Chapter 11
Configure ATM 1 and ATM 2 Interfaces

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 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; in effect making 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 router, which means that only the two devices connected by the VCI or VPI need know the details of the connection. In a typical ATM network, user data might traverse multiple connections, using many different VPI and VCI connections. Each end device, just as each device in the network, needs to know only the VCI and VPI information for the path to the next device.

With ATM 2 interfaces, you can configure virtual path (VP) shaping and operation, administration, and maintenance (OAM) F4 cell flows.

This chapter is organized as follows:

ATM 1 Physical and Logical Interface Properties on page 118

ATM 2 Physical and Logical Interface Properties on page 120

Configure ATM 1 and ATM 2 Physical Interface Properties on page 125

Configure ATM 1 and ATM 2 Logical Interface Properties on page 135

Configure ATM 1 and ATM 2 Interface Encapsulation on page 146

Configure E3 and T3 Parameters on ATM 1 Interfaces on page 153

Configure SONET/SDH Parameters on ATM 1 and ATM 2 Interfaces on page 154

Configure ATM 2 VC Tunnel CoS Components on page 155

Examples: Configure ATM 1 Interfaces on page 158

Examples: Configure ATM 2 Interfaces on page 161

For configuration differences between ATM 1 and ATM 2 interfaces, see Table 12 on page 122.

ATM 1 Physical and Logical Interface Properties

To configure ATM 1 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:

```
[edit interfaces at-fpc/pic/port]
atm-options {
    ilmi;
    pic-type atm1;
    promiscuous-mode {
        [vpi vpi-identifier];
    }
    vpi vpi-identifier {
        maximum-vcs maximum-vcs;
    }
}
e3-options {
    atm-encapsulation (plcp | direct);
    buildout feet;
    framing (g.751 | g.832);
    loopback (local | remote);
    (payload-scrambler | no-payload-scrambler);
}
t3-options {
    atm-encapsulation (plcp | direct);
    buildout feet;
    (cbit-parity | no-cbit-parity);
    loopback (local | remote);
    (payload-scrambler | no-payload-scrambler);
}
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;
    }
    fcs (32 | 16);
    loopback (local | remote);
    path-trace trace-string;
    (payload-scrambler | no-payload-scrambler);
    rfc-2615;
    (z0-increment | no-z0-increment);
}
```

ATM 1 logical interface properties

To configure ATM 1 logical interface properties, include the following 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]
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 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;
    }
}
```

ATM 2 Physical and Logical Interface Properties

To configure ATM 2 physical interface properties, include the atm-options and sonet-options statements at the [edit interfaces at-*fpc*/*pic*/*port*] hierarchy level:

```
[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;
    }
    pic-type atm2;
    promiscuous-mode {
        [vpi vpi-identifier];
    }
    scheduler-maps map-name {
        forwarding-class class-name {
            priority (low | high);
            transmit-weight (cells number | percent number);
            (epd-threshold cells | linear-red-profile profile-name);
        }
        vc-cos-mode (alternate | strict);
    }
    vpi vpi-identifier {
        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);
        }
    }
}
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;
    }
    fcs (32 | 16);
    loopback (local | remote);
    path-trace trace-string;
    (payload-scrambler | no-payload-scrambler);
    rfc-2615;
    (z0-increment | no-z0-increment);
}
```

ATM 2 logical interface properties

To configure ATM 2 logical interface properties, include the following 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]
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);
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;
family inet address address {
    multipoint-destination 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;
    }
}
```

Table 12 lists differences between ATM 1 and ATM 2 interfaces.

Table 12: ATM 1 and ATM 2 Configuration Differences

Item	ATM 1	ATM 2	Comments
Encapsulation and Transport Modes			
ATM Adaptation Layer 5 (AAL5) CCC	Supported	Supported	For ATM 1 and ATM 2 PICs, you can configure any combination of AAL5 CCC, non-promiscuous cell relay, and AAL5 PVCs on the same PIC at the same time. See “Configure ATM 1 and ATM 2 Interface Encapsulation” on page 146.
Cell-Relay accumulation mode: The incoming cells (1 to 8) are packaged into a single packet and forwarded to the LSP.	Supported	Not supported	Cell-relay accumulation mode is per PIC, not per port. If you configure accumulation mode, the entire ATM 1 PIC uses the configured mode. See “Configure ATM 1 and ATM 2 Interface Encapsulation” on page 146.
Cell-Relay promiscuous port mode: All cells in the range 0 through 65,535 of all VPIs (0 through 255) are sent to or received from an LSP.	Supported	Supported	For multiport PICs, you must configure all ports in either promiscuous mode or non-promiscuous mode. For promiscuous mode, you must configure all ports with atm-ccc-cell-relay encapsulation. When in promiscuous mode, no other non-promiscuous cell relay, AAL5 CCC, AAL5 PVCs, or Layer 2 Circuit modes are supported on the PIC at the same time. For ATM 1 and ATM 2 PICs, you can configure both VPI and port modes on different physical interfaces on the same PIC. See “Configure ATM 1 and ATM 2 Cell-Relay Promiscuous Mode” on page 127.
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.	Supported	Supported	
Cell-relay VCI mode: All cells in a VCI are sent to or received from an LSP	Supported	Supported	For ATM 1 PICs, non-promiscuous cell-relay VCI, VPI and port modes are supported on the same PIC with ATM AAL5 PVCs or ATM AAL5 CCC. For ATM 2 PICs, non-promiscuous cell-relay VCI mode is supported on the same PIC with ATM AAL5 PVCs or ATM AAL5 CCC. See “Configure ATM 1 and ATM 2 Interface Encapsulation” on page 146.
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	
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	
Ethernet over ATM encapsulation: Allows ATM interfaces to connect to devices that support only bridged-mode protocol data units (PDUs).	Supported	Supported	See “Configure ATM 1 and ATM 2 Interface Encapsulation” on page 146.

Item	ATM 1	ATM 2	Comments
Layer 2 circuit cell-relay and Layer 2 circuit AAL5 transport modes: Allow you to send ATM cells or AAL5 PDUs between ATM 2 interfaces across a Layer 2 circuit-enabled network. Layer 2 circuits are designed to transport Layer 2 frames between provider edge (PE) routers across a Label Distribution Protocol (LDP)-signaled MPLS backbone.	Not supported	Supported	Transport mode is per PIC, not per port. If you configure Layer 2 circuit cell-relay or Layer 2 circuit AAL5 transport mode, the entire ATM 2 PIC uses the configured transport mode. Layer 2 Circuit cell-relay mode supports both VP- and port-promiscuous modes. See “Configure ATM 2 Layer 2 Circuit Transport Mode” on page 130 and “Configure ATM 2 Layer 2 Circuit Cell-Relay Promiscuous Mode” on page 132.
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 Internet Softw are Guide: VPNs* .
PPP over ATM encapsulation: Associates a PPP link with an ATM AAL5 PVC	Not supported	Supported	For ATM 2 interfaces, the JUNOS software supports three PPP over ATM encapsulation types: atm-ppp-llc—PPP over ATM adaptation layer 5 (AAL5) logical link control (LLC). atm-ppp-vc-mux—PPP over ATM adaptation layer 5 (AAL5) multiplex. atm-mlppp-llc—Multilink PPP over ATM adaptation layer 5 (AAL5) logical link control (LLC). Requires a Link Services PIC. See “Configure PPP over ATM 2 Encapsulation” on page 150.
OAM F4 Cell Flows: Identify and report virtual path connection (VPC) defects and failures.	Not supported	Supported	See “Configure the ATM 2 OAM F4 Cell Flows” on page 133.
OAM F5 Loopback Cell Responses	Supported	Supported	For ATM 1 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 ATM 2 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 “Define the ATM 1 and ATM 2 OAM F5 Loopback Cell Period” on page 144 and “Configure the ATM 1 and ATM 2 OAM F5 Loopback Cell Threshold” on page 145.
PIC Type	Supported	Supported	For ATM 1 interfaces, you can include the pic-type atm1 statement. For ATM 2 interfaces, you can include the pic-type atm2 statement. See “Configure the ATM 1 and ATM 2 PIC Type” on page 126.

Item	ATM 1	ATM 2	Comments
Ping	Supported	Supported	For ATM 1 and ATM 2 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 Operational Mode Command Reference: Protocols, Class of Service, Chassis, and Management*.
Queue Length: Limits the queue size in packets of a particular VC	Supported	Not Supported	See "Configure the ATM 1 Queue Length" on page 142.
EPD Threshold: Limits the queue size in ATM cells of a particular VC or forwarding class configured over a VC when using VC Tunnel 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 "Configure the ATM 2 EPD Threshold" on page 143 and "Configure ATM 2 VC Tunnel CoS Components" on page 155.
Real-time VBR: Supports variable bit rate 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 "Configure ATM 2 Real-Time VBR" on page 139.
VC Tunnel CoS: Allows VCs to be opened as VC tunnels.	Not supported	Supported	A VC tunnel can support four CoS queue. Within the VC tunnel, the class-based weighted fair queueing 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 "Configure ATM 2 VC Tunnel CoS Components" on page 155.

Item	ATM 1	ATM 2	Comments
VCI Management	Supported. 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*.	Supported. You must not include the maximum-vcs statement in the configuration. All ATM 2 interfaces support VCI numbers in the range 0 through 65,535.	For ATM 1 interfaces, the allowable maximum number of VCs differs by interface type: ATM T3 and E3—4090 ATM OC-3—8180 ATM OC-12—16,360 See “Configure the Maximum Number of ATM 1 VCs on a VP” on page 129. For ATM 2 interfaces, the total number of VCIs that you can open on an ATM 2 port depends on two factors: Number of tunnels Sparseness of VCI numbers (the more sparse, the fewer VCIs supported) For ATM 1 and ATM 2 interfaces with promiscuous mode, the allowable maximum number of VCIs is 65,535.
VCI Statistics	Supported	Supported	For ATM 1 interfaces, multipoint VCI statistics are collected from indirect sources. For ATM 2 interfaces, multipoint VCI statistics are collected directly from the PIC. For ATM 1 and ATM 2 interfaces, point-to-point VCI statistics are the same as logical interface statistics.

Configure ATM 1 and ATM 2 Physical Interface Properties

You can configure the following ATM 1- and ATM 2-specific physical interface properties:

- Configure Communication with Directly Attached ATM 1 and ATM 2 Switches on page 126
- Configure the ATM 1 and ATM 2 PIC Type on page 126
- Configure ATM 1 and ATM 2 Cell-Relay Promiscuous Mode on page 127

You can configure the following ATM 1-specific property:

- Configure the Maximum Number of ATM 1 VCs on a VP on page 129

You can configure the following ATM 2-specific properties:

- Configure ATM 2 Layer 2 Circuit Transport Mode on page 130
- Configure ATM 2 Layer 2 Circuit Cell-Relay Promiscuous Mode on page 132
- Configure the ATM 2 Layer 2 Circuit Cell-Relay Cell Maximum on page 133
- Configure the ATM 2 OAM F4 Cell Flows on page 133
- Define Virtual Path Tunnels on ATM 2 Interfaces on page 134

Configure Communication with Directly Attached ATM 1 and ATM 2 Switches

For ATM 1 and ATM 2 interfaces, you can configure communication to directly attached ATM switches to enable querying of the IP addresses and switch port numbers. You query the switch by entering the following show command:

```
user@host> show ilmi interface interface-name
```

The router uses VC 0.16 to communicate with the ATM switch.

To configure communication between the router and its directly attached ATM switches, include the ilmi statement at the [edit interfaces *interface-name* atm-options] hierarchy level:

```
[edit interfaces interface-name atm-options]
ilmi;
```

Configure the ATM 1 and ATM 2 PIC Type

For ATM 1 and ATM 2 interfaces, the JUNOS software does not determine from the interface name at-*fpc*/*pic*/*port* whether your router has an ATM 1 or ATM 2 PIC installed. You can configure the PIC type as ATM 1 or ATM 2 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 ATM 1 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 ATM 2 interface, and sets the PIC type option accordingly.

If you include the promiscuous-mode statement in the configuration of an ATM 2 interface, you must also include the pic-type atm2 statement.

Example: Configure the ATM 1 and ATM 2 PIC Type

Configure the PIC type on an ATM 1 and an ATM 2 interface.

On an ATM 1 interface

```
[edit interfaces]
at-1/0/0 {
    atm-options {
        pic-type atm1;
        vpi 0 maximum-vcs 256;
        vpi 1 maximum-vcs 512;
    }
    ...
}
```

On an ATM 2 interface

```
[edit interfaces]
at-1/1/0 {
    atm-options {
        pic-type atm2;
        vpi 0;
        vpi 2 {
            oam-period 6;
        }
    }
    ...
}
```

Configure ATM 1 and ATM 2 Cell-Relay Promiscuous Mode

For ATM 1 and ATM 2 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.

For ATM 1 and ATM 2 interfaces, changing modes between promiscuous and non-promiscuous causes all physical interfaces to be deleted and re-added.

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];
    }
}
```

For multiport PICs, all ports must be configured in either promiscuous mode or non-promiscuous mode. For promiscuous mode, you must configure all ports with atm-ccc-cell-relay encapsulation.

When you configure interfaces to use promiscuous mode, you cannot configure VCIs.

For the ATM 2 PIC, if you include the promiscuous-mode statement in the configuration, you must also include the pic-type atm2 statement. For more information, see "Configure the ATM 1 and ATM 2 PIC Type" on page 126.

Example: Configure ATM 1 and ATM 2 Cell-Relay Promiscuous Mode

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.

```
[edit interfaces at-1/2/0]
encapsulation atm-ccc-cell-relay;
atm-options {
    promiscuous-mode;
}
unit 0 {
    allow-any-vci;
}
```

Map 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;
        }
    }
}
```

Map a VPI to an LSP

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.

```
[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;
        }
    }
}
```

Configure the Maximum Number of ATM 1 VCs on a VP

For ATM 1 interfaces, you must configure the maximum number of virtual circuits (VCs) allowed on a virtual path (VP) so that sufficient memory on the ATM 1 PIC can be allocated for each VC.

To configure the highest-numbered VCs on a VP, include the vpi and maximum-vcs 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. The highest-numbered VC value you can configure is 4089. For ATM OC-3 interfaces, you can define a maximum of 8180 VCs per interface. For ATM OC-12 interfaces, you can define a maximum of 16,360 VCs per interface. Promiscuous mode removes these limits. For more information, see “Configure ATM 1 and ATM 2 Cell-Relay Promiscuous Mode” on page 127.

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 parameters on ATM interfaces, as described in “Configure SONET/SDH Parameters on ATM 1 and ATM 2 Interfaces” on page 154.

Configure ATM 2 Layer 2 Circuit Transport Mode

On ATM 2 interfaces only, you can configure Layer 2 circuit cell-relay or Layer 2 circuit ATM Adaptation Layer 5 (AAL5) transport mode, as defined in the Internet Engineering Task Force (IETF) document, *Encapsulation Methods for Transport of Layer 2 Frames Over IP and MPLS Networks*.

Layer 2 circuit cell-relay and Layer 2 circuit AAL5 transport modes allow you to send ATM cells between ATM 2 interfaces across a Layer 2 circuit-enabled network. Layer 2 circuits are designed to transport Layer 2 frames between provider edge (PE) routers across a Label Distribution Protocol (LDP)-signaled MPLS backbone. You use Layer 2 circuit AAL5 transport mode to send AAL5 SAR-PDUs (segmentation and reassembly protocol data units) over the Layer 2 circuit.

By default, ATM 2 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 router 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 router segments these packets back into a stream of ATM cells, to be forwarded to the virtual circuit configured for the far-end router.

In Layer 2 circuit cell-relay transport mode, ATM cells are bundled together and transported in packet form to the far-end router, where they are segmented back into individual ATM cells and forwarded to the ATM virtual circuit configured for the far-end router.

The uses for the three 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.

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 AAAL5 mode Layer 2 circuits, the control word carries cell loss priority (CLP) information by default.

To configure Layer 2 circuit AAL5 or Layer 2 circuit cell-relay, you must include the atm-l2circuit-mode statement at the [edit chassis fpc *fpc-slot* pic *pic-slot*] hierarchy level, specifying aal5 or cell; identify the interface as an ATM 2 interface by including the pic-type atm2 statement at the [edit at-*fpc*/*pic*/*port* atm-options] hierarchy level; and include the encapsulation statement at the [edit at-*fpc*/*pic*/*port* unit *logical-unit-number*] hierarchy level, specifying atm-ccc-vc-mux for Layer 2 circuit AAL5 or atm-ccc-cell-relay for Layer 2 circuit cell-relay:

```
[edit chassis fpc slot-number pic pic-number]
atm-l2circuit-mode (cell | aal5);

[edit interfaces interface-name atm-options]
pic-type atm2;

[edit interfaces interface-name unit logical-unit-number]
encapsulation (atm-ccc-vc-mux | atm-ccc-cell-relay);
```

Transport mode is per PIC, not per port. If you do not include the atm-l2circuit-mode statement in the configuration, the ATM 2 PIC uses standard AAL5 transport mode. If you configure Layer 2 circuit cell-relay or Layer 2 circuit AAL5 transport mode, the entire ATM 2 PIC uses the configured transport mode.

For more information about Layer 2 circuits, see the *JUNOS Internet Software Configuration Guide: VPNs* and the *JUNOS Internet Software Configuration Guide: Routing and Routing Protocols*. For a comprehensive example, see the *JUNOS Internet Software Feature Guide*.

Example: Configure ATM 2 Layer 2 Circuit Transport Mode

Configure Layer 2 circuit AAL5 transport mode and cell-relay transport mode:

Configure 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;
   }
}
```

Configure Layer 2 circuit cell-relay transport mode

```
[edit chassis]
fpc 0 {
    pic 1 {
        atm-l2circuit-mode cell;
    }
}

[edit interfaces]
at-0/1/0 {
    atm-options {
        pic-type atm2;
        vpi 0;
    }
    unit 0 {
        encapsulation atm-ccc-cell-relay;
        point-to-point;
        vci 0.32;
    }
}
```

Configure ATM 2 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 “Configure ATM 1 and ATM 2 Cell-Relay Promiscuous Mode” on page 127.

Example: Configure ATM 2 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;
   }
}
```

Configure the ATM 2 Layer 2 Circuit Cell-Relay Cell Maximum

By default, each frame contains up to 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 at the [edit interfaces *interface-name* atm-options] or [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level:

cell-bundle-size *cells*;

The cell bundle size can be in the range 1 through 190.

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 this physical interface. If you include the cell-bundle-size statement at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level, then for this logical interface the configured value overrides the default value.

The transmit rates you configure on the routers at each end of the connection must be the same value.

Configure the ATM 2 OAM F4 Cell Flows

For ATM 2 interfaces, the F4 flow cell is used for management of the VP level. If your router is equipped with an ATM 2 PIC, you can configure OAM F4 cell flows to identify and report virtual path connection (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 Cells

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 time 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 router sends and receives OAM F4 loopback cells.

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 a VPI 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 router 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 AIS or 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 “Examples: Configure ATM 2 Interfaces” on page 161.

Define Virtual Path Tunnels on ATM 2 Interfaces

For ATM 2 interfaces, you can configure shaping on a VPI. When you do this, the VPI is called a VP tunnel. If your router is equipped with an ATM 2 PIC, you can configure VP tunnels and a weight for each VC. 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 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 at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level must also be configured 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 "Define the ATM 1 and ATM 2 Traffic-Shaping Profile" on page 137. For information about ATM 2 shaping values, see "Specify ATM 2 Shaping Values" on page 142.

Configure ATM 1 and ATM 2 Logical Interface Properties

When you use ATM encapsulation on an interface, you must map each logical interface to a virtual circuit identifier (VCI). You can optionally map logical interfaces to a virtual path identifier (VPI).

An ATM interface can be a point-to-point interface or a point-to-multipoint (also called a multipoint nonbroadcast multiaccess [NBMA]) connection.

You can configure the following ATM 1- and ATM 2-specific logical interface properties:

- Configure a Point-to-Point ATM 1 or ATM 2 Connection on page 136
- Configure a Point-to-Multipoint ATM 1 or ATM 2 Connection on page 136
- Configure a Multicast-Capable ATM 1 or ATM 2 Connection on page 137
- Configure Inverse ATM 1 or ATM 2 ARP on page 137
- Define the ATM 1 and ATM 2 Traffic-Shaping Profile on page 137
- Configure the ATM 1 Queue Length on page 142
- Configure the ATM 2 EPD Threshold on page 143
- Configure the ATM 2 Transmission Weight on page 144
- Define the ATM 1 and ATM 2 OAM F5 Loopback Cell Period on page 144
- Configure the ATM 1 and ATM 2 OAM F5 Loopback Cell Threshold on page 145

Configure a Point-to-Point ATM 1 or ATM 2 Connection

For ATM 1 and ATM 2 interfaces, you can configure a VCI and a VPI on a point-to-point ATM interface by including the vci statement at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces interface-name unit logical-unit-number]
vci vpi-identifier.vci-identifier;
```

For each VCI, you configure the VCI and VPI identifiers. The default VPI identifier is 0. For ATM 1 interfaces, the VCI identifier cannot exceed the highest-numbered VC configured for the interface with the vpi statement, as described in "Configure ATM 1 and ATM 2 Physical Interface Properties" on page 125.

VCIs 0 through 31 are reserved for specific ATM values designated by the ATM Forum.

When you are configuring point-to-point connections, the MTU sizes on both sides of the connections must be the same.

Configure a Point-to-Multipoint ATM 1 or ATM 2 Connection

For ATM 1 and ATM 2 interfaces, you can configure a point-to-multipoint (NBMA) ATM connection by including the following statements at the [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* multipoint-destination *destination-address*] hierarchy level:

```
[edit interfaces interface-name unit logical-unit-number family inet address address]
multipoint-destination destination-address {
    epd-threshold cells;
    inverse-arp;
    oam-liveness {
        up-count cells;
        down-count cells;
    }
    oam-period 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;
}
```

address is the interface's address. The address must include the destination prefix (for example, /24).

For each destination, include one multipoint-destination statement. *destination-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.

Configure a Multicast-Capable ATM 1 or ATM 2 Connection

For ATM 1 and ATM 2 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 at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces interface-name unit logical-unit-number]
multicast-vci vpi-identifier.vci-identifier;
```

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.

Configure Inverse ATM 1 or ATM 2 ARP

For ATM 1 and ATM 2 interfaces, you can configure inverse ATM ARP, as described in RFC 2225. When inverse ATM ARP is enabled, the router responds to received Inverse ATM ARP requests by providing IP address information to the requesting ATM device.

The router 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 at the [edit interfaces *interface-name* unit *logical-unit-number*] or [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* multipoint-destination *destination*] hierarchy level:

```
inverse-arp;
```

You must configure ATM LLC-SNAP encapsulation on the logical interface to support inverse ARP. No other ATM encapsulation types are allowed. For more information, see “Configure ATM 1 and ATM 2 Interface Encapsulation” on page 146.

Define the ATM 1 and ATM 2 Traffic-Shaping Profile

When you use an ATM encapsulation on ATM 1 and ATM 2 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 router is equipped with an ATM 2 PIC, each VC can have its own independent shaping parameters. For more information, see “Define Virtual Path Tunnels on ATM 2 Interfaces” on page 134.

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 on a point-to-point interface, include the shaping statement at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces interface-name unit logical-unit-number]
shaping {
   (cbr rate | rtvbr peak rate sustained rate burst length |
            vbr peak rate sustained rate burst length);
   queue-length number;
}
```

The rtvbr statement is supported on ATM 2 PICs only. The queue-length statement is supported on ATM 1 PICs only.

For virtual circuits that are part of a point-to-multipoint interface, include the shaping statement at the [edit interfaces *interface-name* unit *logical-unit-number* family *family* address *address* multipoint-destination *destination-address*] hierarchy level:

```
[edit interfaces interface-name unit logical-unit-number family family address address
multipoint-destination destination-address]
shaping {
   (cbr rate | rtvbr peak rate sustained rate burst length |
            vbr peak rate sustained rate burst length);
   queue-length number;
}
```

The rtvbr statement is supported on ATM 2 PICs only. The queue-length statement is supported on ATM 1 PICs only.

To configure VP tunnels on ATM 2 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;
}
```

When configuring ATM traffic shaping, you can do the following:

Configure ATM 1 and ATM 2 CBR on page 139

Configure ATM 1 and ATM 2 VBR on page 139

Specify ATM 1 Shaping Values on page 140

Specify ATM 2 Shaping Values on page 142

Configure ATM 1 and ATM 2 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 constant bit rate on ATM 1 and ATM 2 interfaces, include the cbr statement at the [edit interfaces *interface-name* unit *logical-unit-number* shaping], [edit interfaces *interface-name* unit *logical-unit-number* family *family* address *address* multipoint-destination *destination-address* shaping], or [edit interfaces *interface-name* atm-options vpi *vpi-identifier* shaping] hierarchy level:

```
cbr rate;
```

Configure ATM 2 Real-Time VBR

By default, ATM interfaces use unspecified bit rate (UBR); that is, bandwidth utilization is unlimited. For ATM 2 interfaces only, you can configure real-time variable bit rate (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 at the [edit interfaces *interface-name* unit *logical-unit-number* shaping], [edit interfaces *interface-name* unit *logical-unit-number* family *family* address *address* multipoint-destination *destination-address* shaping], or [edit interfaces *interface-name* atm-options vpi *vpi-identifier* shaping] hierarchy level:

```
rtvbr peak rate sustained rate burst length;
```

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.

Configure ATM 1 and ATM 2 VBR

By default, ATM interfaces use unspecified bit rate (UBR); that is, bandwidth utilization is unlimited. For ATM 1 and ATM 2 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 variable bandwidth utilization (VBR) on ATM 1 and ATM 2 interfaces, include the vbr statement at the [edit interfaces *interface-name* unit *logical-unit-number* shaping], [edit interfaces *interface-name* unit *logical-unit-number* family *family* address *address* multipoint-destination *destination-address* shaping], or [edit interfaces *interface-name* atm-options vpi *vpi-identifier* shaping] hierarchy level:

```
vbr peak rate sustained rate burst length;
```

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.

Specify ATM 1 Shaping Values

For ATM 1 interfaces, you can specify the rates in bits per second (bps) or cells per second (cps). For OC-3c interfaces, the highest rate is 135,631,698 bps (353,207.55 cps), which corresponds to 100 percent of the available line rate. For OC-12c interfaces, the highest rate is 271,263,396 bps (706,415.09 cps), which corresponds to 50 percent of the available line rate. Table 13 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 OC-12c and OC-3c interfaces. OC-12c interfaces have about four times as many value increments as OC-3c interfaces. For OC-12c rates between 1/2 and 1/128 of the line rate, there are 128 steps between each 1/*n* value. For rates smaller than 1/128, there are (16,384 minus 128) or 16, 256 values. The reason for this is that fractional shaping is ignored at rates below 1/128. This results in about 32,384 distinct rates for OC-12c. For OC-3c, the starting point is full line rate, the fraction/integer breakpoint is about 1/32, and there is a maximum of 4096 scheduler slots, producing about 8032 distinct values.

For ATM 1 interfaces, the actual packet rate on the interface is calculated with the following formula:

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 and ATM (per-cell) overheads. For OC-3c 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 OC-12c 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.

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 13 shows ATM 1 traffic-shaping rates.

Table 13: ATM 1 Traffic-Shaping Rates

Interface Type	Line Rate (bps)	Line Rate (cps)	Percentage of Total Line Rate
OC-3			
	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
OC-12			
	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
	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: Specify A TM 1 Shaping Values

Determine the actual rate in ATM 1 interfaces when the desired rate is 80 percent of the maximum rate:

OC-3c:
135,600,000 bps * 0.8 = 108,480,000 bps
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

OC-12c:
271,263,396 bps * 0.8 = 217,010,716.8 bps
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

Specify ATM 2 Shaping Values

For ATM 2 OC-3c interfaces, the maximum available rate is 100 percent of line rate, or 135,600,000 bps. For ATM 2 OC-12c interfaces, the maximum available rate is 100 percent of line rate, or 542,546,792 bps. You can specify the rates in bits per second (bps) or cells per second (cps). Fractional shaping is accurate within 0.5 percent of the desired rate.

Configure the ATM 1 Queue Length

ATM 1 PICs contain a transmit buffer pool of 16,382 buffers, which are shared by all the permanent virtual circuits (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 ATM 1 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 starved. 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 at the [edit interfaces *interface-name* unit *logical-unit-number* shaping] or [edit interfaces *interface-name* unit *logical-unit-number* family *family* address *address* multipoint-destination *destination-address* shaping] hierarchy level:

```
queue-length number;
```

The length can range 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 ATM 1 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 ATM 1 interfaces on a PIC, the total number of packets that can be held is:

```
16,382 / ( Round Up ( 4,482 / 480 ) ) = 1,638 packets
```

Thus, you can configure up to 1,638 for the combined queue length of all the PVCs on an ATM 1 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 bits per second / 8)

For example, if you configure a PVC on an ATM 1 interface with the default MTU, a CBR shaping rate of 3,840,000 bps (10,000 cells per second), and a queue length of 25 packets. The maximum lifetime is:

(25 x 4,482) / (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.

Configure the ATM 2 EPD Threshold

By default, the ATM 2 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 starved. This results in head-of-line blocking.

For each PVC, you prevent this situation by configuring the early packet discard (EPD) threshold of the PVC. The EPD threshold is a limit on the number of transmit packets that can be queued. Packets that exceed the limit are discarded.

To set the EPD threshold of a PVC, include the epd-threshold statement at the [edit interfaces *interface-name* unit *logical-unit-number*] or [edit interfaces *interface-name* unit *logical-unit-number* family *family* address *address* multipoint-destination *destination-address*] hierarchy level:

epd-threshold *cells*;

For one-port and two-port OC-12 interfaces, the allowable range is 1 through 425,984 cells. For two-port OC-3 interfaces, the allowable range is 1 through 212,992 cells.

You should include the epd-threshold statement in the configuration of all the PVCs that you configure on an ATM 2 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.

Example: Configure the ATM 2 EPD Threshold

Configure the EPD threshold for a point-to-point ATM 2 interface and a point-to-multipoint ATM 2 interface.

On a point-to-point ATM 2 interface

```
[edit interfaces at-1/0/0]
unit 0 {
  vci 0.123;
  epd-threshold 1300;
  ...
}
```

On a point-to-multipoint ATM 2 interface

```
[edit interfaces at-1/0/1]
unit 0 {
  multipoint;
  family inet address 12.12.12.12/24 {
    multipoint-destination 12.12.12.14 vci 0.123 epd-threshold 1300;
    ...
  }
}
```

Configure the ATM 2 Transmission Weight

For ATM 2 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 at the [edit interfaces *interface-name* unit *logical-unit-number*] or [edit interfaces *interface-name* unit *logical-unit-number* family inet address *address* multipoint-destination *destination*] hierarchy level:

```
transmit-weight cells;
```

The number of cells can range from 1 through 32,000. For a configuration example, see "Examples: Configure ATM 2 Interfaces" on page 161.

Define the ATM 1 and ATM 2 OAM F5 Loopback Cell Period

For ATM 1 and ATM 2 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 on a point-to-point interface, include the oam-period statement at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces interface-name unit logical-unit-number]
oam-period (disable | seconds);
```

To send OAM F5 loopback cells on a virtual circuit that is part of a point-to-multipoint interface, include the oam-period statement at the [edit interfaces *interface-name* unit *logical-unit-number* family *family* address *address* multipoint-destination *destination-address*] hierarchy level:

```
[edit interfaces interface-name unit logical-unit-number family family address address
multipoint-destination destination-address]
oam-period (disable | seconds);
```

The period can range from 1 through 900 seconds. You can also choose the disable option to disable the OAM loopback cell transmit feature.

OAM VC-AIS (alarm indication signal) and VC-RDI (remote defect indication) 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 router 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 router sets the logical interface status to down. When no AIS or RDI cells are received for 3 seconds, the router sets the logical interface status to up. You do not need to configure anything to enable defect indication.

Configure the ATM 1 and ATM 2 OAM F5 Loopback Cell Threshold

For ATM 1 and ATM 2 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 on a point-to-point interface, include the oam-liveness statement at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces interface-name unit logical-unit-number]
oam-liveness {
  up-count cells;
  down-count cells;
}
```

To modify the OAM F5 loopback cell count threshold on a virtual circuit that is part of a point-to-multipoint interface, include the oam-liveness statement at the [edit interfaces *interface-name* unit *logical-unit-number* family *family* address *address* multipoint-destination *destination-address*] hierarchy level:

```
[edit interfaces interface-name unit logical-unit-number family family address address
multipoint-destination destination-address]
oam-liveness {
  up-count cells;
  down-count cells;
}
```

The cell count can be a value from 1 through 255.

Configure ATM 1 and ATM 2 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 a label-switched path (LSP). Traffic on the circuit is ATM cells.

ATM PVC—ATM permanent virtual circuit (PVC) encapsulation is defined in RFC 1483, *Multiprotocol Encapsulation over ATM Adaptation Layer 5*.

Ethernet over ATM—This encapsulation type allows ATM interfaces to connect to devices that support only bridged-mode protocol data units (PDUs).

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 at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level:

```
[edit interfaces interface-name unit logical-unit-number]
encapsulation (atm-ccc-cell-relay | atm-ccc-vc-mux | atm-cisco-nlpid | 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);
```

The ATM encapsulations are defined in RFC 1483, *Multiprotocol Encapsulation over ATM Adaptation Layer 5*.

For ATM interfaces, the logical interface encapsulation can be one of the following:

ATM CCC VC multiplex—Use ATM VC multiplex encapsulation on circuit cross-connect (CCC) circuits. When you use this encapsulation type, you can configure the family ccc only.

ATM NLPID—Use ATM NLPID encapsulation. When you use this encapsulation type, you can configure the family inet only.

ATM SNAP—You can configure ATM SNAP encapsulation.

ATM SNAP encapsulation on translational cross-connect (TCC) circuits—You can configure ATM SNAP encapsulation on TCC circuits.

ATM VC multiplex on TCC circuits—You can configure ATM VC multiplex encapsulation on TCC circuits. When you use this encapsulation type, you can configure the family tcc only.

ATM VC multiplex—When you use this encapsulation type, you can configure the family inet only.

Cisco ATM NLPID—Use Cisco ATM NLPID encapsulation. When you use this encapsulation type, you can configure the family inet only.

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, *Multiprotocol Encapsulation over ATM Adaptation Layer 5*. This encapsulation type is used only on ATM 2 interfaces. When you use this encapsulation type, you cannot configure multipoint interfaces.

Multilink PPP over AAL5 logical link control (LLC)—For ATM 2 interface, you can configure Multilink PPP over AAL5 LLC. This encapsulation type is used only on ATM 2 interfaces. For this encapsulation type, your router must be equipped with a Link Services PIC.

PPP over ATM adaptation layer 5 (AAL5) logical link control (LLC)—For ATM 2 interfaces, you can configure PPP over AAL5 LLC encapsulation.

PPP over ATM adaptation layer 5 (AAL5) multiplex—For ATM 2 interfaces, you can configure PPP over AAL5 multiplex encapsulation.

Cell-relay accumulation mode—For ATM 1 interfaces, you can configure cell-relay accumulation mode (CAM). In this mode, the incoming 1 to 8 cells are packaged into a single packet and forwarded to the label-switched path (LSP). You configure CAM as follows:

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

CAM is not supported on ATM 2 interfaces. For more information about CAM, see the *JUNOS Internet Software Configuration Guide: Getting Started*.

With the atm-nlpid, atm-cisco-nlpid, and atm-vc-mux encapsulations, you can configure the family inet only. With the circuit cross-connect (CCC) circuit encapsulations, you can configure the family ccc only. With the translational cross-connect (TCC) circuit encapsulations, you can configure the family tcc only. With the ether-over-atm-llc, ether-vpls-atm-llc, atm-ppp-llc, atm-ppp-vc-mux encapsulation types, you cannot configure point-to-multipoint interfaces.

Configure an ATM 1 Cell-Relay Circuit

For ATM 1 interfaces, 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 ATM 1 PICs, you use the atm-options statement to control the number and location of VCs. 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. For ATM OC-3 interfaces, you can define a maximum of 8180 VCs per interface. For ATM OC-12 interfaces, you can define a maximum of 16,360 VCs per interface. Promiscuous mode removes these limits. For more information, see "Configure ATM 1 and ATM 2 Cell-Relay Promiscuous Mode" on page 127.

For ATM 1 interfaces, if you are dedicating the entire device to a cell-relay circuit, include the allow-any-vci statement at the [edit interfaces unit 0] hierarchy level:

```
[edit interfaces interface-name unit 0] {
allow-any-vci;
```

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 both the physical and logical encapsulation with 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.

Examples: Configure an ATM 1 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;
}
```

Configure 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;
}
```

Configure non-promiscuous 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;
   }
}
```

Configure non-promiscuous 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;
   }
}
```

Configure non-promiscuous 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
   }
}
```

Configure PPP over ATM 2 Encapsulation

For ATM 2 interfaces, you can configure PPP over ATM adaptation layer 5 (AAL5) encapsulation, as described in RFC 2364. 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 ATM adaptation layer 5 (AAL5) logical link control (LLC).

atm-ppp-vc-mux—PPP over ATM AAL5 multiplex.

atm-mlppp-llc—Multilink PPP over ATM AAL5 LLC. For this encapsulation type, your router must be equipped with a Link Services PIC.

To enable PPP over ATM encapsulation, include the encapsulation statement at the [edit interfaces *interface-name* unit *logical-unit-number*] hierarchy level, specifying the atm-mlppp-llc, atm-ppp-llc, or atm-ppp-vc-mux encapsulation type:

```
[edit interfaces interface-name unit logical-unit-number]
encapsulation (atm-mlppp-llc | atm-ppp-llc | atm-ppp-vc-mux);
```

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 “Configure PPP Challenge Handshake Authentication Protocol” on page 55 and “Configure Keepalives” on page 58.

> **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: Configure PPP over ATM 2 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 192.122.13.13/30;
    }
```

```
    unit 1 {
        encapsulation atm-ppp-vc-mux;
        vci 2.120;
        keepalives interval 6 up-count 6 down-count 4;
        family inet address 192.122.14.13/30;
    }
    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 192.122.15.13/30;
    }
}
```

Configure Multilink PPP over ATM 2 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;
            }
        }
    }
...
}
```

Configure E3 and T3 Parameters on ATM 1 Interfaces

For ATM 1 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 (plcp | direct);
    buildout feet;
    framing (g.751 | g.832);
    loopback (local | remote);
    (payload-scrambler | no-payload-scrambler);
}
t3-options {
    atm-encapsulation (plcp | direct);
    buildout feet;
    (cbit-parity | no-cbit-parity);
    loopback (local | remote);
    (payload-scrambler | no-payload-scrambler);
}
```

Some of the options and default values vary from those described in the E3 and T3 interface sections:

atm-encapsulation—PLCP is the default value. The E3 line-format option g.832 supports direct ATM-encapsulation only.

buildout—The default value is 10 feet. *distance* can be any integer value. The range is 0 through 450 feet.

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 framing.

loopback—The default value is no loopback.

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 PICs. For more information about E3- and T3-specific parameters, see "Configure E3 Interfaces" on page 251 and "Configure T3 Interfaces" on page 395.

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 and for ATM E3, this is G.751 PLCP.

Configure SONET/SDH Parameters on ATM 1 and ATM 2 Interfaces

When configuring ATM 1 and ATM 2 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;
    }
    fcs (32 | 16);
    loopback (local | remote);
    path-trace trace-string;
    (payload-scrambler | no-payload-scrambler);
    rfc-2615;
    (z0-increment | no-z0-increment);
}
```

For information about configuring specific SONET/SDH statements, see “Configure SONET/SDH Interfaces” on page 359.

Configure ATM 2 VC Tunnel CoS Components

The ATM 2 interface allows multiple IP queues into each VC. A VC tunnel can support four class-of-service (CoS) queues. Within a VC tunnel, the weighted round robin (WRR) algorithm schedules the cell transmission of each queue. You can configure the queue admission policies, such as EPD or weighted random early detection (WRED), to control the queue size during congestion.

For information about CoS components that apply generally to all interfaces, see “CoS Overview” on page 575 and “CoS Configuration Guidelines” on page 585.

To configure ATM 2 VC tunnel CoS components, include the following statements at the [edit interfaces at-*fpc*/*pic*/*port*] 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;
    }
    scheduler-maps map-name {
        forwarding-class class-name {
            priority (low | high);
            transmit-weight (cells number | percent number);
            (epd-threshold cells | linear-red-profile profile-name);
        }
        vc-cos-mode (alternate | strict);
    }
}
unit logical-unit-number {
    atm-scheduler-map (map-name | default);
}
```

Linear random early discard (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. You can define the following options for each RED profile:

- 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 1 through 64,000 cells.

- High packet-loss priority (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.

- High packet-loss priority (PLP) maximum 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 maximum 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.

> **Note**
>
> queue-depth, high-plp-threshold, and low-plp-threshold are mandatory statements at the [edit interfaces at-*fpc*/*pic*/*port* atm-options linear-red-profiles *profile-name*] hierarchy level.
>
> In ATM 2 PICs, the cell loss priority (CLP) bit is mapped to the PLP bit at ingress; at egress, the PLP bit is mapped to the CLP bit. You can set PLP by configuring a classifier or policer.

To define a scheduler map, you associate it with a forwarding class. Forwarding classes can be best-effort, expedited-forwarding, assured-forwarding, or network-control, which are associated with the following four queues:

- Queue 0—best-effort

- Queue 1—expedited-forwarding

- Queue 2—assured-forwarding

- Queue 3—network-control

The JUNOS software creates these CoS queues for a VC when you include the atm-scheduler-map statement in the configuration. The JUNOS software prefixes each packet delivered to the VC with the next-hop rewrite data associated with each queue. You can define the following options for each forwarding class:

Priority—Configure high or low queueing priority.

Transmit weight—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.

EPD threshold or linear RED profile—Define an EPD threshold or associate the forwarding class with a linear RED profile.

If the scheduler parameters of the forwarding class are not configured, the following defaults are used:

Priority—High for queue 0, low for the remaining queues.

Transmit weight—95 percent for queue 0, 5 percent for queue 3.

EPD threshold—The EPD threshold is determined by the JUNOS software based on the available bandwidth.

For more information about forwarding classes, see "CoS Configuration Guidelines" on page 585.

VC CoS mode defines the CoS queue scheduling priority. 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.

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. The number of cells transmitted can be slightly over the configured or default transmit weight, because the transmission always ends at a packet boundary.

Example: Configure ATM 2 VC Tunnel CoS Components

Configure ATM 2 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 map1 {
         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 192.1.0.100/32 {
            destination 192.1.0.101;
         }
      }
   }
}
```

Examples: Configure ATM 1 Interfaces

The following configuration is sufficient to get an ATM 1 OC-3 or OC-12 interface up and running. By default, ATM interfaces use ATM PVC encapsulation.

```
[edit]
user@host# set interfaces at-fpc/pic/port atm-options vpi vpi-identifier
   maximum-vcs vcs-value
[edit]
user@host# set interfaces at-fpc/pic/port unit 0 vci vpi-identifier.vci-identifier
[edit]
user@host# set interfaces at-fpc/pic/port unit 0 family inet address local-address
   destination remote-address
[edit]
user@host# set interfaces at-fpc/pic/port unit 1 ...
[edit]
user@host# show
```

```
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 destination-address;
                }
            }
        }
        unit 1 {                        # second VC
            ...
        }
    }
}
```

Following is a more complex configuration example

```
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 192.1.0.3/32 {
                    destination 192.1.0.1;
                }
            }
        }
        unit 3 {
            encapsulation atm-snap;
            vci 0.32;
            oam-period 60;
            family inet {
                mtu 1500;
                address 193.123.4.3/32 {
                    destination 193.123.4.2;
                }
            }
        }
    }
```

```
    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 192.234.5.3/32 {
                    destination 192.234.5.2;
                }
            }
        }
    }
    at-0/3/0 {
        encapsulation atm-pvc;
        atm-options {
            vpi 0 maximum-vcs 1200;
        }
        unit 140 {
            encapsulation atm-snap;
            multipoint;
            family inet {
                address 194.236.7.4/24 {
                    multipoint-destination 194.236.7.5;
                        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;
                }
            }
        }
    }
}
```

Examples: Configure ATM 2 Interfaces

Configure VP tunnel-shaping and OAM F4 on an ATM 2 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;
                }
            }
        }
    }
}
```