Chapter 3
Interfaces Overview

For the interfaces on a router to function, you must configure them, specifying properties such as the interface location (that is, which slot the Flexible PIC Concentrator (FPC) is installed in and which location on the FPC the Physical Interface Card (PIC) is installed in), the interface type (such as SONET or ATM), encapsulation, and interface-specific properties. You can configure the interfaces that are currently present in the router, 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.

This chapter discusses the following topics:

Types of Interfaces

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

- Permanent interfaces—Interfaces that are always present in the router.
- Transient interfaces—Interfaces that can be inserted into or removed from the router depending on your network configuration needs.
- Networking interfaces—Interfaces, such as Ethernet or SONET interfaces, that primarily provide traffic connectivity.
- Services interfaces—Interfaces that provide specific capabilities for manipulating traffic before it is delivered to its destination.

Permanent Interfaces

Each router has two permanent interfaces:

Management Ethernet interface—Provides an out-of-band method for connecting to the router. You can connect to the management interface over the network using utilities such as ssh and Telnet. SNMP can use the management interface to gather statistics from the router.

Internal Ethernet interface—Connects the Routing Engine (the portion of the router running the JUNOS Internet software) to the System Control Board (SCB), the System and Switch Board (SSB), the Forwarding Engine Board (FEB), or the System and Forwarding Module (SFM), depending on router model, which is part of the Packet Forwarding Engine. The router uses this interface as the main communications link between the JUNOS software and the components of the Packet Forwarding Engine and runs the embedded microkernel.

The JUNOS software boots the Packet Forwarding Engine hardware, including the control board (SCB, SSB, FEB, or SFM), FPCs, and PICs. 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 router temperature, the condition of the fans, whether an FPC has been removed or inserted, and information from the craft interface on the LCD display panel. The internal Ethernet interface is configured automatically when the JUNOS software boots.

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

Transient Interfaces

The router contains slots for installing FPC boards, and each FPC can accommodate up to four PICs, which provide the actual physical interfaces to the network. These physical interfaces are the router’s transient interfaces. They are referred to as transient because you can hot-swap an FPC and its PICs at any time.

You can insert any FPC into any of the router’s slots, and you can generally place any combination of PICs in any location on an FPC. (You are limited by the total FPC bandwidth, which cannot exceed the equivalent of an OC-48 link and by the fact that some PICs physically require two or four of the PIC locations on the FPC.)

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 some PICs, the port to which you are connecting.

You can configure the interfaces on PICs that are already installed in the router 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 router, 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:

- ES PIC—Provides a security suite for the IPv4 and IPv6 network layers. The suite provides functionality such as authentication of origin, data integrity, confidentiality, replay protection, and non-repudiation of source. It also defines mechanisms for key generation and exchange, management of security associations, and support for digital certificates.

- Multilink Services and Link 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. The JUNOS software supports two multilink-based services PICs: the Multilink Services PIC and the Link Services PIC.

- Monitoring Services PIC—Enables 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.

- 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).

For detailed information about configuring services, see the *JUNOS Internet Software Configuration Guide: Services Interfaces*.

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 is located

- The location on the FPC in which the PIC is installed

- The PIC 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 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)
- Internet Protocol, version 6 (IPv6)
- 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 UNI NNI (MLFR UNI NNI)
- Multilink PPP (MLPPP)
- Multiprotocol Label Switching (MPLS)
- Trivial Network Protocol (TNP)
- 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 ge-0/0/0.1 where the logical unit number is 1.
- You configure the family descriptor by including the family statement within the family 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 the FPC is located in, the location on the FPC that the PIC is installed in, and the PIC 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 DS-3, E1, OC-12, and STM-1 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. It can be one of the following:

ae—Aggregated Ethernet interface. This is actually a virtual aggregated link and has a different naming format; for more information, see “Configure Aggregated Interfaces” on page 45.

as—Aggregated SONET/SDH interface. This is actually a virtual aggregated link and has a different naming format; for more information, see “Configure Aggregated Interfaces” on page 45.

at—ATM 1 or ATM 2 interface.

cau4—Channelized STM-1 QPP interface (configured on Channelized STM-1 PIC with QPP).

coc1—Channelized OC-1 QPP interface (configured on Channelized OC-12 PIC with QPP).

coc12—Channelized OC-12 QPP interface (configured on Channelized OC-12 PIC with QPP).

cstm1—Channelized STM-1 QPP interface (configured on Channelized STM-1 PIC with QPP).

ct1—Channelized T1 QPP interface (configured on Channelized DS-3 PIC with QPP or Channelized OC-12 PIC with QPP).

ct3—Channelized T3 QPP interface (configured on Channelized DS-3 PIC with QPP or Channelized OC-12 PIC with QPP).

ce1—Channelized E1 QPP interface (configured on Channelized E1 PIC with QPP or Channelized STM-1 PIC with QPP).

ds—DS-0 interface (configured on Channelized DS-3 to DS-0 PIC, Channelized E1 PIC, Channelized OC-12 PIC with QPP, Channelized DS-3 PIC with QPP, Channelized E1 PIC with QPP, or Channelized STM-1 PIC with QPP).

dsc—Discard interface.

e1—E1 interface (including Channelized STM-1 to E1 interfaces).

e3—E3 interface.

es—Encryption interface.

fe—Fast Ethernet interface.

fxp—Management and internal Ethernet interfaces.

ge—Gigabit Ethernet interface.

gr—Generic Route Encapsulation tunnel interface.

gre—This interface is internally generated and not configurable.

ip—IP-over-IP encapsulation tunnel interface.

ipip—This interface is internally generated and not configurable.

lo—Loopback interface.

ls—Link services interface.

lsi—This interface is internally generated and not configurable.

ml—Multilink interface (including Multilink Frame Relay and Multilink PPP).

mo—Monitoring services interface (including monitoring services and monitoring services II).

mt—Multicast tunnel interface (internal router interface for VPNs).

mtun—This interface is internally generated and not configurable.

oc3—OC-3 QPP interface (configured on Channelized OC-12 PIC with QPP).

pe—Encapsulates packets destined for the Rendezvous Point (RP) router. This interface is present on the first-hop router.

pd—De-encapsulates packets at the RP. This interface is present on the RP.

pimd—This interface is internally generated and not configurable.

pime—This interface is internally generated and not configurable.

se—Serial interface (including EIA-530, V.35, and X.21 interfaces).

so—SONET/SDH interface.

sp—Adaptive services interface.

t1—T1 interface (including Channelized DS-3 to DS-1 interfaces).

t3—T3 interface (including Channelized OC-12 to DS-3 interfaces).

tap—This interface is internally generated and not configurable.

vt—Virtual loopback tunnel interface.

fpc identifies the number of the FPC card on which the physical interface is located. Specifically, it is the number of the slot in which the FPC card is installed. M40, M40e, M160, T320, and T640 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. The M20 router 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. M5 and M10 routers do not use FPCs; you install the PICs individually. The M5 router has space for up to four PICs, and the M10 router has space for up to eight PICs.

pic identifies the number of the PIC card on which the physical interface is located. Specifically, it is the number of the PIC location on the FPC. The four PIC slots are numbered 0 through 3. The PIC location is printed on the FPC carrier board. For PICs that occupy more than one PIC location, use the lower location number.

port identifies a specific port on a PIC. The number of ports varies depending on the PIC. The port slot 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 in the range 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

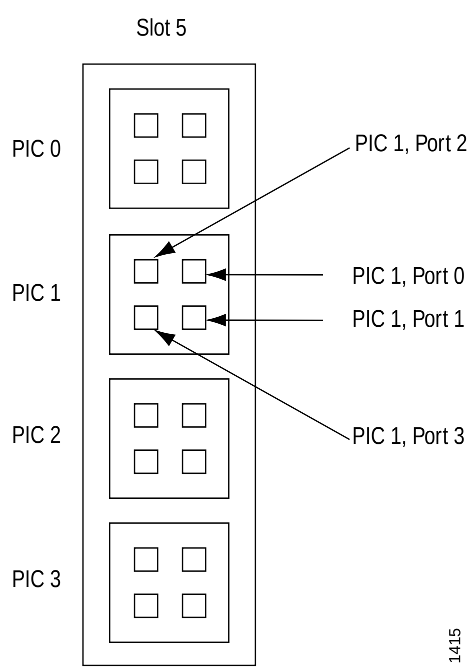
The channel identifier part of the interface name is required only on channelized interfaces. For channelized interfaces, channel 0 identifies the first channelized interface. For channelized QPP interfaces, channel 1 identifies the first channelized interface. A nonconcatenated (that is, channelized) SONET/SDH OC-48 interface has four OC-12 channels, numbered 0 through 3.

To determine which types of channelized PICs are currently installed in the router, use the `show chassis hardware` command from the top level of the CLI. Channelized PICs with QPP are listed in the output with "QPP" in the description. For more information, see "Channelized Interfaces Overview" on page 163.

Examples: Interface Naming

This section provides examples of naming interfaces. See Figure 1 for an illustration of where slots, PICs, and ports are located.

Figure 1: Interface Slot, PIC, and Port Locations



For an FPC in slot 1 with two OC-3 SONET 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 OC-48 SONET FPC 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, the name is:

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

An OC-48 SONET FPC 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 OC-12 PIC in PIC position 2, the DS-3 channels are named:

```
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 OC-12 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
```

How Interface Configurations Are Displayed

When you display a configuration, using 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 router, you can configure the *transmit clock* on each interface; the transmit clock aligns each outgoing packet transmitted over the router's interfaces. For both the router and interfaces, the clock source can be the router's internal stratum 3 clock, which resides on the SCB, SSB, FEB, or MCS (depending on the router model), 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 router'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 2 illustrates the different clock sources.

Figure 2: Clock Sources