax

```
default-action {
    interface-down;
}
```

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management action-profile *profile-name*]

Release Information Statement introduced in JUNOS Release 8.4.

Description Define the action to be taken when connectivity to the remote MEP is lost.

Default If no action is configured, no action is taken.

Options interface-down—When a remote MEP connectivity failure is detected, bring the interface down.

Usage Guidelines See "Configuring a CFM Action Profile Action" on page 653.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

default-chap-secret

Syntax default-chap-secret *name*;

Hierarchy Level [edit interfaces *interface-name* ppp-options chap],
[edit interfaces *interface-name* unit *logical-unit-number* ppp-options chap],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* ppp-options chap]

Release Information Statement introduced in JUNOS Release 8.0.

Description Define the default CHAP secret to be used when no matching CHAP access profile exists.

For ATM2 IQ interfaces only, you can configure a default CHAP secret on the logical interface unit if the logical interface is configured with one of the following PPP over ATM encapsulation types:

- atm-ppp-llc—PPP over AAL5 LLC encapsulation.
- atm-ppp-vc-mux—PPP over AAL5 multiplex encapsulation.

Default If you do not include the default-chap-secret statement in the configuration, and an interface receives a CHAP challenge or response from a peer that is not in the applied access profile, the link is immediately dropped.

Usage Guidelines See “Configuring a Default CHAP Secret” on page 107.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics access-profile

default-pap-password

Syntax default-pap-password *password*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* ppp-options pap],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* ppp-options pap]

Release Information Statement introduced in JUNOS Release 8.3.

Description For PAP authentication, the default PAP password.

Usage Guidelines See “Configuring a Default PAP Password” on page 156.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics access-profile

demux0

Syntax

```
demux0 {
    unit logical-unit-number {
        demux-options {
            underlying-interface interface-name
        }
        family family {
            demux-destination {
                destination-prefix;
            }
            demux-source {
                source-prefix;
            }
            unnumbered-address interface-name <preferred-source-address address>;
        }
    }
}
```

Hierarchy Level

[edit interfaces],
[edit logical-systems *logical-system-name* interfaces]

Release Information

Statement introduced in JUNOS Release 9.0.

Description

Configure the logical demultiplexing (demux) interface.

The statements are explained separately.

Usage Guidelines

See “Specifying the Demux Underlying Interface” on page 241 and “Configuring IP Demux Prefixes” on page 241.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

demux-destination

See the following sections:

- demux-destination (Underlying Interface) on page 926
- demux-destination (Demux Interface) on page 927

demux-destination (Underlying Interface)

Syntax demux-destination *family*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced in JUNOS Release 9.0.
Support for aggregated Ethernet added in JUNOS Release 9.4.

Description Configure the logical demultiplexing (demux) destination family type on the IP demux underlying interface.

NOTE: The IP demux interface feature currently supports only Fast Ethernet, Gigabit Ethernet, 10-Gigabit Ethernet, or aggregated Ethernet underlying interfaces.

Usage Guidelines See "Configuring an IP Demux Underlying Interface" on page 240.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

demux-destination (Demux Interface)

Syntax

```
demux-destination {
    destination-prefix;
}
```

Hierarchy Level

[edit interfaces *interface-name* unit *logical-unit-number* family *family*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

Release Information

Statement introduced in JUNOS Release 9.0.
Support for aggregated Ethernet added in JUNOS Release 9.4.

Description

Configure one or more logical demultiplexing (demux) destination prefixes. The prefixes are matched against the destination address of packets that the underlying interface receives. When a match occurs, the packet is processed as if it was received on the demux interface.

Usage Guidelines

See "Configuring IP Demux Prefixes" on page 241.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

demux-options

Syntax

```
demux–options {
    underlying-interface interface-name
}
```

Hierarchy Level

[edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information

Statement introduced in JUNOS Release 9.0.

Description

Configure logical demultiplexing (demux) interface options.

The statement is explained separately.

Usage Guidelines

See "Specifying the Demux Underlying Interface" on page 241.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

demux-source

See the following sections:

- demux-source (Underlying Interface) on page 928
- demux-source (Demux Interface) on page 929

demux-source (Underlying Interface)

Syntax demux-source *family*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* interfaces *interface-name* unit *logical-unit-number*],

Release Information Statement introduced in JUNOS Release 9.0.
Support for aggregated Ethernet added in JUNOS Release 9.4.

Description Configure the logical demultiplexing (demux) source family type on the IP demux underlying interface.

NOTE: The IP demux interface feature currently supports only Fast Ethernet, Gigabit Ethernet, 10-Gigabit Ethernet, or aggregated Ethernet underlying interfaces.

Usage Guidelines See "Configuring an IP Demux Underlying Interface" on page 240.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

demux-source (Demux Interface)

Syntax
demux-source {
  source-prefix;
}

Hierarchy Level
[edit interfaces *interface-name* unit *logical-unit-number* family *family*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

Release Information
Statement introduced in JUNOS Release 9.0.
Support for aggregated Ethernet added in JUNOS Release 9.4.

Description
Configure one or more logical demultiplexing (demux) source prefixes. The prefixes are matched against the source address of packets that the underlying interface receives. When a match occurs, the packet is processed as if it was received on the demux interface.

Usage Guidelines
See “Configuring IP Demux Prefixes” on page 241.

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

description

Syntax
description *text*;

Hierarchy Level
[edit interfaces *interface-name*],
[edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information
Statement introduced before JUNOS Release 7.4.

Description
Provide a textual description of the interface or the logical unit. Any descriptive text you include is displayed in the output of the show interfaces commands, and is also exposed in the ifAlias Management Information Base (MIB) object. It has no effect on the operation of the interface or the routing platform.

Options
text—Text to describe the interface. If the text includes spaces, enclose the entire text in quotation marks.

Usage Guidelines
See “Adding an Interface Description to the Configuration” on page 90 and “Adding a Logical Unit Description to the Configuration” on page 148.

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

destination

See the following sections:

- destination (DLSw) on page 930
- destination (IPCP) on page 931
- destination (Routing Instance) on page 931
- destination (Tunnels) on page 932

NOTE: For information about the destination statement at the [edit interfaces *interface-name* unit *unit-number* family inet address *address* (vrrp-group | vrrp-inet6-group) *group-number*] or [edit logical-systems *logical-system-name* interfaces *interface-name* unit *unit-number* family (inet | inet6) address *address* (vrrp-group | vrrp-inet6-group) *group-number*] hierarchy level, see the *JUNOS High Availability Configuration Guide*.

destination (DLSw)

Syntax destination *mac-address* priority-cost *priority*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family llc2 redundancy-group *group-number* track dlsw],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family llc2 redundancy-group *group-number* track dlsw]

Release Information Statement introduced in JUNOS Release 7.5.

Description For J-series Services Routers only. On Ethernet interfaces configured for DLSw Ethernet redundancy, enable tracking options for a destination MAC address.

Options *mac-address*—Local MAC address. Specify the MAC address as six hexadecimal bytes in one of the following formats: *nnnn*.*nnnn*.*nnnn* or *nn*:*nn*:*nn*:*nn*:*nn*:*nn*. For example, 0011.2233.4455 or 00:11:22:33:44:55.

priority-cost *priority*—Cost value that is subtracted from the priority value when remote peer connectivity is lost. Specify a value from 1 through 254.

Usage Guidelines See "Configuring DLSw Ethernet Redundancy Using LLC2 Properties" on page 172.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

destination (IPCP)

Syntax destination *address* destination-profile *profile-name*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet unnumbered-address *interface-name*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet unnumbered-address *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For unnumbered interfaces with PPP encapsulation, specify the IP address of the remote interface.

Options *address*—IP address of the remote interface.

The destination-profile statement is explained separately.

Usage Guidelines See "Configuring IPCP Options" on page 168.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics address, negotiate-address, *JUNOS System Basics Configuration Guide*

destination (Routing Instance)

Syntax destination *routing-instance-name*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* tunnel routing-instance],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* tunnel routing-instance]

Release Information Statement introduced before JUNOS Release 7.4.

Description Specify the destination routing instance that points to the routing table containing the tunnel destination address.

Default The default Internet routing table inet.0.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

destination (Tunnels)

Syntax destination *address*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address*],
[edit interfaces *interface-name* unit *logical-unit-number* family inet unnumbered-address *interface-name*],
[edit interfaces *interface-name* unit *logical-unit-number* tunnel],
[edit logical-systems *logical-system-name* interfaces interface-name unit *logical-unit-number* family inet address *address*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet unnumbered-address *interface-name*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* tunnel]

Release Information Statement introduced before JUNOS Release 7.4.

Description For encryption, PPP-encapsulated, and tunnel interfaces, specify the remote address of the connection.

Options *address*—Address of the remote side of the connection.

Usage Guidelines See “Configuring the Interface Address” on page 166 or the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics point-to-point

destination-class-usage

Syntax destination-class-usage;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet accounting],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet accounting]

Release Information Statement introduced before JUNOS Release 7.4.

Description Enable packet counters on an interface that count packets that arrive from specific customers and are destined for specific prefixes on the provider core router.

Usage Guidelines See “Enabling Source Class and Destination Class Usage” on page 204.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics accounting, source-class-usage

destination-profile

Syntax destination-profile *name*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address*],
[edit interfaces *interface-name* unit *logical-unit-number* family inet unnumbered-address *interface-name* destination *address*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet unnumbered-address *interface-name* destination *address*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For interfaces with PPP encapsulation, assign PPP properties to the remote end. You define the profile at the [edit access group-profile *name* ppp] hierarchy level.

Options *name*—Profile name defined at the [edit access group-profile *name* ppp] hierarchy level.

Usage Guidelines See "Configuring IPCP Options" on page 168.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics destination, *JUNOS System Basics Configuration Guide*.

dialer

Syntax dialer *filter-name*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family *family*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Apply a dialer filter to an interface. To create the dialer filter, include the dialer-filter statement at the [edit firewall filter family *family*] hierarchy level.

Options *filter-name*—Dialer filter name.

Usage Guidelines See "Applying the Dial-on-Demand Dialer Filter to the Dialer Interfaces" on page 782.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

dialer-options

Syntax

```
dialer-options {
  activation-delay seconds;
  callback;
  callback-wait-period time;
  deactivation-delay seconds;
  dial-string [ dial-string-numbers ];
  idle-timeout seconds;
  incoming-map {
    caller caller-number | accept-all;
    initial-route-check seconds;
      load-interval seconds;
      load-threshold percent;
      pool pool-name;
      redial-delay time;
      watch-list {
        [ routes ];
      }
    }
  }
}
```

Hierarchy Level

[edit interfaces umd0],
[edit interfaces dl*n* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces dl*n* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Specify the dialer options for configuring logical interfaces for group and user sessions.

The statements are explained separately.

Usage Guidelines See “Configuring ISDN Logical Interface Properties” on page 777 and “Specifying a USB Modem Interface on J-series Routers” on page 87.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS Services Interfaces Configuration Guide*

dialin

Syntax dialin (console | routable);

Hierarchy Level [edit interfaces umd0 modem-options]

Release Information Statement introduced in JUNOS Release 8.5.

Description For J-series Services Routers, configure a USB modem port to act as a dial-in console or WAN backup port.

Options console—Configure the USB modem port to operate as a dial-in console for management.

routable—Configure the USB modem port to operate as a dial-in WAN backup interface.

Default: console

Usage Guidelines See "Specifying a USB Modem Interface on J-series Routers" on page 87.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

dial-options

Syntax

```
dial-options {
   l2tp-interface-id name;
   (shared | dedicated);
}
```

Hierarchy Level [edit interfaces sp-*fpc/pic/port* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Specify the Layer 2 Tunneling Protocol (L2TP) options for configuring logical interfaces for group and user sessions.

Options l2tp-interface-id *name*—Interface identifier that you specified at the [edit access profile *name*] hierarchy level.

(shared | dedicated)—Specify whether a logical interface can host one (dedicated) or multiple (shared) sessions at one time.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS Services Interfaces Configuration Guide*

dial-string

Syntax dial-string [*dial-string-numbers*];

Hierarchy Level [edit interfaces br-*pim*/0/*port* unit *logical-unit-number* dialer-options],
[edit logical-systems *logical-system-name* interfaces br-*pim*/0/*port* unit *logical-unit-number* dialer-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description (J-series Services Routers) For ISDN interfaces, specify one or more ISDN dial strings used to reach a destination subnetwork.

Options *dial-string-numbers*—One or more strings of numbers to call.

Usage Guidelines See "Configuring the Dialer Interface" on page 789.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

direction

Syntax direction (up | down);

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name* mep *mep-id*]

Release Information Statement introduced in JUNOS Release 8.4.

Description Configure the direction of the MEP.

Options up—An UP MEP CCM is transmitted out of every logical interface which is part of the same bridging or vpls instance except for the interface configured on this MEP.

down—Down MEP CCMs are transmitted only out the interface configured on this MEP.

Usage Guidelines See "Configuring the Maintenance End Point Direction" on page 651 and "Configuring IEEE 802.1ag OAM Connectivity-Fault Management" on page 645.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

disable

See the following sections:

- disable (Interface) on page 937
- disable (Link Protection) on page 937

disable (Interface)

Syntax disable;

Hierarchy Level [edit interfaces *interface-name*],
[edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Disable a physical or a logical interface, effectively unconfiguring it.

Usage Guidelines See "Disabling a Physical Interface" on page 133 and "Disabling a Logical Interface" on page 159.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

disable (Link Protection)

Syntax disable;

Hierarchy Level [edit interfaces ae*X* aggregated-ether-options lacp link-protection]

Release Information Statement introduced in JUNOS Release 9.3.

Description Disable LACP link protection on the interface.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

disable-mlppp-inner-ppp-pfc

Syntax disable-mlppp-inner-ppp-pfc;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced in JUNOS Release 8.2.

Description For MLPPP interfaces only, disable compression of the inner PPP header in the MLPPP payload. By default, compression is enabled.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

dlci

Syntax dlci *dlci-identifier*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Frame Relay and Multilink Frame Relay (MLFR) user-to-network interface (UNI) network-to-network interface (NNI) encapsulation only, and for link services, voice services and point-to-point interfaces only, configure the data-link connection identifier (DLCI) for a permanent virtual circuit (PVC) or an switched virtual circuit (SVC).

To configure a DLCI for a point-to-multipoint interface, use the multipoint-destination statement to specify the DLCI.

Options *dlci-identifier*—Data-link connection identifier.

Range: 16 through 1022. For Frame Relay DLCI ranges for channelized interfaces, see “Data-Link Connection Identifiers on Channelized Interfaces” on page 374.

Usage Guidelines See “Configuring Frame Relay DLCIs” on page 366, “Configuring a Point-to-Point Frame Relay Connection” on page 366, and the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics encapsulation, multipoint-destination, multicast-dlci

dlsw

Syntax dlsw {
destination *mac-address* priority-cost *priority*;
peer *ip-address* priority-cost *priority*;
}

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family llc2 redundancy-group *group-number* track],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family llc2 redundancy-group *group-number* track]

Release Information Statement introduced in JUNOS Release 7.5.

Description For J-series Services Routers only. On Ethernet interfaces configured for DLSw, enable tracking options for a remote peer or destination MAC address.

The statements are explained separately.

Usage Guidelines See "Configuring DLSw Ethernet Redundancy Using LLC2 Properties" on page 172.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

do-not-fragment

Syntax do-not-fragment;

Hierarchy Level [edit interfaces gr-*fpc/pic/port* unit *logical-unit-number* tunnel],
[edit logical-systems *logical-system-name* interfaces gr-*fpc/pic/port* unit *logical-unit-number* tunnel]

Release Information Statement introduced in JUNOS Release 9.2.

Description Disable fragmentation of GRE encapsulated packets.

Default By default fragmentation is disabled.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics reassemble-packets

dot1x

Syntax

```
dot1x {
  authenticator {
    authentication-profile-name access-profile-name;
    interface interface-id {
      maximum-requests integer;
      quiet-period seconds;
      reauthentication (disable | interval seconds);
      retries integer;
      server-timeout seconds;
      supplicant (single);
      supplicant-timeout seconds;
      transmit-period seconds;
    }
  }
}
```

Hierarchy Level [edit protocols]

Release Information Statement introduced in JUNOS Release 9.3.

Description For the MX-series only, specifies settings for using 802.1x Port-Based Network Access Control.

Default By default, dot1x is not configured.

Options authenticator—Specify the authentication profile name and the interface.

- authentication-profile-name—RADIUS user authentication for 802.1x Port-Based Network Access Control protocol.
- interface—Interface port configuration for 802.1x Port-Based Network Access Control protocol.
  - maximum-requests *seconds*—See maximum-requests.
  - quiet-period *seconds*—See quiet-period.
  - retries *integer*—See retries.
  - reauthentication (disable | interval *seconds*)—See reauthentication.
  - supplicant (*single*)—See supplicant.
  - server-timeout *seconds*—See server-timeout.
  - supplicant-timeout *seconds*—See supplicant-timeout.
  - transmit-period *seconds*—See transmit-period.

Usage Guidelines See “Configuring IEEE 802.1x Port-Based Network Access Control” on page 693.

Required Privilege Level interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Related Topics authenticator, authentication-profile-name, interface (IEEE 802.1x)

down-count

Syntax down-count *cells*;

Hierarchy Level [edit interfaces *interface-name* atm-options vpi *vpi-identifier* oam-liveness],
[edit interfaces *interface-name* unit *logical-unit-number* oam-liveness],
[edit interfaces *interface-name* unit *logical-unit-number* family *family* address *address* multipoint-destination *address* oam-liveness],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* oam-liveness],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family* address *address* multipoint-destination *address* oam-liveness]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM encapsulation only, configure Operation, Administration, and Maintenance (OAM) F5 loopback cell count thresholds. This feature is not supported on ATM-over-SHDSL interfaces.

For ATM2 IQ PICs only, configure OAM F4 loopback cell count thresholds at the [edit interfaces *interface-name* atm-options vpi *vpi-identifier*] hierarchy level.

Options *cells*—Minimum number of consecutive OAM F4 or F5 loopback cells lost before a VC is declared down.
Range: 1 through 255
Default: 5 cells

Usage Guidelines See “Configuring the ATM OAM F5 Loopback Cell Threshold” on page 316.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

drop-timeout

Syntax drop-timeout *milliseconds*;

Hierarchy Level [edit interfaces *interface-name* mlfr-uni-nni-bundle-options],
[edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For link services, multilink, and voice services interfaces only, configure the drop timeout period, in milliseconds.

Options *milliseconds*—Drop timeout period.

Range: 0 through 2000 milliseconds

Default: 0 ms (disabled)

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

ds0-options

Syntax

```
ds0-options {
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    byte-encoding (nx56 | nx64);
    fcs (16 | 32);
    idle-cycle-flag (flags | ones);
    invert-data;
    loopback payload;
    start-end-flag (filler | shared);
}
```

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure DS0-specific physical interface properties.

The statements are explained separately.

Usage Guidelines See "Configuring Channelized DS3-to-DS0 Interfaces" on page 466.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

dsl-options

Syntax
dsl-options {
  loopback local;
  operating-mode *mode*;
}

Hierarchy Level [edit interfaces at-*fpc*/*pic*/*port*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For J-series Services Routers only, modify the properties of the digital subscriber line for an ATM interface.

The statements are explained separately.

Usage Guidelines See “Configuring ATM-over-ADSL Interfaces” on page 341.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

dsr

Syntax dsr (ignore | normal | require);

Hierarchy Level [edit interfaces *interface-name* serial-options dce-options],
[edit interfaces *interface-name* serial-options dte-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For EIA-530 and V.35 interfaces only, configure the from-DCE signal, data-set-ready (DSR).

Options ignore—The from-DCE signal is ignored.

normal—Normal DSR signal handling as defined by the TIA/EIA Standard 530.

require—The from-DCE signal must be asserted.
  Default: normal

Usage Guidelines See “Configuring the Serial Signal Handling” on page 257.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

dsr-polarity

Syntax dsr-polarity (negative | positive);

Hierarchy Level [edit interfaces *interface-name* serial-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure DSR signal polarity.

Options positive—Positive signal polarity.

negative—Negative signal polarity.

Default: positive

Usage Guidelines See “Configuring Serial Signal Polarities” on page 260.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

dte-options

Syntax

```
dte-options {
   control-signal (assert | de-assert | normal);
   cts (ignore | normal | require);
   dcd (ignore | normal | require);
   dsr (ignore | normal | require);
   dtr signal-handling-option;
   ignore-all;
   indication (ignore | normal | require);
   rts (assert | de-assert | normal);
   tm (ignore | normal | require);
}
```

Hierarchy Level [edit interfaces *interface-name* serial-options]

Release Information Statement introduced in JUNOS Release 8.3.
Statement previously known as control-leads.

Description For M-series and T-series routing platforms, configure the serial interface signal characteristics.

The statements are explained separately.

Usage Guidelines See “Configuring the Serial Signal Handling” on page 257.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

dtr

Syntax dtr *signal-handling-option*;

Hierarchy Level [edit interfaces *interface-name* serial-options dce-options],
[edit interfaces *interface-name* serial-options dte-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For EIA-530 and V.35 interfaces only, configure the to-DCE signal, data-transmit-ready (DTR).

Options *signal-handling-option*—Signal handling for the DTR signal. The signal handling can be one of the following:

assert—The to-DCE signal must be asserted.

auto-synchronize—Normal DTR signal with automatic synchronization. This statement has two substatements:

duration *milliseconds*—Pulse duration of resynchronization.
Range: 1 through 1000 milliseconds
Default: 1000 milliseconds

interval *seconds*—Offset interval for resynchronization.
Range: 1 through 31 seconds
Default: 15 seconds

de-assert—The to-DCE signal must be deasserted.

normal—Normal DTR signal handling as defined by the TIA/EIA Standard 530.
Default: normal

Usage Guidelines See “Configuring the Serial Signal Handling” on page 257.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

dtr-circuit

Syntax dtr-circuit (balanced | unbalanced);

Hierarchy Level [edit interfaces *interface-name* serial-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For EIA-530 and V.35 interfaces only, configure a DTR circuit.

Options balanced—Balanced DTR signal.

unbalanced—Unbalanced DTR signal.

Default: balanced

Usage Guidelines See “Configuring the Serial DTR Circuit” on page 260.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

dtr-polarity

Syntax dtr-polarity (negative | positive);

Hierarchy Level [edit interfaces *interface-name* serial-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure DTR signal polarity.

Options positive—Positive signal polarity.

negative—Negative signal polarity.

Default: positive

Usage Guidelines See “Configuring Serial Signal Polarities” on page 260.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

dump-on-flow-control

Syntax dump-on-flow-control

Hierarchy Level [interface *interface-name* multiservice-options]

Description This option supports high availability functionality and can be used with various service interfaces, including rsp, rms, lsq, and rlsq,

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

dynamic-call-admission-control

Syntax

```
dynamic-call-admission-control {
    activation-priority priority;
    bearer-bandwidth-limit kilobits-per-second;
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced in JUNOS Release 8.2.

Description (J4350 and J6350 Services Routers supporting voice over IP with the TGM550 media gateway module) For Fast Ethernet and Gigabit Ethernet interfaces, ISDN BRI interfaces, and serial interfaces with PPP or Frame Relay encapsulation, configure dynamic call admission control (CAC). Dynamic CAC provides enhanced control over WAN bandwidth. When dynamic CAC is configured on an interface responsible for providing call bandwidth, the TGM550 informs the Media Gateway Controller (MGC) of the bandwidth limit available for voice packets on the interface and requests the MGC to block new calls when the bandwidth is exhausted.

Dynamic CAC must be configured on each Services Router interface responsible for providing call bandwidth.

The statements are explained separately.

Usage Guidelines See “Configuring Dynamic Call Admission Control” on page 157.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS Services Interfaces Configuration Guide*, *J-series Services Router Basic LAN and WAN Access Configuration Guide*

dynamic-profile

See the following sections:

- dynamic-profile on page 948
- dynamic-profile on page 949

dynamic-profile

Syntax

```
dynamic-profile profile-name {
   accept (inet);
   ranges (any | low-tag]-[any | high-tag);
}
```

Hierarchy Level [edit interfaces *interface-name* auto-configure vlan-ranges]

Release Information Statement introduced in JUNOS Release 9.5.

Description Specify the dynamic profile that you want to use when configuring dynamic VLANs.

Options *profile-name*—Name of the dynamic profile that you want to use when configuring dynamic VLANs.

The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics

- Dynamic Profiles Overview
- Configuring a Basic Dynamic Profile
- Associating a Single-Tag VLAN Dynamic Profile to an Interface

dynamic-profile

Syntax

```
dynamic-profile profile-name {
   accept (inet);
   ranges (any | low-tag - high-tag) , (any | low-tag - high-tag);
}
```

Hierarchy Level [edit interfaces *interface-name* auto-configure stacked-vlan-ranges]

Release Information Statement introduced in JUNOS Release 9.5.

Description Specify the dynamic profile that you want to use when configuring dynamic stacked VLANs.

Options *profile-name*—Name of the dynamic profile that you want to use when configuring dynamic stacked VLANs.

The remaining statements are explained separately.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics

- Dynamic Profiles Overview
- Configuring a Basic Dynamic Profile
- Associating a Stacked VLAN Dynamic Profile to an Interface

e1-options

Syntax

```
e1-options {
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    fcs (16 | 32);
    framing (g704 | g704-no-crc4 | unframed);
    idle-cycle-flag (flags | ones);
    invert-data;
    loopback (local | remote);
    start-end-flag (filler | shared);
    timeslots time-slot-range;
}
```

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure E1-specific physical interface properties.

The statements are explained separately.

Usage Guidelines See “Configuring Channelized E1 Interfaces” on page 485, “Configuring Channelized STM1 Interfaces” on page 449, “Configuring E1 Interfaces” on page 513, and “Configuring T1 Interfaces” on page 529.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

e3-options

Syntax

```
e3-options {
    atm-encapsulation (direct | plcp);
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    buildout feet;
    compatibility-mode (digital-link | kentrox | larscom) <subrate value>;
    fcs (16 | 32);
    framing (g.751 | g.832);
    idle-cycle-flag value;
    invert-data;
    loopback (local | remote);
    (payload-scrambler | no-payload-scrambler);
    start-end-flag value;
    (unframed | no-unframed);
}
```

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure E3-specific physical interface properties.

For ATM1 interfaces, you can configure a subset of E3 options statements.

The statements are explained separately.

Usage Guidelines See “Configuring E3 Interfaces” on page 521 and “Configuring T3 Interfaces” on page 539.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics atm-options

east-interface

Syntax

```
east-interface {
  control-channel channel-name{
    vlan number;
  }
}
```

Hierarchy Level [edit protocols protection-group ethernet-ring *ring-name*]

Description For Ethernet ring protection, each ring should have two interface ports: an east-interface and a west-interface.

NOTE: Always configure the east-interface first, before configuring the west-interface.

The interface must use the control channel's logical interface name. The control channel is a dedicated VLAN channel for the ring port.

Options ring-protection-link-end—If this port is one side of the RPL, this flag should be set.

Usage Guidelines See “Configuring Ethernet Ring Protection Switching” on page 753.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics west-interface

encapsulation

See the following sections:

- encapsulation (Container Interface) on page 953
- encapsulation (Logical Interface) on page 954
- encapsulation (Physical Interface) on page 957

encapsulation (Container Interface)

Syntax encapsulation (cisco-hdlc | ppp);

Hierarchy Level [edit interfaces ci*n*]

Release Information Statement introduced in JUNOS Release 9.2.

Description Container link-layer encapsulation type.

Options cisco-hdlc—Use Cisco-compatible High-Level Data Link Control (HDLC) framing.

ppp—Use serial PPP encapsulation.

Usage Guidelines See “Configuring Container Interfaces” on page 817.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

encapsulation (Logical Interface)

Syntax encapsulation (atm-ccc-cell-relay | atm-ccc-vc-mux | atm-cisco-nlpid | atm-tcc-vc-mux | atm-mlppp-llc | atm-nlpid | atm-ppp-llc | atm-ppp-vc-mux | atm-snap | atm-tcc-snap | atm-vc-mux | ether-over-atm-llc | ether-vpls-over-atm-llc | ethernet | frame-relay-ccc | frame-relay-ppp | frame-relay-tcc | frame-relay-ether-type | frame-relay-ether-type-tcc | multilink-frame-relay-end-to-end | multilink-ppp | ppp-over-ether | ppp-over-ether-over-atm-llc | vlan-bridge | vlan-ccc | vlan-vci-ccc | vlan-tcc | vlan-vpls);

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Logical link-layer encapsulation type.

Options atm-ccc-cell-relay—Use ATM cell-relay encapsulation.

atm-ccc-vc-mux—Use ATM virtual circuit (VC) multiplex encapsulation on CCC circuits. When you use this encapsulation type, you can configure the ccc family only.

atm-cisco-nlpid—Use Cisco ATM network layer protocol ID (NLPID) encapsulation. When you use this encapsulation type, you can configure the inet family only.

atm-mlppp-llc—For ATM2 IQ interfaces only, use Multilink PPP (MLPPP) over AAL5 LLC. For this encapsulation type, your routing platform must be equipped with a Link Services or Voice Services PIC. MLPPP over ATM encapsulation is not supported on ATM2 IQ OC48 interfaces.

atm-nlpid—Use ATM NLPID encapsulation. When you use this encapsulation type, you can configure the inet family only.

atm-ppp-llc—For ATM2 IQ interfaces only, use PPP over AAL5 LLC encapsulation.

atm-ppp-vc-mux—For ATM2 IQ interfaces only, use PPP over ATM AAL5 multiplex encapsulation.

atm-snap—Use ATM subnetwork attachment point (SNAP) encapsulation.

atm-tcc-snap—Use ATM SNAP encapsulation on translational cross-connect (TCC) circuits.

atm-tcc-vc-mux—Use ATM VC multiplex encapsulation on TCC circuits. When you use this encapsulation type, you can configure the tcc family only.

atm-vc-mux—Use ATM VC multiplex encapsulation. When you use this encapsulation type, you can configure the inet family only.

ether-over-atm-llc—For interfaces that carry IPv4 traffic, use Ethernet over ATM LLC encapsulation. When you use this encapsulation type, you cannot configure multipoint interfaces.

ether-vpls-over-atm-llc—For ATM2 IQ interfaces only, use the Ethernet virtual private LAN service (VPLS) over ATM LLC encapsulation to bridge Ethernet interfaces and ATM interfaces over a VPLS routing instance (as described in RFC 2684, *Multiprotocol Encapsulation over ATM Adaptation Layer 5*). Packets from the ATM interfaces are converted to standard ENET2/802.3 encapsulated Ethernet frames with the frame check sequence (FCS) field removed.

ethernet—Use Ethernet II encapsulation (as described in RFC 894, *A Standard for the Transmission of IP Datagrams over Ethernet Networks*).

ethernet-vpls—Use Ethernet VPLS encapsulation on Ethernet interfaces that have VPLS enabled and that must accept packets carrying standard Tag Protocol ID (TPID) values.

extended-vlan-vpls—Use extended virtual LAN (VLAN) VPLS encapsulation on Ethernet interfaces that have VLAN 802.1Q tagging and VPLS enabled and that must accept packets carrying TPIDs 0x8100, 0x9100, and 0x9901.

NOTE: The built-in Gigabit Ethernet PIC on an M7i router does not support extended VLAN VPLS encapsulation.

frame-relay-ccc—Use Frame Relay encapsulation on CCC circuits. When you use this encapsulation type, you can configure the ccc family only.

frame-relay-ppp—Use Frame Relay encapsulation on PPP circuits. When you use this encapsulation type, you can configure the ppp family only.

frame-relay-tcc—Use Frame Relay encapsulation on TCC circuits for connecting unlike media. When you use this encapsulation type, you can configure the tcc family only.

frame-relay-ether-type—Use Frame Relay ether type encapsulation for compatibility with Cisco Frame Relay. The physical interface must be configured with flexible-frame-relay encapsulation.

frame-relay-ether-type-tcc—Use Frame Relay ether type TCC for Cisco-compatible Frame Relay on TCC circuits to connect unlike media. The physical interface must be configured with flexible-frame-relay encapsulation.

multilink-frame-relay-end-to-end—Use MLFR FRF.15 encapsulation. This encapsulation is used only on multilink, link services, and voice services interfaces and their constituent T1 or E1 interfaces.

multilink-ppp—Use MLPPP encapsulation. This encapsulation is used only on multilink, link services, and voice services interfaces and their constituent T1 or E1 interfaces.

ppp-over-ether—For underlying Ethernet interfaces on J-series Services Routers only, use PPP over Ethernet encapsulation. When you use this encapsulation type, you cannot configure the interface address. Instead, configure the interface address on the PPP interface.

ppp-over-ether-over-atm-llc—For underlying ATM interfaces on J-series Services Routers only, use PPP over Ethernet over ATM LLC encapsulation. When you use this encapsulation type, you cannot configure the interface address. Instead, configure the interface address on the PPP interface.

vlan-bridge—Use Ethernet VLAN bridge encapsulation on Ethernet interfaces that have IEEE 802.1Q tagging, flexible-ethernet-services, and bridging enabled and that must accept packets carrying TPID 0x8100 or a user-defined TPID.

vlan-ccc—Use Ethernet virtual LAN (VLAN) encapsulation on CCC circuits. When you use this encapsulation type, you can configure the ccc family only.

vlan-vci-ccc—Use ATM-to-Ethernet interworking encapsulation on CCC circuits. When you use this encapsulation type, you can configure the ccc family only.

vlan-tcc—Use Ethernet VLAN encapsulation on TCC circuits. When you use this encapsulation type, you can configure the tcc family only.

vlan-vpls—Use Ethernet VLAN encapsulation on VPLS circuits.

Usage Guidelines See “Configuring Interface Encapsulation on Logical Interfaces” on page 151, “Configuring Circuit and Translational Cross-Connects” on page 213, “Identifying the Access Concentrator” on page 746, “Configuring ATM Interface Encapsulation” on page 316, “Configuring VLAN Encapsulation” on page 579, “Configuring Extended VLAN Encapsulation” on page 580, “Configuring ISDN Logical Interface Properties” on page 777, “Configuring ATM-to-Ethernet Interworking” on page 219, and the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

encapsulation (Physical Interface)

Syntax encapsulation (atm-ccc-cell-relay | atm-pvc | cisco-hdlc | cisco-hdlc-ccc | cisco-hdlc-tcc | ethernet-bridge | ethernet-ccc | ethernet-over-atm | ethernet-tcc | ethernet-vpls | extended-frame-relay-ccc | extended-frame-relay-ether-type-tcc | extended-frame-relay-tcc | extended-vlan-bridge | extended-vlan-ccc | extended-vlan-tcc | extended-vlan-vpls | flexible-ethernet-services | flexible-frame-relay | frame-relay | frame-relay-ccc | frame-relay-ether-type | frame-relay-ether-type-tcc | frame-relay-port-ccc | frame-relay-tcc | multilink-frame-relay-uni-nni | ppp | ppp-ccc | ppp-tcc | vlan-ccc | vlan-vci-ccc | vlan-vpls);

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Physical link-layer encapsulation type.

Default PPP encapsulation.

Options atm-ccc-cell-relay—Use ATM cell-relay encapsulation.

atm-pvc—Use ATM PVC encapsulation.

cisco-hdlc—Use Cisco-compatible High-Level Data Link Control (HDLC) framing.

cisco-hdlc-ccc—Use Cisco-compatible HDLC framing on CCC circuits.

cisco-hdlc-tcc—Use Cisco-compatible HDLC framing on TCC circuits for connecting unlike media.

ethernet-bridge—Use Ethernet bridge encapsulation on Ethernet interfaces that have bridging enabled and that must accept all packets.

ethernet-ccc—Use Ethernet CCC encapsulation on Ethernet interfaces that must accept packets carrying standard Tag Protocol ID (TPID) values.

ethernet-over-atm—For interfaces that carry IPv4 traffic, use Ethernet over ATM encapsulation. When you use this encapsulation type, you cannot configure multipoint interfaces. As defined in RFC 1483, *Multiprotocol Encapsulation over ATM Adaptation Layer 5*, this encapsulation type allows ATM interfaces to connect to devices that support only bridged protocol data units (BPDUs). The JUNOS software does not completely support bridging, but accepts BPDU packets as a default gateway. If you use the router as an edge device, then the router acts as a default gateway. It accepts Ethernet LLC/SNAP frames with IP or ARP in the payload, and drops the rest. For packets destined to the Ethernet LAN, a route lookup is done using the destination IP address. If the route lookup yields a full address match, the packet is encapsulated with an LLC/SNAP and MAC header, and the packet is forwarded to the ATM interface.

ethernet-tcc—For interfaces that carry IPv4 traffic, use Ethernet TCC encapsulation on interfaces that must accept packets carrying standard TPID values. For 8-port, 12-port, and 48-port Fast Ethernet PICs, TCC is not supported.

ethernet-vpls—Use Ethernet VPLS encapsulation on Ethernet interfaces that have VPLS enabled and that must accept packets carrying standard TPID values.

extended-frame-relay-ccc—Use Frame Relay encapsulation on CCC circuits. This encapsulation type allows you to dedicate DLCIs 1 through 1022 to CCC.

extended-frame-relay-tcc—Use Frame Relay encapsulation on TCC circuits to connect unlike media. This encapsulation type allows you to dedicate DLCIs 1 through 1022 to TCC.

extended-vlan-bridge—Use extended VLAN bridge encapsulation on Ethernet interfaces that have IEEE 802.1Q VLAN tagging and bridging enabled and that must accept packets carrying TPID 0x8100 or a user-defined TPID.

extended-vlan-ccc—Use extended VLAN encapsulation on CCC circuits with Gigabit Ethernet and 4-port Fast Ethernet interfaces that must accept packets carrying 802.1Q values. For 8-port, 12-port, and 48-port Fast Ethernet PICs, extended VLAN CCC is not supported. For 4-port Gigabit Ethernet PICs, extended VLAN CCC is not supported.

extended-vlan-tcc—For interfaces that carry IPv4 traffic, use extended VLAN encapsulation on TCC circuits with Gigabit Ethernet interfaces on which you want to use 802.1Q tagging. For 4-port Gigabit Ethernet PICs, extended VLAN TCC is not supported.

extended-vlan-vpls—Use extended VLAN VPLS encapsulation on Ethernet interfaces that have VLAN 802.1Q tagging and VPLS enabled and that must accept packets carrying TPIDs 0x8100, 0x9100, and 0x9901.

NOTE: The built-in Gigabit Ethernet PIC on an M7i router does not support extended VLAN VPLS encapsulation.

flexible-ethernet-services—For Gigabit Ethernet IQ interfaces and Gigabit Ethernet PICs with small form-factor pluggable transceivers (SFPs) (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform), use flexible Ethernet services encapsulation when you want to configure multiple per-unit Ethernet encapsulations. This encapsulation type allows you to configure any combination of route, TCC, CCC, Layer 2 virtual private networks (VPNs), and VPLS encapsulations on a single physical port. Aggregated Ethernet bundles cannot use this encapsulation type. If you configure flexible Ethernet services encapsulation on the physical interface, VLAN IDs from 1 through 511 are no longer reserved for normal VLANs.

flexible-frame-relay—For IQ interfaces only, use flexible Frame Relay encapsulation when you want to configure multiple per-unit Frame Relay encapsulations. This encapsulation type allows you to configure any combination of TCC, CCC, and standard Frame Relay encapsulations on a single physical port. Also, each logical interface can have any DLCI value from 1 through 1022.

frame-relay—Use Frame Relay encapsulation.

frame-relay-ccc—Use Frame Relay encapsulation on CCC circuits.

frame-relay-port-ccc—Use Frame Relay port CCC encapsulation to transparently carry all the DLCIs between two customer edge (CE) routers without explicitly configuring each DLCI on the two provider edge (PE) routers with Frame Relay transport. When you use this encapsulation type, you can configure the ccc family only.

frame-relay-tcc—Use Frame Relay encapsulation on TCC circuits to connect unlike media.

frame-relay-ether-type—Use Frame Relay ether type encapsulation for compatibility with Cisco Frame Relay.

frame-relay-ether-type-tcc—Use Frame Relay ether type TCC for Cisco-compatible Frame Relay on TCC circuits to connect unlike media.

extended-frame-relay-ether-type-tcc—Use extended Frame Relay ether type TCC for Cisco-compatible Frame Relay for DLCIs 1 through 1022. This encapsulation is used for circuits with different media on either side of the connection.

multilink-frame-relay-uni-nni—Use MLFR UNI NNI encapsulation. This encapsulation is used only on link services and voice services interfaces functioning as FRF.16 bundles and their constituent T1 or E1 interfaces.

ppp—Use serial PPP encapsulation.

ppp-ccc—Use serial PPP encapsulation on CCC circuits. When you use this encapsulation type, you can configure the ccc family only.

ppp-tcc—Use serial PPP encapsulation on TCC circuits for connecting unlike media. When you use this encapsulation type, you can configure the tcc family only.

vlan-ccc—Use Ethernet VLAN encapsulation on CCC circuits.

vlan-vci-ccc—Use ATM-to-Ethernet interworking encapsulation on CCC circuits. When you use this encapsulation type, you can configure the ccc family only. All logical interfaces configured on the Ethernet interface must also have the encapsulation type set to vlan-vci-ccc.

vlan-vpls—Use VLAN VPLS encapsulation on Ethernet interfaces with VLAN tagging and VPLS enabled. Interfaces with VLAN VPLS encapsulation accept packets carrying standard TPID values only.

Usage Guidelines See “Configuring Interface Encapsulation on Physical Interfaces” on page 100, “Defining the Encapsulation for Switching Cross-Connects” on page 215, “Configuring ATM Interface Encapsulation” on page 316, “Configuring VLAN Encapsulation” on page 579, “Configuring ATM-to-Ethernet Interworking” on page 219, and “Configuring Extended VLAN Encapsulation” on page 580 .

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

encoding

Syntax encoding (nrz | nrzi);

Hierarchy Level [edit interfaces *interface-name* serial-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For serial interfaces, set the line encoding format.

Default The default line encoding is non-return to zero (NRZ).

Options nrz—Use NRZ line encoding.

nrzi—Use non-return to zero inverted (NRZI) line encoding.

Usage Guidelines See "Configuring Serial Line Encoding" on page 263.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

epd-threshold

See the following sections:

- epd-threshold (Logical Interface) on page 961
- epd-threshold (Physical Interface) on page 962

epd-threshold (Logical Interface)

Syntax epd-threshold *cells* plp1 *cells*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit interfaces *interface-name* unit *logical-unit-number* address *address* family *family* multipoint-destination *address*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* address *address* family *family* multipoint-destination *address*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM2 IQ interfaces only, define the early packet discard (EPD) threshold on a VC. The EPD threshold is a limit on the number of transmit packets that can be queued. Packets that exceed the limit are discarded. For interfaces configured in trunk mode, you can also configure dual EPD thresholds depending on the packet loss priorities (PLPs). For more information, see “Configuring Two EPD Thresholds per Queue” on page 314.

Default Approximately 1 percent of the available cell buffers. If shaping is enabled, the default EPD threshold is proportional to the shaping rate according to the following formula:

default epd-threshold = number of buffers * shaping rate / line rate

The minimum EPD threshold value is 48 cells. If the default EPD threshold formula results in an EPD threshold of less than 48 cells, the result will be ignored, and the minimum value of 48 cells will be used.

Options *cells*—Maximum number of cells.
Range: For 1-port and 2-port OC12 interfaces, 48 through 425,984 cells.

Usage Guidelines See “Configuring the ATM2 IQ EPD Threshold” on page 312.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

epd-threshold (Physical Interface)

Syntax epd-threshold *cells* plp1 *cells*;

Hierarchy Level [edit interfaces at-*fpc/pic/port* atm-options scheduler-maps *map-name* forwarding-class *class-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM2 IQ interfaces only, define the EPD threshold on a VC. The EPD threshold is a limit on the number of transmit packets that can be queued. Packets that exceed the limit are discarded.

Default If you do not include either the epd-threshold or the linear-red-profile statement in the forwarding class configuration, the JUNOS software uses an EPD threshold based on the available bandwidth and other parameters.

Options *cells*—Maximum number of cells.

Range: For 1-port and 2-port OC12 interfaces, 48 through 425,984 cells. For 1-port OC48 interfaces, 48 through 425,984 cells. For 2-port OC3, DS3, and E3 interfaces, 48 through 212,992 cells. For 4-port DS3 and E3 interfaces, 48 through 106,496 cells.

The plp1 statement is explained separately.

Usage Guidelines See “Configuring an ATM Scheduler Map” on page 327.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics linear-red-profile

es-options

Syntax

```
es-options {
   backup-interface interface-name;
}
```

Hierarchy Level [edit interfaces es-*fpc/pic/port*]

Release Information Statement introduced before JUNOS Release 7.4.

Description On ES interfaces, configure ES interface-specific interface properties.

The backup-interface statement is explained separately.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

ethernet

Syntax

```
ethernet {
  connectivity-fault-management {
    action-profile profile-name {
      default-action {
        interface-down;
      }
    }
    performance-monitoring {
      hardware-assisted-timestamping;
    }
    linktrace {
      age (30m | 10m | 1m | 30s | 10s);
      path-database-size path-database-size;
    }
    maintenance-domain domain-name {
      level number;
      name-format (character-string | none | dns | mac+2octet);
      maintenance-association ma-name {
        short-name-format (character-string | vlan | 2octet | rfc-2685-vpn-id);
        continuity-check {
          hold-interval (OAM) minutes;
          interval (10m | 10s | 1m | 1s| 100ms);
          loss-threshold number;
        }
        mep mep-id {
          action-profile profile-name;
          auto-discovery;
          direction (up | down);
          interface interface-name;
          priority number;
          remote-mep mep-id {
            action-profile profile-name;
          }
        }
      }
    }
  }
  evcs evc-id {
    evc-protocol cfm management-domain domain-id (<management-association
      association-id> | vpls (routing-instance instance-id);
    remote-uni-count count;
    multipoint-to-multipoint;
  }
  link-fault-management {
    action-profile profile-name {
      action {
        syslog;
        link-down;
        send-critical-event;
      }
      event {
```

```
                link-adjacency-loss;
                link-event-rate {
                    frame-error count;
                    frame-period count;
                    frame-period-summary count;
                    symbol-period count;
                }
                protocol-down;
            }
        }
        interface interface-name {
            apply-action-profile;
            link-discovery (active | passive);
            pdu-interval interval;
            pdu-threshold threshold-value;
            remote-loopback;
            event-thresholds {
                frame-error count;
                frame-period count;
                frame-period-summary count;
                symbol-period count;
            }
            negotiation-options {
                allow-remote-loopback;
                no-allow-link-events;
            }
        }
    }
    lmi (Ethernet) {
        status-counter count;
        polling-verification-timer value;
        interface name {
            uni-id uni-name;
            status-counter number;
            polling-verification-timer value;
            evc-map-type (all-to-one-bundling | bundling | service-multiplexing);
            evc evc-name {
                default-evc;
                vlan-list vlan-id-list;
            }
        }
    }
}
```

Hierarchy Level [edit protocols oam]

Release Information Statement introduced in JUNOS Release 8.2.

Description For Ethernet interfaces on M320, MX-series, and T-series routing platforms, provide fault signaling and detection for 802.3ah Operation, Administration, and Management (OAM) support.

The remaining statements are explained separately.

Usage Guidelines See “Enabling IEEE 802.3ah OAM Support” on page 698.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

ethernet-policer-profile

Syntax

```
ethernet-policer-profile {
  input-priority-map {
    ieee802.1p premium [ values ];
  }
  output-priority-map {
    classifier {
      premium {
        forwarding-class class-name {
          loss-priority (high | low);
        }
      }
    }
  }
  policer cos-policer-name {
    aggregate {
      bandwidth-limit (ethernet) bps;
      burst-size-limit (ethernet) bytes;
    }
    premium {
      bandwidth-limit (ethernet) bps;
      burst-size-limit (ethernet) bytes;
    }
  }
}
```

Hierarchy Level [edit interfaces *interface-name* gigether-options ethernet-switch-profile],
[edit interfaces *interface-name* aggregated-ether-options ethernet-switch-profile]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Gigabit Ethernet IQ, 10-Gigabit Ethernet, and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform), configure a class of service (CoS)-based policer. Policing applies to the inner VLAN identifiers, not to the outer tag. For Gigabit Ethernet interfaces with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform), the premium policer is not supported.

The statements are explained separately.

Usage Guidelines See "Configuring Gigabit Ethernet Policers" on page 709.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

ethernet-ring

Syntax

```
ethernet-ring ring-name (
    east-interface {
        control-channel channel-name {
            vlan number;
        }
    }
    guard-interval number;
    node-id mac-address;
    restore-interval number;
    ring-protection-link-owner;
    west-interface {
        control-channel channel-name {
            vlan number;
        }
    }
}
```

Hierarchy Level [edit protocols protection-group]

Description For Ethernet PICs on MX-series platforms, specify the Ethernet ring in an Ethernet ring protection switching configuration.

Options The statement options are described separately.

Usage Guidelines See “Configuring Ethernet Ring Protection Switching” on page 753.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

ethernet-switch-profile

Syntax

```
ethernet-switch-profile {
    ethernet-policer-profile {
        input-priority-map {
            ieee802.1p premium [ values ];
        }
        output-priority-map {
            classifier {
                premium {
                    forwarding-class class-name {
                        loss-priority (high | low);
                    }
                }
            }
        }
        policer cos-policer-name {
            aggregate {
                bandwidth-limit (ethernet) bps;
                burst-size-limit (ethernet) bytes;
            }
            premium {
                bandwidth-limit (ethernet) bps;
                burst-size-limit (ethernet) bytes;
            }
        }
        tag-protocol-id tpid;
    }
    (mac-learn-enable | no-mac-learn-enable);
}
```

Hierarchy Level [edit interfaces *interface-name* gigether-options],
[edit interfaces *interface-name* aggregated-ether-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Gigabit Ethernet IQ, 10-Gigabit Ethernet IQ2 and IQ2-E, and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC, aggregated Ethernet with Gigabit Ethernet IQ interfaces, and the built-in Gigabit Ethernet port on the M7i platform), configure VLAN tag and MAC address accounting and filtering properties.

The statements are explained separately.

Default If the ethernet-switch-profile statement is not configured, Gigabit Ethernet IQ and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform) behave like Gigabit Ethernet interfaces.

Usage Guidelines See “Configuring Gigabit Ethernet Policers” on page 709, “Configuring MAC Address Filtering” on page 713, and “Configuring the Management Ethernet Interface” on page 729.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

evcs

Syntax

```
evcs evc-id {
   evc-protocol cfm management-domain domain-id (<management-association
      association-id> | vpls (routing-instance instance-id);
   remote-uni-count count;
   multipoint-to-multipoint;
}
```

Hierarchy Level [edit protocols oam ethernet]

Release Information Statement introduced in JUNOS Release 9.5.

Description On MX-series routers with ge, xe, or ae interfaces, configure an OAM Ethernet virtual connection.

Options evc-protocol cfm | vpls—Specify CFM or VPLS as the EVC protocol.

management-domain *domain-id*—(Optional) For CFM, specify the CFM management domain.

management-association *association-id*—(Optional) For CFM, specify the CFM management association.

routing-instance *instance-id*—(Optional) For VPLS, specify the VPLS routing instance.

remote-uni-count *count*—(Optional) Specify the number of remote UNIs in the EVC configuration, the default is 1.

multipoint-to-multipoint —(Optional) Specify multiple points in the EVC configuration, the default is point-to-point if remote-uni-count is 1.

Usage Guidelines See "Configuring Ethernet Local Management Interface" on page 654.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics lmi (Ethernet)

event

Syntax

```
event {
  link-adjacency-loss;
  link-event-rate {
    frame-error count;
    frame-period count;
    frame-period-summary count;
    symbol-period count;
    }
  protocol-down;
}
```

Hierarchy Level [edit protocols oam ethernet link-fault-management action-profile]

Release Information Statement introduced in JUNOS Release 8.5.

Description Configure threshold values for link events in an action profile.

The remaining statements are explained separately.

Usage Guidelines See “Monitoring Protocol Status” on page 702.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

event-thresholds

Syntax

```
event-thresholds {
  frame-error count;
  frame-period count;
  frame-period-summary count;
  symbol-period count;
}
```

Hierarchy Level [edit protocols oam link-fault-management interface *interface-name*]

Release Information Statement introduced in JUNOS Release 8.4.

Description Configure threshold limit values for link events in periodic OAM PDUs.

The remaining statements are explained separately.

Usage Guidelines See “Configuring Threshold Values for Local Fault Events on an Interface” on page 699.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

eui-64

Syntax eui-64;

Hierarchy Level [edit interfaces *interface-name* unit *number* family ipv6 address *address*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For interfaces that carry IP version 6 (IPv6) traffic, automatically generate the host number portion of interface addresses.

Usage Guidelines See "Configuring the Interface Address" on page 166.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

facility-override

Syntax facility-override *facility-name*;

Hierarchy Level [edit interfaces *interface-name* services-options syslog host *hostname*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Override default facility for system log reporting.

Options *facility-name*—Name of facility that overrides the default assignment.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

failover-delay

Syntax failover-delay *milliseconds*;

Hierarchy Level [edit protocols vrrp]

Description Configure the failover delay for VRRP and VRRP for IPv6 operations.

Options *milliseconds*—Specify the failover delay time in milliseconds.
Range: 500 through 2000

Usage Guidelines See "Configuring VRRP and VRRP for IPv6" on page 705.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

family

Syntax

```
family family {
    accounting {
        destination-class-usage;
        source-class-usage {
            direction;
        }
    }
    address address {
        destination address;
    }
    bundle interface-name;
    filter {
        dialer filter-name;
        input filter-name;
        output filter-name;
        group filter-group-number;
    }
    interface-mode (access | trunk);
    ipsec-sa sa-name;
    keep-address-and-control;
    llc2 {
        ack-delay-time time;
        ack-max count;
        idle-time time;
        local-window count;
        max-retry count;
        p-bit-timeout time;
        redundancy-group group-number {
            advertise-interval seconds;
            map {
                local-mac mac-address request mac-address;
            }
            preempt hold-time seconds;
            no-preempt;
            priority priority;
            track {
                dlsw {
                    peer ip-address priority-cost priority;
                    destination mac-address priority-cost priority;
                }
                interface interface-name priority-cost priority;
            }
        }
        t1-time time;
        t2-time time;
        trej-time time;
    }
    mac-validate (loose | strict);
    mtu bytes;
    multicast-only;
    negotiate-address;
```

```
no-redirects:
policer {
    arp policer-template-name;
    input policer-template-name;
    output policer-template-name;
}
primary;
protocols [inet iso mpls];
proxy inet-address address;
receive-options-packets;
receive-ttl-exceeded;
remote (inet-address address | mac-address address);
rpf-check <fail-filter filter-name>;
sampling {
    direction;
}
service {
    input {
        service-set service-set-name <service-filter filter-name>;
        post-service-filter filter-name;
    }
    output {
        service-set service-set-name <service-filter filter-name>;
    }
}
(translate-discard-eligible | no-translate-discard-eligible);
(translate-fecn-and-becn | no-translate-fecn-and-becn);
vlan-id number;
vlan-id-list [number number-number];
unnumbered-address interface-name destination address destination-profile
    profile-name;
address address {
    arp ip-address (mac | multicast-mac) mac-address <publish>;
    broadcast address;
    destination address;
    destination-profile name;
    eui-64;
    multipoint-destination address dlci dlci-identifier;
    multipoint-destination address {
        epd-threshold cells;
        inverse-arp;
        oam-liveness {
            up-count cells;
            down-count cells;
        }
        oam-period (disable | seconds);
        shaping {
            (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained
                rate burst length);
            queue-length number;
        }
        vci vpi-identifier.vci-identifier;
    }
    primary;
    preferred;
    (vrrp-group | vrrp-inet6-group) group-number {
```

```
            (accept-data | no-accept-data);
            advertise-interval seconds;
            authentication-type authentication;
            authentication-key key;
            fast-interval milliseconds;
            (preempt | no-preempt) {
                hold-time seconds;
            }
            priority-number number;
            track {
                priority-cost seconds;
                priority-hold-time interface-name {
                    interface priority;
                    bandwidth-threshold bits-per-second {
                        priority;
                    }
                }
                route ip-address/mask routing-instance instance-name priority-cost cost;
            }
            virtual-address [ addresses ];
        }
    }
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure protocol family information for the logical interface.

Options *family*—Protocol family:

- any—Protocol-independent family used for Layer 2 packet filtering
- bridge—(M-series and T-series routing platforms only) Configure only when the physical interface is configured with ethernet-bridge type encapsulation or when the logical interface is configured with vlan-bridge type encapsulation
- ccc—Circuit cross-connect protocol suite
- inet—Internet Protocol version 4 suite
- inet6—Internet Protocol version 6 suite
- iso—International Organization for Standardization Open Systems Interconnection (ISO OSI) protocol suite
- mlfr-end-to-end—Multilink Frame Relay FRF.15
- mlfr-uni-nni—Multilink Frame Relay FRF.16
- multilink-ppp—Multilink Point-to-Point Protocol
- mpls—Multiprotocol Label Switching (MPLS)
- tcc—Translational cross-connect protocol suite
- tnp—Trivial Network Protocol
- vpls—(M-series and T-series routing platforms only) Virtual private LAN service

The remaining statements are explained separately.

Usage Guidelines See "Configuring the Protocol Family" on page 164 and the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

fastether-options

Syntax

```
fastether-options {
    802.3ad {
        aex (primary | backup);
        lacp {
            port-priority;
        }
    }
    (flow-control | no-flow-control);
    ignore-l3-incompletes;
    ingress-rate-limit rate;
    (loopback | no-loopback);
    mpls {
        pop-all-labels {
            required-depth number;
        }
    }
    source-address-filter {
        mac-address;
    }
    (source-filtering | no-source-filtering);
}
```

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure Fast Ethernet-specific interface properties.

The statements are explained separately.

Usage Guidelines See “Configuring Ethernet Interfaces” on page 555.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

fcs

Syntax fcs (16 | 32);

Hierarchy Level
[edit interface e1-*fpc/pic/port*],
[edit interface t1-*fpc/pic/port*],
[edit interfaces *interface-name* ds0-options],
[edit interfaces *interface-name* e1-options],
[edit interfaces *interface-name* e3-options],
[edit interfaces *interface-name* sonet-options],
[edit interfaces *interface-name* t1-options],
[edit interfaces *interface-name* t3-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For E1/E3, SONET/SDH, and T1/T3 interfaces, configure the frame checksum (FCS) on the interface. The checksum must be the same on both ends of the interface.

On a channelized OC12 interface, the SONET/SDH fcs statement is not supported. To configure FCS on each DS3 channel, you must include the t3-options fcs statement in the configuration for each channel. For SONET/SDH, the channelized OC12 interface supports DS3 to STS-1 to OC12. For SDH, the channelized OC12 interface supports *N*xDS3 to *N*xVC3 to AU3 to STM.

NOTE: When configuring E1 interfaces on the 10-port Channelized E1/T1 IQE PIC, fcs must be set at the [edit interface e1-fpc/pic/port] hierarchy level.

When configuring T1 interfaces on the 10-port Channelized E1/T1 IQE PIC, fcs must be set at the [edit interface t1-fpc/pic/port] hierarchy level.

Options 16—Use a 16-bit frame checksum on the interface.

32—Use a 32-bit frame checksum on the interface. Using a 32-bit checksum provides more reliable packet verification, but some older equipment might not support 32-bit checksums.
Default: 16

Usage Guidelines See “Configuring the E1 Frame Checksum” on page 515, “Configuring the E3 Frame Checksum” on page 524, “Configuring the SONET/SDH Frame Checksum” on page 805, “Configuring the T1 Frame Checksum” on page 533, and “Configuring the T3 Frame Checksum” on page 544.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

feac-loop-respond

Syntax (feac-loop-respond | no-feac-loop-respond);

Hierarchy Level [edit interfaces *interface-name* t3-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For T3 interfaces only, configure the routing platform so a remote CSU can place the local routing platform into loopback.

If you configure remote or local loopback with the T3 loopback statement, the routing platform does not respond to FEAC requests from the CSU even if you include the feac-loop-respond statement in the configuration. For the routing platform to respond, you must delete the loopback statement from the configuration.

Default The routing platform does not respond to FEAC requests.

Usage Guidelines See “Configuring the T3 FEAC Response” on page 545.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics loopback, remote-loopback-respond

filter

Syntax

```
filter {
    group filter-group-number;
    input filter-name;
    input-list [ filter-names ];
    output filter-name;
    output-list [ filter-names ];
}
```

Hierarchy Level

[edit interfaces *interface-name* unit *logical-unit-number* family *family*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Apply a filter to an interface. You can also use filters for encrypted traffic. When you configure filters, you can configure the family inet, inet6, mpls, or vpls only.

Options

group *filter-group-number*—Define an interface to be part of a filter group. The default filter group number is 0.
Range: 0 through 255

input *filter-name*—Name of one filter to evaluate when packets are received on the interface.

output *filter-name*—Name of one filter to evaluate when packets are transmitted on the interface.

The remaining statements are explained separately.

Usage Guidelines See "Applying a Filter to an Interface" on page 194 and the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS Policy Framework Configuration Guide*, *JUNOS System Basics Configuration Guide*

flexible-vlan-tagging

Syntax

```
flexible-vlan-tagging;
unit logical-unit-number {
    vlan-id number;
    family family {
        address address;
    }
}
unit logical-unit-number {
    vlan-tags inner tpid.vlan-id outer tpid.vlan-id;
    family family {
        address address;
    }
}
```

Hierarchy Level [edit interfaces ge-*fpc/pic/port*]

Release Information Statement introduced in JUNOS Release 8.1.

Description On M-series and T-series routing platforms, for Fast Ethernet and Gigabit Ethernet interfaces only on Gigabit Ethernet IQ2 and IQ2-E, IQ, and IQE PICs, and for aggregated Ethernet interfaces with member links in IQ2 and IQ2-E PICs or in MX-series DPCs, simultaneously support transmission of 802.1Q VLAN single-tag and dual-tag frames on logical interfaces on the same Ethernet port.

The statements are explained separately.

Usage Guidelines See “Configuring Mixed Tagging” on page 572.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

flow-control

Syntax (flow-control | no-flow-control);

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

Release Information Statement introduced before JUNOS Release 7.4.

Description For aggregated Ethernet, Fast Ethernet, and Gigabit Ethernet interfaces only, explicitly enable flow control, which regulates the flow of packets from the routing platform to the remote side of the connection. Enabling flow control is useful when the remote device is a Gigabit Ethernet switch. Flow control is not supported on the 4-port Fast Ethernet PIC.

Default Flow control is the default behavior.

Usage Guidelines See “Configuring Flow Control” on page 564.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

f-max-period

Syntax f-max-period *number*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit interfaces *interface-name* unit *logical-unit-number* compression rtp]

Release Information Statement introduced before JUNOS Release 7.4.

Description For all adaptive services interfaces and for ISDN interfaces on J-series Services Routers. Specify the maximum number of compressed packets allowed between the transmission of full headers in a compressed Real-Time Transport Protocol (RTP) traffic stream.

Options *number*—Maximum number of packets. The value can be from 1 through 65535.

Usage Guidelines See “Configuring Bandwidth on Demand” on page 783 and the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

force

Syntax force (protect | working);

Hierarchy Level [edit interfaces *interface-name* sonet-options aps]

Release Information Statement introduced before JUNOS Release 7.4.

Description Perform a forced switch between the protect and working circuits. This statement is honored only if there are no higher-priority reasons to switch. It can be overridden by a signal failure on the protect circuit, thus causing a switch to the working circuit.

Options protect—Request the circuit to become the protect circuit.

working—Request the circuit to become the working circuit.

Usage Guidelines See “Configuring Switching Between the Working and Protect Circuits” on page 820.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics request

forwarding-class

See the following sections:

- forwarding-class (ATM2 IQ Scheduler Maps) on page 982
- forwarding-class (Gigabit Ethernet IQ Classifier) on page 983

forwarding-class (ATM2 IQ Scheduler Maps)

Syntax

```
forwarding-class class-name {
   epd-threshold cells plp1 cells;
   linear-red-profile profile-name;
   priority (high | low);
   transmit-weight (cells number | percent number);
}
```

Hierarchy Level [edit interfaces at-*fpc/pic/port* atm-options scheduler-maps *map-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM2 IQ interfaces only, define forwarding class name and option values.

Options *class-name*—Name of forwarding class.

The statements are explained separately.

Usage Guidelines See "Configuring ATM2 IQ VC Tunnel CoS Components" on page 325.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics forwarding-class statement in the *JUNOS Class of Service Configuration Guide*

forwarding-class (Gigabit Ethernet IQ Classifier)

Syntax

```
forwarding-class class-name {
    loss-priority (high | low);
}
```

Hierarchy Level [edit interfaces *interface-name* gigether-options ethernet-switch-profile ethernet-policer-profile output-priority-map classifier premium]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Gigabit Ethernet IQ interfaces only, define forwarding class name and option values.

Options *class-name*—Name of forwarding class.

The statements are explained separately.

Usage Guidelines See "Specifying an Output Priority Map" on page 710.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics input-priority-map, forwarding-class statement in the *JUNOS Class of Service Configuration Guide*

fragment-threshold

Syntax fragment-threshold *bytes*;

Hierarchy Level [edit interfaces *interface-name* mlfr-uni-nni-bundle-options],
[edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For multilink, link services, and voice services interfaces, and for J-series Services Routers ISDN interfaces, set the fragmentation threshold.

Options *bytes*—Maximum size, in bytes, for multilink packet fragments. Any nonzero value must be a multiple of 64 bytes.
Range: 128 through 16,320 bytes
Default: 0 bytes (no fragmentation)

Usage Guidelines See "Configuring ISDN Logical Interface Properties" on page 777 and the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

frame-error

Syntax frame-error *count*;

Hierarchy Level [edit protocols oam ethernet link-fault-management action-profile event link-event-rate],
[edit protocols oam link-fault-management interface *interface-name* event-thresholds]

Release Information Statement introduced in JUNOS Release 8.4.

Description Threshold for sending frame error events or taking the action specified in the action profile.

A frame error is any frame error on the underlying physical layer. The threshold is reached when the number of frame errors reaches the configured value within the window. The default window is 1 second and is not configurable.

Options *count*—Threshold count for frame error events.

Range: 1 through 100

Usage Guidelines See “Configuring Threshold Values for Local Fault Events on an Interface” on page 699 and “Configuring Threshold Values for Fault Events in an Action Profile” on page 702.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

frame-period

Syntax frame-period *count*;

Hierarchy Level [edit protocols oam ethernet link-fault-management action-profile event link-event-rate],
[edit protocols oam link-fault-management interface *interface-name* event-thresholds]

Release Information Statement introduced in JUNOS Release 8.4.

Description Threshold for sending frame period error events or taking the action specified in the action profile.

A frame error is any frame error on the underlying physical layer. The frame period threshold is reached when the number of frame errors reaches the configured value within the period window. The default period window is the number of minimum-size frames that can be transmitted on the underlying physical layer in 1 second. The window is not configurable.

Options *count*—Threshold count for frame period error events.

Range: 1 through 100

Usage Guidelines See "Configuring Threshold Values for Local Fault Events on an Interface" on page 699 and "Configuring Threshold Values for Fault Events in an Action Profile" on page 702.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

frame-period-summary

Syntax frame-period-summary *count*;

Hierarchy Level [edit protocols oam ethernet link-fault-management action-profile event link-event-rate],
[edit protocols oam link-fault-management interface *interface-name* event-thresholds]

Release Information Statement introduced in JUNOS Release 8.4.

Description Threshold for sending frame period summary error events or taking the action specified in the action profile.

An errored frame second is any 1-second period that has at least one errored frame. This event is generated if the number of errored frame seconds is equal to or greater than the specified threshold for that period window. The default window is 60 seconds. The window is not configurable.

Options *count*—Threshold count for frame period summary error events.

Range: 1 through 100

Usage Guidelines See "Configuring Threshold Values for Local Fault Events on an Interface" on page 699 and "Configuring Threshold Values for Fault Events in an Action Profile" on page 702.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

framing

See the following sections:

- framing (E1, E3, and T1 Interfaces) on page 988
- framing (10-Gigabit Ethernet Interfaces) on page 989
- framing (SONET and SDH Interfaces) on page 989

framing (E1, E3, and T1 Interfaces)

Syntax framing (g704 | g704-no-crc4 | g.751 | g.832 | unframed | sf | esf);

Hierarchy Level [edit interface ce1-*fpc/pic/port*],
[edit interface ct1-*fpc/pic/port*],
[edit interfaces at-*fpc/pic/port* e3-options],
[edit interfaces e1-*fpc/pic/port* e1-options],
[edit interfaces t1-*fpc/pic/port* t1-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure the framing format.

NOTE: When configuring CE1 interfaces on the 10-port Channelized E1/T1 IQE PIC, framing must be set at the [edit interface ce1-fpc/pic/port] hierarchy level.

When configuring CT1 interfaces on the 10-port Channelized E1/T1 IQE PIC, framing must be set at the [edit interface ct1-fpc/pic/port] hierarchy level.

Default esf for T1 interfaces; g704 for E1 interfaces. There is no default value for E3 over ATM interfaces.

Options esf—Extended superframe (ESF) mode for T1 interfaces.

g704—G.704 framing format for E1 interfaces.

g704-no-crc4—G.704 framing with no cyclic redundancy check 4 (CRC4) for E1 interfaces.

g.751—G.751 framing format for E3 over ATM interfaces.

g.832—G.832 framing format for E3 over ATM interfaces.

sf—Superframe (SF) mode for T1 interfaces.

unframed—Unframed mode for E1 interfaces.

Usage Guidelines See “Configuring E1 Framing” on page 515, “Configuring E3 and T3 Parameters on ATM Interfaces” on page 323, and “Configuring T1 Framing” on page 534.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

framing (10-Gigabit Ethernet Interfaces)

Syntax framing (lan-phy | wan-phy);

Hierarchy Level [edit interfaces xe-*fpc/pic/port*]

Release Information Statement introduced in JUNOS Release 8.0.

Description For M120, M320, and T-series routers using the 10-Gigabit Ethernet IQ2 and IQ2-E PIC, configure the framing format.

Default Operates in LAN PHY mode.

Options lan-phy—10GBASE-R interface framing format that bypasses the WIS sublayer to directly stream block-encoded Ethernet frames on a 10-Gigabit Ethernet serial interface.

wan-phy—10GBASE-W interface framing format that allows 10-Gigabit Ethernet wide area links to use fiber-optic cables and SONET devices.

Usage Guidelines See “Configuring 10-Gigabit Ethernet Framing” on page 735 and “Configuring SONET Options for 10-Gigabit Ethernet Interfaces” on page 826.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

framing (SONET and SDH Interfaces)

Syntax framing (sdh | sonet);

Hierarchy Level [edit interfaces so-*fpc/pic/port*]

Release Information Statement introduced in JUNOS Release 8.1.

Description For the 4-port OC48 PIC with SFP installed and the 4-port OC192 PIC in T-series and M-series routing platforms, configure SONET or SDH framing on a per-port basis. This functionality allows you to mix SONET and SDH modes on interfaces on the same PIC.

Options sdh—SDH framing.

sonet—SONET framing.

Usage Guidelines See “Configuring SONET/SDH Framing” on page 800.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

gigether-options

Syntax

```
gigether-options {
    802.3ad {
        aex (primary | backup);
        lacp {
            port-priority;
        }
    }
    (asynchronous-notification | no-asynchronous-notification);
    auto-negotiation | no-auto-negotiation) remote-fault
    <local-interface-online | local-interface-offline>
    (flow-control | no-flow-control);
    ignore-l3-incompletes;
    (loopback | no-loopback);
    mpls {
        pop-all-labels {
            required-depth number;
        }
    }
    source-address-filter {
        mac-address;
    }
    (source-filtering | no-source-filtering);
    speed (gigether-options)
    ethernet-switch-profile {
        (mac-learn-enable | no-mac-learn-enable);
        tag-protocol-id [ tpids ];
        ethernet-policer-profile {
            input-priority-map {
                ieee802.1p premium [ values ];
            }
            output-priority-map {
                classifier {
                    premium {
                        forwarding-class class-name {
                            loss-priority (high | low);
                        }
                    }
                }
            }
            policer cos-policer-name {
                aggregate {
                    bandwidth-limit (ethernet) bps;
                    burst-size-limit (ethernet) bytes;
                }
                premium {
                    bandwidth-limit (ethernet) bps;
                    burst-size-limit (ethernet) bytes;
                }
            }
        }
    }
```

}

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure Gigabit Ethernet-specific interface properties.

The statements are explained separately.

Usage Guidelines See “Configuring Ethernet Interfaces” on page 555.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

gratuitous-arp-reply

Syntax (gratuitous-arp-reply | no-gratuitous-arp-reply);

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Ethernet interfaces, enable updating of the ARP cache for replies received in response to gratuitous ARP requests.

Default Updating of the ARP cache is disabled on all Ethernet interfaces.

Options gratuitous-arp-reply—Update the ARP cache.

no-gratuitous-arp-reply—Do not update the ARP cache.

Usage Guidelines See “Configuring Gratuitous ARP” on page 565.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics no-gratuitous-arp-request

guard-interval

Syntax guard-interval *number*;

Hierarchy Level [edit protocols protection-group ethernet-ring *ring-name*]

Description Specify the guard timer interval in 10 ms intervals.

Options

Range: 10 through 2000 milliseconds
Default: 500 milliseconds

Usage Guidelines See "Configuring Ethernet Ring Protection Switching" on page 753.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

hardware-assisted-timestamping

Syntax hardware-assisted-timestamping;

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management performance-monitoring]

Release Information Statement introduced in JUNOS Release 9.5.

Description For Ethernet interfaces on Enhanced and Enhanced Queuing Dense Port Concentrators (DPCs) in MX-series routers only, enable hardware-assisted timestamping support for Ethernet frame delay measurement.

By default, the ETH-DM feature calculates frame delays using software-based timestamping of the ETH-DM PDU frames sent and received by the MEPs in the session. As an option that can increase the accuracy of ETH-DM calculations when the DPC is loaded with heavy traffic in the receive direction, you can enable hardware-assisted timestamping of session frames in the receive direction.

Usage Guidelines See "Ethernet Frame Delay Measurements Overview" on page 663, "Guidelines for Configuring Routers to Support an ETH-DM Session" on page 669, and "Enabling the Hardware-Assisted Timestamping Option" on page 678.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

hello-timer

Syntax hello-timer *milliseconds*;

Hierarchy Level [edit interfaces *interface-name* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For link services and voice services interfaces only, configure the rate at which hello messages are sent. A hello message is transmitted after a period defined in milliseconds has elapsed.

Options milliseconds—The rate at which hello messages are sent.
Range: 1 through 180 milliseconds
Default: 10 milliseconds

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics address, acknowledge-timer

high-plp-max-threshold

Syntax high-plp-max-threshold *percent*;

Hierarchy Level [edit interfaces at-*fpc/pic/port* atm-options linear-red-profiles *profile-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM2 IQ interfaces only, define the drop profile fill-level for the high PLP CoS VC. When the fill level exceeds the defined percentage, all packets are dropped.

Options *percent*—Fill-level percentage when linear random early discard (RED) is applied to cells with PLP.

Usage Guidelines See “Configuring ATM2 IQ VC Tunnel CoS Components” on page 325.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics low-plp-max-threshold, low-plp-threshold, queue-depth

high-plp-threshold

Syntax high-plp-threshold *percent*;

Hierarchy Level [edit interfaces at-*fpc/pic/port* atm-options linear-red-profiles *profile-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM2 IQ interfaces only, define CoS VC drop profile fill-level percentage when linear RED is applied to cells with high PLP. When the fill level exceeds the defined percentage, packets with high PLP are randomly dropped by RED. This statement is mandatory.

Options *percent*—Fill-level percentage when linear RED is applied to cells with PLP.

Usage Guidelines See "Configuring ATM2 IQ VC Tunnel CoS Components" on page 325.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics high-plp-max-threshold, low-plp-max-threshold, low-plp-threshold, queue-depth

hierarchical-policer

Syntax

```
hierarchical-policer name {
aggregate {
    if-exceeding {
        bandwidth-limit bandwidth;
        burst-size-limit burst;
    }
    then {
        discard;
    }
}
premium {
    if-exceeding {
        bandwidth-limit bandwidth;
        burst-size-limit burst;
    }
    then {
        discard;
    }
}
```

Hierarchy Level [edit firewall]

Release Information Statement introduced in JUNOS Release 9.5.

Description On M40e, M120, and M320 (with FFPC and SFPC) edge routers and T320, T640, and T1600 core routers with Enhanced Intelligent Queuing (IQE) PICs, to specify a hierarchical policer, use the hierarchical-policer statement at the [edit firewall] hierarchy level.

Options Options are described separately.

Usage Guidelines See "Applying Policers" on page 185 and *Class of Service*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

hold-interval

hold-interval (OAM)

Syntax hold-interval *minutes*;

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name* continuity-check]

Release Information Statement introduced in JUNOS Release 8.4.

Description The time to wait before flushing the maintenance end point (MEP) database, if no updates occur.

Options *minutes*—Time to wait, in minutes.

Usage Guidelines See "Configuring the Continuity Check Hold Interval" on page 650.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

hold-interval (Protection Group)

Syntax hold-interval *number*;

Hierarchy Level [edit protocols protection-group ethernet-ring *name*]

Description Specify the hold-off timer interval *for all rings* in 100-millisecond increments.

Options
Range: 0 through 10000 milliseconds
Default: 100 milliseconds

Usage Guidelines See "Configuring Ethernet Ring Protection Switching" on page 753.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

hold-time

See the following sections:

- hold-time (APS) on page 997
- hold-time (DLSw) on page 998
- hold-time (Physical Interface) on page 999
- hold-time (SONET/SDH Defect Triggers) on page 1000

NOTE: For information about the hold-time statement at the [edit interfaces *interface-name* unit *logical-unit-number* family (inet | inet6) address *address* (vrrp-group | vrrp-inet6-group) *group-number* preempt] and [edit logical-systems *logical-system-name* interface *interface-name* unit *logical-unit-number* family (inet | inet6) address *address* (vrrp-group | vrrp-inet6-group) *group-number* preempt], see the *JUNOS High Availability Configuration Guide*.

hold-time (APS)

Syntax hold-time *milliseconds*;

Hierarchy Level [edit interfaces *interface-name* sonet-options aps]

Release Information Statement introduced before JUNOS Release 7.4.

Description Hold-time value to use to determine whether a neighbor APS router is operational.

Options *milliseconds*—Hold-time value.

Range: 1 through 65,534 milliseconds

Default: 3000 milliseconds (3 times the advertisement interval)

Usage Guidelines See "Configuring APS Timers" on page 822.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics advertise-interval

hold-time (DLSw)

Syntax hold-time *seconds*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family llc2 redundancy-group *group-number* preempt],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family llc2 redundancy-group *group-number* preempt]

Release Information Statement introduced in JUNOS Release 7.5.

Description Hold time before a higher-priority backup router preempts the master router.

Default DLSw preemption is not timed.

Options *seconds*—Hold-time period.

Range: 0 through 3600

Default: 0 seconds (DLSw preemption is not timed.)

Usage Guidelines See “Configuring DLSw Ethernet Redundancy Using LLC2 Properties” on page 172.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

hold-time (Physical Interface)

Syntax hold-time up *milliseconds* down *milliseconds*;

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Hold-time value to use to damp interface transitions. When an interface goes from up to down, it is not advertised to the rest of the system as being down until it has remained down for the hold-time period. Similarly, an interface is not advertised as being up until it has remained up for the hold-time period.

NOTE: The hold-time option is not available for controller interfaces.

Default Interface transitions are not damped.

Options down *milliseconds*—Hold time to use when an interface transitions from up to down. The JUNOS software advertises the transition within 100 milliseconds of the time value you specify.
Range: 0 through 4,294,967,295 milliseconds
Default: 0 milliseconds (interface transitions are not damped)

up *milliseconds*—Hold time to use when an interface transitions from down to up. The JUNOS software advertises the transition within 100 milliseconds of the time value you specify.
Range: 0 through 4,294,967,295 milliseconds
Default: 0 milliseconds (interface transitions are not damped)

Usage Guidelines See “Damping Interface Transitions” on page 131.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics advertise-interval

hold-time (SONET/SDH Defect Triggers)

Syntax hold-time up *milliseconds* down *milliseconds*;

Hierarchy Level [edit interface *interface-name* sonet-options trigger *defect*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM over SONET/SDH and SONET/SDH interfaces only, apply up and down hold times to SONET/SDH defect triggers. When you apply a down hold time to a defect, the defect must remain present for at least the hold-time period before the interface is marked down. When you apply an up hold time to a defect, the defect must remain absent for at least the hold-time period before the interface is marked up, assuming no other defect is outstanding.

NOTE: On M-series and T-series platforms with Channelized SONET IQ PICs and Channelized SONET IQE PICs, the SONET defect alarm trigger hold-time statement is not supported.

Default If you do not include this statement, when a defect is detected the interface is marked down immediately, and when the defect becomes absent the interface is marked up immediately.

Options down *milliseconds*—Hold time to wait before the interface is marked down.

Range: 1 through 65,534 milliseconds
Default: No hold time

up *milliseconds*—Hold time to wait before the interface is marked up.

Range: 1 through 65,534 milliseconds
Default: No hold time

Usage Guidelines See "Configuring SONET/SDH Defect Hold Times" on page 810.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

host

Syntax
```
host hostname {
    facility-override;
    log-prefix prefix-number;
    services priority-level;
}
```

Hierarchy Level [edit interfaces *interface-name* services-options syslog]

Release Information Statement introduced before JUNOS Release 7.4.

Description Specify hostname for system logging utility.

Options *hostname*—Name of system logging utility host machine.

The remaining statements are explained separately.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

idle-cycle-flag

Syntax idle-cycle-flag *value*;

Hierarchy Level [edit interface e1-*fpc/pic/port*],
[edit interface t1-*fpc/pic/port*],
[edit interfaces *interface-name* ds0-options],
[edit interfaces *interface-name* e1-options],
[edit interfaces *interface-name* e3-options],
[edit interfaces *interface-name* serial-options],
[edit interfaces *interface-name* t1-options],
[edit interfaces *interface-name* t3-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure the value that the DS0, E1, E3, T1, or T3 interface transmits during idle cycles.

NOTE: When configuring E1 interfaces on the 10-port Channelized E1/T1 IQE PIC, idle-cycle-flag must be set at the [edit interface e1-fpc/pic/port] hierarchy level.

When configuring T1 interfaces on the 10-port Channelized E1/T1 IQE PIC, idle-cycle-flag must be set at the [edit interface t1-fpc/pic/port] hierarchy level.

Options *value*—Value to transmit in the idle cycles:

- flags—Transmit the value 0x7E.
- ones—Transmit the value 0xFF (all ones).

Default: Flags

Usage Guidelines See “Configuring the E1 Idle Cycle Flag” on page 516, “Configuring the E3 Idle Cycle Flag” on page 525, “Configuring the T1 Idle Cycle Flag” on page 536, and “Configuring the T3 Idle Cycle Flag” on page 545.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

idle-time

Syntax idle-time *time*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family llc2],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family llc2]

Release Information Statement introduced in JUNOS Release 7.4.

Description For J-series Services Routers only. On Ethernet interfaces configured for DLSw, configure the time for which a TCP connection between DLSw peers will stay up without any circuit using the connection.

Options *time*—Number of seconds.
Range: 1 through 60000 seconds
Default: 10 seconds

Usage Guidelines See “Configuring LLC2 Options” on page 171.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Advanced WAN Access Configuration Guide*

idle-timeout

Syntax idle-timeout *seconds*;

Hierarchy Level [edit interface dl*n* unit *logical-unit-number* dialer-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description (J-series Services Routers) For ISDN interfaces, configure the number of seconds the link is idle before losing connectivity.

Options *seconds*—Time for which the connection can remain idle. For interfaces configured to use a filter for traffic, the idle timeout is based on traffic.
Range: 1 through 429497295
Default: 120 seconds

Usage Guidelines See “Configuring ISDN Logical Interface Properties” on page 777.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

ieee802.1p

Syntax
ieee802.1p premium [*values*];

Hierarchy Level
[edit interfaces *interface-name* gigether-options ethernet-switch-profile
ethernet-policer-profile input-priority-map]

Release Information
Statement introduced before JUNOS Release 7.4.

Description
For Gigabit Ethernet IQ and 10-Gigabit Ethernet interfaces only, configure premium priority values for IEEE 802.1p input traffic.

Options
values—Define IEEE 802.1p priority values to be treated as premium.
Range: 0 through 7

Usage Guidelines
See “Specifying an Input Priority Map” on page 710.

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

if-exceeding

Syntax
```
if-exceeding {
   bandwidth-limit bandwidth;
   burst-size-limit burst;
}
```

Hierarchy Level
[edit firewall hierarchical-policer aggregate]
[edit firewall hierarchical-policer premium]

Release Information
Statement introduced in JUNOS Release 9.5.

Description
On M40e, M120, and M320 (with FFPC and SFPC) edge routers and T320, T640, and T1600 core routers with Enhanced Intelligent Queuing (IQE) PICs, to specify bandwidth and burst limits for an aggregate level of a hierarchical policer, use the if-exceeding statement at the [edit firewall hierarchical-policer aggregate] or [edit firewall hierarchical-policer premium]hierarchy level.

Options
Options are described separately.

Usage Guidelines
See “Applying Policers” on page 185 and *Class of Service*.

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

ignore

Syntax ignore;

Hierarchy Level [edit interface *interface-name* sonet-options trigger *defect*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM over SONET/SDH and SONET/SDH interfaces only, ignore a specific SONET/SDH defect trigger.

Default If you do not include this statement, all defects are honored with no hold time.

Usage Guidelines See “Configuring SONET/SDH Defect Triggers to Be Ignored” on page 809.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics hold-time

ignore-all

Syntax ignore-all;

Hierarchy Level [edit interfaces *interface-name* serial-options dce-options],
[edit interfaces *interface-name* serial-options dte-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Ignore all control leads. You can include the ignore-all statement in the configuration only if you do not explicitly enable other signal handling options at the dte-options hierarchy level.

Usage Guidelines See “Configuring the Serial Signal Handling” on page 257.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

ignore-l3-incompletes

Syntax ignore-l3-incompletes;

Hierarchy Level [edit interfaces *interface-name* fastether-options],
[edit interfaces *interface-name* gigether-options]

Release Information Statement introduced in JUNOS Release 9.0.

Description Ignore the counting of Layer 3 incomplete errors on Fast Ethernet, Gigabit Ethernet, and 10-Gigabit Ethernet interfaces.

Usage Guidelines See “Ignoring Layer 3 Incomplete Errors” on page 564

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

ilmi

Syntax ilmi;

Hierarchy Level [edit interfaces at-*fpc/pic/port* atm-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Enable the routing platform to communicate with directly attached ATM switches and routers. The routing platform uses the VC 0.16 to communicate with the ATM switch or router. Once configured, you can display the IP address and port number of an ATM switch or router using the show interfaces *interface-name* switch-id command.

Usage Guidelines See “Configuring Communication with Directly Attached ATM Switches and Routers” on page 277.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics show ilmi and show ilmi statistics commands in the *JUNOS Interfaces Command Reference*

inactivity-timeout

Syntax inactivity-timeout *seconds*;

Hierarchy Level [edit interfaces *interface-name* services-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For adaptive services interfaces, configure the inactivity timeout period for established flows. The timeout configured in the application protocol definition overrides this value.

Options *seconds*—Timeout period, in seconds.

Range: 4 through 86,400 seconds

Default: 30 seconds

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

incoming-called-number

Syntax incoming-called-number *number* <reject>;

Hierarchy Level [edit interfaces br-*pim*/0/*port* isdn-options]

Release Information Statement introduced on JUNOS Release 7.5.

Description (J-series Services Routers) For interfaces configured for ISDN, screen incoming calls. If the incoming number is configured, the call is accepted. If the reject option is specified with the number, the call is rejected. If no numbers are configured, all calls are accepted.

Options *number*—(Optional) Incoming caller number. Multiple numbers can be configured, up to a maximum of 30 entries. Only a precise match is a valid match, For example, the configured caller number 1-222-333-4444 or 222-333-4444 will match the incoming caller number 1-222-333-4444.

reject—(Optional) Rejects the incoming number.

Usage Guidelines See “Configuring an ISDN Interface to Screen Incoming Calls” on page 777.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS Services Interfaces Configuration Guide*

incoming-map

Syntax

```
incoming-map {
    caller caller-number | accept-all;
}
```

Hierarchy Level

[edit interfaces dl*n* unit *logical-unit-number* dialer-options],
[edit logical-systems *logical-system-name* interfaces dl*n* unit *logical-unit-number* dialer-options]

Release Information Statement introduced in JUNOS Release 7.5.

Description (J-series Services Routers) For interfaces configured for ISDN, specify the dialer to accept incoming calls.

The statements are explained separately.

NOTE: The incoming-map statement is mandatory for the router to accept any incoming ISDN calls.

Usage Guidelines See "Configuring Dial-In and Callback" on page 786.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

indication

Syntax indication (ignore | normal | require);

Hierarchy Level [edit interfaces *interface-name* serial-options dce-options],
[edit interfaces *interface-name* serial-options dte-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For X.21 interfaces only, configure the from-DCE signal indication.

Options ignore—The from-DCE signal is ignored.

normal—Normal indication signal handling as defined by ITU-T Recommendation X.21.

require—The from-DCE signal must be asserted.

Default: normal

Usage Guidelines See “Configuring the Serial Signal Handling” on page 257.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

indication-polarity

Syntax indication-polarity (negative | positive);

Hierarchy Level [edit interfaces *interface-name* serial-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For X.21 interfaces only, configure the indication signal polarity.

Options positive—Positive signal polarity.

negative—Negative signal polarity.

Default: positive

Usage Guidelines See “Configuring Serial Signal Polarities” on page 260.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

ingress-rate-limit

Syntax ingress-rate-limit *rate*;

Hierarchy Level [edit interfaces *interface-name* fastether-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Perform port-based rate limiting on ingress traffic arriving on Fast Ethernet 8-port, 12-port, and 48-port PICs.

Options *rate*—Traffic rate, in megabits per second (Mbps).

Range: 1 through 100 Mbps.

Usage Guidelines See "Configuring the Ingress Rate Limit" on page 567.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

init-command-string

Syntax init-command-string *initialization-command-string*;

Hierarchy Level [edit interfaces umd0 modem-options]

Release Information Statement introduced in JUNOS Release 8.2.

Description For J-series Services Routers, configure the command string used to initialize the USB modem.

When you connect the USB modem to the USB port on a Services Router, the router applies the modem AT commands configured in the init-command-string command to the initialization commands on the modem.

For example, the initialization command string ATS0 = 2\n configures the USB modem to pick up a call after 2 rings.

If you do not include the init-command-string statement, the router applies the default initialization string to the modem.

Options *initialization-command-string*—Specify an initialization command string using the following AT command values:

- %C0—Disables data compression.
- &C1—Disables reset of the modem when it loses the carrier signal.
- &Q8—Enables Microcom Networking Protocol (MNP) error control mode.
- AT—Attention. Informs the modem that a command follows.
- E0—Disables the display on the local terminal of commands issued to the modem from the local terminal.
- Q0—Enables the display of result codes.
- S0=0—Disables the auto-answer feature, whereby the modem automatically answers calls.
- S7=45—Instructs the modem to wait 45 seconds for a telecommunications service provider (carrier) signal before terminating the call.
- V1—Displays result codes as words.

Default: AT S7 = 45 S0 = 0 V1 X4 &C1 E0 Q0 &Q8 %C0

Usage Guidelines See “Specifying a USB Modem Interface on J-series Routers” on page 87.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

initial-route-check

Syntax initial-route-check *seconds*;

Hierarchy Level [edit interface dl*n* unit *logical-unit-number* dialer-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description (J-series Services Routers) For ISDN interfaces, allows the router to check whether the primary route is up after the initial startup of the router is complete and the timer expires.

Options *seconds*—How long to wait to check if the primary interface is up after the router comes up.

Range: 1 through 300 seconds

Default: 120 seconds

Usage Guidelines See "Configuring ISDN Interfaces" on page 773.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

inner-tag-protocol-id

Syntax inner-tag-protocol-id *tpid*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit interfaces *interface-name* unit *logical-unit-number* output-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* output-vlan-map]

Release Information Statement introduced in JUNOS Release 8.1.

Description For Gigabit Ethernet IQ, IQ2 and IQ2-E interfaces, and for aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX-series routing platforms, configure the IEEE 802.1Q TPID value to rewrite for the inner tag. All TPIDs you include in input and output VLAN maps must be among those you specify at the [edit interfaces *interface-name* gigether-options ethernet-switch-profile tag-protocol-id [*tpids*]] hierarchy level.

Default If the inner-tag-protocol-id statement is not configured, the TPID value is 0x8100.

Usage Guidelines See "Configuring Inner and Outer TPIDs and VLAN IDs" on page 611.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

inner-vlan-id

Syntax inner-vlan-id *number*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit interfaces *interface-name* unit *logical-unit-number* output-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* output-vlan-map]

Release Information Statement introduced in JUNOS Release 8.1.

Description For Gigabit Ethernet IQ, IQ2 and IQ2-E interfaces, and for aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX-series routing platforms, specify the VLAN ID to rewrite for the inner tag of the final packet.

You cannot include the inner-vlan-id statement with the swap statement, swap-push statement, push-push statement, or push-swap statement and the inner-vlan-id statement at the [edit interfaces *interface-name* unit *logical-unit-number*output-vlan-map] hierarchy level. If you include any of those statements in the output VLAN map, the VLAN ID in the outgoing frame is rewritten to the inner-vlan-id statement you include at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level.

Options *number*—VLAN ID number.
Range: 0 through 4094

Usage Guidelines See "Configuring Inner and Outer TPIDs and VLAN IDs" on page 611.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

inner-vlan-id-range

Syntax inner-vlan-id-range start *start-id* end *end-id*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*],

Release Information Statement introduced in JUNOS Release 9.0.

Description The range of VLAN IDs to be used in the ATM-to-Ethernet interworking cross-connect. Specify the starting VLAN ID and ending VLAN ID.

Options start-id—The lowest VLAN ID to be used.

end-id—The highest VLAN ID to be used.
Range: 32 through 4094

Usage Guidelines See "Configuring ATM-to-Ethernet Interworking" on page 219.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

input

Syntax

```
input {
    service-set service-set-name <service-filter filter-name>;
    post-service-filter filter-name;
}
```

Hierarchy Level [edit interface *interface-name* unit *logical-unit-number* family inet service],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet service]

Release Information Statement introduced before JUNOS Release 7.4.

Description Define one or more input service sets and filters, and one postservice filter to be applied to traffic.

Options The remaining statements are explained separately.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

input-list

Syntax input-list [*filter-names*];

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family *family* filter],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family* filter]

Release Information Statement introduced in JUNOS Release 7.6.

Description Apply a group of filters to evaluate when packets are received on an interface.

Options [*filter-names*]—Name of a filter to evaluate when packets are received on the interface. Up to 16 filters can be included in a filter input list.

Usage Guidelines See “Applying a Filter to an Interface” on page 194.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics output-list, *JUNOS Policy Framework Configuration Guide*, *JUNOS System Basics Configuration Guide*

input-policer

Syntax input-policer *policer-name*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* layer2-policer]

Release Information Statement introduced in JUNOS Release 8.2.

Description Associate a Layer 2 policer with a logical interface. The input-policer and input-three-color statements are mutually exclusive.

Options *policer-name*—Name of the policer that you define at the [edit firewall] hierarchy level.

Usage Guidelines See “Applying a Policer” on page 711.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics output-policer

input-priority-map

Syntax

```
input-priority-map {
    ieee802.1p premium [ values ];
}
```

Hierarchy Level [edit interfaces *interface-name* gigether-options ethernet-switch-profile ethernet-policer-profile]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Gigabit Ethernet IQ and 10-Gigabit Ethernet interfaces only, define the input policer priority map to be applied to incoming frames on this interface.

The statements are explained separately.

Usage Guidelines See "Specifying an Input Priority Map" on page 710.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics output-priority-map

input-three-color

Syntax input-three-color *policer-name*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* layer2-policer]

Release Information Statement introduced in JUNOS Release 8.2.

Description Associate a Layer 2, three-color policer with a logical interface. The input-three-color and input-policer statements are mutually exclusive.

Options *policer-name*—Name of the three-color policer that you define at the [edit firewall] hierarchy level.

Usage Guidelines See "Applying a Policer" on page 711.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics output-three-color

input-vlan-map

See the following sections:

- input-vlan-map (Gigabit Ethernet IQ) on page 1017
- input-vlan-map (Aggregated Ethernet) on page 1018

input-vlan-map (Gigabit Ethernet IQ)

Syntax

```
input-vlan-map {
    (pop | pop-pop | pop-swap | push | push-push | swap | swap-push | swap-swap);
    inner-tag-protocol-id tpid;
    inner-vlan-id number;
    tag-protocol-id tpid;
    vlan-id number;
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.
pop-pop, pop-swap, push-push, swap-push, and swap-swap statements introduced in JUNOS Release 8.1.

Description For Gigabit Ethernet IQ interfaces only, define the rewrite profile to be applied to incoming frames on this logical interface.

The statements are explained separately.

Usage Guidelines See “Stacking a VLAN Tag” on page 614.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics output-vlan-map

input-vlan-map (Aggregated Ethernet)

Syntax

```
input-vlan-map {
    (pop | push | swap);
    tag-protocol-id tpid;
    vlan-id number;
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced in JUNOS Release 8.2.

Description For aggregated Ethernet interfaces using Gigabit Ethernet IQ and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces only, define the rewrite profile to be applied to incoming frames on this logical interface.

The statements are explained separately.

Usage Guidelines See "Stacking a VLAN Tag" on page 614.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics output-vlan-map

instance

Syntax instance *vpls-instance-name*;

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management maintenance-domain *name*]

Description Specify the VPLS instance of the default maintenance domain.

Usage Guidelines See "Configuring Maintenance Intermediate Points" on page 648.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics maintenance-domain

interface

See the following sections:

NOTE: For information about the interface statement available at the [edit interfaces *interface-name* unit *logical-unit-number* family (inet | inet6) address *address* (vrrp-group | vrrp-inet6-group) *group-number* track] and [edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family (inet | inet6) address *address* (vrrp-group | vrrp-inet6-group) *group-number* track] hierarchy levels, see the *JUNOS High Availability Configuration Guide*.

interface (DLSw Ethernet Redundancy)

Syntax interface *interface-name* priority-cost *cost*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family llc2 redundancy-group *group-number* track],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family llc2 redundancy-group *group-number* track]

Release Information Statement introduced in JUNOS Release 7.5.

Description For J-series Services Routers only, on Ethernet interfaces configured for DLSw Ethernet redundancy, enable tracking options for an interface.

Options *interface-name*—Interface name. Include the logical portion of the name, which corresponds to the logical unit number. The statements are explained separately.

priority-cost *cost*—Cost value that is subtracted from the priority value when remote peer connectivity is lost. Specify a value from 1 through 254.

Usage Guidelines See “Configuring DLSw Ethernet Redundancy Using LLC2 Properties” on page 172.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS Services Interfaces Configuration Guide*

interface (Hierarchical CoS Schedulers)

Syntax interface *interface-name*;

Hierarchy Level [edit interfaces interface-set (Ethernet Interfaces) *interface-set-name*]

Release Information Statement introduced in JUNOS Release 8.5.

Description Interface that is a member of the interface set. Supported on Ethernet interfaces and IP demux interfaces on an MX-series router.

Usage Guidelines See the *JUNOS Class of Service Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

interface (IEEE 802.1x)

Syntax

```
interface interface-ids {
    supplicant single;
    retries integer;
    quiet-period seconds;
    transmit-period seconds;
    reauthentication (disable | interval seconds);
    supplicant-timeout seconds;
    server-timeout seconds;
    maximum-requests seconds;
}
```

Hierarchy Level [edit protocols dot1x authenticator]

Release Information Statement introduced in JUNOS Release 9.3.

Description Use this statement to configure the 802.1x Port-Based Network Access Control protocol-specific Ethernet interface options.

Default The default values are provided for the options below on the respective statement pages.

Options

maximum-requests—Specify the maximum number of retransmission times for an EAPOL Request packet to the client before it times out the authentication session.

quiet-period—Specify the number of seconds the port remains in the wait state following a failed authentication exchange with the client, before reattempting the authentication.

reauthentication—Includes two options:

- disable—Periodic reauthentication of the client is disabled.
- interval—Specify the periodic reauthentication time interval.

retries—Specify the number of tries after which the port remains in the wait state for quiet-period seconds before reattempting the authentication.

server-timeout—Specify the number of seconds the port waits for a reply when relaying a response from the client to the authentication server before timing out and invoking the server-fail action.

supplicant (*single*)—Specify supplicant single mode. See the usage guidelines to configure other modes.

supplicant-timeout—Specify the number of seconds the port waits for a response when relaying a request from the authentication server to the client before resending the request.

transmit-period—Specify the number of seconds the port waits before retransmitting the initial EAPOL PDUs to the client.

Usage Guidelines See “Configuring IEEE 802.1x Port-Based Network Access Control” on page 693,

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics authenticator, dot1x

interface (IEEE 802.1ag OAM Connectivity-Fault Management)

Syntax interface (*interface-name* | ((ge- | xe-) (*fpc/pic/port* | *fpc/pic/port.unit-number* | *fpc/pic/port.unit-number* vlan *vlan-id*)));

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name* mep *mep-id*]

Release Information Statement introduced in JUNOS Release 8.4.

Description For Ethernet interfaces on M320, MX-series, and T-series routing platforms, configure IEEE 802.1ag Operation, Administration, and Management (OAM) support.

For Gigabit Ethernet interfaces and 10-Gigabit Ethernet interfaces on MX-series routing platforms, configure IEEE 802.1ag Connectivity Fault Management (CFM) support on trunk interface ports.

Options interface-name—Interface to which the MEP is attached. It could be a physical Ethernet interface, logical Ethernet interface, or on a specific VLAN of a trunk port interface (MX-series only).

Usage Guidelines See “Configuring the Maintenance End Point Interface” on page 651.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

interface (OAM Link-Fault Management)

Syntax

```
interface interface-name {
    apply-action-profile profile-name;
    link-discovery (active | passive);
    pdu-interval interval;
    pdu-threshold threshold-value;
    remote-loopback;
    event-thresholds {
        frame-error count;
        frame-period count;
        frame-period-summary count;
        symbol-period count;
    }
    negotiation-options {
        allow-remote-loopback;
        no-allow-link-events;
    }
}
```

Hierarchy Level [edit protocols oam ethernet link-fault-management]

Release Information Statement introduced in JUNOS Release 8.2.

Description For Ethernet interfaces on M320, MX-series, and T-series routing platforms, configure IEEE 802.3ah Operation, Administration, and Management (OAM) support.

Options interface *interface-name*—Interface to be enabled for IEEE 802.3ah link fault management OAM support.

Range: 1 through 10 interfaces can be tracked.

The remaining statements are described separately.

Usage Guidelines See “Enabling IEEE 802.3ah OAM Support” on page 698.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

interfaces

Syntax interfaces { ... }

Hierarchy Level [edit]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure interfaces on the routing platform.

Default The management and internal Ethernet interfaces are automatically configured. You must configure all other interfaces.

Usage Guidelines See individual chapters.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

interface-down

Syntax interface-down;

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management action-profile *profile-name* default-action]

Release Information Statement introduced in JUNOS Release 8.5.

Description Bring the interface down when a remote MEP connectivity failure is detected.

Usage Guidelines See “Configuring a CFM Action Profile Action” on page 653.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

interface-mode

Syntax interface-mode (access | trunk);

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family bridge],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family bridge]

Release Information Statement introduced in JUNOS Release 9.2.

Description Determines whether the logical interface accepts or discards packets based on VLAN tags. Specify the trunk option to accept packets with a VLAN ID that matches the list of VLAN IDs specified in the vlan-id-list statement, then forward the packet within the bridge domain configured with the matching VLAN ID. Specify the access option to accept packets with no VLAN ID, then forward the packet within the bridge domain configured with the VLAN ID that matches the VLAN ID specified in the vlan-id statement.

Options access—Configure a logical interface to accept untagged packets. Specify the VLAN to which this interface belongs using the vlan-id statement.

trunk—Configure a single logical interface to accept packets tagged with any VLAN ID specified with the vlan-id-list statement.

Usage Guidelines See "Configuring a Logical Interface for Access Mode" on page 589 and "Configuring a Logical Interface for Trunk Mode" on page 590.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

interface-set

See the following sections:

- interface-set (Ethernet Interfaces) on page 1026
- interface-set (IP Demux Interfaces) on page 1026

interface-set (Ethernet Interfaces)

Syntax

```
interface-set interface-set-name {
   interface ethernet-interface-name {
      (unit unit-number | vlan-tags-outer vlan-tag);
   }
}
```

Hierarchy Level [edit interfaces]

Release Information Statement introduced in JUNOS Release 8.5.

Description The set of interfaces used to configure hierarchical CoS schedulers on Ethernet interfaces on the MX-series router.

The remaining statements are described separately.

Usage Guidelines See the *JUNOS Class of Service Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

interface-set (IP Demux Interfaces)

Syntax

```
interface-set interface-set-name {
   interface interface-name {
      unit unit-number;
   }
}
```

Hierarchy Level [edit interfaces]

Release Information Statement introduced in JUNOS Release 9.2.

Description The set of interfaces used to configure hierarchical CoS schedulers for subscribers on IP demux interfaces on the MX-series router.

The remaining statements are described separately.

Usage Guidelines See the *JUNOS Subscriber Access Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

interface-switch

Syntax

```
interface-switch connection-name {
    interface interface-name.unit-number;
    interface interface-name.unit-number;
}
```

Hierarchy Level [edit protocols connections]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure Layer 2 switching cross-connects. The cross-connect is bidirectional, so packets received on the first interface are transmitted out the second interface, and those received on the second interface are transmitted out the first interface.

For Layer 2 switching cross-connects to work, you must also configure MPLS.

Options interface *interface-name.unit-number*—Interface name. Include the logical portion of the name, which corresponds to the logical unit number.

Usage Guidelines See "Defining the Connection for Switching Cross-Connects" on page 218.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Topics *JUNOS MPLS Applications Configuration Guide*

interface-type

Syntax interface-type (bc | coc1 | ct1 | ct3 | dc | ds |so | t1 | t3);

Hierarchy Level [edit interfaces *interface-name* no-partition],
[edit interfaces *interface-name* partition *partition-number*],
[edit interfaces *interface-name* partition *partition-number* oc-slice *oc-slice-range*],
[edit interfaces *interface-name* partition *partition-number* timeslot *timeslot-range*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For IQ and IQE interfaces only, configure the sublevel interface type.

Options bc—Dual—Port Channelized E1 and T1 ISDN PRI interface type. You can specify this interface type at the [edit interfaces *interface-name* partition *partition-number* timeslot *timeslot-range*] hierarchy level to create a bearer (B) channel bc-*pim*/0/*portchannel* interface for each time you want to function as an ISDN PRI B-channel.

coc1—Channelized OC1 interface type. You can specify this interface type at the [edit interfaces *interface-name* partition *partition-number* oc-slice *oc-slice-range* interface-type coc12-*fpc*/*pic*/*port*] hierarchy level.

ct1—Channelized T1 interface type. You can specify this interface type at the [edit interfaces *interface-name* partition *partition-number* interface-type ct3-*fpc*/*pic*/*port*<:*channel*>] hierarchy level.

ct3—Channelized T3 interface type. You can specify this interface type at the [edit interfaces *interface-name* partition *partition-number* oc-slice *oc-slice-range* interface-type coc1-*fpc*/*pic*/*port*:*channel* no-partition] hierarchy level.

dc—Dual-Port Channelized E1 and T1 ISDN PRI interface type. You can specify this interface type at the [edit interfaces *interface-name* partition *partition-number* timeslot *timeslot-range*] hierarchy level to create a (D) channel dc-*pim*/0/*port* to control the B-channels.

ds—DS0 interface type. You can specify this interface type at the [edit interfaces *interface-name*partition *partition-number* interface-type (ce1-*fpc*/*pic*/*port* | ct1-*fpc*/*pic*/*port*<:*channel*>)] hierarchy level.

so—SONET/SDH interface type. You can specify this interface type at the [edit interfaces *interface-name* partition *partition-number* oc-slice *oc-slice-range* interface-type coc12-*fpc*/*pic*/*port*] hierarchy level.

t1—T1 interface type. You can specify this interface type at the [edit interfaces *interface-name* partition *partition-number* oc-slice *oc-slice-range* interface-type (coc12-*fpc*/*pic*/*port* | coc1-*fpc*/*pic*/*port*)] hierarchy level.

t3—T3 interface type. You can specify this interface type at the [edit interfaces *interface-name* partition *partition-number* oc-slice*oc-slice-range* interface-type (coc12-*fpc*/*pic*/*port* | coc1-*fpc*/*pic*/*port*:*channel* no-partition)] hierarchy level.

Usage Guidelines See “Configuring Channelized E1 Interfaces” on page 485, “Configuring Channelized OC12/STM4 Interfaces” on page 411, and “Configuring Channelized T3 Interfaces” on page 463.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

interleave-fragments

Syntax interleave-fragments;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For link services interfaces only, interleave long packets with high-priority packets.

Allows small delay-sensitive packets, such as Voice over IP (VoIP) packets, to interleave with long fragmented packets. This minimizes the latency of delay-sensitive packets.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

interval

Syntax interval (10m | 10s | 1m | 1s | 100ms | 10ms);

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name* continuity-check]

Release Information Statement introduced in JUNOS Release 8.4.
Ten milliseconds option introduced in JUNOS Release 9.1.

Description The time between continuity check messages.

Options 10m—10 minutes.

10s—10 seconds.

1m—1 minute.

1s—1 second.

100ms—100 milliseconds.

10ms—10 milliseconds.

Usage Guidelines See “Configuring the Continuity Check Interval” on page 650.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

inverse-arp

Syntax inverse-arp;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* multipoint-destination *destination*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address* multipoint-destination *destination*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM encapsulation, enable responses to received inverse ATM ARP requests. For Frame Relay encapsulation, enable responses to received inverse Frame Relay ARP requests.

Default Inverse ARP is disabled on all ATM and Frame Relay interfaces.

Usage Guidelines See "Configuring Inverse ATM1 or ATM2 ARP" on page 304 or "Configuring Inverse Frame Relay ARP" on page 365.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

invert-data

Syntax invert-data;

Hierarchy Level [edit interface e1-*fpc/pic/port*],
[edit interface t1-*fpc/pic/port*],
[edit interfaces *interface-name* ds0-options],
[edit interfaces *interface-name* e1-options],
[edit interfaces *interface-name* t1-options],
[edit interfaces *interface-name* e3-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Invert the transmission of unused data bits on the DS0, E1, E3, and T1 interface.

NOTE: When configuring E1 interfaces on the 10-port Channelized E1/T1 IQE PIC, invert-data must be set at the [edit interface e1-fpc/pic/port] hierarchy level.

When configuring T1 interfaces on the 10-port Channelized E1/T1 IQE PIC, invert-data must be set at the [edit interface t1-fpc/pic/port] hierarchy level.

Usage Guidelines See “Configuring E1 Data Inversion” on page 516, “Configuring E3 Data Inversion” on page 525, and “Configuring T1 Data Inversion” on page 533.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

ipsec-sa

Syntax ipsec-sa *sa-name*;

Hierarchy Level [edit interfaces es-*fpc/pic/port* unit *logical-unit-number* family inet],
[edit logical-systems *logical-system-name* interfaces es-*fpc/pic/port* unit *logical-unit-number* family inet]

Release Information Statement introduced before JUNOS Release 7.4.

Description Specify the IP Security (IPsec) security association (SA) name associated with the interface.

Options *sa-name*—IPsec security association name.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS System Basics Configuration Guide*

isdn-options

Syntax

```
isdn-options {
    bchannel-allocation (ascending | descending);
    calling-number number;
    incoming-called-number number <reject>;
    spid1 spid-string;
    spid2 spid-string;
    static-tei-val value;
    switch-type (att5e | etsi | ni1 | ntdms100 | ntt);
    t310 seconds;
    tei-option (first-call | power-up);
}
```

Hierarchy Level

[edit interfaces br-*pim*/0/*port*],
[edit interfaces ct1-*pim*/0/*port*],
[edit interfaces ce1-*pim*/0/*port*]

Release Information

Statement introduced before JUNOS Release 7.4.
bchannel-allocation option added in JUNOS Release 8.3

Description

For J-series Services Routers only. Specify the ISDN options for configuring ISDN interfaces for group and user sessions.

The statements are explained separately.

Usage Guidelines

See “Configuring ISDN Physical Interface Properties” on page 775 and “Allocating B-Channels for Dialout” on page 497.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics

J-series Services Router Basic LAN and WAN Access Configuration Guide

keep-address-and-control

Syntax keep-address-and-control;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family ccc],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family ccc]

Release Information Statement introduced before JUNOS Release 7.4.

Description For interfaces with encapsulation type PPP CCC, do not remove the address and control bytes before encapsulating the packet into a tunnel.

Default If you do not include this statement, address and control bytes are removed before encapsulating the packet into a tunnel.

Usage Guidelines See "Disabling the Removal of Address and Control Bytes" on page 182.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

keepalives

Syntax keepalives <interval *seconds*> <down-count *number*> <up-count *number*>;

Hierarchy Level [edit interfaces *interface-name*],
[edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Enable the sending of keepalives on a physical interface configured with PPP, Frame Relay, or Cisco HDLC encapsulation.

For ATM2 IQ interfaces only, you can enable keepalives on a logical interface unit if the logical interface is configured with one of the following PPP over ATM encapsulation types:

- atm-ppp-llc—PPP over AAL5 LLC encapsulation.
- atm-ppp-vc-mux—PPP over AAL5 multiplex encapsulation.

Default Sending of keepalives is enabled by default. The default keepalive interval is 10 seconds for PPP, Frame Relay, or Cisco HDLC. The default down-count is 3 and the default up-count is 1 for PPP or Cisco HDLC.

Options down-count *number*—The number of keepalive packets a destination must fail to receive before the network takes down a link.
Range: 1 through 255
Default: 3

interval *seconds*—The time in seconds between successive keepalive requests.
Range: 1 through 32767 seconds
Default: 10 seconds

up-count *number*—The number of keepalive packets a destination must receive to change a link's status from down to up.
Range: 1 through 255
Default: 1

Usage Guidelines See "Configuring Keepalives" on page 120 or "Configuring Frame Relay Keepalives" on page 364.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

key

Syntax key *number*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* tunnel],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* tunnel]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Adaptive Services PICs on M-series platforms (except the M320 and M120 routers), identify an individual traffic flow within a tunnel, as defined in RFC 2890, *Key and Sequence Number Extensions to GRE*.

Options *number*—Value of the key.
Range: 0 through 4,294,967,295

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

l2tp-interface-id

Syntax l2tp-interface-id *name*;
(dedicated | shared);

Hierarchy Level [edit interfaces sp-*fpc/pic/port* unit *logical-unit-number* dialer-options],
[edit logical-systems *logical-system-name* interfaces sp-*fpc/pic/port* unit *logical-unit-number* dialer-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Specify the L2TP options for configuring logical interfaces for group and user sessions.

Options (dedicated | shared)—Specifies whether a logical interface can host one (dedicated) or multiple (shared) sessions at one time.

name—Interface identifier that must be replicated at the [edit access profile *name*] hierarchy level.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

lacp

See the following sections:

- lacp (802.3ad) on page 1038
- lacp (Aggregated Ethernet) on page 1039

lacp (802.3ad)

Syntax

```
lacp {
  traceoptions {
    file lacpd;
    flag all;
  }
  ppm (centralized | distributed);
}
```

Hierarchy Level

[edit interfaces *interface-name* fastether-options 802.3ad],
[edit interfaces *interface-name* gigether-options 802.3ad]

Release Information

Statement introduced in JUNOS Release 9.3.
The ppm (centralized | distributed) option introduced in JUNOS Release 9.4.

Description

For aggregated Ethernet interfaces only, configure the Link Aggregation Control Protocol (LACP).

On MX-series routers you can specify distributed or centralized periodic packet management (PPM).

Default

If you do not specify lacp as either active or passive, LACP remains passive.

If you do not specify ppm as either centralized or distributed, PPM will be distributed.

Options

- active—Initiate transmission of LACP packets.
- passive—Respond to LACP packets.
- ppm—Set PPM to centralized or distributed.

The remaining statements are explained separately.

Usage Guidelines

See “Configuring Aggregated Ethernet LACP” on page 597.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

lacp (Aggregated Ethernet)

Syntax

```
lacp {
   (active | passive);
   link-protection {
      disable;
   (revertive | non-revertive);
   periodic interval;
   system-priority priority;
}
```

Hierarchy Level [edit interfaces aex aggregated-ether-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For aggregated Ethernet interfaces only, configure Link Aggregation Control Protocol (LACP).

Default If you do not specify lacp as either active or passive, LACP remains passive.

Options

- active—Initiate transmission of LACP packets.
- passive—Respond to LACP packets.

  The remaining statements are explained separately.

Usage Guidelines See "Configuring Aggregated Ethernet LACP" on page 597.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

layer2-policer

Syntax

```
layer2-policer {
    input-policer policer-name;
    input-three-color policer-name;
    output-policer policer-name;
    output-three-color policer-name;
}
```

Hierarchy Level [edit interfaces *interface-name*unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name*unit *logical-unit-number*]

Release Information Statement introduced in JUNOS Release 8.2.

Description For 1-Gigabit Ethernet and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces on M-series and T-series routing platforms, apply Layer 2 logical interface policers. The following policers are supported:

- Two-color
- Single-rate tricolor marking (srTCM)
- Two-rate tricolor marking (trTCM)

Two-color and tricolor policers are configured at the [edit firewall] hierarchy level.

Options input-policer *policer-name*—Two-color input policer to associate with the interface. This statement is mutually exclusive with the input-three-color statement.

input-three-color *policer-name*—Tricolor input policer to associate with the interface. This statement is mutually exclusive with the input-policer statement.

output-policer *policer-name*—Two-color output policer to associate with the interface. This statement is mutually exclusive with the output-three-color statement.

output-three-color *policer-name*—Tricolor output policer to associate with the interface. This statement is mutually exclusive with the output-policer statement.

Usage Guidelines See “Configuring Gigabit Ethernet Two-Color and Tricolor Policers” on page 714.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS Class of Service Configuration Guide*, *JUNOS Policy Framework Configuration Guide*

lcp-restart-timer

Syntax lcp-restart-timer *milliseconds*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* ppp-options],
[edit logical-systems *logical-system-name* interfaces *interface-name*unit *logical-unit-number* ppp-options]

Release Information Statement introduced in JUNOS Release 8.1.

Description For interfaces with PPP, PPP TCC, PPP over Ethernet, PPP over ATM, and PPP over Frame Relay encapsulations, configure a restart timer for the Link Control Protocol (LCP) component of a PPP session.

Options *milliseconds*—The time in milliseconds between successive LCP configuration requests.
Range: 20 through 10000 milliseconds.
Default: 3 seconds

Usage Guidelines See “Configuring the PPP Restart Timers” on page 153.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

level

Syntax level *number*;

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name*]

Release Information Statement introduced in JUNOS Release 8.4.

Description A number used in CFM messages to identify the maintenance association.

Options number—A number used to identify the maintenance domain to which the CFM message belongs.
Range: 0 through 7

Usage Guidelines See “Configuring the Maintenance Domain Level” on page 648.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

linear-red-profile

Syntax linear-red-profile *profile-name*;

Hierarchy Level [edit interfaces at-*fpc/pic/port* atm-options scheduler-maps *map-name* forwarding-class *class-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM2 IQ interfaces only, assign a linear RED profile to a specified forwarding class. To define the linear RED profiles, include the linear-red-profiles statement at the [edit interfaces at-*fpc/pic/port* atm-options] hierarchy level.

Default If you do not include either the epd-threshold or the linear-red-profile statement in the forwarding class configuration, the JUNOS software uses an EPD threshold based on the available bandwidth and other parameters.

Options *profile-name*—Name of the linear RED profile.

Usage Guidelines See "Configuring an ATM Scheduler Map" on page 327.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics epd-threshold, linear-red-profiles

linear-red-profiles

Syntax

```
linear-red-profiles profile-name {
    high-plp-threshold percent;
    low-plp-threshold percent;
    queue-depth cells;
}
```

Hierarchy Level [edit interfaces at-*fpc/pic/port* atm-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM2 IQ interfaces only, define CoS virtual circuit drop profiles for RED. When a packet arrives, RED checks the queue fill level. If the fill level corresponds to a nonzero drop probability, the RED algorithm determines whether to drop the arriving packet.

Options *profile-name*—Name of the drop profile.

The statements are explained separately.

Usage Guidelines See "Configuring ATM2 IQ VC Tunnel CoS Components" on page 325.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

line-encoding

Syntax line-encoding (ami | b8zs);

Hierarchy Level [edit interface ct1-*fpc/pic/port*],
[edit interfaces *interface-name* t1-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Set the line encoding format on the T1 interface.

NOTE: When configuring CT1 interfaces on the 10-port Channelized E1/T1 IQE PIC, line-encoding must be set at the [edit interface ct1-fpc/pic/port] hierarchy level.

Default The default line encoding is B8ZS.

Options ami—Use Alternate Mark Inversion (AMI) line encoding.

b8zs—Use bipolar with 8-zeros substitution (B8ZS) line encoding.

Usage Guidelines See “Configuring T1 Line Encoding” on page 534.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

line-protocol

Syntax line-protocol *protocol*;

Hierarchy Level [edit interfaces *interface-name* serial-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For serial interfaces only, configure the line protocol.

Options *protocol*—You can specify the one of the following line protocols:

- eia530—Line protocol EIA-530
- v.35—Line protocol V.35
- x.21—Line protocol X.21

Usage Guidelines See “Configuring the Serial Line Protocol” on page 251.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

line-rate

Syntax line-rate *line-rate*;

Hierarchy Level [edit interfaces *interface-name* shdsl-options],
[edit logical-systems *logical-system-name* interfaces *interface-name* shdsl-options]

Release Information Statement introduced in JUNOS Release 7.4.

Description For J-series Services Routers only, configure the SHDSL line rate.

Options *line-rate*—SHDSL line rate, in Kbps. Possible values are:

2-wire (Kbps): 192, 256, 320, 384, 448, 512, 576, 640, 704, 768, 832, 896, 960, 1024, 1088, 1152, 1216, 1280, 1344, 1408, 1472, 1536, 1600, 1664, 1728, 1792, 1856, 1920, 1984, 2048, 2112, 2176, 2240, 2304, auto

4-wire (Kbps): 384, 512, 640, 768, 896, 1024, 1152, 1280, 1408, 1536, 1664, 1792, 1920, 2048, 2176, 2304, 2432, 2560, 2688, 2816, 2944, 3072, 3200, 3328, 3456, 3584, 3712, 3840, 3968, 4096, 4224, 4352, 4480, 4608
Default: For 2-wire mode, auto; for 4-wire mode, 4608 Kbps

Usage Guidelines See "Configuring ATM-over-SHDSL Interfaces" on page 347.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

link-adjacency-loss

Syntax link-adjacency-loss;

Hierarchy Level [edit protocols oam ethernet link-fault-management action-profile event]

Release Information Statement introduced in JUNOS Release 8.5.

Description Loss of adjacency with IEEE 802.3ah link-fault management peer event. When included, the loss-of-adjacency event triggers the action specified under the action statement.

Usage Guidelines See "Monitoring the Loss of Link Adjacency" on page 702.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

link-down

Syntax link-down;

Hierarchy Level [edit protocols oam ethernet link-fault-management action-profile action]

Release Information Statement introduced in JUNOS Release 8.5.

Description Mark the interface down for transit traffic.

Usage Guidelines See "Specifying the Actions to Be Taken for Link-Fault Management Events" on page 701.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

link-discovery

Syntax link-discovery (active | passive);

Hierarchy Level [edit protocols oam ethernet link-fault-management interface *interface-name*]

Release Information Statement introduced in JUNOS Release 8.2.

Description For Ethernet interfaces on M320, M120, MX-series, and T-series routing platforms, specify the discovery mode used for IEEE 802.3ah Operation, Administration, and Management (OAM) support. The discovery process is triggered automatically when OAM 802.3ah functionality is enabled on a port. Link monitoring is done when the interface sends periodic OAM PDUs.

Options (active | passive)—Passive or active mode. In active mode, the interface discovers and monitors the peer on the link if the peer also supports IEEE 802.3ah OAM functionality. In passive mode, the peer initiates the discovery process. Once the discovery process is initiated, both sides participate in discovery.

Usage Guidelines See "Configuring Link Discovery" on page 698.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

link-event-rate

Syntax

```
link-event-rate {
    frame-error count;
    frame-period count;
    frame-period-summary count;
    symbol-period count;
}
```

Hierarchy Level [edit protocols oam ethernet link-fault-management action-profile event]

Release Information Statement introduced in JUNOS Release 8.5.

Description Configure the number of link-fault management events per second.

Usage Guidelines See “Configuring Threshold Values for Fault Events in an Action Profile” on page 702.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

link-fault-management

Syntax

```
link-fault-management {
    action-profile profile-name {
        action {
            syslog;
            link-down;
            send-critical-event;
        }
        event {
            link-adjacency-loss;
            link-event-rate {
                frame-error count;
                frame-period count;
                frame-period-summary count;
                symbol-period count;
            }
            protocol-down;
        }
    }
    interface interface-name {
        apply-action-profile profile-name;
        link-discovery (active | passive);
        pdu-interval interval;
        pdu-threshold threshold-value;
        remote-loopback;
        event-thresholds {
            frame-error count;
            frame-period count;
            frame-period-summary count;
            symbol-period count;
        }
        negotiation-options {
            allow-remote-loopback;
            no-allow-link-events;
        }
    }
}
```

Hierarchy Level [edit protocols oam ethernet]

Release Information Statement introduced in JUNOS Release 8.2.

Description For Ethernet interfaces on M320, M120, MX-series, and T-series routing platforms, specify fault signaling and detection for IEEE 802.3ah Operation, Administration, and Management (OAM) support.

The remaining statements are explained separately.

Usage Guidelines See “Enabling IEEE 802.3ah OAM Support” on page 698.

Required Privilege Level interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

link-layer-overhead

Syntax link-layer-overhead *percent*;

Hierarchy Level [edit interfaces *interface-name* mlfr-uni-nni-bundle-options],
[edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For AS PIC or MultiServices PIC link services IQ interfaces (lsq) only, configure the percentage of total bundle bandwidth to be set aside for link-layer overhead.

Options *percent*—Percentage of total bundle bandwidth to be set aside for link-layer overhead.

Range: 0 through 50 percent

Default: 4 percent

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

link-mode

Syntax link-mode (full-duplex | half-duplex);

Hierarchy Level [edit interfaces *interface-name*],
[edit interfaces ge-*pim*/0/0 switch-options switch-port *port-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Set the device's link connection characteristic.

Options full-duplex—Connection is full duplex.

half-duplex—Connection is half duplex.

Default: Fast Ethernet interfaces, except the J-series ePIM Fast Ethernet interfaces, can operate in either full-duplex or half-duplex mode. The routing platform's management Ethernet interface, fxp0, the built-in Fast Ethernet interfaces on the FIC (M7i routing platform), and the Gigabit Ethernet ports on J-series Services Routers with uPIMs installed and configured for access switching mode autonegotiate whether to operate in full-duplex or half-duplex mode. Unless otherwise noted here, all other interfaces operate only in full-duplex mode.

NOTE: On J-series ePIM Fast Ethernet interfaces, if you specify half-duplex (or if full-duplex mode is not autonegotiated), the following message is written to the system log: "Half-duplex mode not supported on this PIC, forcing full-duplex mode."

Usage Guidelines See "Configuring the Link Characteristics on Ethernet Interfaces" on page 564.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

link-protection

Syntax
```
link-protection {
disable (Link Protection);
(revertive | non-revertive);
}
```

Hierarchy Level [edit interfaces ae*x* aggregated-ether-options]

Release Information Statement introduced in JUNOS Release 8.3.
Support for disable, revertive, and non-revertive statements added in JUNOS Release 9.3.

Description For aggregated Ethernet interfaces only, configure link protection. In addition to enabling link protection, a primary and a secondary (backup) link must be configured to specify what links egress traffic should traverse. To configure primary and secondary links, include the primary and secondary statements at the [edit interfaces ge-*fpc/pic/port* gigether-options 802.3ad ae*x*] hierarchy level or the [edit interfaces fe-*fpc/pic/port* fastether-options 802.3ad ae*x*] hierarchy level.

Options The statements are explained separately.

Usage Guidelines See "Configuring Aggregated Ethernet Link Protection" on page 595.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

link-speed

See the following sections:

- link-speed (Aggregated Ethernet) on page 1052
- link-speed (Aggregated SONET/SDH) on page 1053

link-speed (Aggregated Ethernet)

Syntax link-speed *speed*;

Hierarchy Level [edit interfaces ae*x* aggregated-ether-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For aggregated Ethernet interfaces only, set the required link speed.

Options *speed*—For aggregated Ethernet links, you can specify *speed* in bits per second either as a complete decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000).

Aggregated Ethernet links on the M120 routing platform can have one of the following speed values,

- 100m—Links are 100 Mbps.
- 10g—Links are 10 Gbps.
- 1g—Links are 1 Gbps.
- OC192—Links are OC192 or STM64c.

Usage Guidelines See “Configuring Aggregated Ethernet Link Speed” on page 604.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

link-speed (Aggregated SONET/SDH)

Syntax link-speed (*speed* | mixed);

Hierarchy Level [edit interfaces as*x* aggregated-sonet-options]

Release Information Statement introduced before JUNOS Release 7.4.
mixed option added in Release 8.0.

Description For aggregated SONET/SDH interfaces only, set the required link speed.

Options *speed*—Aggregated SONET/SDH links can have one of the following speed values.

- oc3—Links are OC3c or STM1c.
- oc12—Links are OC12c or STM4c.
- oc48—Links are OC48c or STM16c.
- oc192—Links are OC192c or STM64c.
- oc768—Links are OC768c or STM256c.

mixed—For aggregated SONET/SDH links on T-series routing platforms, you can mix interface speeds in SONET/SDH aggregation bundles. Interface speeds from OC3 through OC768 are supported.

Usage Guidelines See "Configuring Aggregated Ethernet Link Speed" on page 604 and "Configuring Aggregated SONET/SDH Link Speed" on page 837.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

linktrace

Syntax

```
linktrace {
  age (30m | 10m | 1m | 30s | 10s);
  path-database-size path-database-size;
}
```

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management]

Release Information Statement introduced in JUNOS Release 8.5.

Description Configure connectivity fault management linktrace parameters.

Usage Guidelines See "Linktrace Protocol" on page 647.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

llc2

Syntax

```
llc2 {
   ack-delay-time time;
   ack-max count;
   idle-time time;
   local-window count;
   max-retry count;
   p-bit-timeout time;
   redundancy-group group-number {
      advertise-interval seconds;
      map {
         local-mac mac-address request mac-address;
      }
      preempt hold-time seconds;
      no-preempt;
      priority priority;
      track {
         dlsw {
            peer ip-address priority-cost priority;
            destination mac-address priority-cost priority;
         }
         interface interface-name priority-cost priority;
      }
   }
   t1-time time;
   t2-time time;
   trej-time time;
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family]

Release Information Statement introduced in JUNOS Release 7.4.

Description For J-series Services Routers only, configure the data link-layer protocol logical link control 2 (LLC2) used on a LAN. LLC2 provides connection-oriented data transfer for Ethernet interfaces configured for DLSw.

The statements are explained separately.

Usage Guidelines See "Configuring LLC2 Options" on page 171.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS Services Interfaces Configuration Guide*

lmi (interfaces)

Syntax

```
lmi {
  lmi-type (ansi | itu);
  n391dte number;
  n392dce seconds;
  n392dte number;
  n393dce number;
  n393dte number;
  t391dte number;
  t392dce seconds;
}
```

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Set Frame Relay keepalive parameters.

Options n391dte—DTE full status polling interval.

Range: 1 through 255
Default: 6

n392dce—DCE error threshold, in number of errors.

Range: 1 through 10
Default: 3

n392dte—DTE error threshold, in number of errors.

Range: 1 through 10
Default: 3

n393dce—DCE monitored event-count.

Range: 1 through 10
Default: 4

n393dte—DTE monitored event-count.

Range: 1 through 10
Default: 4

t391dte—DTE polling timer.

Range: 5 through 30 seconds
Default: 10 seconds

t392dce—DCE polling timer.

Range: 5 through 30 seconds
Default: 15 seconds

The remaining statements are explained separately.

Usage Guidelines See "Configuring Tunable Keepalives for Frame Relay LMI" on page 364.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics lmi-type

lmi (Ethernet)

Syntax

```
lmi {
  status-counter count;
  polling-verification-timer value;
  interface name; {
    uni-id uni-name;
    status-counter number;
    polling-verification-timer value;
    evc-map-type (<all-to-one-bundling | bundling | service-multiplexing>);
    evc evc-name {
      default-evc;
      vlan-list vlan-id-list;
    }
  }
}
```

Hierarchy Level [edit protocols oam ethernet]

Release Information Statement introduced in JUNOS Release 9.5.

Description On MX-series routers with ge, xe, or ae interfaces, configure an OAM Ethernet Local Management Interface.

Options status-counter *count*—Status counter (N393), defaults to 4.

interface *name*—Polling verification timer (T392), defaults to 15 seconds.

uni-id *uni-name*—(Optional) Defaults to the physical interface name.

status-counter *number*—(Optional) Defaults to a global value.

polling-verification-timer *value*—(Optional) Defaults to a global value.

evc-map-type (<all-to-one-bundling | bundling | service-multiplexing>)—Specify the EVC map type.

evc *evc-name*—Specify the name of the EVC.

default-evc—Set the specified EVC as the default EVC.

vlan-list *vlan-id-list*—Specify a group of VLANs to assign to the EVC.

Usage Guidelines See "Configuring Ethernet Local Management Interface" on page 654.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics evcs

lmi-type

Syntax lmi-type (ansi | itu);

Hierarchy Level [edit interfaces *interface-name* lmi (interfaces)],
[edit interfaces *interface-name* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Set Frame Relay Local Management Interface (LMI) type.

Options ansi—Use ANSI T1.167 Annex D LMIs.

itu—Use ITU Q933 Annex A LMIs.
Default: ansi

Usage Guidelines See "Configuring Tunable Keepalives for Frame Relay LMI" on page 364 and the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

load-interval

Syntax load-interval *seconds*;

Hierarchy Level [edit interfaces dl*n* unit *logical-unit-number* dialer-options],
[edit logical-systems *logical-system-name* interfaces dl*n* unit *logical-unit-number* dialer-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description (J-series Services Routers) For ISDN logical interfaces, the interval used to calculate the average load on the network. By default, the average interface load is calculated every 60 seconds.

Options *seconds*—Number of seconds at which the average load calculation is triggered.
Range: 20 through 180, in 10-second intervals
Default: 60 seconds

Usage Guidelines See "Configuring ISDN Logical Interface Properties" on page 777.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

load-threshold

Syntax load-threshold *percent*;

Hierarchy Level [edit interfaces dl*n* unit *logical-unit-number* dialer-options],
[edit logical-systems *logical-system-name* interfaces dl*n* unit *logical-unit-number* dialer-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description (J-series Services Routers) For ISDN logical interfaces, specify the bandwidth threshold percentage used for adding interfaces. Another link is added to the multilink bundle when the load reaches the threshold value you set. Specify a percentage between 0 and 100.

Options *percent*—Bandwidth threshold percentage used for adding interfaces. When set to 0, all available channels are dialed.
Range: 0 through 100
Default: 100 seconds

Usage Guidelines See "Configuring Bandwidth on Demand" on page 783.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

local-mac

Syntax local-mac *mac-address* remote-mac *mac-address*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family llc2 redundancy-group *group-number* map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family llc2 redundancy-group *group-number* map]

Release Information Statement introduced in JUNOS Release 7.5.

Description For J-series Services Routers only. On Ethernet interfaces configured for DLSw, specify the local MAC address to be mapped to a remote destination MAC address.

Options *mac-address*—MAC address. Specify the MAC address as six hexadecimal bytes in one of the following formats: *nnnn*.*nnnn*.*nnnn* or *nn*:*nn*:*nn*:*nn*:*nn*:*nn*. For example, 0011.2233.4455 or 00:11:22:33:44:55.

Usage Guidelines See "Configuring DLSw Ethernet Redundancy Using LLC2 Properties" on page 172.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS Services Interfaces Configuration Guide*

local-name

Syntax local-name *name*;

Hierarchy Level [edit interfaces *interface-name* ppp-options chap],
[edit interfaces *interface-name* ppp-options pap],
[edit interfaces *interface-name* unit *logical-unit-number* ppp-options chap],
[edit interfaces *interface-name* unit *logical-unit-number* ppp-options pap],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* ppp-options chap],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* ppp-options pap]

Release Information Statement introduced before JUNOS Release 7.4.
Support for PAP added in JUNOS Release 8.3.

Description For CHAP authentication, the value sent in CHAP challenge and response packets on a per interface basis. For PAP authentication, the local hostname for sending PAP authentication requests.

For ATM2 IQ interfaces only, you can configure a CHAP local name on the logical interface unit if the logical interface is configured with one of the following PPP over ATM encapsulation types:

- atm-ppp-llc—PPP over AAL5 LLC encapsulation.
- atm-ppp-vc-mux—PPP over AAL5 multiplex encapsulation.

Default For CHAP authentication, if you do not include the local-name statement in the configuration, the interface sends the routing platform's system hostname in CHAP challenge and response packets.

Usage Guidelines See "Configuring the PPP Challenge Handshake Authentication Protocol" on page 106 and "Configuring the PPP Password Authentication Protocol" on page 108.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS System Basics Configuration Guide*

local-password

Syntax local-password *password*;

Hierarchy Level [edit interfaces *interface-name* ppp-options pap],
[edit interfaces *interface-name* unit *logical-unit-number* ppp-options pap],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* ppp-options pap]

Release Information Statement introduced in JUNOS Release 8.3.

Description Configure the host password for sending PAP requests.

Usage Guidelines See “Configuring the Local Password” on page 156.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics Configuring the PPP Password Authentication Protocol on page 108

local-window

Syntax local-window *count*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family llc2],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family llc2]

Release Information Statement introduced in JUNOS Release 7.4.

Description For J-series Services Routers only. On Ethernet interfaces configured for DLSw, configure the maximum number of Information-frames (I-frames) to send before waiting for acknowledgment.

Options *count*—Number of I-frames.
Range: 1 through 127 I-frames
Default: 7 I-frames

Usage Guidelines See “Configuring LLC2 Options” on page 171.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Advanced WAN Access Configuration Guide*

lockout

Syntax lockout;

Hierarchy Level [edit interfaces *interface-name* sonet-options aps]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure a lockout of protection, forcing the use of the working circuit and locking out the protect circuit regardless of anything else.

Usage Guidelines See “Configuring Switching Between the Working and Protect Circuits” on page 820.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

logical-interface-policer

Syntax logical-interface-policer;

Hierarchy Level [edit firewall policer *policer-template-name*],
[edit firewall three-color-policer *policer-name*],

Release Information Statement introduced in JUNOS Release 8.2.

Description Apply a policer to a logical interface in the ingress or egress direction as part of a configuration to discard high loss priority traffic, or configure an aggregate policer.

Usage Guidelines See “Configuring Gigabit Ethernet Two-Color and Tricolor Policers” on page 714, See “Applying a Policer” on page 716, and the *JUNOS Class of Service Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics action (Policer)

logical-systems

Syntax logical-systems *logical-system-name*;

Hierarchy Level [edit]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure a logical system.

Options *logical-system-name*—Name of the logical system.

Usage Guidelines See "Configuring Logical System Interface Properties" on page 147.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

log-prefix

Syntax log-prefix *prefix-number*;

Hierarchy Level [edit interfaces *interface-name* services-options syslog host *hostname*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Set the system logging prefix value.

Options *prefix-number*—System logging prefix value.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

long-buildout

Syntax (long-buildout | no-long-buildout);

Hierarchy Level [edit interfaces *interface-name* t3-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure the T3 line buildout. A T3 interface has two settings for the T3 line buildout: a short setting, which is less than 255 feet (68 meters), and a long setting, which is greater than 255 feet and shorter than 450 feet (137 meters).

This statement applies to copper-cable-based T3 interfaces only. You cannot configure a line buildout for a DS3 channel on a channelized OC12 interface, which runs over fiber-optic cable.

Default A T3 interface uses the short line buildout setting (no-long-buildout) for wires shorter than 255 feet (68 meters).

Usage Guidelines See "Configuring the T3 Line Buildout" on page 545.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

loopback

See the following sections:

- loopback (ADSL, DS0, E1/E3, SONET/SDH, SHDSL, and T1/T3) on page 1066
- loopback (Aggregated Ethernet, Fast Ethernet, and Gigabit Ethernet) on page 1067
- loopback (Serial) on page 1068

loopback (ADSL, DS0, E1/E3, SONET/SDH, SHDSL, and T1/T3)

Syntax loopback (local | payload | remote);

Hierarchy Level [edit interface ce1-*fpc/pic/port*],
[edit interface ct1-*fpc/pic/port*],
[edit interface t1-*fpc/pic/port*],
[edit interfaces *interface-name* ds0-options],
[edit interfaces *interface-name* dsl-options],
[edit interfaces *interface-name* e1-options],
[edit interfaces *interface-name* e3-options],
[edit interfaces *interface-name* shdsl-options},
[edit interfaces *interface-name* sonet-options],
[edit interfaces *interface-name* t1-options],
[edit interfaces *interface-name* t3-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure a loopback connection. To turn off the loopback capability, remove the loopback statement from the configuration.

NOTE: When configuring CE1 interfaces on the 10-port Channelized E1/T1 IQE PIC, local/remote loopback must be set at the [edit interface ce1-fpc/pic/port] hierarchy level.

When configuring CT1 interfaces on the 10-port Channelized E1/T1 IQE PIC, local/remote loopback must be set at the [edit interface ct1-fpc/pic/port] hierarchy level.

When configuring T1 interfaces on the 10-port Channelized E1/T1 IQE PIC, payload loopback must be set at the [edit interface t1-fpc/pic/port] hierarchy level.

Options local—Loop packets, including both data and timing information, back on the local routing platform's PIC. *N*xDS0 IQ interfaces do not support local loopback.

payload—For channelized T3, T1, and *N*xDS0 IQ interfaces only, loop back data only (without clocking information) on the remote routing platform's PIC. With payload loopback, overhead is recalculated. Neither ATM-over-asymmetrical digital subscriber line (ADSL) interfaces nor ATM-over-SHDSL interfaces support payload loopback.

remote—Loop packets, including both data and timing information, back on the remote routing platform's interface card. *N*xDS0 IQ interfaces do not support remote loopback. ATM-over-ADSL interfaces do not support payload loopback.

Usage Guidelines See "Configuring E3 and T3 Parameters on ATM Interfaces" on page 323, "Configuring E1 Loopback Capability" on page 517, "Configuring E3 Loopback Capability" on page 525, "Configuring Channelized IQ and IQE SONET/SDH Loop Timing" on page 806, "Configuring Channelized IQ and IQE SONET/SDH Loop Timing" on page 806, "Configuring SHDSL Operating Mode on an ATM Physical Interface" on page 350,

"Configuring T1 Loopback Capability" on page 534, and "Configuring T3 Loopback Capability" on page 546.

To configure loopback on channelized IQ and IQE PICs, SONET/SDH level, use the sonet-options loopback statement local and remote options at the controller interface (coc48, cstm16, coc12, cstm4, coc3, cstm1). It is ignored for path-level interfaces so-*fpc/pic/port* or so-*fpc/pic/port*:*channel*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics feac-loop-respond

loopback (Aggregated Ethernet, Fast Ethernet, and Gigabit Ethernet)

Syntax (loopback | no-loopback);

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

Release Information Statement introduced before JUNOS Release 7.4.

Description For aggregated Ethernet, Fast Ethernet, Gigabit Ethernet, and 10-Gigabit Ethernet interfaces, enable or disable loopback mode.

NOTE: By default, local aggregated Ethernet, Fast Ethernet, Tri-Rate Ethernet copper, Gigabit Ethernet, and 10-Gigabit Ethernet interfaces connect to a remote system.

Usage Guidelines See "Configuring Ethernet Loopback Capability" on page 563.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

loopback (Serial)

Syntax loopback *mode*;

Hierarchy Level [edit interfaces *interface-name* serial-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure a loopback connection.

Default If you do not include this statement, there is no loopback connection.

Options *mode*—You can specify the one of the following loopback modes:

- dce-local—For EIA-530 interfaces only, loop packets back on the local DCE.
- dce-remote—For EIA-530 interfaces only, loop packets back on the remote DCE.
- local—Loop packets back on the local routing platform's PIC.
- remote—Loop packets back on the line interface unit (LIU).

Usage Guidelines See "Configuring Serial Loopback Capability" on page 261.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

loopback-clear-timer

Syntax loopback-clear-timer *seconds*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* ppp-options],
[edit logical-systems *logical-system-name* interfaces *interface-name*unit *logical-unit-number* ppp-options]

Release Information Statement introduced in JUNOS Release 8.5.

Description For interfaces with PPP, PPP TCC, PPP over Ethernet, PPP over ATM, and PPP over Frame Relay encapsulations, configure a loop detection clear timer for the Link Control Protocol (LCP) component of a PPP session.

Options *seconds*—The time in seconds to wait before the loop detection flag is cleared if it is not cleared by the protocol.
Range: 1 through 60 seconds.
Default: 9 seconds

Usage Guidelines See "Configuring the PPP Clear Loop Detected Timer" on page 154.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

loop-timing

Syntax (loop-timing | no-loop-timing);

Hierarchy Level [edit interfaces ct3-*fpc/pic/port* t3-options],
[edit interfaces e1-*fpc/pic/port*:0 sonet-options],
[edit interfaces stm1-*fpc/pic/port* sonet-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For channelized IQ interfaces and non-IQ channelized STM1 interfaces only, configure the SONET/SDH or DS3-level clocking source.

Options loop-timing—Configure loop timing (external) clocking.

no-loop-timing—Configure line timing (internal) clocking.

Default: no-loop-timing

Usage Guidelines See "Configuring Channelized IQ and IQE SONET/SDH Loop Timing" on page 806 and "Configuring the Channelized T3 Loop Timing" on page 546.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics clocking

loss-priority

Syntax loss-priority (high | low);

Hierarchy Level [edit interfaces *interface-name* gigether-options ethernet-switch-profile ethernet-policer-profile output-priority-map classifier premium forwarding-class *class-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Specify the packet loss priority value.

Options high—Packet has high loss priority.

low—Packet has low loss priority.

Usage Guidelines See "Specifying an Output Priority Map" on page 710.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

loss-threshold

Syntax loss-threshold *number*;

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name* continuity-check]

Release Information Statement introduced in JUNOS Release 8.4.

Description The number of continuity check messages lost before marking the remote MEP as down.

Options number—Specify how many continuity check messages can be lost before the remote MEP is considered down.

Usage Guidelines See "Configuring the Continuity Check Loss Threshold" on page 650.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

low-plp-max-threshold

Syntax low-plp-max-threshold *percent*;

Hierarchy Level [edit interfaces at-*fpc/pic/port* atm-options linear-red-profiles *profile-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM2 IQ interfaces only, define the drop profile fill-level for the low PLP CoS VC. When the fill level exceeds the defined percentage, all packets are dropped.

Options *percent*—Fill-level percentage when linear RED is applied to cells with PLP.

Usage Guidelines See "Configuring ATM2 IQ VC Tunnel CoS Components" on page 325.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics high-plp-max-threshold, low-plp-threshold, queue-depth

low-plp-threshold

Syntax low-plp-threshold *percent*;

Hierarchy Level [edit interfaces at-*fpc/pic/port* atm-options linear-red-profiles *profile-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM2 IQ interfaces only, define the CoS VC drop profile fill-level percentage when linear RED is applied to cells with low PLP. When the fill level exceeds the defined percentage, packets with low PLP are randomly dropped by RED. This statement is mandatory.

Options *percent*—Fill-level percentage when linear RED is applied to cells with low PLP.

Usage Guidelines See "Configuring ATM2 IQ VC Tunnel CoS Components" on page 325.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics high-plp-max-threshold, high-plp-threshold, low-plp-max-threshold, queue-depth

lsq-failure-options

Syntax

```
lsq-failure-options {
    no-termination-request;
    [trigger-link-failure interface-name];
}
```

Hierarchy Level [edit interfaces lsq-*fpc/pic/port*]

Release Information Statement introduced in JUNOS Release 7.4.

Description For AS PIC or MultiServices PIC link services IQ (lsq) interfaces only, define the failure recovery option settings.

Options The remaining statements are explained separately.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

mac

Syntax mac *mac-address*;

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Set the MAC address of the interface. You can configure the MAC address on the management Ethernet interface (fxp0) only.

Options *mac-address*—MAC address. Specify the MAC address as six hexadecimal bytes in one of the following formats: *nnnn*.*nnnn*.*nnnn* or *nn*:*nn*:*nn*:*nn*:*nn*:*nn*. For example, 0011.2233.4455 or 00:11:22:33:44:55.

Usage Guidelines See "Configuring the MAC Address on the Management Ethernet Interface" on page 730.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

mac-address

Syntax mac-address *mac-address*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* accept-source-mac],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* accept-source-mac]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Gigabit Ethernet IQ and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform), specify a remote MAC address on which to count incoming and outgoing packets.

Options *mac-address*—MAC address. Specify the MAC address as six hexadecimal bytes in one of the following formats: *nnnn*.*nnnn*.*nnnn* or *nn*:*nn*:*nn*:*nn*:*nn*:*nn*. For example, 0011.2233.4455 or 00:11:22:33:44:55.

Usage Guidelines See "Configuring MAC Address Filtering" on page 713.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

mac-learn-enable

Syntax (mac-learn-enable | no-mac-learn-enable);

Hierarchy Level [edit interfaces *interface-name* gigether-options ethernet-switch-profile],
[edit interfaces *interface-name* aggregated-ether-options ethernet-switch-profile]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Gigabit Ethernet IQ and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform), configure whether source and destination MAC addresses are dynamically learned:

- mac-learn-enable—Allow the interface to dynamically learn source and destination MAC addresses.
- no-mac-learn-enable—Prohibit the interface from dynamically learning source and destination MAC addresses.

MAC address learning is based on source addresses. You can start accounting for traffic after there has been traffic sent from the MAC address. Once the MAC address is learned, the frames and bytes transmitted to or received from the MAC address can be tracked.

Usage Guidelines See “Configuring MAC Address Filtering” on page 713.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

mac-validate

Syntax mac-validate (loose | strict);

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family *family*]

Release Information Statement introduced in JUNOS Release 9.3.

Description Enable IP and MAC address validation for static Ethernet and IP demux interfaces. Supported on MX-series routers only.

Options loose—Forwards incoming packets when both the IP source address and the MAC source address match one of the trusted address tuples. Drops packets when the IP source address matches one of the trusted tuples, but the MAC address does not match the MAC address of the tuple. Continues to forward incoming packets when the source address of the incoming packet does not match any of the trusted IP addresses.

strict—Forwards incoming packets when both the IP source address and the MAC source address match one of the trusted address tuples. Drops packets when the MAC address does not match the tuple's MAC source address, or when IP source address of the incoming packet does not match any of the trusted IP addresses.

Usage Guidelines See “Configuring MAC Address Validation on Static Ethernet Interfaces” on page 641 and “Configuring MAC Address Validation on Static Demux Interfaces” on page 242.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

maintenance-association

Syntax

```
maintenance-association ma-name {
    short-name-format (character-string | vlan | 2octet | rfc-2685-vpn-id);
    continuity-check {
        hold-interval (OAM) minutes;
        interval (10m | 10s | 1m | 1s| 100ms);
        loss-threshold number;
    }
    mep mep-id {
        auto-discovery;
        direction (up | down);
        interface interface-name;
        priority number;
        remote-mep mep-id {
            action-profile profile-name;
        }
    }
}
```

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name*]

Release Information Statement introduced in JUNOS Release 8.4.

Description Configure the name of the maintenance association in IEEE-compliant format.

Options ma-name—The name of the maintenance association within the maintenance domain.

The remaining statements are explained separately.

Usage Guidelines See “Creating the Maintenance Association” on page 649.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

maintenance-domain

Syntax

```
maintenance-domain domain-name {
    bridge-domain name;
    instance vpls-instance;
    level number;
    mip-half-function(none | default | explicit);
    name-format (character-string | none | dns | mac+2oct);
    maintenance-association ma-name {
        short-name-format (character-string | vlan | 2octet | rfc-2685-vpn-id);
        continuity-check {
            hold-interval (OAM) minutes;
            interval (10m | 10s | 1m | 1s| 100ms);
            loss-threshold number
        }
        mep mep-id {
            action-profile profile-name;
            auto-discovery;
            direction (up | down);
            interface interface-name;
            priority number;
            remote-mep mep-id {
                action-profile profile-name;
            }
        }
        mip-half-function (none | default | explicit);
    }
    routing-instance name {
        bridge-domain name;
    }
}
```

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management]

Release Information Statement introduced in JUNOS Release 8.4.

Description Configure the name of the maintenance domain in IEEE-compliant format.

Options domain-name—The name for the maintenance domain.

The remaining statements are explained separately.

Usage Guidelines See “Creating the Maintenance Domain” on page 647.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

map

Syntax

```
map {
   local-mac mac-address remote-mac mac-address;
}
```

Hierarchy Level

[edit interfaces interface-name unit logical-unit-number family llc2 redundancy-group group-number],
[edit logical-systems logical-system-name interfaces interface-name unit logical-unit-number family llc2 redundancy-group group-number]

Release Information Statement introduced in JUNOS Release 7.5.

Description For J-series Services Routers only. On Ethernet interfaces configured for DLSw Ethernet redundancy, map a local peer MAC address to a remote peer MAC address.

The statements are explained separately

NOTE: For DLSw configurations, you must specify the local-mac statement and the remote-mac statement when you configure the map statement. If you do not include the MAC translation information with the map statement, the commit operation will fail.

Usage Guidelines See "Configuring DLSw Ethernet Redundancy Using LLC2 Properties" on page 172.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS Services Interfaces Configuration Guide*

master-only

Syntax master-only;

Hierarchy Level [edit groups rex interfaces fxp0 unit *logical-unit-number* family *family* address],
[edit groups rex logical-systems *logical-system-name* interfaces fxp0 unit *logical-unit-number* family *family* address]
[edit interfaces fxp0 unit *logical-unit-number* family *family* address],
[edit logical-systems *logical-system-name* interfaces fxp0 unit *logical-unit-number* family *family* address]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure the IP address to be used when the Routing Engine is the current master.

Usage Guidelines See "Configuring a Consistent Management IP Address" on page 729.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics For information about the groups statement, see the *JUNOS CLI User Guide*.

maximum-contexts

Syntax maximum-contexts *number* <force>;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* compression rtp],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* compression rtp]

Release Information Statement introduced in JUNOS Release 7.5.

Description Specify the maximum number of RTP contexts to accept during negotiation.

Options *number*—Maximum number of contexts.

force—(Optional) Requires the PIC to use the value specified for maximum RTP contexts, regardless of the negotiated value. This option allows the software to interoperate with JUNOS releases that base the RTP context value on link speed.

Usage Guidelines See *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

maximum-vcs

Syntax maximum-vcs *maximum-vcs*;

Hierarchy Level [edit interfaces at-*fpc/pic/port* atm-options vpi *vpi-identifier*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM1 interfaces, configure the maximum number of virtual circuits (VCs) allowed on a virtual path (VP). When configuring ATM1 interfaces on the routing platform, you must include this statement.

For a configured virtual path identifier (VPI), valid virtual channel identifier (VCI) numbers are from 0 through (*maximum-vcs* value – 1). VCI numbers 0 through 31 are reserved by the ATM Forum. It is recommended that you use a VCI number higher than 31 when connecting to an ATM switch.

Options *maximum-vcs*—Maximum number of VCs on the VP.
Range: 1 through 4090

Usage Guidelines See "Configuring the Maximum Number of ATM1 VCs on a VP" on page 286.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics multipoint-destination, promiscuous-mode, vci

maximum-requests

Syntax maximum-requests *times*;

Hierarchy Level [edit protocols dot1x authenticator interface *interface-id*]

Release Information Statement introduced in JUNOS Release 9.3.

Description Specify the maximum number of retransmission times of an EAPOL Request packet to the client before it times out the authentication session.

Options *times*—Specify the maximum number of retransmission times.
Range: 1 through 10 times
Default: 2 times

Usage Guidelines See "Configuring IEEE 802.1x Port-Based Network Access Control" on page 693.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics dot1x, authenticator, interface (IEEE 802.1x)

max-retry

Syntax max-retry *count*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family llc2],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family llc2]

Release Information Statement introduced in JUNOS Release 7.4.

Description For J-series Services Routers only. On Ethernet interfaces configured for DLSw, configure the number of retries the router should attempt when waiting for a response.

Options *count*—Number of retries.

Range: 1 through 127

Default: 10

Usage Guidelines See "Configuring LLC2 Options" on page 171.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Advanced WAN Access Configuration Guide*

member-interface-speed

Syntax member-interface-speed *speed*;

Hierarchy Level [edit interfaces container-options member-interface-type]

Release Information Statement introduced in JUNOS Release 9.2.

Description Specify container-interface member-interface speed options.

Options *speed*—Set interface speed to OC3, OC12, OC48, OC192, OC768, or mixed.

Usage Guidelines See "Configuring Container Interfaces" on page 817.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics container-options

member-interface-type

Syntax

```
member-interface-type sonet {
   member-interface-speed [ speed ];
}
```

Hierarchy Level [edit interfaces container-options]

Release Information Statement introduced in JUNOS Release 9.2.

Description Specify container-interface member-interface type as sonet and speed options.

Options sonet—Protocol type of the container interface, specify sonet.

speed—Set interface speed to OC3, OC12, OC48, OC192, OC768, or mixed.

Usage Guidelines See "Configuring Container Interfaces" on page 817.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics container-options

mep

Syntax

```
mep mep-id {
    auto-discovery;
    direction (up | down);
    interface interface-name;
    priority number;
    remote-mep mep-id {
        action-profile profile-name;
    }
}
```

Hierarchy Level

[edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name*]

Release Information

Statement introduced in JUNOS Release 8.4.

Description

The numeric identifier of the maintenance association end point (MEP) within the maintenance association.

Options

mep-id—Specify the numeric identifier of the MEP.
Range: 1 through 8191

The remaining statements are explained separately.

Usage Guidelines

See "Creating a Maintenance End Point" on page 651.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

minimum-links

Syntax minimum-links *number*;

Hierarchy Level [edit interfaces ae*x* aggregated-ether-options],
[edit interfaces as*x* aggregated-sonet-options],
[edit interfaces *interface-name* mlfr-uni-nni-bundle-options],
[edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For aggregated Ethernet, SONET/SDH, multilink, link services, and voice services interfaces only, set the minimum number of links that must be up for the bundle to be labeled up.

Options *number*—Number of links.

Range: 1 through 8 (1 through 16 for Ethernet and SONET interfaces on the MX-series, M320, M120, T-series or TX matrix routers)

Default: 1

Usage Guidelines See "Configuring Aggregated Ethernet Minimum Links" on page 604, "Configuring Aggregated SONET/SDH Minimum Links" on page 837, or the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

mip-half-function

Syntax mip-half-function (none | default | explicit);

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management maintenance-domain *md-name*]

Description Specify the OAM Ethernet CFM maintenance domain MIP half functions.

NOTE: Whenever a MIP is configured and a bridge domain is mapped to multiple maintenance domains (MD) or maintenance associations (MA), it is essential that the mip-half-function value for all MDs and MAs are the same.

Options none—Specify to not use the mip-half-function.

default—Specify to use the default mip-half-function.

explicit—Specify an explicit mip-half-function.

Usage Guidelines See “Creating the Maintenance Domain” on page 647.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics See maintenance-domain.

mlfr-uni-nni-bundle-options

Syntax

```
mlfr-uni-nni-bundle-options {
    acknowledge-retries number;
    acknowledge-timer milliseconds;
    action-red-differential-delay (disable-tx | remove-link);
    drop-timeout milliseconds;
    fragment-threshold bytes;
    hello-timer milliseconds;
    link-layer-overhead percent;
    lmi-type (ansi | itu);
    minimum-links number;
    mrru bytes;
    n391 number;
    n392 number;
    n393 number;
    red-differential-delay milliseconds;
    t391 seconds;
    t392 number;
    yellow-differential-delay milliseconds;
}
```

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure link services and voice services interface management properties.

The statements are explained separately.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

mode

Syntax mode loose;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family (inet | inet6) rpf-check],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family (inet | inet6) rpf-check]

Release Information Statement introduced before JUNOS Release 7.4.

Description Check whether the packet has a source address with a corresponding prefix in the routing table. If a corresponding prefix is not found, unicast reverse path forwarding (RPF) loose mode does not accept the packet. Unlike strict mode, loose mode does not check whether the interface expects to receive a packet with a specific source address prefix.

Default If you do not include this statement, unicast RPF is in strict mode.

Usage Guidelines See “Configuring Unicast RPF Strict Mode” on page 199 and “Configuring Unicast RPF Loose Mode” on page 200.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

modem-options

Syntax

```
modem-options {
    dialin (console | routable);
    init-command-string initialization-command-string;
}
```

Hierarchy Level [edit interfaces umd0]

Release Information Statement introduced in JUNOS Release 8.2.

Description For J-series Services Routers, configure a USB port to act as a USB modem.

The remaining statement is explained separately.

Usage Guidelines See “Specifying a USB Modem Interface on J-series Routers” on page 87.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

monitor-session

Syntax monitor-session (*interface-name* | all);

Hierarchy Level [edit protocols ppp]

Release Information Statement introduced in JUNOS Release 7.5.

Description Monitor PPP packet exchanges. When monitoring is enabled, packets exchanged during a session are logged to the default log of /var/log/pppd.

Default If you do not include this statement, no PPPD-specific monitoring operations are performed.

Options all—Monitor PPP packet exchanges on all sessions.

interface-name—Logical interface name on which to enable session monitoring.

Usage Guidelines See “Monitoring a PPP Session” on page 112.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

mpls

Syntax

```
mpls {
    pop-all-labels {
        required-depth number;
    }
}
```

Hierarchy Level [edit interfaces *interface-name* atm-options],
[edit interfaces *interface-name* sonet-options],
[edit interfaces *interface-name* fastether-options],
[edit interfaces *interface-name* gigether-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For passive monitoring on ATM and SONET/SDH interfaces and 10-Gigabit Ethernet interfaces in WAN PHY mode, process incoming IP packets that have MPLS labels.

The remaining statements are explained separately.

Usage Guidelines See “Removing MPLS Labels from Incoming Packets” on page 280 and “Removing MPLS Labels from Incoming Packets” on page 828.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS Services Interfaces Configuration Guide*

mrru

Syntax mrru *bytes*;

Hierarchy Level [edit interfaces *interface-name* mlfr-uni-nni-bundle-options],
[edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For multilink, link services, voice services, and J-series Services Routers ISDN interfaces only, set the maximum received reconstructed unit (MRRU). The MRRU is similar to the MTU, but is specific to multilink interfaces.

Options *bytes*—MRRU size.

Range: 1500 through 4500 bytes

Default: 1500 bytes

Usage Guidelines See "Configuring the Dialer Interface" on page 784 and the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics mtu

mtu

Syntax mtu *bytes*;

Hierarchy Level [edit interfaces *interface-name*],
[edit interfaces *interface-name* unit *logical-unit-number* family *family*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Maximum transmission unit (MTU) size for the media or protocol. The default MTU size depends on the device type. Not all devices allow you to set an MTU value, and some devices have restrictions on the range of allowable MTU values. Changing the media MTU or protocol MTU causes an interface to be deleted and added again.

Options *bytes*—MTU size.

Range: 0 through 9192 bytes

Default: 1500 bytes (INET, INET6, and ISO families), 1448 bytes (MPLS)

Usage Guidelines See "Configuring the Media MTU" on page 92 and "Setting the Protocol MTU" on page 181.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

multicast-dlci

Syntax multicast-dlci *dlci-identifier*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For point-to-multipoint Frame Relay, link services, and voice services interfaces only, enable multicast support on the interface. You can configure multicast support on the interface if the Frame Relay switch performs multicast replication.

Options *dlci-identifier*—DLCI identifier, a number from 16 through 1022 that defines the Frame Relay DLCI over which the switch expects to receive multicast packets for replication.

Usage Guidelines See “Configuring a Multicast-Capable Frame Relay Connection” on page 367 and the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics dlci, multipoint-destination

multicast-vci

Syntax multicast-vci *vpi-identifier*.*vci-identifier*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM encapsulation only, and for point-to-multipoint ATM logical interfaces only, enable the support of multicast on the interface. You can configure multicast support on the interface if the ATM switch performs multicast replication.

Options *vci-identifier*—ATM virtual circuit identifier.
Range: 0 through 16384

vpi-identifier—ATM virtual path identifier.
Range: 0 through 255
Default: 0

Usage Guidelines See "Configuring a Multicast-Capable ATM1 or ATM2 IQ Connection" on page 304.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics multipoint-destination, vci

multicast-only

Syntax multicast-only;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure the unit and family so that it can transmit and receive multicast traffic only. You can configure this property on the IP family only.

Usage Guidelines See "Configuring the Protocol Family" on page 164.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics tunnel, *JUNOS Services Interfaces Configuration Guide*

multilink-max-classes

Syntax multilink-max-classes *number*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Adaptive Services (AS) PIC link services IQ interfaces (lsq) only, configure the number of multilink classes to be negotiated when a link joins the bundle.

Options *number*—The number of multilink classes to be negotiated when a link joins the bundle.

Range: 1 through 8

Default: None

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics multipoint

multipoint

Syntax multipoint;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure the interface unit as a multipoint connection.

Default If you omit this statement, the interface unit is configured as a point-to-point connection.

Usage Guidelines See “Configuring a Multipoint Connection” on page 149.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics point-to-point

multipoint-destination

Syntax

```
multipoint-destination address dlci dlci-identifier;
multipoint-destination address {
   epd-threshold cells;
   inverse-arp;
   oam-liveness {
      up-count cells;
      down-count cells;
   }
   oam-period (disable | seconds);
   shaping {
      (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained rate
         burst length);
      queue-length number;
   }
   vci vpi-identifier.vci-identifier;
}
```

Hierarchy Level

[edit interfaces *interface-name* unit *logical-unit-number* family *family* address *address*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family* address *address*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For point-to-multipoint Frame Relay or ATM interfaces only, enable the support of multicast on the interface. You can configure multicast support on the interface if the Frame Relay or ATM switch performs multicast replication.

Options *address*—Address of the remote side of the point-to-multipoint connection.

dlci-identifier—For Frame Relay interfaces, the data-link connection identifier.
Range: 0 through 0xFFFFFF (24 bits)

vci-identifier—For ATM interfaces, the virtual circuit identifier.
Range: 0 through 16384

vpi-identifier—For ATM interfaces, the virtual path identifier.
Range: 0 through 255
Default: 0

The remaining statements are explained separately.

Usage Guidelines See "Configuring a Point-to-Point ATM1 or ATM2 IQ Connection" on page 303, and "Configuring a Point-to-Multipoint Frame Relay Connection" on page 367.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics dlci, encapsulation

multiservice-options

Syntax

```
multiservice-options {
    (syslog | no-syslog);
    (core-dump | no-core-dump);
    (dump-on-flow-control);
}
```

Hierarchy Level [edit interfaces mo-*fpc/pic/port*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For monitoring services interfaces only, configure multiservice-specific interface properties.

The statements are explained separately.

Usage Guidelines See "Configuring Multiservice Physical Interface Properties" on page 132 and the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics passive-monitor-mode

n391

Syntax n391 *number*;

Hierarchy Level [edit interfaces *interface-name* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For link services and voice services interfaces only, set the Frame Relay full status polling interval.

Options number—Number of polling interval.

Range: 1 through 255

Default: 6

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics n392, n393, timeslots, and t392

n392

Syntax n392 *number*;

Hierarchy Level [edit interfaces *interface-name* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For link services and voices interfaces only, set the Frame Relay error threshold, in number of errors.

Options number—Error threshold.

Range: 1 through 10

Default: 3

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics n391, n393, timeslots, t392

n393

Syntax n393 *number*;

Hierarchy Level [edit interfaces *interface-name* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For link services and voices interfaces only, set the Frame Relay monitored event count.

Options *number*—Number of event count.

Range: 1 through 255

Default: 6

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics n391, n392, timeslots, t392

name-format

Syntax name-format (character-string | none | dns | mac+2oct);

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name*]

Release Information Statement introduced in JUNOS Release 8.4.

Description Specify the format of the maintenance domain name.

Options character-string—The name is an ASCII character string.

none—Name format none means that maintenance domain name is not used.

dns—Name is in domain name service (DNS) format. For example: www.juniper.net.

mac+2octet—Name is the MAC address plus a two-octet maintenance association identifier. For example: 08:00:22:33:44:55.100

Default: character-string

Usage Guidelines See "Configuring the Maintenance Association Short Name Format" on page 649.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

native-vlan-id

Syntax native-vlan-id *number*;

Hierarchy Level [edit interfaces ge-*fpc/pic/port*]

Release Information Statement introduced in JUNOS Release 8.3.

Description For 1-, 4-, and 8-port Gigabit Ethernet IQ2 and IQ2-E PICs, for 1-port 10-Gigabit Ethernet IQ2 and IQ2-E PICs configured for 802.1Q flexible VLAN tagging, for all Ethernet interfaces on MX-series routers, and for aggregated Ethernet interfaces on IQ2 and IQ2-E PICs or MX-series DPCs, configure mixed tagging support for untagged packets on a port. When the native-vlan-id statement is included with the flexible-vlan-tagging statement, untagged packets are accepted on the same mixed VLAN-tagged port.

The logical interface on which untagged packets will be received must be configured with the same native VLAN ID as that configured on the physical interface. To configure the logical interface, include the vlan-id statement (matching the native-vlan-id statement on the physical interface) at the [edit interface *interface-name* unit *logical-unit-number*] hierarchy level.

When the native-vlan-id statement is included with the interface-mode the statement, untagged packets are accepted and forwarded within the bridge domain that is configured with the matching VLAN ID.

Options *number*—VLAN ID number.

Usage Guidelines See “Configuring Mixed Tagging Support for Untagged Packets” on page 573, flexible-vlan-tagging, and “Configuring a Logical Interface for Access Mode” on page 589.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

ncp-restart-timer

Syntax ncp-restart-timer *milliseconds*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* ppp-options],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* ppp-options]

Release Information Statement introduced in JUNOS Release 8.1.

Description For interfaces with PPP and PPP TCC encapsulations and on multilink PPP bundle interfaces, configure a restart timer for the Network Control Protocol (NCP) component of a PPP session.

Options *milliseconds*—The time in milliseconds between successive NCP configuration requests.

Range: 500 through 10000 milliseconds.

Default: 3 seconds

Usage Guidelines See “Configuring the PPP Restart Timers” on page 153.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

negotiate-address

Syntax negotiate-address;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet]

Release Information Statement introduced before JUNOS Release 7.4.

Description For interfaces with PPP encapsulation, enable the interface to be assigned an IP address by the remote end.

Usage Guidelines See “Configuring IPCP Options” on page 168.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics address, unnumbered-address, *JUNOS System Basics Configuration Guide*

negotiation-options

Syntax

```
negotiation-options {
    allow-remote-loopback;
    no-allow-link-events;
}
```

Hierarchy Level [edit protocols oam link-fault-management interface *interface-name*]

Release Information Statement introduced in JUNOS Release 8.4.

Description Enable and disable IEEE 802.3ah Operation, Administration, and Management (OAM) features for Ethernet interfaces.

The statements are explained separately.

Usage Guidelines See "Configuring IEEE 802.3ah OAM Link-Fault Management" on page 697.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

neighbor

Syntax neighbor *address*;

Hierarchy Level [edit interfaces *interface-name* sonet-options aps]

Release Information Statement introduced before JUNOS Release 7.4.

Description If you are configuring one router to be the working router and a second to be the protect router, configure the address of the remote interface. You configure this on one or both of the interfaces.

The address you specify for the neighbor must never be routed through the interface on which APS is configured, or instability will result. We strongly recommend that you directly connect the working and protect routers and that you configure the interface address of this shared network as the neighbor address.

Options *address*—Neighbor's address.

Usage Guidelines See "Configuring Basic APS Support" on page 815.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

no-allow-link-events

Syntax no-allow-link-events;

Hierarchy Level [edit protocols oam ethernet link-fault-management interface *interface-name* negotiation-options]

Release Information Statement introduced in JUNOS Release 8.4.

Description Disable the sending of link event TLVs.

Usage Guidelines See “Disabling the Sending of Link Event TLVs” on page 700.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

no-asynchronous-notification

See asynchronous-notification

no-auto-mdix

See See speed (gigether-options).

no-auto-negotiation

See auto-negotiation

no-cbit-parity

See cbit-parity

no-core-dump

See core-dump

no-feac-loop-respond

See feac-loop-respond

no-flow-control

See flow-control

no-gratuitous-arp-reply

See gratuitous-arp-reply

no-gratuitous-arp-request

Syntax no-gratuitous-arp-request;

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Ethernet interfaces, do not respond to gratuitous ARP requests.

Default Gratuitous ARP responses are enabled on all Ethernet interfaces.

Usage Guidelines See “Configuring Gratuitous ARP” on page 565.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics gratuitous-arp-reply

no-keepalives

Syntax no-keepalives;

Hierarchy Level [edit interfaces *interface-name*],
[edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Disable the sending of keepalives on a physical interface configured with PPP, Frame Relay, or Cisco HDLC encapsulation. The default keepalive interval is 10 seconds.

For ATM2 IQ interfaces only, you can disable keepalives on a logical interface unit if the logical interface is configured with one of the following PPP over ATM encapsulation types:

- atm-ppp-llc—PPP over AAL5 LLC encapsulation.
- atm-ppp-vc-mux—PPP over AAL5 multiplex encapsulation.

Usage Guidelines See “Configuring Keepalives” on page 120 “Disabling the Sending of PPPoE Keepalive Messages” on page 742, and “Configuring Frame Relay Keepalives” on page 364.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

no-long-buildout

See long-buildout

no-loopback

See loopback

no-mac-learn-enable

See mac-learn-enable

node-id

Syntax node-id *mac-address*;

Hierarchy Level [edit protocols protection-group ethernet-ring *ring-name*]

Description Optionally specify the MAC address of a node in the protection group. If this statement is not included, the router assigns the node's MAC address by default.

Usage Guidelines See "Configuring Ethernet Ring Protection Switching" on page 753.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

non-revertive

Syntax non-revertive;

Hierarchy Level [edit interfaces ae*X* aggregated-ether-options lacp link-protection]

Release Information Statement introduced in JUNOS Release 9.3.

Description Disable the ability to switch to a better priority link (if one is available) once a link is established as active and collection distribution is enabled.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

no-partition

See the following sections:

no-partition (Channelized E1 IQ Interfaces)

Syntax no-partition interface-type e1;

Hierarchy Level [edit interfaces ce1-*fpc/pic/port*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Channelized E1 IQ PICs only, configure the channelized E1 interface as an unpartitioned, clear channel.

Default If you do not include either this statement or the partition statement, the Channelized IQ PIC is not partitioned, and no data channels are configured.

Usage Guidelines See "Configuring Channelized E1 Interfaces" on page 485.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics partition

no-partition (Channelized OC1 IQ Interfaces)

Syntax no-partition interface-type (ct3 | t3);

Hierarchy Level [edit interfaces coc1-*fpc/pic/port*:*channel*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For the Channelized OC12 PIC only, convert the channelized OC1 IQ interface into a channelized T3 interface or a T3 interface. You perform this configuration task for C-bit parity and M13-mapped configurations.

Default If you do not include either this statement or the partition statement, the Channelized IQ PICs not partitioned, and no data channels are configured.

Options ct3—Channelized T3 interface type.

t3—T3 interface type.

Usage Guidelines See "Configuring Channelized OC12/STM4 Interfaces" on page 411.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics partition

no-partition (Channelized OC12 IQ Interfaces)

Syntax no-partition interface-type so;

Hierarchy Level [edit interfaces coc12-*fpc/pic/port*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Channelized OC12 IQ PICs only, configure the channelized OC12 interface as an unpartitioned, clear channel.

Default If you do not include either this statement or the partition statement, the Channelized IQ PICs not partitioned, and no data channels are configured.

Usage Guidelines See "Configuring an OC12/STM4 Interface" on page 415.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics partition

no-partition (Channelized STM1 IQ Interfaces)

Syntax no-partition interface-type (cau4 | so);

Hierarchy Level [edit interfaces cstm1-*fpc/pic/port*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For the Channelized STM1 PIC only, convert the channelized STM1 IQ interface into a channelized Administrative Unit 4 (AU-4) interface or a SONET/SDH STM1 interface.

Default If you do not include either this statement or the partition statement, the Channelized IQ PICs not partitioned, and no data channels are configured.

Options cau4—Channelized AU-4 interface type.

so—SONET/SDH STM1 interface type.

Usage Guidelines See "Configuring Channelized STM1 IQ and IQE Interfaces" on page 449.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics partition

no-partition (Channelized T3 IQ Interfaces)

Syntax no-partition interface-type t3;

Hierarchy Level [edit interfaces ct3-*fpc/pic/port*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For the Channelized DS3 PIC only, configure the channelized T3 interface as an unpartitioned, clear channel.

Default If you do not include either this statement or the partition statement, the Channelized IQ PIC is not partitioned, and no data channels are configured.

Usage Guidelines See "Configuring T3 IQ Interfaces" on page 463.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics partition

no-payload-scrambler

See payload-scrambler

no-preempt

See preempt

no-redirects

Syntax no-redirects;

Hierarchy Level [edit interfaces *interface-name* unit *number* family *family*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Do not send protocol redirect messages on the interface.

To disable the sending of protocol redirect messages for the entire routing platform, include the no-redirects statement at the [edit system] hierarchy level.

Default Interfaces send protocol redirect messages.

Usage Guidelines See “Disabling the Transmission of Redirect Messages on an Interface” on page 182.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS System Basics Configuration Guide*

no-source-filtering

See source-filtering

no-syslog

See syslog

no-termination-request

Syntax no-termination-request;

Hierarchy Level [edit interfaces *interface-name* ppp-options],
[edit interfaces lsq-*fpc/pic/port* lsq-failure-options]

Release Information Statement introduced in JUNOS Release 7.4.
Support at the [edit interfaces *interface-name* ppp-options] hierarchy level added in JUNOS Release 8.3.

Description For LSQ PICs or link PICs in redundant LSQ configurations, you can inhibit the router from sending PPP termination-request messages to the remote host if the PIC fails.

Usage Guidelines See "Configuring Link PIC Failover on Channelized OC3 IQ and IQE Interfaces" on page 448 for Channelized OC3 IQ PICs, "Configuring Link PIC Failover on Channelized OC12/STM4 IQ and IQE Interfaces" on page 434 for OC12 IQ PICs, "Configuring Link PIC Failover on Channelized STM1 Interfaces" on page 459 for Channelized STM1 IQ PICs, and the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

no-translate-discard-eligible

See translate-discard-eligible

no-translate-fecn-and-becn

See translate-fecn-and-becn

no-unframed

See unframed

no-z0-increment

See z0-increment

oam

Syntax

```
oam {
  ethernet {
    connectivity-fault-management {
      action-profile profile-name {
        default-action {
          interface-down;
        }
      }
      performance-monitoring {
        hardware-assisted-timestamping;
      }
      linktrace {
        age (30m | 10m | 1m | 30s | 10s);
        path-database-size path-database-size;
      }
      maintenance-domain domain-name {
        level number;
        name-format (character-string | none | dns | mac+2octet);
        maintenance-association ma-name {
          short-name-format (character-string | vlan | 2octet | rfc-2685-vpn-id);
          continuity-check {
            hold-interval (OAM) minutes;
            interval (10m | 10s | 1m | 1s| 100ms);
            loss-threshold number;
          }
          mep mep-id {
            action-profile profile-name;
            auto-discovery;
            direction (up | down);
            interface interface-name;
            priority number;
            remote-mep mep-id {
              action-profile profile-name;
            }
          }
        }
      }
    }
    link-fault-management {
      action-profile profile-name {
        action {
          syslog;
          link-down;
          send-critical-event;
        }
        event {
          link-adjacency-loss;
          link-event-rate {
            frame-error count;
            frame-period count;
            frame-period-summary count;
```

```
                symbol-period count;
            }
            protocol-down;
        }
    }
    interface interface-name {
        apply-action-profile
        link-discovery (active | passive);
        pdu-interval interval;
        pdu-threshold threshold-value;
        remote-loopback;
        event-thresholds {
            frame-error count;
            frame-period count;
            frame-period-summary count;
            symbol-period count;
        }
        negotiation-options {
            allow-remote-loopback;
            no-allow-link-events;
        }
    }
   }
  }
}
```

Hierarchy Level [edit protocols]

Release Information Statement introduced in JUNOS Release 8.2.

Description For Ethernet interfaces on M320, M120, MX-series, and T-series routing platforms, provide IEEE 802.3ah Operation, Administration, and Management (OAM) support.

The remaining statements are explained separately.

Usage Guidelines See “Configuring IEEE 802.3ah OAM Link-Fault Management” on page 697.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

oam-liveness

Syntax

```
oam-liveness {
   down-count cells;
   up-count cells;
}
```

Hierarchy Level

[edit interfaces *interface-name* atm-options vpi *vpi-identifier*],
[edit interfaces *interface-name* unit *logical-unit-number*],
[edit interfaces *interface-name* unit *logical-unit-number* family *family* address *address* multipoint-destination *address*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family* address *address* multipoint-destination *address*]

Release Information

Statement introduced before JUNOS Release 7.4.

Description

For ATM encapsulation only, configure Operation, Administration, and Maintenance (OAM) F5 loopback cell count thresholds. Not supported on ATM-over-SHDSL interfaces.

For ATM2 IQ PICs only, configure OAM F4 loopback cell count thresholds at the [edit interfaces *interface-name* atm-options vpi *vpi-identifier*] hierarchy level.

Options

down-count *cells*—Minimum number of consecutive OAM F4 or F5 loopback cells lost before a VC is declared down.
Range: 1 through 255
Default: 5 cells

up-count *cells*—Minimum number of consecutive OAM F4 or F5 loopback cells received before a VC is declared up.
Range: 1 through 255
Default: 5 cells

Usage Guidelines

See “Configuring the ATM OAM F5 Loopback Cell Threshold” on page 316.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

oam-period

Syntax oam-period (disable | *seconds*);

Hierarchy Level [edit interfaces *interface-name* atm-options vpi *vpi-identifier*],
[edit interfaces *interface-name* unit *logical-unit-number*],
[edit interfaces *interface-name* unit *logical-unit-number* family *family* address *address* multipoint-destination *address*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family* address *address* multipoint-destination *address*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM encapsulation only, configure the OAM F5 loopback cell period. Not supported on ATM-over-SHDSL interfaces.

For ATM2 IQ PICs only, configure OAM F4 loopback cell period at the [edit interfaces *interface-name* atm-options vpi *vpi-identifier*] hierarchy level.

Default If you omit this statement, OAM F5 loopback cells are not originated, but the interface still responds if it receives OAM F5 loopback cells.

Options disable—Disable OAM loopback cell transmit feature.

seconds—OAM loopback cell period.
Range: 1 through 900 seconds

Usage Guidelines See "Defining the ATM OAM F5 Loopback Cell Period" on page 315.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

oc-slice

Syntax oc-slice *oc-slice-range*;

Hierarchy Level [edit interfaces *interface-name* partition *partition-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For channelized OC12 IQ interfaces only, configure the range of SONET/SDH slices.

Default If you do not include either this statement or the no-partition statement, the Channelized OC12 IQ PICs not partitioned, and no data channels are configured.

Options *oc-slice-range*—Range of SONET/SDH slices. OC3 interfaces must occupy three consecutive OC slices per interface, in the form 1–3, 4–6, 7–9, or 10–12. The T3, T1, and DS0 interface types each occupy one OC slice per interface.
Range: For OC3 interfaces,1–3, 4–6, 7–9, or 10–12; for SONET/SDH and T3 interfaces, 1–12.

The remaining statement is explained separately.

Usage Guidelines See "Configuring Channelized OC12/STM4 Interfaces" on page 411.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

open-timeout

Syntax open-timeout *seconds*;

Hierarchy Level [edit interfaces *interface-name* services-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure timeout period for Transmission Control Protocol (TCP) session establishment.

Options *seconds*—Timeout period in seconds.
Range: 4 through 86,400 seconds
Default: 30 seconds

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

operating-mode

Syntax operating-mode *mode*;

Hierarchy Level [edit interfaces at-*fpc*/*pic*/*port* dsl-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For J-series Services Routers only, modify the operating mode of the digital subscriber line for an ATM interface.

Options *mode*—Operating mode for ATM-over-ADSL interfaces. The mode can be one of the following:

- adsl2plus—Set the ADSL line to train in the ITU G.992.5 mode.
- ansi-dmt—Set the ADSL line to train in the ANSI T1.413 Issue 2 mode.
- auto—Set the ADSL line to autonegotiate the setting to match the setting of the DSL access multiplexer (DSLAM) located at the central office. The ADSL line trains in the ANSI T1.413 Issue 2 (ansi-dmt) or ITU G.992.1 (itu-dmt) mode.
- etsi—Set the ADSL line to train in the ETSI TS 101 388 V1.3.1 mode.
- itu-annexb-ur2—Set the ADSL line to train in the ITU G.992.1 UR-2 mode.
- itu-annexb-non-ur2—Set the ADSL line to train in the ITU G.992.1 non-UR-2 mode.
- itu-dmt—Set the ADSL line to train in the ITU G.992.1 mode.
- itu-dmt-bis—Set the ADSL line to train in the ITU G.992.3 mode.

Default: auto

Usage Guidelines See “Configuring ATM-over-ADSL Interfaces” on page 341.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

optics-options

Syntax

```
optics-options {
  wavelength nm;
}
```

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For 10-Gigabit Ethernet dense wavelength-division multiplexing (DWDM) interfaces only, configure full C-band International Telecommunication Union (ITU)-Grid tunable optics.

Options The wavelength statement is explained separately.

Usage Guidelines See "Configuring the 10-Gigabit Ethernet DWDM Interface Wavelength" on page 733.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

otn-options

Syntax

```
otn-options {
  apply-groups group-name;
  apply-groups-except exception-group-name;
  fec (efec | gfec | none);
  (laser-enable | no-laser-enable);
  (line-loopback } no-line-loopback);
  pass-thru;
  rate (fixed-stuff-bytes | no-fixed-stuff-bytes | pass-thru);
  trigger (oc-lof | oc-lom | oc-los | oc-wavelength-lock | odu-ais | odu-bbe-th | odu-bdi |
    odu-es-th | odu-lck | odu-oci | odu-sd | odu-ses-th | odu-ttim | odu-uas-th | opu-ptm |
    otu-ais | otu-bbe-th | otu-bdi | otu-es-th | otu-fec-deg | otu-fec-exe | otu-iae | otu-sd |
    otu-ses-th | otu-ttim | otu-uas-th);
  tti;
}
```

Hierarchy Level [edit interfaces ge-*fpc*/*pic*/*port*]

Release Information Statement introduced in JUNOS Release 9.4.

Description Specify the Gigabit Ethernet Optical Transport Network (OTN) interface and the Xenpac interface OTN options.

Options apply-groups—Groups from which to inherit configuration data.

apply-groups-except—Don't inherit configuration data from these groups.

fec—Enable Forward Error Correction (FEC) mode.

laser-enable—Enable laser.

line-loopback—Enable line loopback.

no-laser-enable—Don't enable laser.

no-line-loopback—Don't enable line loopback.

rate (options)—OTN mode, select from the following options:

- fixed-stuff-bytes—Fixed Stuff Bytes 11.0957Gbps
- no-fixed-stuff-bytes—No Fixed Stuff Bytes 11.0491Gbps
- pass-through—Enable OTN passthrough mode.
- no-pass-through—Do not enable OTN passthrough mode.

trigger—Defect triggers, specify from the following possible completions:

- oc-lof—OC Loss of Frame defect trigger.
- oc-lom—OC Loss of Multiframe defect trigger.

- oc-los—OC Loss of Signal defect trigger.
- oc-wavelength-lock—OC Wavelength Lock defect trigger.
- odu-ais—ODU Alarm Indication Signal defect trigger.
- odu-bbe-th—ODU Background Block Error Threshold defect trigger.
- odu-bdi—ODU Backward Defect Indication defect trigger.
- odu-es-th—ODU Errored Seconds Threshold defect trigger.
- odu-lck—ODU Locked defect trigger.
- odu-oci—ODU Open Connection Indication defect trigger.
- odu-sd—ODU Signal Degrade defect trigger.
- odu-ses-th—ODU Severely Errored Seconds Threshold defect trigger.
- odu-ttim—ODU Trail Trace Identifier Mismatch defect trigger.
- odu-uas-th—ODU Unavailable Seconds Threshold defect trigger.
- opu-ptm—OPU Payload Type Mismatch defect trigger.
- otu-ais—OTU Alarm Indication Signal defect trigger.
- otu-bbe-th—OTU Background Block Error Threshold defect trigger.
- otu-bdi—OTU Backward Defect Indication defect trigger.
- otu-es-th—OTU Errored Seconds Threshold defect trigger.
- otu-fec-deg—OTU FEC Degrade defect trigger.
- otu-fec-exe—OTU FEC Excessive Error defect trigger.
- otu-iae—OTU Incoming Alignment defect trigger.
- otu-sd—OTU Signal Degrade defect trigger.
- otu-ses-th—OTU Severely Errored Seconds Threshold defect trigger.
- otu-ttim—OTU Trail Trace Identifier Mismatch defect trigger.
- otu-uas-th—OTU Unavailable Seconds Threshold defect trigger.

tti—Trace identifier, select from the following options:

- odu-dapi—ODU Destination Access Point Identifier.
- odu-expected-receive-dapi—ODU Expected Receive Destination Access Point Identifier.
- odu-expected-receive-sapi—ODU Expected Receive Source Access Point Identifier.
- odu-sapi—ODU Source Access Point Identifier.
- otu-dapi—OTU Destination Access Point Identifier.
- otu-expected-receive-dapi—OTU Expected Receive Destination Access Point Identifier.
- otu-expected-receive-sapi—OTU Expected Receive Source Access Point Identifier.
- otu-sapi—OTU Source Access Point Identifier.

Usage Guidelines See “Configuring Gigabit Ethernet OTN Options” on page 727.

Required Privilege Level interfaces—To view this statement in the configuration.
interfaces-control—To add this statement to the configuration.

output

Syntax

```
output {
    service-set service-set-name <service-filter filter-name>;
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet service],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet service]

Release Information Statement introduced before JUNOS Release 7.4.

Description Define one or more output service sets and filters to be applied to traffic.

Options The remaining statements are explained separately.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

output-list

Syntax output-list [*filter-names*];

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family *family* filter],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family* filter]

Release Information Statement introduced in JUNOS Release 7.6.

Description Apply a group of filters to evaluate when packets are transmitted on an interface.

Options [*filter-names*]—Name of a filter to evaluate when packets are transmitted on the interface. Up to 16 filters can be included in a filter input list.

Usage Guidelines See “Applying a Filter to an Interface” on page 194 and the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics input-list, *JUNOS Policy Framework Configuration Guide*, *JUNOS System Basics Configuration Guide*

output-policer

Syntax output-policer *policer-name*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* layer2-policer]

Release Information Statement introduced in JUNOS Release 8.2.

Description Associate a Layer 2 policer with a logical interface. The output-policer and output-three-color statements are mutually exclusive.

Options *policer-name*—Name of the policer that you define at the [edit firewall] hierarchy level.

Usage Guidelines See "Applying a Policer" on page 711.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics input-policer

output-priority-map

Syntax

```
output-priority-map {
    classifier {
        premium {
            forwarding-class class-name {
                loss-priority (high | low);
            }
        }
    }
}
```

Hierarchy Level [edit interfaces *interface-name* gigether-options ethernet-switch-profile ethernet-policer-profile]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Gigabit Ethernet IQ and 10-Gigabit Ethernet interfaces only, define the output policer priority map to be applied to outgoing frames on this interface.

The statements are explained separately.

Usage Guidelines See "Specifying an Output Priority Map" on page 710.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics input-priority-map

output-three-color

Syntax output-three-color *policer-name*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* layer2-policer]

Release Information Statement introduced in JUNOS Release 8.2.

Description Associate a Layer 2, three-color policer with a logical interface. The output-three-color and output-policer statements are mutually exclusive.

Options *policer-name*—Name of the three-color policer that you define at the [edit firewall] hierarchy level.

Usage Guidelines See "Applying a Policer" on page 711.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics input-three-color

output-vlan-map

See the following sections:

- output-vlan-map (Gigabit Ethernet IQ) on page 1120
- output-vlan-map (Aggregated Ethernet) on page 1121

output-vlan-map (Gigabit Ethernet IQ)

Syntax

```
output-vlan-map {
   (pop | pop-pop | pop-swap | push | push-push | swap | swap-push | swap-swap);
   inner-tag-protocol-id tpid;
   inner-vlan-id number;
   tag-protocol-id tpid;
   vlan-id number;
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.
pop-pop, pop-swap, push-push, swap-push, and swap-swap statements added in JUNOS Release 8.1.

Description For Gigabit Ethernet IQ interfaces only, define the rewrite operation to be applied to outgoing frames on this logical interface.

The statements are explained separately.

Usage Guidelines See “Stacking and Rewriting Gigabit Ethernet VLAN Tags” on page 607.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics input-vlan-map

output-vlan-map (Aggregated Ethernet)

Syntax

```
output-vlan-map {
    (pop | push | swap);
    tag-protocol-id tpid;
    vlan-id number;
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced in JUNOS Release 8.2.

Description For aggregated Ethernet interfaces using Gigabit Ethernet IQ and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces only, define the rewrite profile to be applied to outgoing frames on this logical interface.

The statements are explained separately.

Usage Guidelines See "Stacking and Rewriting Gigabit Ethernet VLAN Tags" on page 607.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics input-vlan-map

overflow

See the following sections:

- overflow (Receive Bucket) on page 1122
- overflow (Transmit Bucket) on page 1122

overflow (Receive Bucket)

Syntax overflow (discard | tag);

Hierarchy Level [edit interfaces *interface-name* receive-bucket]

Release Information Statement introduced before JUNOS Release 7.4.

Description Specify how to handle packets that exceed the threshold for the receive leaky bucket.

Options tag—Tag, count, and process received packets that exceed the threshold.

discard—Discard received packets that exceed the threshold. No counting is done.

Usage Guidelines See "Configuring Receive and Transmit Leaky Bucket Properties" on page 122 and "Configuring Receive and Transmit Leaky Bucket Properties on SONET/SDH Interfaces" on page 830.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

overflow (Transmit Bucket)

Syntax overflow discard;

Hierarchy Level [edit interfaces *interface-name* transmit-bucket]

Release Information Statement introduced before JUNOS Release 7.4.

Description Discard packets that exceed the threshold for the transmit leaky bucket.

Usage Guidelines See "Configuring Receive and Transmit Leaky Bucket Properties" on page 122 and "Configuring Receive and Transmit Leaky Bucket Properties on SONET/SDH Interfaces" on page 830.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

paired-group

Syntax paired-group *group-name*;

Hierarchy Level [edit interfaces *interface-name* sonet-options aps]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure load sharing between two working–protect circuit pairs.

Options *group-name*—Circuit's group name, as configured with the protect-circuit or working-circuit statement.

Usage Guidelines See "Configuring APS Load Sharing Between Circuit Pairs" on page 824.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics working-circuit

pap

Syntax

```
pap {
    access-profile name;
    default-pap-password password;
    local-name name;
    local-password password;
    passive;
}
```

Hierarchy Level

[edit interfaces *interface-name* ppp-options],
[edit interfaces *interface-name* unit *logical-unit-number* ppp-options],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* ppp-options]

Release Information Statement introduced in JUNOS Release 8.3.

Description Configure the Password Authentication Protocol (PAP). Use PAP authentication as a means to provide a simple method for the peer to establish its identity using a two-way handshake. This is done only upon initial link establishment.

After the link is established, an ID and password pair is repeatedly sent by the peer to the authenticator until authentication is acknowledged or the connection is terminated.

The statements are explained separately.

Usage Guidelines See "Configuring the PPP Challenge Handshake Authentication Protocol" on page 106, "Configuring PPP PAP Authentication" on page 155, and "Tracing Operations of the pppd Process" on page 113.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics traceoptions, *JUNOS System Basics Configuration Guide*

pap-password

Syntax pap-password *password*;

Hierarchy Level [edit access profile *profile-name* client *client-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure the Password Authentication Protocol (PAP) password.

Options *password*—PAP password.

Usage Guidelines See “Configuring PPP PAP Authentication” on page 155.

Required Privilege Level admin—To view this statement in the configuration.
admin-control—To add this statement to the configuration.

Related Topics chap-secret and *JUNOS System Basics Configuration Guide*

partition

Syntax partition *partition-number* oc-slice *oc-slice-range* interface-type *type* timeslots *time-slot-range*;

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For IQ interfaces and J-series interfaces on the Dual-Port Channelized E1 and T1PIM, configure the channelized interface partition. The partition number is correlated with the channel number. Partition and channel numbering on IQ interfaces begins with :1, not :0.

Default If you omit this statement, the channelized PIC or PIM is not partitioned, and no data channels are configured.

Options *partition-number*—Sublevel interface partition index.

Ranges:

- 1 through 4 for an OC3 interface on a channelized OC12 IQ interface.
- 1 through 12 for a T3 interface on a channelized OC12 IQ interface.
- 1 through 4 for a a T3 interface on a channelized T3 IQ interface.
- 1 through 28 for a T1 IQ interface on a channelized OC12 IQ or channelized T3 IQ interface.
- 1 through 10 for an E1 interface on a channelized E1 IQ interface.
- 1 through 30 on a channelized E1 interface.
- 1 through 23 on a channelized T1 interface.
- 1 through 24 for *N*xDS0 interfaces on either channelized OC12 IQ or channelized DS3 IQ interfaces.
- 0 through 31(with 0 reserved for framing) for *N*xDS0 interfaces on channelized E1 IQ interfaces.

The remaining statements are explained separately.

Usage Guidelines See “Configuring Channelized E1 Interfaces” on page 485, “Configuring Channelized OC12/STM4 Interfaces” on page 411, and “Configuring Channelized T3 Interfaces” on page 463.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics no-partition

passive

See the following sections:

- passive (CHAP) on page 1127
- passive (PAP) on page 1128

passive (CHAP)

Syntax passive;

Hierarchy Level [edit interfaces *interface-name* ppp-options chap],
[edit interfaces *interface-name* unit *logical-unit-number* ppp-options chap],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* ppp-options chap]

Release Information Statement introduced before JUNOS Release 7.4.

Description Do not challenge the peer, but respond if challenged. If you omit this statement from the configuration, the interface always challenges its peer.

For ATM2 IQ interfaces only, you can configure CHAP on the logical interface unit if the logical interface is configured with one of the following PPP over ATM encapsulation types:

- atm-ppp-llc—PPP over AAL5 LLC encapsulation.
- atm-ppp-vc-mux—PPP over AAL5 multiplex encapsulation.

Usage Guidelines See “Configuring Passive Mode” on page 108.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS System Basics Configuration Guide*

passive (PAP)

Syntax passive;

Hierarchy Level [edit interfaces *interface-name* ppp-options pap],
[edit interfaces *interface-name* unit *logical-unit-number* ppp-options pap],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* ppp-options pap]

Release Information Statement introduced in JUNOS Release 8.3.

Description Do not challenge the peer, but respond if challenged. If you omit this statement from the configuration, the interface always challenges its peer.

Usage Guidelines See “Configuring Passive Mode” on page 111.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS System Basics Configuration Guide*

passive-monitor-mode

Syntax passive-monitor-mode;

Hierarchy Level [edit interfaces *interface-name*],
[edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM, Ethernet, and SONET/SDH interfaces only, monitor packet flows from another routing platform. If you include this statement in the configuration, the interface does not send keepalives or alarms, and does not participate actively on the network.

For ATM and Ethernet interfaces, you can include this statement on the physical interface only.

For SONET/SDH interfaces, you can include this statement on the logical interface only.

Usage Guidelines See “Enabling Passive Monitoring on ATM Interfaces” on page 279, “Enabling Passive Monitoring on Ethernet Interfaces” on page 643, and “Enabling Passive Monitoring on SONET/SDH Interfaces” on page 828.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics multiservice-options, *JUNOS Services Interfaces Configuration Guide*

path-database-size

Syntax path-database-size *path-database-size*;

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management linktrace]

Release Information Statement introduced in JUNOS Release 8.5.

Description Number of linktrace reply entries to be stored per linktrace request.

Options path-database-size—Database size.

Range: 1 through 500

Default: 100

Usage Guidelines See “Configuring the Linktrace Database Size” on page 654.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

path-trace

Syntax path-trace *trace-string*;

Hierarchy Level [edit interfaces *interface-name* sonet-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For SONET/SDH interfaces and 10-Gigabit Ethernet interfaces in WAN PHY mode, configure a path trace identifier, which is a text string that identifies the circuit.

On SONET/SDH OC48 interfaces that are configured for channelized (multiplexed) mode (by including the no-concatenate statement at the [edit chassis fpc *slot-number* pic *pic-number*] hierarchy level), the bytes e1-quiet and bytes f1 options have no effect. The bytes f2, bytes z3, bytes z4, and path-trace options work correctly on channel 0 and work in the transmit direction only on channels 1, 2, and 3.

For DS3 channels on a channelized OC12 interface, you can configure a unique path trace for each of the 12 channels. Each path trace can be up to 16 bytes. For channels on a channelized OC12 IQ interface, each path trace can be up to 64 bytes.

Options *trace-string*—Text string that identifies the circuit. If the string contains spaces, enclose it in quotation marks. A common convention is to use the circuit identifier as the path trace identifier. If you do not configure an identifier, the JUNOS software uses the system and interface names to construct the default *trace-string*. For all nonchannelized SONET/SDH interfaces, the default *trace-string* is <*system-name* <*interface-name*>. For channelized SONET/SDH interfaces and 10–Gigabit Ethernet WAN-PHY interfaces, the default *trace-string* is <*interface-name*>.

Usage Guidelines See “Configuring the SONET/SDH Path Trace Identifier” on page 807.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics sonet-options

payload-scrambler

Syntax (payload-scrambler | no-payload-scrambler);

Hierarchy Level [edit interfaces *interface-name* e3-options],
[edit interfaces *interface-name* sonet-options],
[edit interfaces *interface-name* t3-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Enable or disable HDLC scrambling on an E3, a SONET/SDH, or a T3 interface. This type of scrambling provides better link stability. Both sides of a connection must either use or not use scrambling.

If you commit a T3 interface configuration that has HDLC payload scrambling enabled, the interface must also be configured to be compatible with the channel service unit (CSU) at the remote end of the line.

Disable payload scrambling on an E3 interface if Digital Link compatibility mode is used.

On a channelized OC12 interface, the sonet payload-scrambler statement is ignored. To configure scrambling on the DS3 channels on the interface, you can include the t3-options payload-scrambler statement in the configuration for each DS3 channel.

Default Payload scrambling is disabled on all E3 and T3 interfaces; it is enabled by default on E3/T3 over ATM interfaces and on SONET/SDH interfaces.

Usage Guidelines See "Configuring E3 and T3 Parameters on ATM Interfaces" on page 323, "Configuring E3 HDLC Payload Scrambling" on page 527, "Configuring SONET/SDH HDLC Payload Scrambling" on page 808, "Configuring T3 HDLC Payload Scrambling" on page 548, and "Examples: Configuring T3 Interfaces" on page 549.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics compatibility-mode

payload-size

Syntax payload-size *bytes* ;

Hierarchy Level [edit interfaces *interface-name* satop-options],

Release Information Option introduced in JUNOS Release 9.3.

Description Specify the satop-options payload-size in integer number of bytes.

Usage Guidelines See "Circuit Emulation Interfaces Overview" on page 503.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics satop-options

p-bit-timeout

Syntax p-bit–timeout *time*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family llc2],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family llc2]

Release Information Statement introduced in JUNOS Release 7.4.

Description For J-series Services Routers only. On Ethernet interfaces configured for DLSw, configure the length of time the router waits for a response to a poll bit.

Options *time*—Number of milliseconds.
Range: 1 through 60000
Default: 3000 milliseconds

Usage Guidelines See "Configuring LLC2 Options" on page 171.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Advanced WAN Access Configuration Guide*

pdu-interval

Syntax pdu-interval *interval*;

Hierarchy Level [edit protocols oam ethernet link-fault-management interface *interface-name*]

Release Information Statement introduced in JUNOS Release 8.2.

Description For Ethernet interfaces on M320, M120, MX-series, and T-series routing platforms, specify the periodic OAM PDU sending interval for fault detection. Used for IEEE 802.3ah Operation, Administration, and Management (OAM) support.

Options *interval*—Periodic OAM PDU sending interval.
Range: 100 through 1000 milliseconds
Default: 1000 milliseconds

Usage Guidelines See “Configuring the OAM PDU Interval” on page 699.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

pdu-threshold

Syntax pdu-threshold *threshold-value*;

Hierarchy Level [edit protocols oam ethernet link-fault-management interface *interface-name*]

Release Information Statement introduced in JUNOS Release 8.2.

Description For Ethernet interfaces on M320, M120, MX-series, and T-series routing platforms, specify the number of OAM PDUs to miss before an error is logged. Used for IEEE 802.3ah Operation, Administration, and Management (OAM) support.

Options *threshold-value*—The number of PDUs missed before declaring the peer lost.
Range: 3 through 10 PDUs
Default: 3 PDUs

Usage Guidelines See “Configuring the OAM PDU Threshold” on page 699.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

peer

Syntax peer *ip-address* priority-cost *priority*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family llc2 redundancy-group *group-number* track dlsw],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family llc2 redundancy-group *group-number* track dlsw]

Release Information Statement introduced in JUNOS Release 7.5.

Description For J-series Services Routers only, Ethernet interfaces configured for DLSw, enable tracking options for a remote peer.

Options *ip-address*—IP address of the remote peer.

priority-cost *priority*—Cost value that is subtracted from the priority value when remote peer connectivity is lost. Specify a value from 1 through 254.

Usage Guidelines See “Configuring DLSw Ethernet Redundancy Using LLC2 Properties” on page 172.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS Services Interfaces Configuration Guide*

peer-unit

Syntax peer-unit *unit-number*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure a peer relationship between two logical systems.

Options *unit-number*—Peering logical system unit number.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

performance-monitoring

Syntax

```
performance-monitoring {
   hardware-assisted-timestamping;
}
```

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management]

Release Information Statement introduced in JUNOS Release 9.5.

Description For Ethernet interfaces on Dense Port Concentrators (DPCs) in MX-series routers only, specify performance monitoring support for Ethernet frame delay measurement.

Usage Guidelines See “Ethernet Frame Delay Measurements Overview” on page 663, “Guidelines for Configuring Routers to Support an ETH-DM Session” on page 669, and “Enabling the Hardware-Assisted Timestamping Option” on page 678.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

periodic

Syntax periodic *interval*;

Hierarchy Level [edit interfaces aex aggregated-ether-options lacp]

Release Information Statement introduced before JUNOS Release 7.4.

Description For aggregated Ethernet interfaces only, configure the interval for periodic transmission of LACP packets.

Options *interval*—Interval for periodic transmission of LACP packets.

- fast—Transmit packets every second.
- slow—Transmit packets every 30 seconds.

  Default: fast

Usage Guidelines See “Configuring Aggregated Ethernet LACP” on page 597.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

per-unit-scheduler

Syntax per-unit-scheduler;

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For channelized OC3 IQ, channelized OC12 IQ, channelized STM1 IQ, channelized T3 IQ, channelized E1 IQ, E3 IQ, link services IQ interfaces (lsq-), link services (ls-) on J-series platforms, Gigabit Ethernet IQ, Gigabit Ethernet IQ2 and IQ2-E, and 10-Gigabit Ethernet interfaces only, enable association of scheduler map names with logical interfaces.

NOTE: Per-unit scheduling is not supported on T1 interfaces configured on the Channelized OC12 IQ PIC.

NOTE: On Gigabit Ethernet IQ2 and IQ2-E PICs without the per-unit-scheduler statement, the entire PIC supports 4071 VLANs and the user can configure all the VLANs on the same port.

On Gigabit Ethernet IQ2 and IQ2-E PICs with the per-unit-scheduler statement, the entire PIC supports 1024 – 2 * number of ports (1024 minus two times the number of ports), because each port is allocated two default schedulers.

Usage Guidelines When configuring the per-unit-scheduler statement on interfaces on the IQ2 and IQ2-E PIC, you must also include the vlan-tagging statement. See the *JUNOS Class of Service Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

pfc

Syntax pfc;

Hierarchy Level [edit interfaces *interface-name* ppp-options compression],
[edit interfaces *interface-name* unit *logical-unit-number* ppp-options compression],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* ppp-options compression]

Release Information Statement introduced before JUNOS Release 7.4.

Description For interfaces with PPP encapsulation, configure the router to compress the protocol field to one byte.

Usage Guidelines See “Configuring the PPP Protocol Field Compression” on page 115.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

pic-type

Syntax pic-type (atm1 | atm2);

Hierarchy Level [edit interfaces at-*fpc/pic/port* atm-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM interfaces, configure the type of ATM PIC installed in your routing platform.

Options atm1—ATM1 PIC

atm2—ATM2 IQ PIC

Usage Guidelines See “Configuring the ATM PIC Type” on page 281.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

plp1

Syntax plp1 *cells*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit interfaces *interface-name* unit *logical-unit-number* address *address* family *family* multipoint-destination *address*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* address *address* family *family* multipoint-destination *address*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM2 IQ interfaces only, define the EPD threshold on a VC. The EPD threshold is a limit on the number of transmit packets that can be queued. Packets that exceed the limit are discarded. This threshold applies to packets that have a PLP of 1.

Default EPD threshold is unregulated.

Options *cells*—Maximum number of cells.

Range: For 1-port and 2-port OC12 interfaces, 1 through 425,984 cells.

For 1-port OC48 interfaces, 1 through 425,984 cells.

For 2-port OC3, DS3, and E3 interfaces, 1 through 212,992 cells.

For 4-port DS3 and E3 interfaces, 1 through 106,496 cells.

Usage Guidelines See “Configuring Two EPD Thresholds per Queue” on page 314 and “Configuring an ATM Scheduler Map” on page 327.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics epd-threshold, linear-red-profile

plp-to-clp

Syntax plp-to-clp;

Hierarchy Level [edit interfaces at-*fpc/pic/port* atm-options],
[edit interfaces at-*fpc/pic/port* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces at–*fpc/pic/port* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM2 IQ interfaces only, enable the PLP setting to be copied to the cell-loss priority (CLP) bit.

Default If you omit this statement, the JUNOS software does not copy the PLP setting to the CLP bit.

Usage Guidelines See “Enabling the PLP Setting to Be Copied to the CLP Bit” on page 334.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

point-to-point

Syntax point-to-point;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For all interfaces except aggregated Ethernet, Fast Ethernet, and Gigabit Ethernet, configure the interface unit as a point-to-point connection. This is the default connection type.

Default If you omit this statement, the interface unit is configured as a point-to-point connection.

Usage Guidelines See “Configuring a Point-to-Point Connection” on page 148.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics multipoint

policer

See the following sections:

policer (CoS)

Syntax

```
policer cos-policer-name {
  aggregate {
    bandwidth-limit (ethernet) bps;
    burst-size-limit (ethernet) bytes;
  }
  premium {
    bandwidth-limit (ethernet) bps;
    burst-size-limit (ethernet) bytes;
  }
}
```

Hierarchy Level [edit interfaces *interface-name* gigether-options ethernet-switch-profile ethernet-policer-profile]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Gigabit Ethernet IQ and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform), define a CoS policer template to specify the premium bandwidth and burst-size limits, and the aggregate bandwidth and burst-size limits. For Gigabit Ethernet interfaces with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform), the premium policer is not supported.

Options *cos-policer-name*—Name of one policer to specify the premium bandwidth and burst-size limits, and the aggregate bandwidth and burst-size limits.

The remaining statements are explained separately.

Usage Guidelines See "Configuring Gigabit Ethernet Policers" on page 709.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

policer (Interface)

Syntax

```
policer {
    arp policer-template-name;
    input policer-template-name;
    output policer-template-name;
}
```

Hierarchy Level

[edit interfaces *interface-name* unit *logical-unit-number* family *family*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Apply a policer to an interface.

Options

arp *policer-template-name*—For inet family only, name of one policer to evaluate when ARP packets are received on the interface.

input *policer-template-name*—Name of one policer to evaluate when packets are received on the interface.

output *policer-template-name*—Name of one policer to evaluate when packets are transmitted on the interface.

Usage Guidelines See “Applying Policers” on page 185 and the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS Policy Framework Configuration Guide*

policer (MAC)

Syntax

```
policer {
   input cos-policer-name;
   output cos-policer-name;
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* accept-source-mac mac-address *mac-address*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* accept-source-mac mac-address *mac-address*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Gigabit Ethernet IQ and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform), configure MAC policing.

Options input *cos-policer-name*—Name of one policer to specify the premium bandwidth and aggregate bandwidth.

output *cos-policer-name*—Name of one policer to specify the premium bandwidth and aggregate bandwidth.

Usage Guidelines See “Configuring MAC Address Filtering” on page 713.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

pool

Syntax pool *pool-name* <priority *priority*>;

Hierarchy Level [edit interfaces br-*pim*/0/*port* dialer-options],
[edit interfaces umd0 dialer-options],
[edit interfaces dl*n* unit *logical-unit-number* dialer-options],
[edit logical-systems *logical-system-name* interfaces dl*n* unit *logical-unit-number* dialer-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description (J-series Services Routers) for logical and physical ISDN interfaces, specify the dial pool. The dial pool allows logical (dialer) and physical (br-*pim*/0/*port*) interfaces to be bound together dynamically on a per-call basis. On a dialer interface, pool directs the dialer interface which dial pool to use. On br-*pim*/0/*port* interface, pool defines the pool to which the interface belongs.

Options *pool-name*—Pool identifier.

priority *priority*—(Physical br-*pim*/0/*port* interfaces only) Specify a priority value of 0 (lowest) to 255 (highest) for the interface within the pool.

Usage Guidelines See "Configuring ISDN Physical Interface Properties" on page 775 and "Specifying a USB Modem Interface on J-series Routers" on page 87.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

pop

Syntax pop;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit interfaces *interface-name* unit *logical-unit-number* output-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* output-vlan-map]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Gigabit Ethernet IQ and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces and aggregated Ethernet interfaces using Gigabit Ethernet IQ interfaces, specify the VLAN rewrite operation to remove a VLAN tag from the top of the VLAN tag stack. The outer VLAN tag of the frame is removed.

Usage Guidelines See “Removing a VLAN Tag” on page 615.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

pop-all-labels

Syntax

```
pop-all-labels {
    required-depth number;
}
```

Hierarchy Level

[edit interfaces *interface-name* atm-options mpls],
[edit interfaces *interface-name* sonet-options mpls],
[edit interfaces *interface-name* fastether-options mpls],
[edit interfaces *interface-name* gigether-options mpls]

Release Information Statement introduced before JUNOS Release 7.4.

Description For passive monitoring on ATM and SONET/SDH interfaces only, removes up to two MPLS labels from incoming IP packets.

This statement has no effect on IP packets with more than two MPLS labels. Packets with MPLS labels cannot be processed by the Monitoring Services PIC; if packets with MPLS labels are forwarded to the Monitoring Services PIC, they are discarded.

The remaining statement is explained separately.

Default If you omit this statement, the MPLS labels are not removed, and the packet is not processed by the Monitoring Services PIC.

Usage Guidelines See "Removing MPLS Labels from Incoming Packets" on page 280 and "Removing MPLS Labels from Incoming Packets" on page 828.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS Services Interfaces Configuration Guide*

pop-pop

Syntax pop-pop;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit interfaces *interface-name* unit *logical-unit-number* output-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* output-vlan-map]

Release Information Statement introduced in JUNOS Release 8.1.

Description For Gigabit Ethernet IQ, IQ2 and IQ2-E interfaces, and for aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX-series routing platforms, specify the VLAN rewrite operation to remove both the outer and inner VLAN tags of the frame.

Usage Guidelines See “Removing the Outer and Inner VLAN Tags” on page 615.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

pop-swap

Syntax pop-swap;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit interfaces *interface-name* unit *logical-unit-number* output-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* output-vlan-map]

Release Information Statement introduced in JUNOS Release 8.1.

Description For Gigabit Ethernet IQ, IQ2 and IQ2-E interfaces, and for aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX-series routing platforms, specify the VLAN rewrite operation to remove the outer VLAN tag of the frame, and replace the inner VLAN tag of the frame with a user-specified VLAN tag value. The inner tag becomes the outer tag in the final frame.

Usage Guidelines See “Removing the Outer VLAN Tag and Rewriting the Inner VLAN Tag” on page 616.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

port

Syntax

```
port {
    minimum port-number;
    maximum port-number;
}
```

Hierarchy Level [edit interfaces vsp-*fpc/pic/port* unit *logical-unit-number* compression rtp]

Release Information Statement introduced before JUNOS Release 7.4.

Description For voice services interfaces only, assign User Datagram Protocol (UDP) destination port numbers reserved for Real-Time Transport Protocol (RTP) traffic.

Options minimum *port-number*—Specify minimum port number.

Range: 0 through 65,535

maximum *port-number*—Specify maximum port number.

Range: 0 through 65,535

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

port-priority

Syntax port-priority *priority*;

Hierarchy Level [edit interfaces *interface-name* gigether-options 802.3ad lacp]

Release Information Statement introduced in JUNOS Release 9.3.

Description Define LACP port priority at the interface level.

Options *priority*—Priority for being elected to be the active port and both collect and distribute traffic. A smaller value indicates a higher priority for being elected.

Range: 1 through 255

Default: 127

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

post-service-filter

Syntax post-service-filter *filter-name*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet service input],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*
family inet service input]

Release Information Statement introduced before JUNOS Release 7.4.

Description Define the filter to be applied to traffic after service processing. The filter is applied only if a service set is configured and selected.

Options *filter-name*—Identifier for postservice filter.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

pppoe-options

Syntax

```
pppoe-options {
    access-concentrator name;
    auto-reconnect seconds;
    (client | server);
    service-name name;
    underlying-interface interface-name;
}
```

Hierarchy Level [edit interfaces pp0 unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces pp0 unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.
client Statement introduced in JUNOS Release 8.5.
server Statement introduced in JUNOS Release 8.5.

Description For J-series Services Routers and M120 Multiservice Edge Routers with PPP over Ethernet interfaces, configure PPP over Ethernet-specific interface properties.

The remaining statements are explained separately.

Usage Guidelines See "Configuring a PPPoE Interface" on page 745.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

ppp-options

Syntax

```
ppp-options {
  chap {
    access-profile name;
    default-chap-secret name;
    local-name name;
    passive;
  }
  compression {
    acfc;
    pfc;
  }
  dynamic-profile profile-name;
  lcp-restart-timer milliseconds;
  loopback-clear-timer seconds;
  ncp-restart-timer milliseconds;
  pap {
    access-profile name;
    default-pap-password password;
    local-name name;
    local-password password;
    passive;
  }
}
```

Hierarchy Level

[edit interfaces *interface-name*],
[edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information

Statement introduced before JUNOS Release 7.4.
lcp-restart-timer Statement introduced in JUNOS Release 8.1.
ncp-restart-timer Statement introduced in JUNOS Release 8.1.
loopback-clear-timer Statement introduced in JUNOS Release 8.5.
dynamic-profile Statement introduced in JUNOS Release 9.5.

Description

On interfaces with PPP encapsulation, configure PPP-specific interface properties.

For ATM2 IQ interfaces only, you can configure CHAP on the logical interface unit if the logical interface is configured with one of the following PPP over ATM encapsulation types:

- atm-ppp-llc—PPP over AAL5 LLC encapsulation.
- atm-ppp-vc-mux—PPP over AAL5 multiplex encapsulation.

The remaining statements are explained separately.

Usage Guidelines

See “Configuring the PPP Challenge Handshake Authentication Protocol” on page 106.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

preempt

Syntax

```
(preempt | no-preempt) {
   hold-time seconds;
}
```

Hierarchy Level

[edit interfaces *interface-name* unit *logical-unit-number* family llc2 redundancy-group *group-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family llc2 redundancy-group *group-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure whether a DLSw backup router can preempt a master router:

- preempt—Allow the master router to be preempted.
- no-preempt—Prohibit the preemption of the master router.

The remaining statement is explained separately.

Default If you omit this statement, the backup router cannot preempt a master router.

Usage Guidelines See “Configuring DLSw Ethernet Redundancy Using LLC2 Properties” on page 172.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics For information about the preempt statement at the [edit interfaces *interface-name* unit *unit-number* family inet address *address* (vrrp-group | vrrp-inet6-group) *group-number*] or [edit logical-systems *logical-system-name* interfaces *interface-name* unit *unit-number* family (inet | inet6) address *address* (vrrp-group | vrrp-inet6-group) *group-number*] hierarchy level, see the *JUNOS High Availability Configuration Guide*.

preferred

Syntax preferred;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family *family* address *address*],
[edit logical-systems *logical-system-name* interfaces *interface-name*unit *logical-unit-number* family *family* address *address*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure this address to be the preferred address on the interface. If you configure more than one address on the same subnet, the preferred source address is chosen by default as the source address when you originate packets to destinations on the subnet.

Default The lowest numbered address on the subnet is the preferred address.

Usage Guidelines See "Configuring the Interface Address" on page 166.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

preferred-source-address

Syntax preferred-source-address *address*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet unnumbered-address *interface-name*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet unnumbered-address *interface-name*]

Release Information Statement introduced in JUNOS Release 9.0.

Description For unnumbered Ethernet interfaces configured with a loopback interface as the donor interface, specify one of the loopback interface's secondary addresses as the preferred source address for the unnumbered Ethernet interface. Configuring the preferred source address enables you to use an IP address other than the primary IP address on some of the unnumbered Ethernet interfaces in your network.

Currently, configuration of a preferred source address for unnumbered Ethernet interfaces is supported only for the IPv4 address family.

Options *address*—Secondary IP address of the donor loopback interface.

Usage Guidelines See "Configuring a Preferred Source Address for Unnumbered Ethernet or Demux Interfaces" on page 178.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics address, *JUNOS System Basics Configuration Guide*

premium

See the following sections:

- premium (firewall) on page 1153
- premium (Output Priority Map) on page 1154
- premium (Policer) on page 1154

premium (firewall)

Syntax

```
premium {
  if-exceeding {
    bandwidth-limit bandwidth;
    burst-size-limit burst;
  }
  then {
    discard;
  }
}
```

Hierarchy Level [edit firewall hierarchical-policer]

Release Information Statement introduced in JUNOS Release 9.5.

Description On M40e, M120, and M320 (with FFPC and SFPC) edge routers and T320, T640, and T1600 core routers with Enhanced Intelligent Queuing (IQE) PICs, to specify a premium level for a hierarchical policer, use the premium statement at the [edit firewall hierarchical-policer] hierarchy level.

Options Options are described separately.

Usage Guidelines See "Applying Policers" on page 185 and *Class of Service*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

premium (Output Priority Map)

Syntax

```
premium {
   forwarding-class class-name {
      loss-priority (high | low);
   }
}
```

Hierarchy Level [edit interfaces *interface-name* gigether-options ethernet-switch-profile ethernet-policer-profile output-priority-map classifier]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Gigabit Ethernet IQ interfaces only, define the classifier for egress premium traffic.

The statements are explained separately.

Usage Guidelines See “Specifying an Output Priority Map” on page 710.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics input-priority-map

premium (Policer)

Syntax

```
premium {
   bandwidth-limit (ethernet) bps;
   burst-size-limit (ethernet) bytes;
}
```

Hierarchy Level [edit interfaces *interface-name* gigether-options ethernet-switch-profile ethernet-policer-profile policer *cos-policer-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Define a policer to apply to nonpremium traffic.

The statements are explained separately.

Usage Guidelines See “Configuring Gigabit Ethernet Policers” on page 709.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics aggregate, ieee802.1p

preserve-interface

Syntax preserve-interface;

Hierarchy Level [edit interfaces *interface-name* sonet-options aps]

Release Information Statement introduced in JUNOS Release 7.6.

Description Provide link PIC replication, providing MLPPP link redundancy at the port level. This feature is supported with SONET APS and the following link PICs:

- Channelized OC3 IQ PIC
- Channelized OC12 IQ PIC
- Channelized STM1 IQ PIC

Link PIC replication provides the ability to add two sets of links, one from the active SONET PIC and the other from the standby SONET PIC, to the same bundle. If the active SONET PIC fails, links from the standby PIC are used without triggering link renegotiation. All the negotiated state is replicated from the active links to the standby links to prevent link renegotiation.

Usage Guidelines See "Configuring Link PIC Redundancy" on page 823.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS Services Interfaces Configuration Guide*

primary

See the following sections:

primary (Address on Interface)

Syntax primary;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family *family* address *address*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family* address *address*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure this address to be the primary address of the protocol on the interface. If the logical unit has more than one address, the primary address is used by default as the source address when packets originate from the interface and the destination does not indicate the subnet.

Default For unicast traffic, the primary address is the lowest non-127 preferred address on the unit.

Usage Guidelines See "Configuring the Interface Address" on page 166.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

primary (AS PIC or MultiServices PIC Interfaces)

Syntax primary *interface-name*;

Hierarchy Level [edit interfaces (rsp0 | rsp1) redundancy-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Specify the primary AS PIC or MultiServices PIC interface.

Options *interface-name*—The identifier for the AS PIC interface or MultiServices PIC interface, which must be of the form sp-*fpc*/*pic*/*port*.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

priority

See the following sections:

- priority (DLSw) on page 1157
- priority (OAM Connectivity-Fault Management) on page 1158
- priority (Schedulers) on page 1158

NOTE: For information about the priority statement at the [edit interfaces *interface-name* unit *unit-number* family inet address *address* (vrrp-group | vrrp-inet6-group) *group-number*] or [edit logical-systems *logical-system-name* interfaces *interface-name* unit *unit-number* family (inet | inet6) address *address* (vrrp-group | vrrp-inet6-group) *group-number*] hierarchy level, see the *JUNOS High Availability Configuration Guide*.

priority (DLSw)

Syntax priority *priority*;

Hierarchy Level [edit interfaces *interface-name*unit *logical-unit-number* family inet address *address* redundancy-group *group-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name*unit *logical-unit-number* family inet address *address* redundancy-group *group-number*]

Release Information Statement introduced in JUNOS Release 7.5.

Description When configuring DLSw Ethernet redundancy on Fast Ethernet and Gigabit Ethernet interfaces, configure a DLSw router's priority for becoming the master default router. The router with the highest priority within the group becomes the master.

Options *priority*—Router's priority for being elected to be the master router in the VRRP group. A larger value indicates a higher priority for being elected.
Range: 1 through 255
Default: 100 (for backup routers)

Usage Guidelines See "Configuring DLSw Ethernet Redundancy Using LLC2 Properties" on page 172.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

priority (OAM Connectivity-Fault Management)

Syntax priority *number*;

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name* mep *mep-id*]

Release Information Statement introduced in JUNOS Release 8.4.

Description IEEE 802.1p priority bits used by the continuity check messages.

Options *number*—Configure the IEEE 802.1p priority bits to be used in the VLAN header of the CFM packets.

Range: 0 through 7

Usage Guidelines See "Configuring the Maintenance End Point Priority" on page 652

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

priority (Schedulers)

Syntax priority (high | low);

Hierarchy Level [edit interfaces at-*fpc/pic/port* atm-options scheduler-maps *map-name* forwarding-class *class-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM2 IQ interfaces only, assign queuing priority to a forwarding class.

Options low—Forwarding class has low priority.

high—Forwarding class has high priority.

Usage Guidelines See "Configuring ATM2 IQ VC Tunnel CoS Components" on page 325.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

priority-cost

Syntax priority-cost *priority*;

Hierarchy Level [edit interfaces *interface-name* unit *unit-number* family llc2 redundancy-group *group-number* priority *priority* track interface *interface-name*]

Release Information Statement introduced in JUNOS Release 8.1.

Description When configuring DLSw Ethernet redundancy, configure a DLSw router's priority cost for becoming the master default router. The router with the highest priority within the group becomes the master.

Options priority-cost *priority*—The value subtracted from the configured DLSw priority when the tracked interface is down, forcing a new master router election. The sum of all the costs for all interfaces or routes that are tracked must be less than or equal to the configured priority of the DLSw group.

Range: 1 through 254

Usage Guidelines See "Configuring DLSw Ethernet Redundancy Using LLC2 Properties" on page 172.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

promiscuous-mode

Syntax

```
promiscuous-mode {
    vpi vpi-identifier;
}
```

Hierarchy Level [edit interfaces *interface-name* atm-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM interfaces with atm-ccc-cell-relay encapsulation, map all incoming cells from either an interface port or a VP to a single label-switched path (LSP) without restricting the VCI number. Promiscuous mode allows you to map traffic from all 65,535 VCIs to a single LSP, or from all 256 VPIs to a single LSP.

Options *vpi-identifier*—Open this VPI in promiscuous mode.

Range: 0 through 255

Usage Guidelines See "Configuring ATM Cell-Relay Promiscuous Mode" on page 282.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics vpi

protect-circuit

Syntax protect-circuit *group-name*;

Hierarchy Level [edit interfaces *interface-name* sonet-options aps]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure the protect router in an APS circuit pair. When the working interface fails, APS brings up the protection circuit and the traffic is moved to the protection circuit.

Options *group-name*—Circuit's group name.

Usage Guidelines See "Configuring Basic APS Support" on page 815.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics working-circuit

protection-group

Syntax

```
protection-group {
    ethernet-ring ring-name (
        east-interface {
            control-channel channel-name {
                vlan number;
            }
        }
        guard-interval number;
        node-id mac-address;
        restore-interval number;
        ring-protection-link-owner;
        west-interface {
            control-channel channel-name {
                vlan number;
            }
        }
    }
}
```

Hierarchy Level [edit protocols]

Release Information Statement introduced in JUNOS Release 9.4.

Description Use this statement and its options to configure Ethernet ring protection switching.

Options The statement options are described separately.

Usage Guidelines See “Configuring Ethernet Ring Protection Switching” on page 753.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

protocol-down

Syntax protocol-down;

Hierarchy Level [edit protocols oam ethernet link-fault-management action-profile event]

Release Information Statement introduced in JUNOS Release 8.5.

Description Upper layer indication of protocol down event. When the protocol-down statement is included, the protocol down event triggers the action specified under the action statement.

Usage Guidelines See “Configuring an OAM Action Profile” on page 700.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

protocols

Syntax protocols [inet iso mpls];

Hierarchy Level [edit interfaces *interface-name* unit logical-unit-number family tcc]

Release Information Statement introduced in JUNOS Release 8.3.

Description For Layer 2.5 VPNs on T-series, M120, and M320 routers support, configure IS-IS (ISO traffic) or MPLS traffic to traverse a TCC interface. By default, IPv4 (inet) traffic runs on T-series, M120, and M320 routers and over TCC interfaces. You must configure the same traffic type on both ends of the Layer 2.5 VPN.

Usage Guidelines See "Configuring IS-IS or MPLS Traffic for TCC Interfaces" on page 219.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

proxy

Syntax proxy inet-address *address*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family tcc],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family tcc]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Layer 2.5 VPNs using an Ethernet interface as the TCC routing platform, configure the IP address for which the TCC routing platform is proxying. Ethernet TCC is supported on interfaces that carry IPv4 traffic only. Ethernet TCC encapsulation is supported on 1-port Gigabit Ethernet, 2-port Gigabit Ethernet, 4-port Gigabit Ethernet, and 4-port Fast Ethernet PICs only. Ethernet TCC is not supported on the T640 routing node.

Options inet-address—Configure the IP address of the neighbor to the TCC routing platform.

Usage Guidelines See "Configuring Ethernet TCC" on page 632 and "Example: Configuring an Ethernet TCC or Extended VLAN TCC" on page 633.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics remote, *JUNOS VPNs Configuration Guide*

proxy-arp

Syntax proxy-arp;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Ethernet interfaces only, configure the router to respond to any ARP request, as long as the router has an active route to the ARP request's target address.

Usage Guidelines See "Configuring Unrestricted Proxy ARP" on page 637.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

push

Syntax push;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit interfaces *interface-name* unit *logical-unit-number* output-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* output-vlan-map]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Gigabit Ethernet IQ and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces and aggregated Ethernet interfaces using Gigabit Ethernet IQ interfaces, specify the VLAN rewrite operation to add a new VLAN tag to the top of the VLAN stack. An outer VLAN tag is pushed in front of the existing VLAN tag. If you include the push statement in the configuration, you must also include the pop statement at the [edit interfaces *interface-name* unit *logical-unit-number* output-vlan-map] hierarchy level.

Usage Guidelines See "Stacking a VLAN Tag" on page 614.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

push-push

Syntax push-push;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit interfaces *interface-name* unit *logical-unit-number* output-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* output-vlan-map]

Release Information Statement introduced in JUNOS Release 8.1.

Description For Gigabit Ethernet IQ, IQ2 and IQ2-E interfaces, and for aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX-series routing platforms, specifies the VLAN rewrite operation to push two VLAN tags in front of the frame.

Usage Guidelines See “Stacking Two VLAN Tags” on page 617.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

queue-depth

Syntax queue-depth *cells*;

Hierarchy Level [edit interfaces *interface-name* atm-options linear-red-profiles *profile-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM2 IQ interfaces only, define maximum queue depth in the CoS VC drop profile. Packets are always dropped beyond the defined maximum. This statement is mandatory; there is no default configuration.

Default Buffer usage is unregulated.

Options *cells*—Maximum number of cells the queue can contain.
Range: 1 through 64,000 cells

Usage Guidelines See “Configuring ATM2 IQ VC Tunnel CoS Components” on page 325.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics high-plp-threshold, low-plp-threshold

queue-length

Syntax queue-length *number*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* address *address* family *family* multipoint-destination *address* shaping],
[edit interfaces *interface-name* unit *logical-unit-number* shaping],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* address *address* family *family* multipoint-destination *address* shaping],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* shaping]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM1 interfaces only, define the maximum queue length in the traffic-shaping profile. For ATM1 PICs, each VC has its own independent shaping parameters.

Default Buffer usage is unregulated.

Options *number*—Maximum number of packets the queue can contain.
Range: 1 through 16383 packets
Default: 16383 packets

Usage Guidelines See "Configuring the ATM1 Queue Length" on page 311.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

queues

Syntax queues [*queue-numbers*];

Hierarchy Level [edit interfaces vsp-*fpc/pic/port* unit *logical-unit-number* compression rtp]

Release Information Statement introduced before JUNOS Release 7.4.

Description For voice services interfaces only, assign queue numbers for RTP traffic.

Options queues *queue-numbers*—Assign one or more of the following queues: q0, q1, q2, q3.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*. For VRRP services, specify the q3 option instead of q0.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

quiet-period

Syntax quiet-period *seconds*;

Hierarchy Level [edit protocols dot1x authenticator interface *interface-id*]

Release Information Statement introduced in JUNOS Release 9.3.

Description Specify the number of seconds the port remains in the wait state following a failed authentication exchange with the client, before reattempting authentication.

Options *seconds*—Specify the number of seconds the port remains in the wait state following a failed authentication exchange with the client, before reattempting authentication.
Range: 0 through 65,535 seconds
Default: 60 seconds

Usage Guidelines See "Configuring IEEE 802.1x Port-Based Network Access Control" on page 693.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics dot1x, authenticator, interface (IEEE 802.1x)

ranges

See the following sections:

- ranges on page 1168
- ranges on page 1168

ranges

Syntax ranges (any | *low-tag*) - (any | *high-tag*);

Hierarchy Level [edit interfaces *interface-name* auto-configure vlan-ranges dynamic-profile *profile-name*]

Release Information Statement introduced in JUNOS Release 9.5.

Description Configure VLAN ranges for dynamic, auto-sensed VLANs.

Options any—The entire VLAN range.

low-tag—The lower limit of the VLAN range.

high-tag—The upper limit of the VLAN range.
Range: 1 through 4094

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics
- Configuring Single-Level VLAN Ranges for Use with VLAN Dynamic Profiles

ranges

Syntax ranges (any | *low-tag* - *high-tag*) , (any | *low-tag* - *high-tag*);

Hierarchy Level [edit interfaces *interface-name* auto-configure stacked-vlan-ranges dynamic-profile *profile-name*]

Release Information Statement introduced in JUNOS Release 9.5.

Description Configure VLAN ranges for dynamic, auto-sensed stacked VLANs.

Options any—The entire VLAN range.

low-tag—The lower limit of the VLAN range.

high-tag—The upper limit of the VLAN range.
Range: 1 through 4094

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics
- Configuring Stacked VLAN Ranges for Use with Stacked VLAN Dynamic Profiles

rate

Syntax rate *percentage*;

Hierarchy Level [edit interfaces *interface-name* receive-bucket],
[edit interfaces *interface-name* transmit-bucket]

Release Information Statement introduced before JUNOS Release 7.4.

Description Specify percentage of the interface line rate that is available to receive or transmit packets.

Options *percentage*—Percentage of the interface line rate that is available to receive or transmit packets.

Range: 0 through 100

Usage Guidelines See "Configuring Receive and Transmit Leaky Bucket Properties" on page 122 and "Configuring Receive and Transmit Leaky Bucket Properties on SONET/SDH Interfaces" on page 830.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

reassemble-packets

Syntax reassemble-packets;

Hierarchy Level [edit interfaces gr-*fpc/pic/port* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces gr-*fpc/pic/port* unit *logical-unit-number*]

Release Information Statement introduced in JUNOS Release 9.2.

Description Enable reassembly of fragmented tunnel packets on generic routing encapsulation (GRE) tunnel interfaces.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

reauthentication

Syntax reauthentication (disable | interval *seconds*);

Hierarchy Level [edit protocols dot1x authenticator interface *interface-id*]

Release Information Statement introduced in JUNOS Release 9.3.

Description Set or disable the periodic reauthentication of the client.

Options

- disable—Disable the periodic reauthentication of the client.
- interval *seconds*—Specify the periodic reauthentication time interval.

  Range: 1 through 65,535 seconds
  Default: 3600 seconds

Usage Guidelines See "Configuring IEEE 802.1x Port-Based Network Access Control" on page 693

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics dot1x, interface (IEEE 802.1x), quiet-period

receive-bucket

Syntax

```
receive-bucket {
    overflow (discard | tag);
    rate percentage;
    threshold bytes;
}
```

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Set parameters for the receive leaky bucket, which specifies what percentage of the interface's total capacity can be used to receive packets.

For each DS3 channel on a channelized OC12 interface, you can configure a unique receive bucket.

The statements are explained separately.

Usage Guidelines See "Configuring Receive and Transmit Leaky Bucket Properties on SONET/SDH Interfaces" on page 830.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics transmit-bucket

receive-options-packets

Syntax receive-options-packets;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet]

Release Information Statement introduced before JUNOS Release 7.4.

Description For a Monitoring Services PIC and an ATM or SONET/SDH PIC installed in an M160, M40e, or T-series routing platform, guarantee conformity with cflowd records structure. This statement is required when you enable passive monitoring.

Usage Guidelines See "Enabling Passive Monitoring on ATM Interfaces" on page 279 and "Enabling Passive Monitoring on SONET/SDH Interfaces" on page 828.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

receive-ttl-exceeded

Syntax receive-ttl-exceeded;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Monitoring Services PIC and an ATM or SONET/SDH PIC installed in an M160, M40e, or T-series routing platform, guarantee conformity with cflowd records structure. This statement is required when you enable passive monitoring.

Usage Guidelines See "Enabling Passive Monitoring on ATM Interfaces" on page 279 and "Enabling Passive Monitoring on SONET/SDH Interfaces" on page 828.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

red-differential-delay

Syntax red-differential-delay *milliseconds*;

Hierarchy Level [edit interfaces *interface-name* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For link services and voice services interfaces only, configure the red differential delay among bundle links to give warning when a link has a differential delay that exceeds the configured threshold.

Options *milliseconds*—Red differential delay threshold.

Range: 1 through 2000 milliseconds
Default: 10 milliseconds

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics action-red-differential-delay, yellow-differential-delay

redial-delay

Syntax redial-delay *time*;

Hierarchy Level [edit interfaces dl*n* unit *logical-unit-number* dialer-options],
[edit logical-systems *logical-system-name* interfaces dl*n* unit *logical-unit-number* dialer-options]

Release Information Statement introduced in JUNOS Release 7.5.

Description (J-series Services Routers) For interfaces configured for ISDN with dialout, specify the delay (in seconds) between two successive calls made by the dialer. To configure callback mode, include the callback statement at the [edit interfaces dl*n* unit *logical-unit-number* dialer-options] hierarchy level.

If the callback statement is configured, you cannot use the caller *caller-id* statement at the [edit interfaces dl*n* unit *logical-unit-number* dialer-options] hierarchy level.

Options *time*—Delay (in seconds) between two successive calls.

Range: 2 through 255 seconds
Default: 3 seconds

Usage Guidelines See "Configuring ISDN Interfaces" on page 773.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

redundancy-group

Syntax

```
redundancy-group group-number {
    advertise-interval seconds;
    map {
        local-mac mac-address request mac-address;
    }
    preempt hold-time seconds;
    no-preempt;
    priority priority;
    track {
        dlsw {
            peer ip-address priority-cost priority;
            destination mac-address priority-cost priority;
        }
        interface interface-name priority-cost priority;
    }
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family llc2],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family llc2]

Release Information Statement introduced in JUNOS Release 7.5.

Description For J-series Services Routers only. On Ethernet interfaces configured for DLSw, configure the router for DLSw redundancy.

The statements are explained separately.

Usage Guidelines See "Configuring DLSw Ethernet Redundancy Using LLC2 Properties" on page 172.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Advanced WAN Access Configuration Guide*

redundancy-options

Syntax

```
redundancy-options {
    primary interface-name;
    secondary interface-name;
    hot-standby;
}
```

Hierarchy Level

[edit interfaces (rsp0 | rsp1)],
[edit interfaces rlsq*number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Specify the primary and secondary (backup) AS PIC interfaces or MultiServices PIC interfaces.

Options The remaining statements are explained separately.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

remote

Syntax

```
remote {
    (inet-address address | mac-address address);
}
```

Hierarchy Level

[edit interfaces *interface-name* unit *logical-unit-number* family tcc],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family tcc]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Layer 2.5 VPNs using an Ethernet interface as the TCC routing platform, configure the location of the remote routing platform. Ethernet TCC is supported on interfaces that carry IPv4 traffic only. Ethernet TCC encapsulation is supported on 1-port Gigabit Ethernet, 2-port Gigabit Ethernet, 4-port Gigabit Ethernet, and 4-port Fast Ethernet PICs only.

Options mac-address—Configure the MAC address of the remote site.

inet-address—Configure the IP address of the remote site.

Usage Guidelines See “Configuring Ethernet TCC” on page 632 and “Example: Configuring an Ethernet TCC or Extended VLAN TCC” on page 633.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics proxy, *JUNOS VPNs Configuration Guide*

remote-loopback

Syntax remote-loopback;

Hierarchy Level [edit protocols oam link-fault-management interface *interface-name*]

Release Information Statement introduced in JUNOS Release 8.2.

Description For Ethernet interfaces on M320, M120, MX-series, and T-series routing platforms, set the remote DTE into loopback mode. Remove the statement from the configuration to take the remote DTE out of loopback mode. Used for IEEE 802.3ah Operation, Administration, and Management (OAM) support.

Usage Guidelines See “Setting a Remote Interface into Loopback Mode” on page 703.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

remote-loopback-respond

Syntax remote-loopback-respond;

Hierarchy Level [edit interface ct1-*fpc/pic/port*],
[edit interfaces *interface-name* t1-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For T1 interfaces only, configure the routing platform to respond to remote loopback requests. Remote loopback requests can be from the facilities data link or inband.

NOTE: When configuring CT1 interfaces on the 10-port Channelized E1/T1 IQE PIC, remote-loopback-respond must be set at the [edit interface ct1-fpc/pic/port] hierarchy level.

Default The routing platform does not respond to remote loop requests.

Usage Guidelines See "Configuring the T1 Remote Loopback Response" on page 533.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics feac-loop-respond, loopback

remote-mep

Syntax

```
remote-mep mep-id {
  action-profile profile-name;
}
```

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name* mep *mep-id*]

Release Information Statement introduced in JUNOS Release 8.4.

Description The numeric identifier of the remote maintenance association end point (MEP) within the maintenance association.

Options mep-id—Specify the numeric identifier of the MEP.

Range: 1 through 8191

The remaining statements are explained separately.

Usage Guidelines See "Creating a Remote Maintenance End Point" on page 652.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

request

Syntax request (protect | working);

Hierarchy Level [edit interfaces *interface-name* sonet-options aps]

Release Information Statement introduced before JUNOS Release 7.4.

Description Perform a manual switch between the protect and working circuits. This statement is honored only if there are no higher-priority reasons to switch.

Options protect—Request that the circuit become the protect circuit.

working—Request that the circuit become the working circuit.

Usage Guidelines See "Configuring Switching Between the Working and Protect Circuits" on page 820.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics force

required-depth

Syntax required-depth *number*;

Hierarchy Level [edit interfaces *interface-name* atm-options mpls pop-all-labels],
[edit interfaces *interface-name* sonet-options mpls pop-all-labels],
[edit interfaces *interface-name* fastether-options mpls pop-all-labels],
[edit interfaces *interface-name* gigether-options mpls pop-all-labels]

Release Information Statement introduced before JUNOS Release 7.4.

Description For passive monitoring on ATM and SONET/SDH interfaces only, specify the number of MPLS labels an incoming packet must have for the pop-all-labels statement to take effect.

If you include the required-depth 1 statement, the pop-all-labels statement takes effect for incoming packets with one label only. If you include the required-depth 2 statement, the pop-all-labels statement takes effect for incoming packets with two labels only.

Options *number*—Number of MPLS labels on incoming IP packets.

Range: 1 through 2 labels.

Default: If you omit this statement, the pop-all-labels statement takes effect for incoming packets with one or two labels. The default is equivalent to including the required-depth [1 2] statement.

Usage Guidelines See “Removing MPLS Labels from Incoming Packets” on page 280 and “Removing MPLS Labels from Incoming Packets” on page 828.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS Services Interfaces Configuration Guide*

restore-interval

Syntax restore-interval *number*;

Hierarchy Level [edit protocols protection-group ethernet-ring *ring-name*]

Description Specify the wait time to restore the interval, in minutes.

Options **Range:** from 5 through 12 minutes

Usage Guidelines See “Configuring Ethernet Ring Protection Switching” on page 753.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

retries

Syntax retries *integer*;

Hierarchy Level [edit protocols dot1x authenticator interface *interface-id*]

Release Information Statement introduced in JUNOS Release 9.3.

Description Set the number of tries after which the port remains in the wait state for quiet-period seconds before reattempting authentication.

Options *integer*—Specify the number of retries.

Range: 1 through 10

Default: 3 retries

Usage Guidelines See "Configuring IEEE 802.1x Port-Based Network Access Control" on page 693

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics dot1x, interface (IEEE 802.1x), quiet-period

revertive

Syntax revertive;

Hierarchy Level [edit interfaces ae*X* aggregated-ether-options lacp link-protection]

Release Information Statement introduced in JUNOS Release 9.3.

Description Enable the ability to switch to a better priority link (if one is available).

NOTE: By default, LACP link protection is revertive. However, you can use this statement to define a specific aggregated Ethernet interface as revertive to override a global non-revertive statement specified at the [edit chassis] hierarchy.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

revert-time

Syntax revert-time *seconds*;

Hierarchy Level [edit interfaces *interface-name* sonet-options aps]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure APS revertive mode.

Default APS operates in nonrevertive mode.

Options *seconds*—Amount of time to wait after the working circuit has again become functional before making the working circuit active again.

Range: 1 through 65,535 seconds

Default: none (APS operates in nonrevertive mode)

Usage Guidelines See “Configuring Revertive Mode” on page 821.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

rfc-2615

Syntax rfc-2615;

Hierarchy Level [edit interfaces *interface-name* sonet-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Include this statement to enable features described in RFC 2615, *PPP over SONET/SDH*.

Default Settings required by RFC 1619, *PPP over SONET/SDH*.

Usage Guidelines See “Configuring SONET/SDH RFC 2615 Support” on page 809.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

ring-protection-link-end

Syntax ring-protection-link-end;

Hierarchy Level [edit protocols protection-group ethernet-ring *ring-name* (east-interface | west-interface)]

Description If this port is one side of RPL, the ring protection link end flag should be set.

To set the ring protection link end, use the set ring-protection-link-end statement at the [edit protocols protection-group ethernet-ring *ring-name* (east-interface | west-interface)] hierarchy level.

To delete the ring protection link end, use the delete ring-protection-link-end statement at the [edit protocols protection-group ethernet-ring *ring-name* (east-interface | west-interface)] hierarchy level.

Usage Guidelines See "Configuring Ethernet Ring Protection Switching" on page 753.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

ring-protection-link-owner

Syntax ring-protection-link-owner;

Hierarchy Level [edit protocols protection-group ethernet-ring *ring-name*]

Description Use this statement to set the ring protection link owner flag in the Ethernet protection ring. For each ring, only one node should be configured as a ring-protection-link-owner; so only one node in each ring should have the flag set.

To set the ring protection link owner, use the set ring-protection-link-owner statement at the [edit protocols protection-group ethernet-ring *ring-name*] hierarchy level.

To delete the ring protection link owner, use the delete ring-protection-link-owner statement at the [edit protocols protection-group ethernet-ring *ring-name*] hierarchy level.

Usage Guidelines See "Configuring Ethernet Ring Protection Switching" on page 753.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

routing-instance

Syntax

routing-instance {
  destination *routing-instance-name*;
  bridge-domain *name*;
}

Hierarchy Level

[edit interfaces *interface-name* unit *logical-unit-number* tunnel],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* tunnel],
[edit protocols oam ethernet connectivity-fault-management maintenance-domain *name*]

Release Information

Statement introduced before JUNOS Release 7.4.

Description

To configure interfaces and logical-systems, specify the destination routing instance that points to the routing table containing the tunnel destination address.

To configure protocols for the oam ethernet connectivity-fault-management maintenance-domain, specify the routing-instance *name*.

Default

The default Internet routing table is inet.0.

Usage Guidelines

See *JUNOS Services Interfaces Configuration Guide*.

See “Configuring Maintenance Intermediate Points” on page 648.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

rpf-check

Syntax

```
rpf-check {
    fail-filter filter-name;
    mode loose;
}
```

Hierarchy Level

[edit interfaces *interface-name* unit *logical-unit-number* family *family*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family*]

Release Information

Statement introduced before JUNOS Release 7.4.

Description

Check whether traffic is arriving on an expected path. You can include this statement with the inet or inet6 protocol family only.

The mode statement is explained separately.

Options

fail-filter—A filter to evaluate when packets are received on the interface. If the RPF check fails, this optional filter is evaluated. If the fail filter is not configured, the default action is to silently discard the packet.

Usage Guidelines

See “Configuring Unicast RPF Strict Mode” on page 199 and “Configuring Unicast RPF Loose Mode” on page 200.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

rtp

Syntax

```
rtp {
    f-max-period number;
    queues [ queue-numbers ];
    port {
        minimum port-number;
        maximum port-number;
    }
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* compression]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure the real-time transport protocol (RTP) properties for voice services traffic.

The remaining statements are described separately.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

rts

Syntax rts (assert | de-assert | normal);

Hierarchy Level [edit interfaces *interface-name* serial-options dce-options],
[edit interfaces *interface-name* serial-options dte-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For EIA-530 and V.35 interfaces only, configure the to-DCE signal, request to send (RTS).

Options assert—The to-DCE signal must be asserted.

de-assert—The to-DCE signal must be deasserted.

normal—Normal RTS signal handling, as defined by the TIA/EIA Standard 530.
Default: normal

Usage Guidelines See "Configuring the Serial Signal Handling" on page 257.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

rts-polarity

Syntax rts-polarity (negative | positive);

Hierarchy Level [edit interfaces *interface-name* serial-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure RTS signal polarity.

Options negative—Negative signal polarity.

positive—Positive signal polarity.

Default: positive

Usage Guidelines See "Configuring Serial Signal Polarities" on page 260.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

rtvbr

Syntax rtvbr peak *rate* sustained *rate* burst *length*;

Hierarchy Level [edit interfaces *interface-name* atm-options vpi *vpi-identifier* shaping],
[edit interfaces *interface-name* unit *logical-unit-number* address *address* family *family* multipoint-destination *address* shaping],
[edit interfaces *interface-name* unit *logical-unit-number* shaping],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* shaping],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* address *address* family *family* multipoint-destination *address* shaping]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM2 IQ PICs only, define the real-time variable bandwidth utilization in the traffic-shaping profile.

When you configure the real-time bandwidth utilization, you must specify all three options (burst, peak, and sustained). You can specify *rate* in bits per second either as a complete decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000). You can also specify *rate* in cells per second by entering a decimal number followed by the abbreviation c; values expressed in cells per second are converted to bits per second using the formula 1 cps = 384 bps.

Default If the rtvbr statement is not included, bandwidth utilization is unlimited.

Options burst *length*—Burst length, in cells. If you set the length to 1, the peak traffic rate is used.
Range: 1 through 4000 cells

peak *rate*—Peak rate, in bits per second or cells per second.
Range: For ATM2 IQ OC3 and OC12 interfaces, 33 Kbps through 542,526,792 bps. For ATM2 IQ OC48 interfaces, 33 Kbps through 2,170,107,168 bps. For ATM2 IQ DS3 and E3 interfaces, 33 Kbps through the maximum rate, which depends on the ATM encapsulation and framing you configure. For more information, see Table 26 on page 306.

sustained *rate*—Sustained rate, in bps or cps.
Range: For ATM2 IQ OC3 and OC12 interfaces, 33 Kbps through 542,526,792 bps. For ATM2 IQ OC48 interfaces, 33 Kbps through 2,170,107,168 bps. For ATM2 IQ DS3 and E3 interfaces, from 33 Kbps through the maximum rate, which depends on the ATM encapsulation and framing you configure. For more information, see Table 26 on page 306.

Usage Guidelines See "Configuring ATM2 IQ Real-Time VBR" on page 307.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics cbr, vbr

sampling

Syntax sampling *direction*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure the direction of traffic to be sampled.

Options *direction* can be one of the following:

input—Configure at least one expected ingress point.

output—Configure at least one expected egress point.

input output—On a single interface, configure at least one expected ingress point and one expect egress point.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

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*]

Description Set Structure-Agnostic TDM over Packet protocol options.

Options excessive-packet-loss-rate <options>—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 jitter buffer.

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.

Usage Guidelines See “Circuit Emulation Interfaces Overview” on page 503.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

scheduler-maps

Syntax

```
scheduler-maps map-name {
    forwarding-class (class-name | assured-forwarding | best-effort | expedited-forwarding
        | network-control);
    vc-cos-mode (alternate | strict);
}
```

Hierarchy Level [edit interfaces *interface-name* atm-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM2 IQ interfaces only, define CoS parameters assigned to forwarding classes.

Options *map-name*—Name of the scheduler map.

The remaining statements are explained separately.

Usage Guidelines See “Configuring ATM2 IQ VC Tunnel CoS Components” on page 325.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics atm-scheduler-map, *JUNOS Class of Service Configuration Guide*

schedulers

Syntax schedulers *number*;

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced in JUNOS Release 8.2.

Description Specify the number of schedulers for Ethernet IQ2 and IQ2-E PIC port interfaces.

Default If you omit this statement, the 1024 schedulers are distributed equally over all ports in multiples of 4.

Options *number*—Number of schedulers to configure on the port.
Range: 1 through 1024

Usage Guidelines See the *JUNOS Class of Service Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

secondary

Syntax secondary *interface-name*;

Hierarchy Level [edit interfaces (rsp0 | rsp1) redundancy-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Specify the secondary (backup) AS PIC interface or MultiServices PIC interface.

Options *interface-name*—The identifier for the AS PIC interface or MultiServices PIC interface, which must be of the form sp-*fpc*/*pic*/*port*.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

send-critical-event

Syntax send-critical-event;

Hierarchy Level [edit protocols oam ethernet link-fault-management action-profile action]

Release Information Statement introduced in JUNOS Release 8.5.

Description Send OAM PDUs with the critical event bit set.

Usage Guidelines See “Specifying the Actions to Be Taken for Link-Fault Management Events” on page 701.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

serial-options

Syntax

```
serial-options {
    clock-rate rate;
    clocking-mode (dce | loop);
    control-polarity (negative | positive);
    cts-polarity (negative | positive);
    dcd-polarity (negative | positive);
    dce-options {
        control-signal (assert | de-assert | normal);
        cts (ignore | normal | require);
        dcd (ignore | normal | require);
        dsr (ignore | normal | require);
        dtr signal-handling-option;
        ignore-all;
        indication (ignore | normal | require);
        rts (assert | de-assert | normal);
        tm (ignore | normal | require);
    }
    dsr-polarity (negative | positive);
    dte-options {
        control-signal (assert | de-assert | normal);
        cts (ignore | normal | require);
        dcd (ignore | normal | require);
        dsr (ignore | normal | require);
        dtr signal-handling-option;
        ignore-all;
        indication (ignore | normal | require);
        rts (assert | de-assert | normal);
        tm (ignore | normal | require);
    }
    dtr-circuit (balanced | unbalanced);
    dtr-polarity (negative | positive);
    encoding (nrz | nrzi);
    indication-polarity (negative | positive);
    line-protocol protocol;
    loopback (dce-local | dce-remote | local | remote);
    rts-polarity (negative | positive);
    tm-polarity (negative | positive);
    transmit-clock invert;
}
```

Hierarchy Level [edit interfaces se-*pim*/0/*port*]

Release Information Statement introduced prior to JUNOS Release 7.4.

Description Configure serial-specific interface properties.

The statements are explained separately.

Usage Guidelines See “Configuring Serial Interfaces” on page 249.

Required Privilege Level interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Related Topics no-concatenate in the *JUNOS System Basics Configuration Guide*

server

Syntax server;

Hierarchy Level [edit interfaces pp0 unit *logical-unit-number* pppoe-options],
[edit logical-systems *logical-system-name* interfaces pp0 unit *logical-unit-number* pppoe-options]

Release Information Statement introduced in JUNOS Release 8.5.

Description Configure the router to operate in the PPPoE server mode. Supported on M120 Multiservice Edge Routers operating as access concentrators.

Usage Guidelines See "Configuring the PPPoE Server Mode" on page 747.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

server-timeout

Syntax server-timeout *seconds*;

Hierarchy Level [edit protocols dot1x authenticator interface *interface-id*]

Release Information Statement introduced in JUNOS Release 9.3.

Description Specify the number of seconds the port waits for a response when relaying a request from the authentication server to the client before resending the request.

Options *seconds*—The number of seconds the port waits for a response when relaying a request from the authentication server to the client before resending the request.
Range: 1 through 60 seconds
Default: 30 seconds

Usage Guidelines See "Configuring IEEE 802.1x Port-Based Network Access Control" on page 693.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics dot1x, authenticator, interface (IEEE 802.1x)

service

Syntax

```
service {
    input {
        service-set service-set-name <service-filter filter-name>;
        post-service-filter filter-name;
    }
    output {
        service-set service-set-name <service-filter filter-name>;
    }
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet]

Release Information Statement introduced before JUNOS Release 7.4.

Description Define one or more service sets and filters, and one postservice filter to be applied to an interface.

Options The remaining statements are explained separately.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

service-domain

Syntax service-domain (inside | outside);

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For adaptive services interfaces, specify a service interface domain. If you specify this interface using the next-hop-service statement at the [edit services service-set *service-set-name*] hierarchy level, the interface domain must match that used with the inside-service-interface and outside-service-interface statements.

Options inside—Interface used within the network.

outside—Interface used outside the network.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

service-filter

Syntax service-filter *filter-name*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet service (input | output)],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet service (input | output)]

Release Information Statement introduced before JUNOS Release 7.4.

Description Define the filter to be applied to traffic before it is accepted for service processing. Configuration of a service filter is optional; if you include the service-set statement without a service-filter definition, the JUNOS software assumes the match condition is true and selects the service set for processing automatically.

Options *filter-name*—Identifies the filter to be applied in service processing.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

service-name

Syntax service-name *name*;

Hierarchy Level [edit interfaces pp0 unit *logical-unit-number* pppoe-options],
[edit logical-systems *logical-system-name* interfaces pp0 unit *logical-unit-number* pppoe-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For J-series Services Routers with PPP over Ethernet interfaces, configure the service to be requested from the PPP over Ethernet server; that is, the access concentrator. For example, you can use this statement to indicate an Internet service provider (ISP) name or a class of service.

Options *name*—Service to be requested from the PPP over Ethernet server.

Usage Guidelines See “Configuring the PPPoE Service Name” on page 747.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

service-set

Syntax service-set *service-set-name*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet service (input | output)],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet service (input | output)]

Release Information Statement introduced before JUNOS Release 7.4.

Description Define one or more service sets to be applied to an interface. If you define multiple service sets, the JUNOS software evaluates the filters in the order in which they appear in the configuration.

Options *service-set-name*—Identifies the service set.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

services

Syntax services *priority-level*;

Hierarchy Level [edit interfaces *interface-name* services-options syslog host *hostname*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Specify system logging priority level.

Options *priority-level*—Assigns a priority level to the facility. Valid entries are as follows:

- alert—Conditions that should be corrected immediately
- any—Matches any level.
- emergency—Panic conditions.
- critical—Critical conditions.
- error—Error conditions.
- info—Informational messages.
- notice—Conditions that require special handling.
- warning—Warning messages.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

services-options

Syntax

```
services-options {
    inactivity-timeout seconds;
    open-timeout seconds;
    syslog {
        host hostname {
            facility-override facility-name;
            log-prefix prefix-number;
            services priority-level;
        }
    }
}
```

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Define the service options to be applied on an interface.

Options The remaining statements are explained separately.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

shaping

Syntax

```
shaping {
  (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained rate
    burst length);
  queue-length number;
}
```

Hierarchy Level

[edit interfaces *interface-name* atm-options vpi *vpi-identifier*],
[edit interfaces *interface-name* unit *logical-unit-number*],
[edit interfaces *interface-name* unit *logical-unit-number* address *address* family *family* multipoint-destination *address*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* address *address* family *family* multipoint-destination *address*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM encapsulation only, define the traffic-shaping profile.

For ATM2 IQ interfaces, changing or deleting VP tunnel traffic shaping causes all logical interfaces on a VP to be deleted and then re-added.

VP tunnels are not supported on multipoint interfaces.

The statements are explained separately.

Usage Guidelines See “Defining Virtual Path Tunnels” on page 302 and “Defining the ATM Traffic-Shaping Profile” on page 305.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

shdsl-options

Syntax

```
shdsl-options {
    annex (annex-a | annex-b);
    line-rate line-rate;
    loopback (local | remote | payload);
    snr-margin {
        current margin;
        snext margin;
    }
}
```

Hierarchy Level [edit interfaces *interface-name*],
[edit logical-systems *logical-system-name* interfaces *interface-name*

Release Information Statement introduced in JUNOS Release 7.4.

Description For J-series Services Routers only, configure symmetric DSL (SHDSL) options.

The statements are explained separately.

Usage Guidelines See “Configuring ATM-over-SHDSL Interfaces” on page 347.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

short-name-format

Syntax short-name-format (character-string | vlan | 2octet | rfc-2685-vpn-id);

Hierarchy Level [edit protocols oam ethernet connectivity-fault-management maintenance-domain *domain-name* maintenance-association *ma-name*]

Release Information Statement introduced in JUNOS Release 8.4.

Description Specify the name format of the maintenance association name.

Options character-string—The name is an ASCII character string.

vlan—The primary VLAN identifier.

2octet—A number in the range 0 through 65535.

rfc-2685-vpn-id—A VPN identifier that complies with RFC 2685.
Default: character-string

Usage Guidelines See “Configuring the Maintenance Association Short Name Format” on page 649.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

short-sequence

Syntax short-sequence;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For multilink interfaces only, set the length of the packet sequence identification number to 12 bits.

Default If you omit this statement from the configuration, the length is set to 24 bits.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

snext

Syntax snext *margin*;

Hierarchy Level [edit interfaces *interface-name* shdsl-options snr-margin],
[edit logical-systems *logical-system-name* interfaces *interface-name* shdsl-options snr-margin]

Release Information Statement introduced in JUNOS Release 7.4.

Description For J-series Services Routers only, configure self-near-end crosstalk (SNEXT) signal-to-noise ratio (SNR) margin for a SHDSL line. When configured, the line trains at higher than SNEXT threshold. The SNR margin is the difference between the desired SNR and the actual SNR.

Options *margin*—Desired SNEXT margin. Possible values are disabled or a margin between –10dB and 10 dB.
Default: disabled

Usage Guidelines See “Configuring ATM-over-SHDSL Interfaces” on page 347.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

snr-margin

Syntax

```
snr-margin {
    current margin;
    snext margin;
}
```

Hierarchy Level

[edit interfaces *interface-name* shdsl-options],
[edit logical-systems *logical-system-name* interfaces *interface-name* shdsl-options]

Release Information Statement introduced in JUNOS Release 7.4.

Description For J-series Services Routers only, configure the SHDSL signal-to-noise ratio (SNR) margin. The SNR margin is the difference between the desired SNR and the actual SNR. Configuring the SNR creates a more stable SHDSL connection by making the line train at a SNR margin higher than the threshold. If any external noise below the threshold is applied to the line, the line remains stable.

The statements are explained separately.

Usage Guidelines See "Configuring ATM-over-SHDSL Interfaces" on page 347.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

sonet-options

Syntax

```
sonet-options {
    aps {
        advertise-interval milliseconds;
        annex-b
        authentication-key key;
        force;
        hold-time milliseconds;
        lockout;
        neighbor address;
        paired-group group-name;
        protect-circuit group-name;
        request;
        revert-time seconds;
        switching-mode (bidirectional | unidirectional);
        working-circuit group-name;
    }
    bytes {
        c2 value;
        e1-quiet value;
        f1 value;
        f2 value;
        s1 value;
        z3 value;
        z4 value;
    }
    fcs (16 | 32);
    loopback (local | remote);
    mpls {
        pop-all-labels {
            required-depth number;
        }
    }
    path-trace trace-string;
    (payload-scrambler | no-payload-scrambler);
    rfc-2615;
    trigger {
        defect ignore;
        defect hold-time up milliseconds down milliseconds;
    }
}
vtmapping (itu-t | klm);
(z0-increment | no-z0-increment);
```

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure SONET/SDH-specific interface properties.

On SONET/SDH OC48 interfaces that you configure for channelized (multiplexed) mode (by including the no-concatenate statement at the [edit chassis fpc *slot-number* pic *pic-number*] hierarchy level), the bytes e1-quiet and bytes f1 options have no effect. The bytes f2, bytes z3, bytes z4, and path-trace options work correctly on channel 0 and work in the transmit direction only on channels 1, 2, and 3.

On a channelized OC12 interface, the bytes e1-quiet, bytes f1, bytes f2, bytes z3, and bytes z4 options are not supported. The fcs and payload-scrambler statements are also not supported; you must configure these for each DS3 channel using the t3-options fcs and t3-options payload-scrambler statements. The aps and loopback statements are supported only on channel 0 and are ignored if included in the configurations for channels 1 through 11. You can configure loopbacks for each DS3 channel with the t3-options loopback statement. The path-trace statement can be included in the configuration for each DS3 channel, thereby configuring a unique path trace for each channel.

To configure loopback on channelized IQ and IQE PICs, SONET/SDH level, use the loopback statement local and remote options at the controller interface (coc48, cstm16, coc12, cstm4, coc3, cstm1). It is ignored for path-level interfaces so-*fpc*/*pic*/*port* or so-*fpc*/*pic*/*port*:*channel*.

If you are running Intermediate System-to-Intermediate System (IS-IS) over SONET/SDH interfaces, use PPP if you are running Cisco IOS Release 12.0 or later. If you need to run HDLC, configure an ISO family MTU of 4469 on the routing platform.

The statements are explained separately.

Usage Guidelines See “Configuring SONET/SDH Parameters on ATM Interfaces” on page 324, “Configuring Channelized OC12/STM4 Interfaces” on page 411, “Configuring Channelized STM1 Interfaces” on page 449, and “Configuring SONET/SDH Physical Interface Properties” on page 798.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics no-concatenate in the *JUNOS System Basics Configuration Guide*

source

Syntax source *source-address*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* tunnel *address*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* tunnel *address*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Specify the source address of the tunnel.

Default If you do not specify a source address, the tunnel uses the unit's primary address as the source address of the tunnel.

Options *source-address*—Address of the local side of the tunnel. This is the address that is placed in the outer IP header's source field.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics multicast-only, primary

source-address-filter

Syntax

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

Hierarchy Level

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

Release Information Statement introduced before JUNOS Release 7.4.

Description For aggregated Ethernet, Fast Ethernet, Gigabit Ethernet, Gigabit Ethernet IQ interfaces, and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC and the built-in Gigabit Ethernet port on the M7i platform), specify the MAC addresses from which the interface can receive packets. For this statement to have any effect, you must include the source-filtering statement in the configuration to enable source address filtering. This statement is not supported on the J-series Services Routers.

Options *mac-address*—MAC address filter. You can specify the MAC address as *nn*:*nn*:*nn*:*nn*:*nn*:*nn* or *nnnn*.*nnnn*.*nnnn*, where *n* is a decimal digit. To specify more than one address, include multiple *mac-address* options in the source-address-filter statement.

If you enable the VRRP on a Fast Ethernet or Gigabit Ethernet interface, as described in "Configuring VRRP and VRRP for IPv6" on page 705, and if you enable MAC source address filtering on the interface, you must include the virtual MAC address in the list of source MAC addresses that you specify in the source-address-filter statement. MAC addresses ranging from 00:00:5e:00:01:00 through 00:00:5e:00:01:ff are reserved for VRRP, as defined in RFC 3768, *Virtual Router Redundancy Protocol*. When you configure the VRRP group, the group number must be the decimal equivalent of the last hexadecimal byte of the virtual MAC address.

On untagged Gigabit Ethernet interfaces you should not configure the source-address-filter statement and the accept-source-mac statement simultaneously. On tagged Gigabit Ethernet interfaces you should not configure the source-address-filter statement and the accept-source-mac statement with an identical MAC address specified in both filters.

Usage Guidelines See "Enabling Ethernet MAC Address Filtering" on page 561.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics source-filtering

source-class-usage

Syntax

```
source-class-usage {
  direction;
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet accounting],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet accounting]

Release Information Statement introduced before JUNOS Release 7.4.

Description Enable packet counters on an interface that count packets that arrive from specific prefixes on the provider core router and are destined for specific prefixes on the customer edge router.

Options *direction* can be one of the following:

input—Configure at least one expected ingress point.

output—Configure at least one expected egress point.

input output—On a single interface, configure at least one expected ingress point and one expect egress point.

Usage Guidelines See "Enabling Source Class and Destination Class Usage" on page 204 or the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics accounting, destination-class-usage

source-filtering

Syntax (source-filtering | no-source-filtering);

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

Release Information Statement introduced before JUNOS Release 7.4.

Description For aggregated Ethernet, Fast Ethernet, Gigabit Ethernet, and Gigabit Ethernet IQ interfaces only, enable the filtering of MAC source addresses, which blocks all incoming packets to that interface. To allow the interface to receive packets from specific MAC addresses, include the source-address-filter statement.

If the remote Ethernet card is changed, the interface will no longer be able to receive packets from the new card because it will have a different MAC address.

Default Source address filtering is disabled.

Usage Guidelines See “Enabling Ethernet MAC Address Filtering” on page 561.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics accept-source-mac, source-address-filter

speed

See the following sections:

- speed (gigether-options) on page 1207
- speed (Ethernet) on page 1208
- speed (SONET/SDH) on page 1209

speed (gigether-options)

Syntax speed (auto | 1Gbps | 100Mbps | 10Mbps)

Hierarchy Level [edit interface ge-/fpc/pic/port]

Release Information Statement introduced in JUNOS Release 9.5.

Description On MX-series platforms with Combo Line Rate DPCs and Tri-Rate Copper SFPs you can set auto-negotiation of speed. To specify the auto-negotiation speed, use the speed (<auto | 1Gbps | 100Mbps | 10Mbps>) statement under the [edit interface ge-/fpc/pic/port] hierarchy level. The <auto> option will attempt to automatically match the rate of the connected interface. To set port speed negotiation to a specific rate, set the port speed to either 1Gbps, 100Mbps, or 10Mbps.

NOTE: If the negotiated speed and the interface-speed do not match, the link will not be brought up. Half duplex mode is not supported.

You can disable auto MDI/MDIX using the <no-auto-mdix> statement option under the [edit interface ge-/fpc/pic/port gigether-options] hierarchy level.

Options You can specify the speed as either <auto> (autonegotiate), 1Gbps (1 Gbps), 100Mbps (100 Mbps), or 10Mbps (10 Mbps).

Usage Guidelines See “Configuring Gigabit Ethernet Autonegotiation” on page 719.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

speed (Ethernet)

Syntax speed (10m | 100m | 1g | auto);

Hierarchy Level [edit interfaces *interface-name*],
[edit interfaces ge-*pim*/0/0 switch-options switch-port *port-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure the interface speed. This statement applies to the management Ethernet interface (fxp0), Fast Ethernet 12-port and 48-port PICs, the built-in Fast Ethernet port on the FIC (M7i routing platform), the built-in Ethernet interfaces on J-series Services Routers, Combo Line Rate DPCs and Tri-Rate Ethernet Copper interfaces on MX-series routers, and on the Gigabit Ethernet ports on J-series Services Routers with uPIMs installed and configured for access switching mode. When you configure the Tri-Rate Ethernet copper interface to operate at 1 Gbps, autonegotiation must be enabled. When you configure 100BASE-FX SFP, you must set the port speed at 100 Mbps.

Options You can specify the speed as either 10m (10 Mbps), 100m (100 Mbps), or on J-series Services Routers with uPIMs installed and on MX-series routers, 1g (1 Gbps). You can specify the auto option only on MX-series routers.

Usage Guidelines See “Configuring the Interface Speed” on page 116, “Configuring the Interface Speed on Ethernet Interfaces” on page 566, “Configuring Gigabit Ethernet Autonegotiation” on page 719, and “Configuring J-series Services Router Switching Interfaces” on page 559.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

speed (SONET/SDH)

Syntax speed (oc3 | oc12 | oc48);

Hierarchy Level [edit interfaces so-*fpc/pic/port*],
[edit interfaces so-*fpc/pic/port*:*channel*]

Release Information Statement introduced in JUNOS Release 8.3.

Description Configure the interface speed. This statement applies to SONET/SDH interfaces on next-generation SONET/SDH Type 1 and Type 2 PICs with SFP. Available speeds depend on whether the PIC is in concatenated mode or nonconcatenated mode. Include the channel in the interface name when configuring nonconcatenated interfaces.

Options oc3 | oc12 | oc48—Speed when the PIC is in concatenated mode. For example, you can configure each port of a 4-port OC12 PIC to have a speed of oc3.

You can configure port 0 of a 4-port OC12 PIC to have a speed of oc12.

oc3 | oc12—Speed when the PIC is in nonconcatenated mode.

Usage Guidelines See “Configuring SONET/SDH Interface Speed” on page 801.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

spid1

Syntax spid1 *spid1-string*;

Hierarchy Level [edit interfaces br-*pim*/0/*port* isdn-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure the Service Profile Identifier (SPID).

Options *spid1-string*—Numeric SPID.

Usage Guidelines See “Configuring ISDN Physical Interface Properties” on page 775.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

spid2

Syntax spid2 *spid2-string*;

Hierarchy Level [edit interfaces br-*pim*/0/*port* isdn-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure an additional SPID.

Options *spid2-string*—Numeric SPID.

Usage Guidelines See "Configuring ISDN Physical Interface Properties" on page 775.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Configuration Guide*

stacked-vlan-ranges

Syntax

```
stacked-vlan-ranges {
    dynamic-profileprofile-name {
        accept (inet);
        ranges (any | low-tag - high-tag) , (any | low-tag - high-tag);
    }
}
```

Hierarchy Level [edit interfaces *interface-name* auto-configure]

Release Information Statement introduced in JUNOS Release 9.5.

Description Configure multiple VLANs. Each VLAN is assigned a VLAN ID number from the range.

Options any—Any valid VLAN ID number.

vlan-id-low—Specify the first VLAN ID number for the group of VLANs.

vlan-id-high—Specify the last VLAN ID number for the group of VLANs.
Range: 1 through 4094

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing–control—To add this statement to the configuration.

Related Topics

- Configuring Stacked VLAN Ranges for Use with Stacked VLAN Dynamic Profiles
- Configuring Dynamic Mixed VLAN Ranges

stacked-vlan-tagging

Syntax stacked-vlan-tagging;

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Gigabit Ethernet IQ interfaces, enable stacked VLAN tagging for all logical interfaces on the physical interface.

Usage Guidelines See “Configuring the Management Ethernet Interface” on page 729.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics vlan-tags

start-end-flag

Syntax start-end-flag (filler | shared);

Hierarchy Level [edit interface e1-*fpc/pic/port*],
[edit interface t1-*fpc/pic/port*],
[edit interfaces *interface-name* ds0-options],
[edit interfaces *interface-name* e1-options],
[edit interfaces *interface-name* e3-options],
[edit interfaces *interface-name* t1-options],
[edit interfaces *interface-name* t3-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For DS0, E1, E3, T1, and T3 interfaces, configure the interface to share the transmission of start and end flags.

NOTE: When configuring E1 interfaces on the 10-port Channelized E1/T1 IQE PIC, start-end-flag must be set at the [edit interface e1-fpc/pic/port] hierarchy level.

When configuring T1 interfaces on the 10-port Channelized E1/T1 IQE PIC, start-end-flag must be set at the [edit interface t1-fpc/pic/port] hierarchy level.

Default shared

Options filler—Wait two idle cycles between the start and end flags.

shared—Share the transmission of the start and end flags.

Usage Guidelines See "Configuring E1 Start and End Flags" on page 518, "Configuring the E3 Start and End Flags" on page 527, "Configuring T1 Start and End Flags" on page 536, and "Configuring T3 Start and End Flags" on page 549.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

static-tei-val

Syntax static-tei-val *value*;

Hierarchy Level [edit interfaces br-*pim*/0/*port* isdn-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For J-series Services Routers only. Statically configure the Terminal Endpoint Identifier (TEI) value. The TEI value represents any ISDN-capable device attached to an ISDN network that is the terminal endpoint. TEIs are used to distinguish between several different devices using the same ISDN links.

Options *value*—Value between 0 through 63.

Usage Guidelines See “Configuring ISDN Physical Interface Properties” on page 775.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

supplicant

Syntax supplicant *single*;

Hierarchy Level [edit protocols dot1x authenticator interface *interface-id*]

Release Information Statement introduced in JUNOS Release 9.3.

Description Specify the supplicant mode. Only single mode is supported.

This option will authenticate only the first client that connects to a port. All other clients that connect later (802.1x compliant or non-compliant) will be allowed free access on that port without any further authentication. If the first authenticated client logs out, all other users are locked out until a client authenticates again.

Options single—Sets single mode.

Usage Guidelines See “Configuring IEEE 802.1x Port-Based Network Access Control” on page 693.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics dot1x, authenticator, interface (IEEE 802.1x)

supplicant-timeout

Syntax supplicant-timeout *seconds*;

Hierarchy Level [edit protocols dot1x authenticator interface *interface-id*]

Release Information Statement introduced in JUNOS Release 9.3.

Description Specify the number of seconds the port waits for a response when relaying a request from the authentication server to the client before resending the request.

Options *seconds*—Specify the number of seconds the port waits for the supplicant timeout.

Range: 1 through 60 seconds

Default: 30 seconds

Usage Guidelines See “Configuring IEEE 802.1x Port-Based Network Access Control” on page 693.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics dot1x, authenticator, interface (IEEE 802.1x)

swap

Syntax swap;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit interfaces *interface-name* unit *logical-unit-number* output-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* output-vlan-map]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Gigabit Ethernet IQ and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces and aggregated Ethernet using Gigabit Ethernet IQ interfaces, specify the VLAN rewrite operation to replace a VLAN tag. The outer VLAN tag of the frame is overwritten with the user-specified VLAN tag information.

Usage Guidelines See “Rewriting the VLAN Tag on Tagged Frames” on page 617.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

swap-push

Syntax swap-push;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit interfaces *interface-name* unit *logical-unit-number* output-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* output-vlan-map]

Release Information Statement introduced in JUNOS Release 8.1.

Description For Gigabit Ethernet IQ, IQ2 and IQ2-E interfaces, and for aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX-series routing platforms, specify the VLAN rewrite operation to replace the outer VLAN tag of the frame with a user-specified VLAN tag value. A user-specified outer VLAN tag is pushed in front. The outer tag becomes an inner tag in the final frame.

Usage Guidelines See “Rewriting a VLAN Tag and Adding a New Tag” on page 621.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

swap-swap

Syntax swap-swap;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit interfaces *interface-name* unit *logical-unit-number* output-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* output-vlan-map]

Release Information Statement introduced in JUNOS Release 8.1.

Description For Gigabit Ethernet IQ, IQ2 and IQ2-E interfaces, and for aggregated Ethernet interfaces using Gigabit Ethernet IQ2 and IQ2-E or 10-Gigabit Ethernet PICs on MX-series routing platforms, specify the VLAN rewrite operation to replace both the inner and the outer VLAN tags of the frame with a user-specified VLAN tag value.

Usage Guidelines See “Rewriting the Inner and Outer VLAN Tags” on page 621.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

switching-mode

Syntax switching-mode (bidirectional | unidirectional);

Hierarchy Level [edit interfaces *interface-name* sonet-options aps]

Release Information Statement introduced before JUNOS Release 7.4.

Description For unchannelized OC3, OC12, and OC48 SONET/SDH interfaces on T-series platforms only, configure the interface to interoperate with SONET/SDH line-terminating equipment (LTE) that is provisioned for unidirectional linear APS in 1 + 1 architecture.

Default If the switching-mode statement is not configured, the mode is bidirectional, and the interface does not interoperate with a unidirectional SONET/SDH LTE.

Options bidirectional—Support bidirectional mode only.

unidirectional—Interoperate with a SONET/SDH LTE provisioned for unidirectional mode.

Usage Guidelines See “Configuring Unidirectional Switching Mode Support” on page 821.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

switch-options

Syntax

```
switch-options {
    switch-port port-number {
        (auto-negotiation | no-auto-negotiation);
        speed (10m | 100m | 1g);
        link-mode (full-duplex | half-duplex);
    }
}
```

Hierarchy Level [edit interfaces ge-*pim*/0/0]

Release Information Statement introduced in JUNOS Release 8.4.

Description On a J-series Services Router with multiport Gigabit Ethernet uPIMs installed and operating in access switching mode, only one physical interface is configured for the entire multiport Gigabit Ethernet uPIM. Configuration of the physical port characteristics is done under the single physical interface.

Usage Guidelines See “Configuring J-series Services Router Switching Interfaces” on page 559.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

switch-port

Syntax

```
switch-port port-number {
    (auto-negotiation | no-auto-negotiation);
    speed (10m | 100m | 1g);
    link-mode (full-duplex | half-duplex);
}
```

Hierarchy Level [edit interfaces ge-*pim*/0/0 switch-options]

Release Information Statement introduced in JUNOS Release 8.4.

Description On a J-series Services Router with Ethernet uPIMs installed and operating in access switching mode, configuration of the physical port characteristics, done under the single physical interface.

Default Autonegotiation is enabled by default. If the link speed and duplex are also configured, the interfaces use the values configured as the desired values in the negotiation.

Options *port-number*—Ports are numbered 0 through 5 on the 6-port Gigabit Ethernet uPIM, 0 through 7 on the 8-port Gigabit Ethernet uPIM, and 0 through 15 on the 16-port Gigabit Ethernet uPIM.

The remaining statements are explained separately.

Usage Guidelines See “Configuring J-series Services Router Switching Interfaces” on page 559.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

switch-type

Syntax switch-type (att5e | etsi | ni1 | ntdms-100)

Hierarchy Level [edit interfaces br-*pim*/0/*port* isdn-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For J-series Services Routers only. Configure the ISDN variant supported.

Options att5e—AT&T switch variant.

etsi—European Telecommunications Standards Institute switch variant.

ni1—National ISDN 1 switch variant.

ntdms-100—Northern Telecom DMS-100.

ntt—NTT Group switch for Japan.

Usage Guidelines See “Configuring ISDN Interfaces” on page 773.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

symbol-period

Syntax symbol-period *count*;

Hierarchy Level [edit protocols oam ethernet link-fault-management action-profile event, link-event-rate],
[edit protocols oam link-fault-management interface *interface-name* event-thresholds]

Release Information Statement introduced in JUNOS Release 8.4.

Description Configure the threshold for sending symbol period events or taking the action specified in the action profile.

A symbol error is any symbol code error on the underlying physical layer. The symbol period threshold is reached when the number of symbol errors reaches the configured value within the period window. The default period window is the number of symbols that can be transmitted on the underlying physical layer in 1 second. The window is not configurable.

Options *count*—Threshold count for symbol period events.

Range: 1 through 100

Usage Guidelines See "Configuring Threshold Values for Local Fault Events on an Interface" on page 699 and "Configuring Threshold Values for Fault Events in an Action Profile" on page 702.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

syslog

See the following sections:

syslog (Interfaces)

Syntax

```
syslog {
   host hostname {
      facility-override facility-name;
      log-prefix prefix-number;
      services priority-level;
   }
}
```

Hierarchy Level [edit interfaces *interface-name* services-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For adaptive services interfaces, configure generation of system log messages for the service set. System log information is passed to the kernel for logging in the /var/log directory. Any values configured in the service set definition override these values.

Options The remaining statements are explained separately.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

syslog (Monitoring)

Syntax (syslog | no-syslog);

Hierarchy Level [edit interfaces mo-*fpc/pic/port* multiservice-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description System logging is enabled by default. The system log information of the Monitoring Services PIC is passed to the kernel for logging in the /var/log directory.

- syslog—Enable PIC system logging.
- no-syslog—Disable PIC system logging.

Usage Guidelines See “Configuring Multiservice Physical Interface Properties” on page 132 or the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

syslog (OAM Action)

Syntax syslog;

Hierarchy Level [edit protocols oam ethernet link-fault-management action-profile action]

Release Information Statement introduced in JUNOS Release 8.5.

Description Generate a syslog message for the Ethernet Operation, Administration, and Management (OAM) event.

Usage Guidelines See “Specifying the Actions to Be Taken for Link-Fault Management Events” on page 701.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

system-priority

Syntax system-priority *priority*;

Hierarchy Level [edit interfaces ae*X* aggregated-ether-options lacp]

Release Information Statement introduced in JUNOS Release 9.3.

Description Define LACP system priority at the aggregated Ethernet interface level. This system priority value takes precedence over a system priority value configured at the global ([edit chassis]) hierarchy level.

Options *priority*—Priority for the aggregated Ethernet system. A smaller value indicates a higher priority.

Range: 0 through 65535

Default: 127

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

t1-options

Syntax

```
t1-options {
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    buildout value;
    byte-encoding (nx56 | nx64);
    crc-major-alarm-threshold (1e-3 | 5e-4 | 1e-4 | 5e-5 | 1e-5);
    crc-minor-alarm-threshold (1e-3 | 5e-4 | 1e-4 | 5e-5 | 1e-5 | 5e-6 | 1e-6);
    fcs (16 | 32);
    framing (esf | sf);
    idle-cycle-flag (flags | ones);
    invert-data;
    line-encoding (ami | b8zs);
    loopback (local | payload | remote);
    remote-loopback-respond;
    start-end-flag (filler | shared);
    timeslots time-slot-range;
}
```

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure T1-specific physical interface properties.

The statements are explained separately.

Usage Guidelines See “Configuring T1 Interfaces” on page 529.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

t1-time

Syntax
t1-time *time*;

Hierarchy Level
[edit interfaces *interface-name* unit *logical-unit-number* family llc2],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family llc2]

Release Information
Statement introduced in JUNOS Release 7.4.

Description
For J-series Services Routers only. On Ethernet interfaces configured for DLSw, configure the length of time the router waits for an acknowledgment of transmitted frames.

Options
time—Number of milliseconds.
Range: 1 through 60000
Default: 1000 milliseconds

Usage Guidelines
See “Configuring LLC2 Options” on page 171.

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics
J-series Services Router Advanced WAN Access Configuration Guide

t2-time

Syntax
t2–time *time*;

Hierarchy Level
[edit interfaces *interface-name* unit *logical-unit-number* family llc2],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family llc2]

Release Information
Statement introduced in JUNOS Release 7.4.

Description
For J-series Services Routers only. On Ethernet interfaces configured for DLSw, configure the length of time the router withholds the I-frame response.

Options
time—Number of milliseconds.
Range: 1 through 60000
Default: 100 milliseconds

Usage Guidelines
See “Configuring LLC2 Options” on page 171.

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics
J-series Services Router Advanced WAN Access Configuration Guide

t310

Syntax t310-value *seconds*;

Hierarchy Level [edit interfaces br-*pim*/0/*port* isdn-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ISDN interfaces, configure the Q.931-specific timer for T310, in seconds. The Q.931 protocol is involved in the setup and termination of connections.

Options *seconds*—Timer value, in seconds.

Range: 1 through 65536

Default: 10 seconds

Usage Guidelines See "Configuring ISDN Physical Interface Properties" on page 775.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

t391

Syntax t391 *seconds*;

Hierarchy Level [edit interfaces *interface-name* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For link services and voices interfaces only, set Frame Relay link integrity polling interval.

Options *seconds*—Link integrity polling interval.

Range: 5 through 30 seconds

Default: 10 seconds

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics n391, n392, n393, t392

t392

Syntax t392 *seconds*;

Hierarchy Level [edit interfaces *interface-name* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For link services and voices interfaces only, set Frame Relay polling verification interval.

Options *seconds*—Polling verification interval.

Range: 5 through 30 seconds

Default: 15 seconds

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics n391, n392, n393, timeslots

t3-options

Syntax

```
t3-options {
    atm-encapsulation (direct | plcp);
    bert-algorithm algorithm;
    bert-error-rate rate;
    bert-period seconds;
    (cbit-parity | no-cbit-parity);
    compatibility-mode (digital-link | kentrox | larscom) <subrate value>;
    fcs (16 | 32);
    (feac-loop-respond | no-feac-loop-respond);
    idle-cycle-flag value;
    (long-buildout | no-long-buildout);
    (loop-timing | no-loop-timing);
    loopback (local | payload | remote);
    start-end-flag value;
}
```

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure T3-specific physical interface properties, including the properties of DS3 channels on a channelized OC12 interface. The long-buildout statement is not supported for DS3 channels on a channelized OC12 interface.

On T3 interfaces, the default encapsulation is PPP.

For ATM1 interfaces, you can configure a subset of E3 options statements.

The statements are explained separately.

Usage Guidelines See “Configuring T3 Interfaces” on page 539.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

tag-protocol-id

See the following sections:

- tag-protocol-id (TPIDs Expected to Be Sent or Received) on page 1228
- tag-protocol-id (TPID to Rewrite) on page 1229

tag-protocol-id (TPIDs Expected to Be Sent or Received)

Syntax tag-protocol-id [*tpids*];

Hierarchy Level [edit interfaces *interface-name* gigether-options ethernet-switch-profile],
[edit interfaces *interface-name* aggregated-ether-options ethernet-switch-profile]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Gigabit Ethernet IQ and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces, aggregated Ethernet with Gigabit Ethernet IQ interfaces, and Gigabit Ethernet PICs with SFPs (except the 10-port Gigabit Ethernet PIC, and the built-in Gigabit Ethernet port on the M7i platform), define the TPIDs expected to be sent or received on a particular VLAN. For each Gigabit Ethernet port, you can configure up to eight TPIDs using the tag-protocol-id statement; but only the first four TPIDs are supported on IQ2 and IQ2-E interfaces.

Options *tpids*—TPIDs to be accepted on the VLAN. Specify TPIDs in hexadecimal.

Usage Guidelines See "Configuring Frames with Particular TPIDs to Be Processed as Tagged Frames" on page 610.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

tag-protocol-id (TPID to Rewrite)

Syntax tag-protocol-id *tpid*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit interfaces *interface-name* unit *logical-unit-number* output-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* output-vlan-map]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Gigabit Ethernet IQ and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces only, configure the outer TPID value. All TPIDs you include in input and output VLAN maps must be among those you specify at the [edit interfaces *interface-name* gigether-options ethernet-switch-profile tag-protocol-id [*tpids*]] hierarchy level.

Default If the tag-protocol-id statement is not configured, the TPID value is 0x8100.

Usage Guidelines See "Configuring Inner and Outer TPIDs and VLAN IDs" on page 611.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

tei-option

Syntax tei-option (first-call | power-up);

Hierarchy Level [edit interfaces br-*pim*/0/*port* isdn-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ISDN interfaces, configure when the Terminal Endpoint Identifier (TEI) negotiates with the ISDN provider.

Options first-call—Activation does not occur until the call setup is sent.

power-up—Activation occurs when the Services Router is powered on.
Default: power-up

Usage Guidelines See "Configuring ISDN Physical Interface Properties" on page 775.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

then

Syntax
```
then {
   discard;
}
```

Hierarchy Level [edit firewall hierarchical-policer aggregate]
[edit firewall hierarchical-policer premium]

Release Information Statement introduced in JUNOS Release 9.5.

Description On M40e, M120, and M320 (with FFPC and SFPC) edge routers and T320, T640, and T1600 core routers with Enhanced Intelligent Queuing (IQE) PICs, to discard packets when a specified bandwidth or burst limits for an aggregate level of a hierarchical policer is reached, use the then discard statement at the [edit firewall hierarchical-policer aggregate] or [edit firewall hierarchical-policer premium] hierarchy level.

Options discard—Discard packets if condition is met.

Usage Guidelines See "Applying Policers" on page 185 and *Class of Service*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

threshold

Syntax threshold *bytes*;

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Specify the bucket threshold, which controls the burstiness of the leaky bucket mechanism. The larger the value, the more bursty the traffic, which means that over a very short amount of time, the interface can receive or transmit close to line rate, but the average over a longer time is at the configured bucket rate.

Options *bytes*—Maximum size, in bytes, for traffic bursts.
Range: 0 through 65,535 bytes.

Usage Guidelines See "Configuring Receive and Transmit Leaky Bucket Properties" on page 122 and "Configuring Receive and Transmit Leaky Bucket Properties on SONET/SDH Interfaces" on page 830. For ease of entry, you can enter *number* either as a complete decimal number or as a decimal number followed by the abbreviation k (1000). For example, the entry threshold 2k corresponds to a threshold of 2000 bytes.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

timeslots

Syntax timeslots *time-slot-range*;

Hierarchy Level [edit interface e1-*fpc/pic/port*],
[edit interface t1-*fpc/pic/port*],
[edit interfaces *interface-name* e1-options],
[edit interfaces *interface-name* partition *partition-number*],
[edit interfaces *interface-name* t1-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For E1 and T1interfaces, allocate the specific time slots by number.

NOTE: When configuring E1 interfaces on the 10-port Channelized E1/T1 IQE PIC, timeslots must be set at the [edit interface e1-fpc/pic/port] hierarchy level.

When configuring T1 interfaces on the 10-port Channelized E1/T1 IQE PIC, timeslots must be set at the [edit interface t1-fpc/pic/port] hierarchy level.

Options *time-slot-range*—Actual time slot numbers allocated:

Range:

Ranges vary by interface type and configuration option as follows:

- 1 through 24 for T1 interfaces (0 is reserved)
- 1 through 31 for 4-port E1 PICs (0 is reserved)
- 1 through 31 for *Nx*DS0 interfaces (0 is reserved)
- 2 through 32 for 10-port Channelized E1 and 10-port Channelized E1 IQ PICs (1 is reserved)
- 2 through 32 for the setting under e1-options with IQE PICs (1 is reserved) (when creating fractional E1)
- 1 through 31 for the setting under partition with IQE PICs (0 is reserved) (when creating *Nx*DS0)

NOTE: When creating fractional E1 interfaces only, if you connect a 4-port E1 PIC interface to a device that uses time slot numbering from 2 through 32, you must subtract 1 from the configured number of time slots.

Usage Guidelines See "Configuring Fractional E1 IQ and IQE Interfaces" on page 486, "Configuring Fractional T1 IQ and IQE Interfaces" on page 464, "Configuring Fractional E1 Time Slots" on page 518, "Configuring Fractional T1 Time Slots" on page 537, and configuring

"Configuring a Channelized T1/E1 Interface to Drop and Insert Time Slots" on page 494.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

tm

Syntax tm (ignore | normal | require);

Hierarchy Level [edit interfaces *interface-name* serial-options dce-options],
[edit interfaces *interface-name* serial-options dte-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For EIA-530 interfaces only, configure the from-DCE signal, test-mode (TM).

Options ignore—The from-DCE signal is ignored.

normal—Normal TM signal handling as defined by the TIA/EIA Standard 530.

require—The from-DCE signal must be asserted.
Default: normal

Usage Guidelines See "Configuring the Serial Signal Handling" on page 257.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

tm-polarity

Syntax tm-polarity (negative | positive);

Hierarchy Level [edit interfaces *interface-name* serial-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure TM signal polarity.

Options negative—Negative signal polarity.

positive—Positive signal polarity.
Default: positive

Usage Guidelines See "Configuring Serial Signal Polarities" on page 260.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

traceoptions

See the following sections:

- traceoptions (Individual Interfaces) on page 1234
- traceoptions (Interface Process) on page 1235
- traceoptions (LACP) on page 1237
- traceoptions (PPP process) on page 1239

NOTE: For information about the traceoptions statement at the [edit protocols vrrp] hierarchy level, see the *JUNOS High Availability Configuration Guide*.

traceoptions (Individual Interfaces)

Syntax

```
traceoptions {
   flag flag;
}
```

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Define tracing operations for individual interfaces.

To specify more than one tracing operation, include multiple flag statements.

The interfaces traceoptions statement does not support a trace file. The logging is done by the kernel, so the tracing information is placed in the system syslog file in the directory /var/log.

Default If you do not include this statement, no interface-specific tracing operations are performed.

Options *flag*—Tracing operation to perform. To specify more than one tracing operation, include multiple flag statements. The following are the interface-specific tracing options.

- all—All interface tracing operations
- event—Interface events
- ipc—Interface interprocess communication (IPC) messages
- media—Interface media changes
- q921—Trace ISDN Q.921 frames
- q931—Trace ISDN Q.931 frames

Usage Guidelines See “Tracing Operations of an Individual Router Interface” on page 231.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

traceoptions (Interface Process)

Syntax

```
traceoptions {
  file &lt;filename&gt; &lt;files number&gt; &lt;match regular-expression&gt; &lt;size size&gt; &lt;world-readable |
    no-world-readable&gt;;
  flag flag &lt;disable&gt;;
  no-remote-trace;
}
```

Hierarchy Level [edit interfaces]

Release Information Statement introduced before JUNOS Release 7.4.

Description Define tracing operations for the interface process (dcd).

Default If you do not include this statement, no interface-specific tracing operations are performed.

Options disable—(Optional) Disable the tracing operation. You can use this option to disable a single operation when you have defined a broad group of tracing operations, such as all.

filename—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. All files are placed in the directory /var/log. By default, interface process tracing output is placed in the file dcd.

files *number*—(Optional) Maximum number of trace files. When a trace file named *trace-file* reaches its maximum size, it is renamed *trace-file*.0, then *trace-file*.1, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum number of files, you also must specify a maximum file size with the size option.
Range: 2 through 1000
Default: 3 files

flag—Tracing operation to perform. To specify more than one tracing operation, include multiple flag statements. You can include the following flags:

- change-events—Log changes that produce configuration events
- config-states—Log the configuration state machine changes
- kernel—Log configuration IPC messages to kernel
- kernel-detail—Log details of configuration messages to kernel

no-world-readable—(Optional) Disallow any user to read the log file.

size *size*—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named *trace-file* reaches this size, it is renamed *trace-file*.0. When the *trace-file* again reaches its maximum size, *trace-file*.0 is renamed *trace-file*.1 and *trace-file* is renamed *trace-file*.0. This renaming scheme continues until the maximum number of trace files is reached. Then, the oldest trace file is overwritten.

If you specify a maximum file size, you also must specify a maximum number of trace files with the files option.
Syntax: *x*k to specify kilobytes, *x*m to specify megabytes, or *x*g to specify gigabytes
Range: 10 KB through the maximum file size supported on your routing platform
Default: 1 MB

world-readable—(Optional) Allow any user to read the log file.

match *regex*—(Optional) Refine the output to include only those lines that match the given regular expression.

Usage Guidelines See "Tracing Operations of the Interface Process" on page 231.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

traceoptions (LACP)

Syntax

```
traceoptions {
    file <filename> <files number> <size size> <world-readable | no-world-readable>;
    flag flag;
    no-remote-trace;
}
```

Hierarchy Level [edit protocols lacp]

Release Information Statement introduced in JUNOS Release 7.6.

Description Define tracing operations for the LACP protocol.

Default If you do not include this statement, no LACP protocol tracing operations are performed.

Options disable—(Optional) Disable the tracing operation. You can use this option to disable a single operation when you have defined a broad group of tracing operations, such as all.

filename—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. All files are placed in the directory /var/log. By default, interface process tracing output is placed in the file lacpd.

files *number*—(Optional) Maximum number of trace files. When a trace file named *trace-file* reaches its maximum size, it is renamed *trace-file*.0, then *trace-file*.1, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum number of files, you also must specify a maximum file size with the size option.
Range: 2 through 1000
Default: 3 files

flag—Tracing operation to perform. To specify more than one tracing operation, include multiple flag statements. You can include the following flags:

- all—All LACP tracing operations
- configuration—Configuration code
- packet—Packets sent and received
- process—LACP process events
- protocol—LACP protocol state machine
- routing-socket—Routing socket events
- startup—Process startup events

no-world-readable—(Optional) Prevent any user from reading the log file.

size *size*—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named *trace-file* reaches this size, it is renamed *trace-file*.0. When the *trace-file* again reaches its maximum size, *trace-file*.0 is renamed *trace-file*.1 and *trace-file* is renamed *trace-file*.0. This renaming scheme continues until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum file size, you also must specify a maximum number of trace files with the files option:

Syntax: *x*k to specify kilobytes, *x*m to specify megabytes, or *x*g to specify gigabytes
Range: 10 KB through the maximum file size supported on your routing platform
Default: 1 MB

world-readable—(Optional) Allow any user to read the log file.

Usage Guidelines See "Tracing LACP Operations" on page 600.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

traceoptions (PPP process)

Syntax

```
traceoptions {
    file filename <files number> <match regular-expression> <size size> <world-readable |
        no-world-readable>;
    flag flag;
    level severity-level;
    no-remote-trace;
}
```

Hierarchy Level [edit protocols ppp]

Release Information Statement introduced in JUNOS Release 7.5.

Description Define tracing operations for the PPP process.

To specify more than one tracing operation, include multiple flag statements.

You cannot specify a separate trace tile. Tracing information is placed in the system syslog file in the directory /var/log/pppd.

Default If you do not include this statement, no PPPD-specific tracing operations are performed.

Options *filename*—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. All files are placed in the directory /var/log. By default, commit script process tracing output is placed in the file ppd. If you include the file statement, you must specify a filename. To retain the default, you can specify eventd as the filename.

files *number*—(Optional) Maximum number of trace files. When a trace file named *trace-file* reaches its maximum size, it is renamed *trace-file*.0, then *trace-file*.1, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum number of files, you also must specify a maximum file size with the size option and a filename.
Range: 2 through 1000
Default: 3 files

disable—(Optional) Disable the tracing operation. You can use this option to disable a single operation when you have defined a broad group of tracing operations, such as all.

flag—Tracing operation to perform. To specify more than one tracing operation, include multiple flag statements. The following are the PPPD-specific tracing options.

- access—Access code
- address-pool—Address pool code
- all—All areas of code

- auth—Authentication code
- chap—Challenge Handshake Authentication Protocol (CHAP) code
- config—Configuration code
- ifdb—Interface database code
- lcp—LCP state machine code
- memory—Memory management code
- message—Message processing code
- mlppp—Trace MLPPP code
- ncp—NCP state machine code
- pap—Password Authentication Protocol (PAP) code
- ppp—PPP protocol processing code
- radius—RADIUS processing code
- rtsock—Routing socket code
- session—Session management code
- signal—Signal handling code
- timer—Timer code
- ui—User interface code

match *regex*—(Optional) Refine the output to include only those lines that match the given regular expression.

size *size*—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named *trace-file* reaches this size, it is renamed *trace-file*.0. When the *trace-file* again reaches its maximum size, *trace-file*.0 is renamed *trace-file*.1 and *trace-file* is renamed *trace-file*.0. This renaming scheme continues until the maximum number of trace files is reached. Then the oldest trace file is overwritten.

If you specify a maximum file size, you also must specify a maximum number of trace files with the files option and filename.
Syntax: *x*k to specify KB, *x*m to specify MB, or *x*g to specify GB
Range: 10 KB through 1 GB
Default: 128 KB

world-readable—(Optional) Enable unrestricted file access.

non-world-readable—(Optional) By default, log files can be accessed only by the user who configures the tracing operation. Specify non-world-readable to reset the default.

Usage Guidelines See “Tracing Operations of the pppd Process” on page 113.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

track

Syntax

```
track {
  dlsw {
    destination mac-address priority-cost priority;
    peer ip-address priority-cost priority;
  }
  interface interface-name priority-cost priority;
}
```

Hierarchy Level

[edit interfaces *interface-name* unit *logical-unit-number* family llc2 redundancy-group *group-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family llc2 redundancy-group *group-number*]

Release Information

Statement introduced in JUNOS Release 7.5.

Description

For J-series Services Routers only. On Ethernet interfaces configured for DLSw Ethernet redundancy, enable tracking options for an interface, remote peer, or destination MAC address.

The statements are explained separately.

Options

destination *mac-address*—Local MAC address. Specify the MAC address as six hexadecimal bytes in one of the following formats: *nnnn*.*nnnn*.*nnnn* or *nn*:*nn*:*nn*:*nn*:*nn*:*nn*. For example, 0011.2233.4455 or 00:11:22:33:44:55.

dlsw—DLSw protocol.

interface *interface-name*—Interface name. Include the logical portion of the name, which corresponds to the logical unit number.

peer *ip-address*—IP address of the remote peer.

priority-cost *priority*—Cost value that is subtracted from the priority value when remote peer connectivity is lost. Specify a value from 1 through 254.

Usage Guidelines

See "Configuring DLSw Ethernet Redundancy Using LLC2 Properties" on page 172.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics

For information about DLSw, see the *JUNOS Services Interfaces Configuration Guide*.

For information about the track statement at the [edit interfaces *interface-name* unit *unit-number* family inet address *address* (vrrp-group | vrrp-inet6-group) *group-number*] or [edit logical-systems *logical-system-name* interfaces *interface-name* unit *unit-number* family (inet | inet6) address *address* (vrrp-group | vrrp-inet6-group) *group-number*] hierarchy level, see the *JUNOS High Availability Configuration Guide*.

translate-discard-eligible

Syntax (translate-discard-eligible | no-translate-discard-eligible);

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family ccc],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family ccc]

Release Information Statement introduced before JUNOS Release 7.4.

Description For interfaces with encapsulation type Frame Relay CCC, enable or disable translation of Frame Relay discard eligible (DE) control bits.

Default DE bit translation is disabled.

Usage Guidelines See "Configuring Frame Relay Control Bit Translation" on page 361.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

translate-fecn-and-becn

Syntax (translate-fecn-and-becn | no-translate-fecn-and-becn);

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family ccc],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family ccc]

Release Information Statement introduced before JUNOS Release 7.4.

Description For interfaces with encapsulation type Frame Relay CCC, enable or disable translation of Frame Relay forward explicit congestion notification (FECN) control bits and Frame Relay backward explicit congestion notification (BECN) control bits.

Default FECN and BECN bit translation is disabled.

Usage Guidelines See "Configuring Frame Relay Control Bit Translation" on page 361.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

transmit-bucket

Syntax

```
transmit-bucket {
    overflow discard;
    rate percentage;
    threshold bytes;
}
```

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Set parameters for the transmit leaky bucket, which specifies what percentage of the interface's total capacity can be used to transmit packets.

For each DS3 channel in a channelized OC12 interface, you can configure a unique transmit bucket.

The statements are explained separately.

Usage Guidelines See "Configuring Receive and Transmit Leaky Bucket Properties" on page 122 and "Configuring Receive and Transmit Leaky Bucket Properties on SONET/SDH Interfaces" on page 830.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics receive-bucket

transmit-clock

Syntax transmit-clock invert;

Hierarchy Level [edit interfaces *interface-name* serial-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure the transmit clock signal.

Options invert—Shift the clock phase 180 degrees.

Usage Guidelines See "Configuring the Serial Clocking Mode" on page 255.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

transmit-period

Syntax transmit-period *seconds*;

Hierarchy Level [edit protocols dot1x authenticator interface *interface-id*]

Release Information Statement introduced in JUNOS Release 9.3.

Description Set the number of seconds the port waits before retransmitting the initial EAPOL PDUs to the client.

Options *seconds*—The number of seconds the port waits before retransmitting the initial EAPOL PDUs to the client.

Range: 1 through 65,535 seconds

Default: 30 seconds

Usage Guidelines See "Configuring IEEE 802.1x Port-Based Network Access Control" on page 693.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics dot1x, authenticator, interface (IEEE 802.1x)

transmit-weight

See the following sections:

- transmit-weight (ATM2 IQ CoS Forwarding Class) on page 1246
- transmit-weight (ATM2 IQ Virtual Circuit) on page 1247

transmit-weight (ATM2 IQ CoS Forwarding Class)

Syntax transmit-weight (cells *number* | percent *number*);

Hierarchy Level [edit interfaces *interface-name* atm-options scheduler-maps *map-name* forwarding-class *class-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM2 IQ interfaces only, assign a transmission weight to a forwarding class.

Default 95 percent for queue 0, 5 percent for queue 3.

Options percent *percent*—Transmission weight of the forwarding class as a percentage of the total bandwidth.
Range: 5 through 100

cells *number*—Transmission weight of the forwarding class as a number of cells.
Range: 0 through 32,000

Usage Guidelines See "Configuring ATM2 IQ VC Tunnel CoS Components" on page 325.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

transmit-weight (ATM2 IQ Virtual Circuit)

Syntax transmit-weight *number*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM2 IQ PICs only, configure the transmission weight.

Each VC is serviced in weighted round robin (WRR) mode. When VCs have data to send, they send the number of cells equal to their weight before passing control to the next active VC. This allows proportional bandwidth sharing between multiple VCs within a rate-shaped VP tunnel. VP tunnels are not supported on multipoint interfaces.

Options *number*—Number of cells a VC sends before passing control to the next active VC within a VP tunnel.
Range: 1 through 32,767

Usage Guidelines See “Configuring the ATM2 IQ Transmission Weight” on page 315.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

traps

Syntax (traps | no-traps);

Hierarchy Level [edit interfaces *interface-name*],
[edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Enable or disable the sending of Simple Network Management Protocol (SNMP) notifications when the state of the connection changes.

Usage Guidelines See “Enabling or Disabling SNMP Notifications on Physical Interfaces” on page 132 and “Enabling or Disabling SNMP Notifications on Logical Interfaces” on page 151.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

trej-time

Syntax trej-time *time*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family llc2],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family llc2]

Release Information Statement introduced in JUNOS Release 7.4.

Description For J-series Services Routers only. On Ethernet interfaces configured for DLSw, configure the length of time a router waits for a rejected frame to be re-sent before the router sends the reject command.

Options *time*—Number of milliseconds.

Range: 1 through 60000

Default: 3000 milliseconds

Usage Guidelines See "Configuring LLC2 Options" on page 171.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Advanced WAN Access Configuration Guide*

trigger

Syntax

```
trigger {
   defect ignore;
   defect hold-time up milliseconds down milliseconds;
}
```

Hierarchy Level [edit interfaces *interface-name* sonet-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM over SONET/SDH, SONET/SDH interfaces, and 10-Gigabit Ethernet interfaces in WAN PHY mode, configure SONET/SDH defect triggers to be ignored.

Default If you do not include this statement, all SONET/SDH defect triggers are honored.

Options *defect*—Defect to ignore or hold. It can be one of the following:

- ais-l—Line alarm indication signal
- ais-p—Path alarm indication signal
- ber-sd—Bit error rate signal degrade
- ber-sf—Bit error rate signal fault
- locd (ATM only)—Loss of cell delineation
- lof—Loss of frame
- lol—PHY loss of light
- lop-p—Path loss of pointer
- los—Loss of signal
- pll—PHY phase-locked loop out of lock
- plm-p—Path payload label mismatch
- rfi-l—Line remote failure indication
- rfi-p—Path remote failure indication
- uneq-p—Path unequipped

The remaining statements are explained separately.

Usage Guidelines See “Configuring SONET/SDH Defect Triggers to Be Ignored” on page 809.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

trigger-link-failure

Syntax [trigger-link-failure *interface-name*];

Hierarchy Level [edit interfaces lsq-*fpc/pic/port* lsq-failure-options]

Release Information Statement introduced in JUNOS Release 7.4.

Description List of SONET interfaces connected to the LSQ interface that can implement Automatic Protection Switching (APS) if the LSQ PIC fails.

Options *interface-name*—Name of SONET interface.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

trunk-bandwidth

Syntax trunk-bandwidth *rate*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM2 IQ interfaces configured to use Layer 2 circuit trunk mode, configure a scheduler so that unused bandwidth from any inactive trunk is proportionally shared among the active trunks.

During congestion, each trunk receives a proportional share of the leftover bandwidth, thus minimizing the latency on each trunk.

Options *rate*—Peak rate, in bits per second (bps) or cells per second (cps). You can specify a value in bits per second either as a complete decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000). You can also specify a value in cells per second by entering a decimal number followed by the abbreviation c; values expressed in cells per second are converted to bits per second by means of the formula 1 cps = 384 bps.
Range: 1,000,000 through 542,526,792 bps

Usage Guidelines See “Configuring Layer 2 Circuit Trunk Mode Scheduling” on page 295.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

trunk-id

Syntax trunk-id *number*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM2 IQ interfaces with ATM CCC cell-relay encapsulation, configure the trunk identification number.

When you associate a trunk ID number with a logical interface, you are in effect specifying the interfaces that are allowed to send ATM traffic over an LSP.

Options *number*—A valid trunk identifier.

Range: For UNI mode, 0 through 7. For NNI mode, 0 through 31.

Usage Guidelines See "Configuring Layer 2 Circuit Transport Mode" on page 286.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

ttl

Syntax ttl *value*;

Hierarchy Level [edit interfaces *interface-name* unit *number* tunnel]

Release Information Statement introduced before JUNOS Release 7.4

Description Set the time-to-live value bit in the header of the outer IP packet.

Options *value*—Time-to-live value.

Range: 0 through 255

Default: 64

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

tunnel

Syntax

```
tunnel {
  backup-destination address;
  destination address;
  key number;
  routing-instance {
    destination routing-instance-name;
  }
  source source-address;
  ttl number;
}
```

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure a tunnel. You can use the tunnel for unicast and multicast traffic or just for multicast traffic. You can also use tunnels for encrypted traffic or VPNs.

The statements are explained separately.

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide* and *JUNOS VPNs Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

underlying-interface

Syntax underlying-interface *interface-name*;

Hierarchy Level [edit interfaces pp0 unit *logical-unit-number* pppoe-options],
[edit interfaces demux0 unit *logical-unit-number* demux-options],
[edit logical-systems *logical-system-name* interfaces demux0 unit *logical-unit-number* demux-options],
[edit logical-systems *logical-system-name* interfaces pp0 unit *logical-unit-number* pppoe-options],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* interfaces demux0 unit *logical-unit-number* demux-options]
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* interfaces pp0 unit *logical-unit-number* pppoe-options],

Release Information Statement introduced before JUNOS Release 7.4.
Support for aggregated Ethernet added in JUNOS Release 9.4.

Description For J-series Services Routers and M120 Internet routers with PPP over Ethernet interfaces, configure the interface on which PPP over Ethernet is running.

For demux interfaces, configure the underlying interface on which the demultiplexing (demux) interface is running.

Options *interface-name*—Name of the interface on which PPP over Ethernet or demux is running. For example, at-0/0/1.0 (ATM VC), fe-1/0/1.0 (Fast Ethernet interface), ge-2/0/0.0 (Gigabit Ethernet interface), or ae1.0 (aggregated Ethernet interface).

NOTE: Logical demux interfaces are currently supported only on Gigabit Ethernet, Fast Ethernet, 10-Gigabit Ethernet interfaces, or aggregated Ethernet.

Usage Guidelines See "Configuring an IP Demux Underlying Interface" on page 240, "Specifying the Demux Underlying Interface" on page 241, and "Configuring the PPPoE Underlying Interface" on page 745.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

unframed

Syntax (unframed | no-unframed);

Hierarchy Level [edit interfaces *interface-name* e3-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For E3 IQ interfaces only, enable or disable unframed mode. In unframed mode, the E3 IQ interface do not detect yellow (ylw) or loss-of-frame (lof) alarms.

Default Unframed mode is disabled.

Usage Guidelines See “Configuring E3 IQ and IQE Unframed Mode” on page 528.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

unidirectional

Syntax unidirectional;

Hierarchy Level [edit interfaces *interface-name*],
[edit logical-systems *logical-system-name* interfaces *interface-name*]

Release Information Statement introduced in JUNOS Release 8.5.

Description Create two new, unidirectional (transmit-only and receive-only) physical interfaces subordinate to the original parent interface. Unidirectional links are currently supported only on 10-Gigabit Ethernet interfaces on the following hardware:

- 4-port 10-Gigabit Ethernet DPC on the MX960 router
- 10–Gigabit Ethernet IQ2 PIC and 10–Gigabit Ethernet IQ2E PIC on the T-series routing platform

Default Disabled.

Usage Guidelines See “Enabling Unidirectional Traffic Flow on Physical Interfaces” on page 132.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

unit

Syntax

```
unit logical-unit-number {
    accept-source-mac {
        mac-address mac-address {
            policer {
                input cos-policer-name;
                output cos-policer-name;
            }
        }
    }
    accounting-profile name;
    allow-any-vci;
    atm-scheduler-map (map-name | default);
    backup-options {
        interface interface-name;
    }
    bandwidth rate;
    cell-bundle-size cells;
    clear-dont-fragment-bit;
    compression {
        rtp {
            maximum-contexts number <force>;
            f-max-period number;
            queues [ queue-numbers ];
            port {
                minimum port-number;
                maximum port-number;
            }
        }
    }
    compression-device interface-name;
    copy-tos-to-outer-ip-header;
    demux-destination family;
    demux-source family;
    demux-options {
        underlying-interface interface-name;
    }
    description text;
    dial-options {
        l2tp-interface-id name;
        (dedicated | shared);
    }
    dialer-options {
        activation-delay seconds;
        callback;
        callback-wait-period time;
        deactivation-delay seconds;
        dial-string [ dial-string-numbers ];
        idle-timeout seconds;
        incoming-map {
            caller caller-id) | accept-all;
            initial-route-check seconds;
```

```
            load-interval seconds;
            load-threshold percent;
            pool pool-name;
            redial-delay time;
            watch-list {
                [ routes ];
            }
        }
    }
    disable;
    disable-mlppp-inner-ppp-pfc;
    dlci dlci-identifier;
    drop-timeout milliseconds;
    dynamic-call-admission-control {
        activation-priority priority;
        bearer-bandwidth-limit kilobits-per-second;
    }
    encapsulation type;
    epd-threshold cells plp1 cells;
    fragment-threshold bytes;
    inner-vlan-id-range start start-id end end-id;
    input-vlan-map {
        (pop | pop-pop | pop-swap | push | push-push | swap |
        swap-push | swap-swap);
        inner-tag-protocol-id tpid;
        inner-vlan-id number;
        tag-protocol-id tpid;
        vlan-id number;
    }
    interleave-fragments;
    inverse-arp;
    layer2-policer {
        input-policer policer-name;
        input-three-color policer-name;
        output-policer policer-name;
        output-three-color policer-name;
    }
    link-layer-overhead percent;
    minimum-links number;
    mrru bytes;
    multicast-dlci dlci-identifier;
    multicast-vci vpi-identifier.vci-identifier;
    multilink-max-classes number;
    multipoint;
    oam-liveness {
        up-count cells;
        down-count cells;
    }
    oam-period (disable | seconds);
    output-vlan-map {
        (pop | pop-pop | pop-swap | push | push-push | swap |
        swap-push | swap-swap);
        inner-tag-protocol-id tpid;
        inner-vlan-id number;
        tag-protocol-id tpid;
        vlan-id number;
```

```
}
passive-monitor-mode;
peer-unit unit-number;
plp-to-clp;
point-to-point;
ppp-options {
    chap {
        access-profile name;
        default-chap-secret name;
        local-name name;
        passive;
    }
    compression {
        acfc;
        pfc;
    }
    dynamic-profile profile-name;
    lcp-restart-timer milliseconds;
    loopback-clear-timer seconds;
    ncp-restart-timer milliseconds;
    pap {
        access-profile name;
        default-pap-password password;
        local-name name;
        local-password password;
        passive;
    }
}
pppoe-options {
    access-concentrator name;
    auto-reconnect seconds;
    (client | server);
    service-name name;
    underlying-interface interface-name;
}
proxy-arp;
service-domain (inside | outside);
shaping {
    (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained rate
        burst length);
    queue-length number;
}
short-sequence;
transmit-weight number;
(traps | no-traps);
trunk-bandwidth rate;
trunk-id number;
tunnel {
    backup-destination address;
    destination address;
    key number;
    routing-instance {
        destination routing-instance-name;
    }
    source source-address;
```

```
    ttl number;
}
vci vpi-identifier.vci-identifier;
vci-range start start-vci end end-vci;
vpi vpi-identifier;
vlan-id number;
vlan-id-range number-number;
vlan-tags inner tpid.vlan-id outer tpid.vlan-id;
family family {
    accounting {
        destination-class-usage;
        source-class-usage {
            direction;
        }
    }
    bundle interface-name;
    filter {
        group filter-group-number;
        input filter-name;
        input-list {
            [ filter-names ];
            output filter-name;
        }
        output-list {
            [ filter-names ];
        }
    }
    ipsec-sa sa-name;
    interface-mode (access | trunk);
    keep-address-and-control;
    mac-validate (loose | strict);
    mtu bytes;
    multicast-only;
    no-redirects;
    policer {
        arp policer-template-name;
        input policer-template-name;
        output policer-template-name;
    }
    primary;
    proxy inet-address address;
    receive-options-packets;
    receive-ttl-exceeded;
    remote (inet-address address | mac-address address);
    rpf-check <fail-filter filter-name> {
        <mode loose>;
    }
    sampling {
        direction;
    }
    service {
        input {
            service-set service-set-name <service-filter filter-name>;
            post-service-filter filter-name;
        }
        output {
```

```
            service-set service-set-name <service-filter filter-name>;
        }
    }
    (translate-discard-eligible | no-translate-discard-eligible);
    (translate-fecn-and-becn | no-translate-fecn-and-becn);
    unnumbered-address interface-name destination address destination-profile
        profile-name;
    address address {
        arp ip-address (mac | multicast-mac) mac-address <publish>;
        broadcast address;
        destination address;
        eui-64;
        master-only;
        multipoint-destination address (dlci dlci-identifier | vci vci-identifier);
        multipoint-destination address {
            epd-threshold cells plp1 cells;
            inverse-arp;
            oam-liveness {
                up-count cells;
                down-count cells;
            }
            oam-period (disable | seconds);
            shaping {
                (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained
                    rate burst length);
                queue-length number;
            }
            vci vpi-identifier.vci-identifier;
        }
        preferred;
        primary;
        (vrrp-group | vrrp-inet6-group) group-number {
            (accept-data | no-accept-data);
            advertise–interval seconds;
            authentication-type authentication;
            authentication-key key;
            fast-interval milliseconds;
            (preempt | no-preempt) {
                hold-time seconds;
            }
            priority-number number;
            track {
                priority-cost seconds;
                priority-hold-time interface-name {
                    interface priority;
                    bandwidth-threshold bits-per-second {
                        priority;
                    }
                }
            }
            virtual-address [ addresses ];
        }
    }
  }
}
```

Hierarchy Level [edit interfaces *interface-name*],
[edit logical-systems *logical-system-name* interfaces *interface-name*],
[edit interfaces interface-set (Ethernet Interfaces) *interface-set-name* interface *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure a logical interface on the physical device. You must configure a logical interface to be able to use the physical device.

Options *logical-unit-number*—Number of the logical unit.

Range: 0 through 16,384

The remaining statements are explained separately.

Usage Guidelines See "Configuring Logical Interface Properties" on page 135.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS Services Interfaces Configuration Guide*

unnumbered-address

See the following sections:

- unnumbered-address (Demux) on page 1261
- unnumbered-address (Ethernet) on page 1262
- unnumbered-address (PPP) on page 1262

unnumbered-address (Demux)

Syntax unnumbered-address *interface-name* <preferred-source-address *address*>;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet]

Release Information Statement introduced in JUNOS Release 8.2.
preferred-source-address option introduced in JUNOS Release 9.0.
IP demultiplexing interfaces supported in JUNOS Release 9.2.

Description For IP demultiplexing interfaces, enable the local address to be derived from the specified interface. Configuring an unnumbered interface enables IP processing on the interface without assigning an explicit IP address to the interface.

Options *interface-name*—Name of the interface from which the local address is derived. The specified interface must have a logical unit number and a configured IP address, and must not be an unnumbered interface.

The preferred-source-address statement is explained separately.

Usage Guidelines See "Configuring an Unnumbered Interface" on page 176.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics address, *JUNOS System Basics Configuration Guide*

unnumbered-address (Ethernet)

Syntax unnumbered-address *interface-name* <preferred-source-address *address*>;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet]

Release Information Statement introduced in JUNOS Release 8.2.
preferred-source-address option introduced in JUNOS Release 9.0.

Description For Ethernet interfaces, enable the local address to be derived from the specified interface. Configuring an unnumbered Ethernet interface enables IP processing on the interface without assigning an explicit IP address to the interface.

Options *interface-name*—Name of the interface from which the local address is derived. The specified interface must have a logical unit number and a configured IP address, and must not be an unnumbered interface.

The preferred-source-address statement is explained separately.

Usage Guidelines See “Configuring an Unnumbered Interface” on page 176.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics address, *JUNOS System Basics Configuration Guide*

unnumbered-address (PPP)

Syntax unnumbered-address *interface-name* destination *address* destination-profile *profile-name*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family inet],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet]

Release Information Statement introduced before JUNOS Release 7.4.

Description For interfaces with PPP encapsulation, enable the local address to be derived from the specified interface.

Options *interface-name*—Interface from which the local address is derived. The interface name must include a logical unit number and must have a configured address.

The remaining statements are explained separately.

Usage Guidelines See “Configuring IPCP Options” on page 168.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics address, negotiate-address, *JUNOS System Basics Configuration Guide*

up-count

Syntax up-count *cells*;

Hierarchy Level [edit interfaces *interface-name* atm-options vpi *vpi-identifier* oam-liveness],
[edit interfaces *interface-name* unit *logical-unit-number* oam-liveness],
[edit interfaces *interface-name* unit *logical-unit-number* family *family* address *address* multipoint-destination *address* oam-liveness],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* oam-liveness],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family *family* address *address* multipoint-destination *address* oam-liveness]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM encapsulation only, configure Operation, Administration, and Maintenance (OAM) F5 loopback cell count thresholds. Not supported on ATM-over-SHDSL interfaces.

For ATM2 IQ PICs only, configure OAM F4 loopback cell count thresholds at the [edit interfaces *interface-name* atm-options vpi *vpi-identifier*] hierarchy level.

Options *cells*—Minimum number of consecutive OAM F4 or F5 loopback cells received before a VC is declared up.
Range: 1 through 255
Default: 5 cells

Usage Guidelines See “Configuring the ATM OAM F5 Loopback Cell Threshold” on page 316.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

vbr

Syntax vbr peak *rate* sustained *rate* burst *length*;

Hierarchy Level [edit interfaces *interface-name* atm-options vpi *vpi-identifier* shaping],
[edit interfaces *interface-name* unit *logical-unit-number* address *address* family *family* multipoint-destination *address* shaping],
[edit interfaces *interface-name* unit *logical-unit-number* shaping],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* address *address* family *family* multipoint-destination *address* shaping],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* shaping]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM encapsulation only, define the variable bandwidth utilization in the traffic-shaping profile.

When you configure the variable bandwidth utilization, you must specify all three options (burst, peak, and sustained). You can specify *rate* in bits per second either as a complete decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000). You can also specify *rate* in cells per second by entering a decimal number followed by the abbreviation c; values expressed in cells per second are converted to bits per second by means of the formula 1 cps = 384 bps.

Default If the vbr statement is not specified, bandwidth utilization is unlimited.

Options burst *length*—Burst length, in cells. If you set the length to 1, the peak traffic rate is used.
Range: 1 through 4000 cells

peak *rate*—Peak rate, in bits per second or cells per second.
Range: For ATM1 interfaces, 33 Kbps through 135.6 Mbps (ATM OC3); 33 Kbps through 276 Mbps (ATM OC12). For ATM2 IQ OC3 and OC12 interfaces, 33 Kbps through 542,526,792 bps. For ATM2 IQ OC48 interfaces, 33 Kbps through 2,170,107,168 bps. For ATM2 IQ DS3 and E3 interfaces, from 33 Kbps through the maximum rate, which depends on the ATM encapsulation and framing you configure.

For more information, see Table 26 on page 306.

sustained *rate*—Sustained rate, in bits per second or cells per second.
Range: For ATM1 interfaces, 33 Kbps through 135.6 Mbps (ATM OC3); 33 Kbps through 276 Mbps (ATM OC12).

For ATM2 IQ OC3 and OC12 interfaces, 33 Kbps through 542,526,792 bps.

For ATM2 IQ OC48 interfaces, 33 Kbps through 2,170,107,168 bps.

For ATM2 IQ DS3 and E3 interfaces, from 33 Kbps through the maximum rate, which depends on the ATM encapsulation and framing you configure. For more information, see Table 26 on page 306.

Usage Guidelines See “Defining the ATM Traffic-Shaping Profile” on page 305.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics cbr, rtvbr, shaping

vc-cos-mode

Syntax vc-cos-mode (alternate | strict);

Hierarchy Level [edit interfaces *interface-name* atm-options scheduler-maps *map-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM2 IQ interfaces only, specify packet-scheduling priority value for ATM2 IQ VC tunnels.

Options alternate—VC CoS queue has high priority. The scheduling of the queues alternates between the high-priority queue and the remaining queues, so every other scheduled packet is from the high-priority queue.

strict—VC CoS queue has strictly high priority. A queue with strict high priority is always scheduled before the remaining queues. The remaining queues are scheduled in round-robin fashion.
Default: alternate

Usage Guidelines See “Configuring ATM2 IQ VC Tunnel CoS Components” on page 325.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

vci

Syntax vci *vpi-identifier*.*vci-identifier*;

Hierarchy Level [edit interfaces at-*fpc/pic/port* unit *logical-unit-number*],
[edit interfaces at-*fpc/pic/port* unit *logical-unit-number* family *family* address *address* multipoint-destination *address*],
[edit logical-systems *logical-system-name* interfaces at-*fpc/pic/port* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces at-*fpc/pic/port* unit *logical-unit-number* family *family* address *address* multipoint-destination *address*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM point-to-point logical interfaces only, configure the virtual circuit identifier (VCI) and virtual path identifier (VPI).

To configure a VPI for a point-to-multipoint interface, specify the VPI in the multipoint-destination statement.

VCIs 0 through 31 are reserved for specific ATM values designated by the ATM Forum.

Options *vci-identifier*—ATM virtual circuit identifier. Unless you configure the interface to use promiscuous mode, this value cannot exceed the largest numbered VC configured for the interface with the maximum-vcs option of the vpi statement.
Range: 0 through 4089 or 0 through 65,535 with promiscuous mode, with VCIs 0 through 31 reserved.

vpi-identifier—ATM virtual path identifier.
Range: 0 through 255
Default: 0

Usage Guidelines See "Configuring a Point-to-Point ATM1 or ATM2 IQ Connection" on page 303.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics multipoint-destination, promiscuous-mode, vpi

vci-range

Syntax vci-range start *start-vci* end *end-vci*;

Hierarchy Level [edit interfaces at-*fpc/pic/port* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces at-*fpc/pic/port* unit *logical-unit-number*]

Release Information Statement introduced in JUNOS Release 9.0.

Description Range of VCI values used in ATM-to-Ethernet interworking cross-connects. VCI 0 through 31 are reserved. VCI 0 through 31 should not be used.

Options start-vci—Lowest number VCI in the range.

end-vci—Highest number VCI in the range.
Range: 0 through 255

Usage Guidelines See “Configuring ATM-to-Ethernet Interworking” on page 219.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

vlan-id

See the following sections:

vlan-id (VLAN ID to Be Bound to a Logical Interface)

Syntax vlan-id *number*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Fast Ethernet, Gigabit Ethernet, and Aggregated Ethernet interfaces only, bind a 802.1Q VLAN tag ID to a logical interface.

Options *number*—A valid VLAN identifier.

Range: For aggregated Ethernet, 4-port, 8-port, and 12-port Fast Ethernet PICs, and for management and internal Ethernet interfaces, 1 through 1023.

For 48-port Fast Ethernet and Gigabit Ethernet PICs, 1 through 4094.

VLAN ID 0 is reserved for tagging the priority of frames.

Usage Guidelines See “Configuring Mixed Tagging” on page 572.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

vlan-id (Family Bridge)

Syntax vlan-id *number*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family bridge],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family bridge]

Release Information Statement introduced in JUNOS Release 9.2.

Description The VLAN ID configured on the logical port. Received packets with no VLAN tags are forwarded within the bridge domain with the matching VLAN ID.

Options number—The VLAN ID.

Range: 1 through 4095

Usage Guidelines See "Configuring a Logical Interface for Access Mode" on page 589.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

vlan-id (VLAN ID to Rewrite)

Syntax vlan-id *number*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit interfaces *interface-name* unit *logical-unit-number* output-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* input-vlan-map],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* output-vlan-map]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Gigabit Ethernet IQ and 10-Gigabit Ethernet IQ2 and IQ2-E interfaces and aggregated Ethernet using Gigabit Ethernet IQ interfaces, specify the line VLAN identifiers to be rewritten at the input or output interface.

You cannot include the vlan-id statement with the swap statement, swap-push statement, push-push statement, or push-swap statement at the [edit interfaces *interface-name* unit *logical-unit-number* output-vlan-map] hierarchy level. If you include any of those statements in the output VLAN map, the VLAN ID in the outgoing frame is rewritten to the vlan-id statement you include at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level.

Usage Guidelines See "Rewriting the VLAN Tag on Tagged Frames" on page 617 and "Binding VLAN IDs to Logical Interfaces" on page 574.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

vlan-id (Outer VLAN ID)

Syntax vlan-id *outer-vlan-id*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced in JUNOS Release 9.0.

Description The outer VLAN ID to be used in ATM-to-Ethernet interworking cross-connects. Outer VLAN IDs are converted to the ATM VPI. The outer VLAN ID must match the VPI value configured. The allowable VPI range is 0 to 255. Do not configure the outer VLAN ID to be greater than 255.

Options outer-vlan-id—Outer VLAN ID number.
Range: 0 through 4094

Usage Guidelines See “Configuring ATM-to-Ethernet Interworking” on page 219.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

vlan-id-list

See the following sections:

- vlan-id-list on page 1271
- vlan-id-list (Ethernet VLAN Circuit) on page 1272

vlan-id-list

Syntax vlan-id-list [*number number-number*];

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* family bridge],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family bridge]

Release Information Statement introduced in JUNOS Release 9.2.

Description Configure a logical interface to forward packets and learn MAC addresses within each bridge domain configured with a VLAN ID that matches a VLAN ID specified in the list. VLAN IDs can be entered individually using a space to separate each ID, entered as an inclusive list separating the starting VLAN ID and ending VLAN ID with a hyphen, or a combination of both.

Options *number number*—Individual VLAN IDs separated by a space.

number-number—Starting VLAN ID and ending VLAN ID in an inclusive range.
Range: 1 through 4095

Usage Guidelines See "Configuring a Logical Interface for Trunk Mode" on page 590 and "Configuring the VLAN ID List for a Trunk Interface" on page 590.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

vlan-id-list (Ethernet VLAN Circuit)

Syntax vlan-id-list [*vlan-id vlan-id–vlan-id*];

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced in JUNOS Release 9.5.

Description (MX-series routers only) Binds a single-tag logical interface to a list of VLAN IDs. Configures a logical interface to receive and forward any tag frame whose VLAN ID tag matches the list of VLAN IDs you specify.

NOTE:

When you create a circuit cross-connect (CCC) using VLAN-bundled single-tag logical interfaces on Layer 2 VPN routing instances, the circuit automatically uses ethernet encapsulation. For l2vpn, you need to include the encapsulation-type statement and specify the value ethernet at either of the following hierarchy levels:

- [edit routing-instances *routing-instance-name* protocols l2vpn]
- [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn]

For more information about the encapsulation-type configuration statement and the Layer 2 encapsulation types ethernet and ethernet-vlan, see the *JUNOS VPNs Configuration Guide*.

Options [*vlan-id vlan-id–vlan-id*]—A list of valid VLAN ID numbers. Specify the VLAN IDs individually by using a space to separate each ID, as an inclusive list by separating the starting VLAN ID and ending VLAN ID with a hyphen, or as a combination of both.
Range: 1 through 4094. VLAN ID 0 is reserved for tagging the priority of frames.

Usage Guidelines See “Binding VLAN IDs to Logical Interfaces” on page 574.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics

- encapsulation (Logical Interface)
- encapsulation (Physical Interface)
- encapsulation-type (Layer 2 VPN routing instance)
- flexible-vlan-tagging
- vlan-tagging
- vlan-tags (inner-list/ inner vlan-tag bundle)

vlan-id-range

Syntax [edit interfaces *interface-name* unit *logical-unit-number* family bridge],

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced in JUNOS Release 8.4.

Description Bind a range of VLAN IDs to a logical interface.

Options number—The first number is the lowest VLAN ID in the range the second number is the highest VLAN ID in the range.
Range: 1 through 4095

VLAN ID 0 is reserved for tagging the priority of frames.

Usage Guidelines See "Binding a Range of VLAN IDs to a Logical Interface" on page 576.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

vlan-ranges

Syntax

```
vlan-ranges {
    dynamic-profile profile-name {
        accept (inet);
        ranges (any | low-tag) - (any | high-tag);
    }
}
```

Hierarchy Level [edit interfaces *interface-name* dynamic-profile *profile-name*]

Release Information Statement introduced in JUNOS Release 9.5.

Description Configure multiple VLANs. Each VLAN is assigned a VLAN ID number from the range.

Options any—Any valid VLAN ID number.

vlan-id-low—Specify the first VLAN ID number for the group of VLANs.

vlan-id-high—Specify the last VLAN ID number for the group of VLANs.
Range: 1 through 4094

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing–control—To add this statement to the configuration.

Related Topics

- Configuring Single-Level VLAN Ranges for Use with VLAN Dynamic Profiles
- Configuring Dynamic Mixed VLAN Ranges

vlan-rewrite

Syntax vlan-rewrite translate (200 500 | 201 501)

Hierarchy Level [edit interfaces *interface-name* unit *number* family bridge interface-mode trunk]

Description Translates incoming VLAN to a bridge-domain VLAN, corresponding counter translation at egress. Supports translation of vlan 200 to vlan 500 and vlan 201 to vlan 501. Other valid vlan pass through without translation.

Options translate 200 500—translates incoming packets with vlan 200 to 500

translate 201 501—translates incoming packets with vlan 201 to 501

translate 202 502—translates incoming packets with vlan 202 to 502

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

vlan-tagging

Syntax vlan-tagging;

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Fast Ethernet and Gigabit Ethernet interfaces and aggregated Ethernet interfaces configured for VPLS, enables the reception and transmission of 802.1Q VLAN-tagged frames on the interface.

Usage Guidelines See “Configuring 802.1Q VLANs” on page 569 and “Configuring Tagged Aggregated Ethernet Interfaces” on page 602.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

vlan-tags

See the following sections:

- vlan-tags on page 1276
- vlan-tags (inner-list/ inner vlan-tag bundle) on page 1277

vlan-tags

Syntax vlan-tags inner *tpid*.*vlan-id* inner-range *vid1–vid2* outer *tpid*.*vlan-id*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For Gigabit Ethernet IQ and IQE interfaces only, binds TPIDs and 802.1Q VLAN tag IDs to a logical interface. You must include the stacked-vlan-tagging statement at the [edit interfaces *interface-name*] hierarchy level.

NOTE: The inner-range *vid1–vid2* option is supported on MX-series with IQE PICs only.

Options inner *tpid*.*vlan-id*—A TPID and a valid VLAN identifier.
Range: For VLAN ID, 1 through 4094. VLAN ID 0 is reserved for tagging the priority of frames.

inner-range *vid1–vid2*—For MX-series routers with Enhanced IQ (IQE) PICs only; specify a range of VLAN IDs where vid1 is the start of the range and vid2 is the end of the range.
Range: For VLAN ID, 1 through 4094. VLAN ID 0 is reserved for tagging the priority of frames.

outer *tpid*.*vlan-id*—A TPID and a valid VLAN identifier.
Range: For VLAN ID, 1 through 511 for normal interfaces, and 512 through 4094 for VLAN CCC interfaces. VLAN ID 0 is reserved for tagging the priority of frames.

Usage Guidelines See "Configuring Dual VLAN Tags" on page 611.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics stacked-vlan-tagging

vlan-tags (inner-list/ inner vlan-tag bundle)

Syntax vlan-tags outer <*tpid*.>*vlan-id* inner-list [*vlan-id vlan-id–vlan-id*];

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced in JUNOS Release 9.5.

Description (MX-series routers only) Binds a dual-tag logical interface to a list of VLAN IDs. Configures the logical interface to receive and forward any dual-tag frame whose inner VLAN ID tag matches the list of VLAN IDs you specify.

NOTE:

To create a circuit cross-connect (CCC) using VLAN-bundled dual-tag logical interfaces on Layer 2 VPN routing instances, you must include the encapsulation-type statement and specify the value ethernet-vlan at the one of the following hierarchy levels:

- [edit routing-instances *routing-instance-name* protocols l2vpn]
- [edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn]

For more information about the encapsulation-type configuration statement and the Layer 2 encapsulation types ethernet and ethernet-vlan, see the *JUNOS VPNs Configuration Guide*.

Options outer <*tpid*.>*vlan-id*—An optional Tag Protocol ID (TPID) and a valid VLAN ID.
Range: For TPID, specify a hexadecimal value in the format 0x*nnnn*.
Range: For VLAN ID, 1 through 4094. VLAN ID 0 is reserved for tagging the priority of frames.

inner-list [*vlan-id vlan-id vlan-id-vlan-id*]—A list of valid VLAN ID numbers. Specify the VLAN IDs individually by using a space to separate each ID, as an inclusive list by separating the starting VLAN ID and ending VLAN ID with a hyphen, or as a combination of both.
Range: 1 through 4094. VLAN ID 0 is reserved for tagging the priority of frames.

Usage Guidelines See “Binding VLAN IDs to Logical Interfaces” on page 574.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics

- encapsulation (Logical Interface)
- encapsulation (Physical Interface)
- encapsulation-type (Layer 2 VPN routing instance)
- flexible-vlan-tagging
- vlan-id-list (Ethernet VLAN Circuit)

- vlan-tagging

vlan-tags-outer

Syntax vlan-tags-outer *vlan-tag*;

Hierarchy Level [edit interfaces interface-set (Ethernet Interfaces) *interface-set-name* interface *interface-name*]

Release Information Statement introduced in JUNOS Release 8.5.

Description The S-VLAN outer tag that belongs to a set of interfaces used to configure hierarchical CoS schedulers.

Usage Guidelines See the *JUNOS Class of Service Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

vlan-vci-tagging

Syntax vlan-vci-tagging;

Hierarchy Level [edit interfaces *interface-name*],
[edit logical-systems *logical-system-name* interfaces *interface-name*]

Release Information Statement introduced in JUNOS Release 9.0.

Description Enable the ATM-to-Ethernet interworking cross-connect function on a Gigabit Ethernet, 10-Gigabit Ethernet, or aggregated Ethernet interface.

Usage Guidelines See “Configuring ATM-to-Ethernet Interworking” on page 219.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

vpi

See the following sections:

- vpi (ATM CCC Cell-Relay Promiscuous Mode) on page 1279
- vpi (Define Virtual Path) on page 1280
- vpi (Logical Interface and Interworking) on page 1281

vpi (ATM CCC Cell-Relay Promiscuous Mode)

Syntax vpi *vpi-identifier*;

Hierarchy Level [edit interfaces at-*fpc/pic/port* atm-options promiscuous-mode]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM interfaces, allow all VCIs in this VPI to open in ATM CCC cell-relay mode.

When you include vpi statements at the [edit interfaces *interface-name* atm-options promiscuous-mode] hierarchy level, the specified VPIs open in promiscuous mode.

Options *vpi-identifier*—ATM virtual path identifier. This is one of the VPIs that you define in the vci statement. (For a list of hierarchy levels at which you can include the vci statement, see vci.)

Range: 0 through 255

Usage Guidelines See "Configuring ATM Cell-Relay Promiscuous Mode" on page 282.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

vpi (Define Virtual Path)

Syntax

```
vpi vpi-identifier {
  maximum-vcs maximum-vcs;
  oam-liveness {
    up-count cells;
    down-count cells;
  }
  oam-period (disable | seconds);
  shaping {
    (cbr rate | rtvbr peak rate sustained rate burst length | vbr peak rate sustained rate
      burst length);
    queue-length number;
  }
}
```

Hierarchy Level [edit interfaces at-*fpc/pic/port* atm-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For ATM interfaces, configure the virtual path (VP).

Options *vpi-identifier*—ATM virtual path identifier. This is one of the VPIs that you define in the vci statement. (For a list of hierarchy levels at which you can include the vci statement, see vci.)

Range: 0 through 255

The remaining statements are explained separately.

Usage Guidelines See “Configuring the Maximum Number of ATM1 VCs on a VP” on page 286.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics multipoint-destination, promiscuous-mode, vci

vpi (Logical Interface and Interworking)

Syntax vpi *virtual-path-identifier*;

Hierarchy Level [edit interfaces at-*fpc/pic/port* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces at-*fpc/pic/port* unit *logical-unit-number*]

Release Information Statement introduced in JUNOS Release 9.0.

Description VPI used in an ATM-to-Ethernet interworking cross-connect.

Options virtual-path-identifier—VPI to be used.
Range: 0 through 255

Usage Guidelines See "Configuring ATM-to-Ethernet Interworking" on page 219 and "Configuring ATM Cell-Relay Promiscuous Mode" on page 282.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

vtmapping

Syntax vtmapping (itu-t | klm);

Hierarchy Level [edit interfaces *interface-name* sonet-options];
[edit chassis fpc *number* pic *number*]

Release Information Statement introduced before JUNOS Release 7.4.

Description For the Channelized STM1 IQ PIC or Channelized STM1 PIC, configure virtual tributary mapping.

For the Channelized STM1 PIC, you configure virtual tributary mapping at the [edit chassis fpc *number* pic *number*] hierarchy level.

Options itu-t—International Telephony Union standard

klm—KLM standard
Default: klm

Usage Guidelines See "Configuring Virtual Tributary Mapping of Channelized STM1 Interfaces" on page 456.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *JUNOS System Basics Configuration Guide*

watch-list

Syntax

```
watch-list {
    [ routes ];
}
```

Hierarchy Level [edit interface dl*n* unit *logical-unit-number* dialer-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description (J-series Services Routers) For ISDN interfaces, configure an ISDN list of routes to watch. Used only for dialer watch.

Options *routes*—IP prefix of a route. Specify one or more. The primary interface is considered up if there is at least one valid route for any of the addresses in the watch list to an interface other than the backup interface.

Usage Guidelines See "Configuring Dialer Watch" on page 789.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics *J-series Services Router Basic LAN and WAN Access Configuration Guide*

wavelength

Syntax wavelength *nm*;

Hierarchy Level [edit interfaces *interface-name* optics-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For 10-Gigabit Ethernet DWDM interfaces only, configure full C-band ITU-Grid tunable optics.

Options *nm*—Wavelength value. It can be one of the following:

- 1528.77—1528.77 nanometers (nm), corresponds to 196.10 terahertz (THz)
- 1529.55—1529.55 nm, corresponds to 196.00 THz
- 1530.33—1530.33 nm, corresponds to 195.90 THz
- 1531.12—1531.12 nm, corresponds to 195.80 THz
- 1531.90—1531.90 nm, corresponds to 195.70 THz
- 1532.68—1532.68 nm, corresponds to 195.60 THz
- 1533.47—1533.47 nm, corresponds to 195.50 THz
- 1534.25—1534.25 nm, corresponds to 195.40 THz
- 1535.04—1535.04 nm, corresponds to 195.30 THz
- 1535.82—1535.82 nm, corresponds to 195.20 THz
- 1536.61—1536.61 nm, corresponds to 195.10 THz
- 1537.40—1537.40 nm, corresponds to 195.00 THz
- 1538.19—1538.19 nm, corresponds to 194.90 THz
- 1538.98—1538.98 nm, corresponds to 194.80 THz
- 1539.77—1539.77 nm, corresponds to 194.70 THz
- 1540.56—1540.56 nm, corresponds to 194.60 THz
- 1541.35—1541.35 nm, corresponds to 194.50 THz
- 1542.14—1542.14 nm, corresponds to 194.40 THz
- 1542.94—1542.94 nm, corresponds to 194.30 THz
- 1543.73—1543.73 nm, corresponds to 194.20 THz
- 1544.53—1544.53 nm, corresponds to 194.10 THz
- 1545.32—1545.32 nm, corresponds to 194.00 THz
- 1546.12—1546.12 nm, corresponds to 193.90 THz
- 1546.92—1546.92 nm, corresponds to 193.80 THz
- 1547.72—1547.72 nm, corresponds to 193.70 THz

- 1548.52—1548.52 nm, corresponds to 193.60 THz
- 1549.32—1549.32 nm, corresponds to 193.50 THz
- 1550.12—1550.12 nm, corresponds to 193.40 THz
- 1550.92—1550.92 nm, corresponds to 193.30 THz
- 1551.72—1551.72 nm, corresponds to 193.20 THz
- 1552.52—1552.52 nm, corresponds to 193.10 THz
- 1553.33—1553.33 nm, corresponds to 193.00 THz
- 1554.13—1554.13 nm, corresponds to 192.90 THz
- 1554.94—1554.94 nm, corresponds to 192.80 THz
- 1555.75—1555.75 nm, corresponds to 192.70 THz
- 1556.56—1556.56 nm, corresponds to 192.60 THz
- 1557.36—1557.36 nm, corresponds to 192.50 THz
- 1558.17—1558.17 nm, corresponds to 192.40 THz
- 1558.98—1558.98 nm, corresponds to 192.30 THz
- 1559.79—1559.79 nm, corresponds to 192.20 THz
- 1560.61—1560.61 nm, corresponds to 192.10 THz
- 1561.42—1561.42 nm, corresponds to 192.00 THz
- 1562.23—1562.23 nm, corresponds to 191.90 THz
- 1563.05—1563.05 nm, corresponds to 191.80 THz
- 1563.86—1563.86 nm, corresponds to 191.70 THz
- **Default:** 1550.12—1550.12 nm, corresponds to 193.40 THz

Usage Guidelines See "Configuring the 10-Gigabit Ethernet DWDM Interface Wavelength" on page 733.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

west-interface

Syntax

```
west-interface {
    control-channel channel-name {
        vlan number;
    }
}
```

Hierarchy Level [edit protocols protection-group ethernet-ring *ring-name*]

Description For Ethernet ring protection, each ring should have two interface ports; an east-interface and a west-interface.

NOTE: Always configure the east-interface first, before configuring the west-interface.

The interface must use the control channel's logical interface name. The control channel is a dedicated VLAN channel for the ring port.

Options ring-protection-link-end—If this port is one side of RPL, this flag should be set.

Usage Guidelines See "Configuring Ethernet Ring Protection Switching" on page 753.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics ethernet-ring

working-circuit

Syntax working-circuit *group-name*;

Hierarchy Level [edit interfaces *interface-name* sonet-options aps]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure the working router in an APS circuit pair.

Options *group-name*—Circuit's group name.

Usage Guidelines See "Configuring Basic APS Support" on page 815.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics protect-circuit

yellow-differential-delay

Syntax yellow-differential-delay *milliseconds*;

Hierarchy Level [edit interfaces *interface-name* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description For link services and voices interfaces only, configure the yellow differential delay among bundle links to give warning when a link has a differential delay that exceeds the configured threshold.

Options *milliseconds*—Yellow differential delay threshold.

Range: 1 through 2000 milliseconds

Default: 6 milliseconds

Usage Guidelines See the *JUNOS Services Interfaces Configuration Guide*.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics action-red-differential-delay, remote

z0-increment

Syntax (z0-increment | no-z0-increment);

Hierarchy Level [edit interfaces *interface-name* sonet-options]

Release Information Statement introduced before JUNOS Release 7.4.

Description Configure an incrementing STM ID rather than a static one.

Usage Guidelines See "Configuring an Incrementing STM ID" on page 804.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Topics sonet-options

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