Chapter 3

Interfaces Overview

For the interfaces on a routing platform 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/SDH or Asynchronous Transfer Mode [ATM]), encapsulation, and interface-specific properties. You can configure the interfaces that are currently present in the routing platform, and you can also configure interfaces that are not currently present but that you might add in the future. When a configured interface appears, the JUNOS software detects its presence and applies the appropriate configuration to it.

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

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

Permanent Interfaces

Each routing platform has two permanent interfaces:

- Management Ethernet interface—Provides an out-of-band method for connecting to the routing platform. You can connect to the management interface over the network using utilities such as ssh and telnet. Simple Network Management Protocol (SNMP) can use the management interface to gather statistics from the routing platform.

- Internal Ethernet interface—Connects the Routing Engine (the portion of the routing platform running the JUNOS software) to the packet forwarding components on the routing platform.

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

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

Transient Interfaces

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

Services Interfaces

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

- Adaptive Services (AS) PIC—Allows you to provide multiple services on a single PIC by configuring a set of services and applications. The AS PIC offers a special range of services you configure in one or more service sets.

- ES PIC—Provides a security suite for the IP version 4 (IPv4) and IP version 6 (IPv6) network layers. The suite provides functionality such as authentication of origin, data integrity, confidentiality, replay protection, and non-repudiation of source. It also defines mechanisms for key generation and exchange, management of security associations, and support for digital certificates.

- 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. On a Monitoring Services II PIC, you can configure either monitoring interfaces or collector interfaces. A collector interface allows you to combine multiple cflowd records into a compressed ASCII data file and export the file to an FTP server.

- Multilink Services, Link Services, and Voice Services PICs—Enable you to split, recombine, and sequence datagrams across multiple logical data links. The goal of multilink operation is to coordinate multiple independent links between a fixed pair of systems, providing a virtual link with greater bandwidth than any of the members. The JUNOS software supports three multilink-based services PICs: the Multilink Services PIC, the Link Services PIC, and the Voice Services PIC.

- 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 Services Interfaces Configur ation Guide*.

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 virtual local area networks (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:

- IPv4
- 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 user-to-network interface network-to-network interface (MLFR UNI NNI)
- Multilink Point-to-Point Protocol (MLPPP)
- Multiprotocol Label Switching (MPLS)
- Trivial Network Protocol (TNP)
- 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, as shown in the following examples:

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

[edit]
user@host# edit interfaces t3-0/0/0.0

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

- You configure the family descriptor by including the family statement within the unit statement.

- You configure address entries by including the address statement within the family statement.

- You configure tunnels by including the tunnel statement within the unit statement.

Interface Naming

Each interface has an interface name, which specifies the media type, the slot 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 DS3, E1, OC12, and STM1 interfaces.

The following sections provide interface naming configuration guidelines:

Physical Part of an Interface Name

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

type-fpc/pic/port

type is the media type, which identifies the network device. It can be one of the following:

- ae—Aggregated Ethernet interface. This is a virtual aggregated link and has a different naming format; for more information, see “Configuring Aggregated Ethernet Interfaces” on page 392.
- as—Aggregated SONET/SDH interface. This is a virtual aggregated link and has a different naming format; for more information, see “Configuring Aggregated SONET/SDH Interfaces” on page 538.
- at—ATM1 or ATM2 intelligent queuing (IQ) interface.
- cau4—Channelized AU-4 IQ interface (configured on the Channelized STM1 IQ PIC).
- coc1—Channelized OC1 IQ interface (configured on the Channelized OC12 IQ or Channelized OC3 IQ PIC).
- coc3—Channelized OC3 IQ interface (configured on the Channelized OC3 IQ PIC).
- coc12—Channelized OC12 IQ interface (configured on the Channelized OC12 IQ PIC).
- cstm-1—Channelized STM1 IQ interface (configured on the Channelized STM1 IQ PIC).
- ct1—Channelized T1 IQ interface (configured on the Channelized DS3 IQ PIC, Channelized OC3 IQ PIC, or Channelized OC12 IQ PIC).

ct3—Channelized T3 IQ interface (configured on the Channelized DS3 IQ PIC, Channelized OC3 IQ PIC, or Channelized OC12 IQ PIC).

ce1—Channelized E1 IQ interface (configured on the Channelized E1 IQ PIC or Channelized STM1 IQ PIC).

cp—Collector interface (configured on the Monitoring Services II PIC).

ds—DS0 interface (configured on the Multichannel DS3 PIC, Channelized E1 PIC, Channelized OC3 IQ PIC, Channelized OC12 IQ PIC, Channelized DS3 IQ PIC, Channelized E1 IQ PIC, or Channelized STM1 IQ PIC).

dsc—Discard interface.

e1—E1 interface (including channelized STM1-to-E1 interfaces).

e3—E3 interface (including E3 IQ interfaces).

es—Encryption interface.

fe—Fast Ethernet interface.

fxp—Management and internal Ethernet interfaces.

ge—Gigabit Ethernet interface (including Gigabit Ethernet IQ interfaces).

gr—Generic routing encapsulation (GRE) 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. This interface is internally generated. The logical interface lo0.16383 is a non-configurable interface for routing platform control traffic.

ls—Link services interface.

lsi—This interface is internally generated and not configurable.

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

mo—Monitoring services interface (including monitoring services and monitoring services II). The logical interface mo-*fpc*/*pic*/*port*.16383 is an internally generated, non-configurable interface for routing platform control traffic.

mt—Multicast tunnel interface (internal routing platform interface for VPNs).

mtun—This interface is internally generated and not configurable.

oc3—OC3 IQ interface (configured on the Channelized OC12 IQ PIC or Channelized OC3 IQ PIC).

pe—Encapsulates packets destined for the rendezvous point routing platform. This interface is present on the first-hop routing platform.

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

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. The logical interface sp-*fpc*/*pic*/*port*.16383 is an internally generated, non-configurable interface for routing platform control traffic.

t1—T1 interface (including channelized DS3-to-DS1 interfaces).

t3—T3 interface (including channelized OC12-to-DS3 interfaces).

tap—This interface is internally generated and not configurable.

vsp—Voice services interface.

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, M320, 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 routing platform has four FPC slots that are numbered 0 through 3, from top to bottom as you are facing the front of the chassis. The slot number is printed adjacent to each slot. M5, M7i, M10, and M10i routing platforms do not use FPCs; you install the PICs individually. The M5 and M7i routing platforms have space for up to four PICs. The M7i routing platform also comes with an integrated Tunnel PIC or an optional integrated AS PIC. The M10 and M10i routing platforms have space for up to eight PICs. A routing matrix can have up to 32 FPCs (numbered 0 through 31). For more information about interface naming for a routing matrix, see "Interface Naming for a Routing Matrix" on page 33.

pic identifies the number of the PIC on which the physical interface is located. Specifically, it is the number of the PIC location on the FPC. 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 from 0 through 16384.

Separators in an Interface Name

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

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

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

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

Channel Part of an Interface Name

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

To determine which types of channelized PICs are currently installed in the routing platform, use the show chassis hardware command from the top level of the command-line interface (CLI). Channelized IQ PICs are listed in the output with "intelligent queuing" or "IQ" in the description. For more information, see "Channelized Interfaces Overview" on page 247.

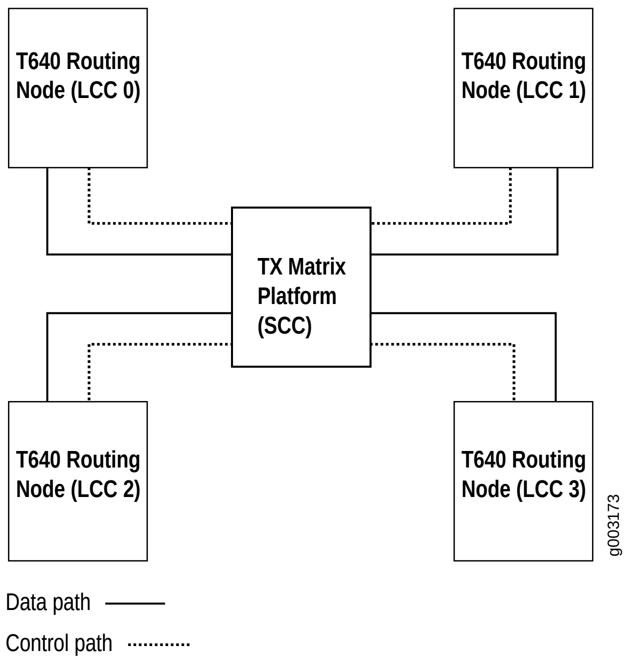
NOTE: In the JUNOS software implementation, the term *logical interfaces* generally refers to interfaces you configure by including the unit statement at the [edit interfaces *interface-name*] hierarchy level. As such, logical interfaces have the *.logical* descriptor at the end of the interface name,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

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

Interface Naming for a Routing Matrix

A routing matrix is a multichassis architecture composed of one TX Matrix platform, to which you can connect from one to four T640 routing nodes, as shown in Figure 1 on page 34.

Figure 1: Routing Matrix



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

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

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

type-fpc/pic/port

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

On LCC 0, FPC hardware slots 0 through 7 are configured as 0 through 7.

On LCC 1, FPC hardware slots 0 through 7 are configured as 8 through 15.

On LCC 2, FPC hardware slots 0 through 7 are configured as 16 through 23.

On LCC 3, FPC hardware slots 0 through 7 are configured as 24 through 31.

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

Table 2 summarizes the FPC numbering for a routing matrix.

Table 2: FPC Numbering for T640 Routing Nodes in a Routing Matrix

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

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

Table 3: One-to-One FPC Numbering for T640 Routing Nodes in a Routing Matrix

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

Chassis Interface Naming

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

Standalone routing platform interface naming:

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

Routing matrix interface naming:

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

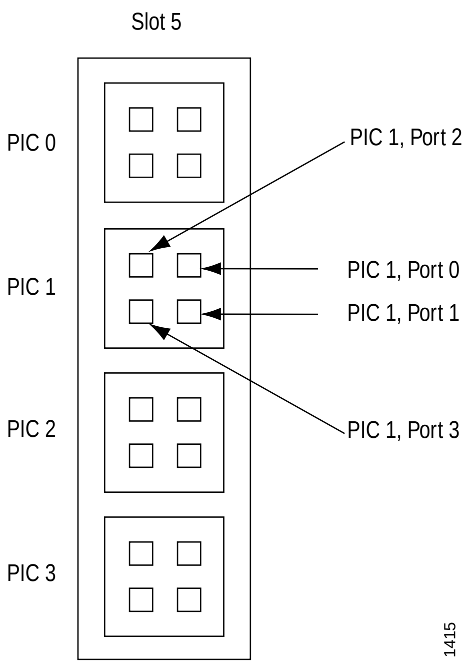
For the FPC slot number, you specify the actual hardware slot number, as labeled on the T640 routing node chassis. Do not use the corresponding software FPC number shown in Table 3 on page 35.

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

Examples: Interface Naming

This section provides examples of naming interfaces. For an illustration of where slots, PICs, and ports are located, see Figure 2 on page 37.

Figure 2: Interface Slot, PIC, and Port Locations



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

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

An OC48 SONET/SDH 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, it has the following name:

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

An OC48 SONET/SDH 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 OC12 PIC in PIC position 2, the DS3 channels have the following names:

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

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

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

In a routing matrix on the T640 routing node labeled lcc1, for an FPC in slot 5 with four SONET OC-192 PICs, the four PICs, each with a single port and a single logical unit, have the following names:

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

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

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

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

Figure 3 on page 39 illustrates the different clock sources.

Figure 3: Clock Sources