Link and Multilink Properties

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YEAR 2000 NOTICE

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About the Documentation

Documentation and Release Notes

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Supported Platforms

For the features described in this document, the following platforms are supported:

- M Series
- T Series

Using the Examples in This Manual

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

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

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

Merging a Full Example

To merge a full example, follow these steps:

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

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

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

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

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

Merging a Snippet

To merge a snippet, follow these steps:

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

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

   ```
   commit {
     file ex-script-snippet.xsl; }
   ```

2. Move to the hierarchy level that is relevant for this snippet by issuing the following configuration mode command:

```
[edit]
user@host# edit system scripts
[edit system scripts]
```

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

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

For more information about the **load** command, see the CLI User Guide.

Documentation Conventions

Table 1 on page xiii defines notice icons used in this guide.

Table 1: Notice Icons

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

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

Table 2: Text and Syntax Conventions

Convention	Description	Examples
Bold text like this	Represents text that you type.	To enter configuration mode, type the**configure** command: user@host> **configure**
`Fixed-width text like this`	Represents output that appears on the terminal screen.	`user@host>` **show chassis alarms** `No alarms currently active`

Table 2: Text and Syntax Conventions *(continued)*

Convention	Description	Examples
Italic text like this	• Introduces or emphasizes important new terms. • Identifies book names. • Identifies RFC and Internet draft titles.	• A policy *term* is a named structure that defines match conditions and actions. • *Junos OS System Basics Configuration Guide* • RFC 1997, *BGP Communities Attribute*
Italic text like this	Represents variables (options for which you substitute a value) in commands or configuration statements.	Configure the machine's domain name: [edit] root@# **set system domain-name** *domain-name*
Text like this	Represents names of configuration statements, commands, files, and directories; configuration hierarchy levels; or labels on routing platform components.	• To configure a stub area, include the **stub** statement at the **[edit protocols ospf area area-id]** hierarchy level. • The console port is labeled **CONSOLE**.
< > (angle brackets)	Enclose optional keywords or variables.	**stub <default-metric** ***metric*****>;**
| (pipe symbol)	Indicates a choice between the mutually exclusive keywords or variables on either side of the symbol. The set of choices is often enclosed in parentheses for clarity.	**broadcast | multicast** **(*string1* | *string2* | *string3*)**
# (pound sign)	Indicates a comment specified on the same line as the configuration statement to which it applies.	**rsvp { # Required for dynamic MPLS only**
[ ] (square brackets)	Enclose a variable for which you can substitute one or more values.	**community name members [** ***community-ids*** **]**

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

; (semicolon)	Identifies a leaf statement at a configuration hierarchy level.	
J-Web GUI Conventions		
Bold text like this	Represents J-Web graphical user interface (GUI) items you click or select.	• In the Logical Interfaces box, select **All Interfaces**. • To cancel the configuration, click **Cancel**.
> (bold right angle bracket)	Separates levels in a hierarchy of J-Web selections.	In the configuration editor hierarchy, select **Protocols>Ospf**.

Documentation Feedback

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- Document or topic name
- URL or page number
- Software release version (if applicable)

Requesting Technical Support

Technical product support is available through the Juniper Networks Technical Assistance Center (JTAC). If you are a customer with an active J-Care or JNASC support contract, or are covered under warranty, and need post-sales technical support, you can access our tools and resources online or open a case with JTAC.

- JTAC policies—For a complete understanding of our JTAC procedures and policies, review the *JTAC User Guide* located at http://www.juniper.net/us/en/local/pdf/resource-guides/7100059-en.pdf .
- Product warranties—For product warranty information, visit http://www.juniper.net/support/warranty/ .
- JTAC hours of operation—The JTAC centers have resources available 24 hours a day, 7 days a week, 365 days a year.

Self-Help Online Tools and Resources

For quick and easy problem resolution, Juniper Networks has designed an online self-service portal called the Customer Support Center (CSC) that provides you with the following features:

- Find CSC offerings: http://www.juniper.net/customers/support/
- Search for known bugs: http://www2.juniper.net/kb/
- Find product documentation: http://www.juniper.net/techpubs/
- Find solutions and answer questions using our Knowledge Base: http://kb.juniper.net/
- Download the latest versions of software and review release notes: http://www.juniper.net/customers/csc/software/
- Search technical bulletins for relevant hardware and software notifications: https://www.juniper.net/alerts/

- Join and participate in the Juniper Networks Community Forum: http://www.juniper.net/company/communities/
- Open a case online in the CSC Case Management tool: http://www.juniper.net/cm/

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

Opening a Case with JTAC

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

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

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

PART 1

Overview

CHAPTER 1

Link and Multilink Services

Link and Multilink Services Overview

Multilink-based protocols enable you to split, recombine, and sequence datagrams across multiple logical data links. The goal of a 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 Juniper Networks Junos operating system (Junos OS) supports several multilink-based protocols (such as MLPPP, FRF.15, and FRF.16) on the services PICs such as the Multilink Services PIC, the Link Services PIC, and the link services intelligent queuing (IQ) and voice services configured on the Adaptive Services (AS) and MultiServices PICs. For more information about link services IQ, see Layer 2 Service Package Capabilities and Interfaces. For more information about voice services, see Configuring Services Interfaces for Voice Services.

Starting with Junos OS Release 12.1, the following channelized MICs on MX240, MX480, and MX960 routers support Multilink Point-to-Point Protocol (MLPPP)-based services:

- 4-port Channelized SONET/SDH OC3/STM1 (Multi-Rate) MIC with SFP (MIC-3D-4CHOC3-2CHOC12)
- 8-port Channelized SONET/SDH OC3/STM1 (Multi-Rate) MIC with SFP (MIC-3D-8CHOC3-4CHOC12)
- 8-port Channelized DS3/E3 MIC (MIC-3D-8CHDS3-E3-B)

. For more information about Multilink Point-to-Point Protocol (MLPPP)-based services MICs, see "Multilink Interfaces on Channelized MICs Overview" on page 8.

NOTE: The ml- interface type is used to configure interfaces on the Multilink Services PIC and does not support class-of-service (CoS) features. The ls- interface type is used for limited CoS configurations on the Link Services PIC (except on J Series Services Routers), and the lsq- interface type is used for full CoS configurations on the Adaptive Services and MultiServices PICs. The bundle interfaces are configured on the Multiservices DPC as link services IQ (lsq) interfaces and virtual LSQ redundancy (rlsq) interfaces.

For link services IQ (lsq) interfaces, Junos OS CoS components are fully supported and are handled normally on M Series and T Series routers, as described in the Junos OS Class of Service Configuration Guide. There are some restrictions on J Series Services Routers; for more information on link services IQ configuration, see Layer 2 Service Package Capabilities and Interfaces.

The Link Services and Multilink Services PICs support the following encapsulation types:

- Multilink Point-to-Point Protocol (MLPPP)
- Multilink Frame Relay (MLFR)

Starting with Junos OS Release 12.1, support for the following encapsulation types and protocols has been extended to the MX240, MX480, and MX960 routers with Multiservices DPCs:

- Multilink Point-to-Point Protocol (MLPPP)
- Multiclass MLPPP
- Multilink Frame Relay (MLFR) end-to-end (FRF.15)
- Multilink Frame Relay (MLFR) UNI NNI (FRF.16) (also referred to as MFR)
- Compressed Real-Time Transport Protocol (CRTP)

MLPPP enables you to bundle multiple PPP links into a single logical link. MLFR enables you to bundle multiple Frame Relay data-link connection identifiers (DLCIs) into a single logical link. MLPPP and MLFR provide service option granularity between low-speed T1 and E1 services and higher-speed T3 and E3 services. You use MLPPP and MLFR to increase bandwidth in smaller, more cost-effective increments. In addition to providing incremental bandwidth, bundling multiple links can add a level of fault tolerance to your dedicated access service, because you can implement bundling across multiple PICs, protecting against the failure of any single PIC.

NOTE: Even if the PIC can support up to 4xDS3 total throughput, each aggregate can only run a volume of traffic equal to one DS3 in bandwidth. Aggregating DS3 links is not supported.

At the logical unit level, the Multilink Services and Link Services PICs support the MLPPP and MLFR Frame Relay Forum (FRF) 15 encapsulation types. At the physical interface level, the Link Services PIC also supports the MLFR FRF.16 encapsulation type.

MLPPP and MLFR FRF.15 are supported on interface types **ml-*fpc/pic/port***, **ls-*fpc/pic/port***, and **lsq-*fpc/pic/port***. For MLFR FRF.15, multiple permanent virtual circuits (PVCs) are combined into one aggregated virtual circuit (AVC). This provides fragmentation over multiple PVCs on one end and reassembly of the AVC on the other end.

MLFR FRF.16 is supported on a channelized interface, **ls-*fpc/pic/port*:*channel***, which denotes a single MLFR FRF.16 bundle. For MLFR FRF.16, multiple links are combined to form one logical link. Packet fragmentation and reassembly occur on a per-VC basis. Each bundle can support multiple VCs. Link Services PICs can support up to 256 DLCIs per MLFR FRF.16 bundle. The physical connections must be E1, T1, channelized DS3-to-DS1, channelized DS3-to-DS0, channelized E1, channelized STM1, or channelized IQ interfaces. When you bundle channelized interfaces using the link services interface, the channelized interfaces require M Series Enhanced Flexible PIC Concentrators (FPCs).

NOTE: When running MLPPP or MLFR on a non-QPP interface, you cannot mix logical units that are members of an aggregate with logical units configured using other families, such as inet. For example, the following configuration is not valid:

```
interface e3-0/0/0 {
    encapsulation frame-relay;
    unit 99 {
        dlci 99;
        family mlfr-end-to-end {
            bundle ls-0/0/0.1;
        }
    }
    unit 100 { ## mixes mlfr with family inet
        dlci 100;
        family inet {
            address 192.168.164.53/30;
        }
    }
}
```

The standards for MLPPP, MLFR FRF.15, and MLFR FRF.16 are defined in the following specifications:

- RFC 1990, *The PPP Multilink Protocol (MP)*
- FRF.15, *End-to-End Multilink Frame Relay Implementation Agreement*
- FRF.16.1, *Multilink Frame Relay UNI/NNI Implementation Agreement*

NOTE: Endpoint Discriminator Class compatibility checking is enabled on MLPPP interfaces. Prior to Junos OS Release 8.0, when a Juniper Networks router received an unsupported Endpoint Discriminator Class message from an MLPPP session peer, it returned an ACK response.

Related Documentation

- Understanding MLPPP Bundles and Link Fragmentation and Interleaving (LFI) on Serial Links on page 12
- Example: Configuring an MLPPP Bundle on page 42
- Example: Configuring Multilink Frame Relay FRF.15 on page 49
- Example: Configuring Multilink Frame Relay FRF.16 on page 46

Multilink and Link Services PICs Overview

Each Multilink Services or Link Services PIC can support a number of *bundles*. A bundle can contain up to eight individual *links*.

For Multilink Services PICs, the links can be T1, E1, or DS0 physical interfaces, and each link is associated with a logical unit number that you configure. For Link Services PICs, the links can be E1, T1, channelized DS3-to-DS1, channelized DS3-to-DS0, channelized E1, channelized STM1 interfaces, or channelized IQ interfaces. For MLFR FRF.16 bundles, each link is associated with a channel number that you configure.

You must configure a link before it can join a bundle. Each bundle should consist solely of one type of link; the mixing of physical interfaces of differing speeds within a bundle is not supported.

NOTE: On both Juniper Networks J Series Services Routers and M Series Multiservice Edge Routers, only one DS3 link is allowed in an MLFR bundle. MLPPP bundles can include two DS3 links.

Three versions of Multilink Services and three versions of Link Services PICs are available, as shown in Table 3 on page 6. The PIC hardware is identical, except for different faceplates that enable you to identify which version you are installing. The software limits the unit numbers and maximum number of physical interfaces you assign to the PIC.

Table 3: Multilink and Link Services PIC Capacities

PIC Capacity	Unit Numbers	Maximum Number of T1/DS0 Interfaces	Maximum Number of E1 Interfaces
4-bundle PIC	0 through 3	32 links	32 links
32-bundle PIC	0 through 31	256 links	219 links
128-bundle PIC	0 through 127	292 links	219 links

A single PIC can support an aggregate bandwidth of 450 megabits per second (Mbps).

You can configure a larger number of links, but the Multilink Services and Link Services PICs can reliably process only 450 Mbps of traffic. A higher rate of traffic might degrade performance.

NOTE: In Junos OS releases 9.0 and above you are not allowed to configure a unit number greater than the maximum unit number available on your link services PIC. Attempting to do so will cause an error message.

For configuration information, see the following sections:

- Configuring the Number of Bundles on Link Services PICs on page 17
- Configuring the Links in a Multilink or Link Services Bundle on page 18

Multilink Interfaces on Channelized MICs Overview

Multiservices Modular Interface Cards (MICs) enable you to perform multiple services on the same MIC by configuring a set of services and applications such as voice services and Layer 2 Tunneling Protocol (L2TP) services. On Juniper Networks MX Series 3D Universal Edge Routers, the Multiservices DPC provides essentially the same capabilities as the Multiservices PIC. The interfaces on both platforms are configured in the same way. The Multilink interfaces are hosted on a channelized MIC. The bundle interfaces are configured on Multiservices DPC as virtual LSQ redundancy (rlsq) interfaces.

Starting with Junos OS Release 12.1, the following channelized MICs on MX240, MX480, and MX960 routers support Multilink Point-to-Point Protocol (MLPPP)-based services:

- 4-port Channelized SONET/SDH OC3/STM1 (Multi-Rate) MIC with SFP (MIC-3D-4CHOC3-2CHOC12)
- 8-port Channelized SONET/SDH OC3/STM1 (Multi-Rate) MIC with SFP (MIC-3D-8CHOC3-4CHOC12)
- 8-port Channelized DS3/E3 MIC (MIC-3D-8CHDS3-E3-B)

The following encapsulations, interfaces, protocol, and packet types are supported on the aforementioned MICs:

- Multilink Point-to-Point Protocol (MLPPP)—Supports Priority-based Flow Control (PFC) for data packets and Link Control Protocol (LCP) for control packets. Compressed Real-Time Transport Protocol (CRTP) and Multiclass MLPPP are supported for both data and control packets.
- Multilink Frame Relay (MLFR) end-to-end (FRF.15)—Supports Ethernet Local Management Interface (LMI), Consortium LMI (C-LMI), and Link Integrity Protocol (LIP) for data and control packets.
- Multilink Frame Relay (MFR) UNI NNI (FRF.16)—Supports Ethernet Local Management Interface (LMI), Consortium LMI (C-LMI), and Link Integrity Protocol (LIP) for data and control packets.
- Link fragmentation and interleaving (LFI) non multilink MLPPP and MLFR packets.

Layer 2 services and voice services functionality are implemented on the Multiservices Dense Port Concentrators which supports the following two kinds of traffic that are routed by the Packet Forwarding Engine:

- Customer-end to provider-end (also, known as customer traffic)—Here, the Multilink fragments from the customer end arrive at the Multiservices interfaces configured on the channelized MIC. These fragments are then transmitted to the Multiservices DPC for Layer 2 processing such as CoS and are reassembled by the Multiservices software running on the Multiservices DPC. These reassembled packets are sent to the Packet Forwarding Engine where they go through the regular router lookup process and are finally sent over the Internet to the provider end. The voice packets also go through the same process.
- Provider-end to customer-end (also, known as Internet traffic)—Here, the data packets that are sent from the Internet provider end are received at any generic ingress interface in the Packet Forwarding Engine. These packets are then sent to the Multiservices DPC for Layer 2 processing. The Multiservices software running on Multiservices DPC

fragment these data packets and send it to the Packet Forwarding Engine. These Multilink fragments are sent over the channelized MIC interfaces to the customer end. The voice packets also go through the same process.

NOTE: All the features that are supported on Multilink and Link Services PICs are also supported on the Multilink Services or Link Services MICs. For more information about Multilink and Link Services PICs, see "Multilink and Link Services PICs Overview" on page 6.

Support for the following encapsulations, interfaces, protocol, and packet types are now extended to the aforementioned MICs:

- Multilink Point-to-Point Protocol (MLPPP)—Supports priority-based flow control (PFC) for data packets and Link Control Protocol (LCP) for control packets. Compressed Real-Time Transport Protocol (CRTP) and multiclass MLPPP are supported for both data and control packets.
- Multilink Frame Relay (MLFR) end-to-end (FRF.15)—Supports Ethernet Local Management Interface (LMI) and Consortium LMI (C-LMI) for data and control packets.
- Multilink Frame Relay (MLFR) UNI NNI (FRF.16)—Supports Ethernet Local Management Interface (LMI), Consortium LMI (C-LMI), and Link Integrity Protocol (LIP) for data and control packets.
- Link fragmentation and interleaving (LFI) on multilink MLPPP and MLFR packets—Reduces delay and jitter on links by breaking up large data packets and interleaving delay-sensitive voice packets with the resulting smaller packets.

Related Documentation

- Link and Multilink Services Overview on page 3
- Example: Configuring Link Interfaces on Channelized MICs on page 52
- Example: Configuring an MLPPP Bundle on page 42
- Example: Configuring Multilink Frame Relay FRF.15 on page 49
- Example: Configuring Multilink Frame Relay FRF.16 on page 46

Multilink and Link Services Logical Interface Configuration Overview

You configure multilink and link services interface properties at the logical unit level. Default settings for multilink and link services logical interface properties are described in "Default Settings for Multilink and Link Services Logical Interfaces" on page 11.

For general information about logical unit properties or **family inet** properties, see the Junos® OS Network Interfaces. For information about multilink and link services properties you configure at the **family inet** hierarchy level, see "Configuring the Links in a Multilink or Link Services Bundle" on page 18.

NOTE: On DS0, E1, or T1 interfaces in LSQ bundles, you can configure the **bandwidth** statement, but the router does not use the bandwidth value if the interfaces are included in an MLPPP or MLFR bundle. The bandwidth is calculated internally according to the time slots, framing, and byte-encoding of the interface. For more information about logical interface properties, see the Junos® OS Network Interfaces.

Default Settings for Multilink and Link Services Logical Interfaces

Table 4 on page 11 lists the default settings for multilink and link services statements, together with the other permitted values or value ranges.

Table 4: Multilink and Link Services Logical Interface Statements

Option	Default Value	Possible Values
DLCI	None	16 through 1022
Drop timeout period	500 ms for bundles greater than or equal to the T1 bandwidth value and 1500 ms for other bundles.	0 through 2000 milliseconds
Encapsulation	For multilink interfaces, **multilink-ppp**. For link services interfaces, **multilink-frame-relay-end-to-end**.	**multilink-frame-relay-end-to-end**, **multilink-ppp**
Fragmentation threshold	0 bytes	128 through 16,320 bytes (*N*x64)
Interleave fragments	disabled	enabled, disabled
Minimum links	1 link	1 through 8 links
Maximum received reconstructed unit (MRRU)	1504 bytes	1500 through 4500 bytes
Sequence ID format for MLPPP	24 bits	12 or 24 bits
Sequence ID format for MLFR FRF.15 and FRF.16	12 bits	12 bits

See "Default Settings for Link Services Interfaces" on page 29 for statements that apply to link services physical interfaces only.

Related Documentation

- Configuring Encapsulation for Multilink and Link Services Logical Interfaces on page 19
- Configuring the Drop Timeout Period on Multilink and Link Services Logical Interfaces on page 20

Understanding MLPPP Bundles and Link Fragmentation and Interleaving (LFI) on Serial Links

MX240, MX480, and MX960 3D Universal Edge Routers support MLPPP and MLFR multilink encapsulations. MLPPP enables you to bundle multiple PPP links into a single multilink bundle, and MLFR enables you to bundle multiple Frame Relay data-link connection identifiers (DLCIs) into a single multitlink bundle. Multilink bundles provide additional bandwidth, load balancing, and redundancy by aggregating low-speed links, such as T1, E1, and serial links.

You configure multilink bundles as logical units or channels on the link services interface **lsq-0/0/0**:

- With MLPPP and MLFR FRF.15, multilink bundles are configured as logical units on **lsq-0/0/0**—for example, **lsq-0/0/0.0** and **lsq-0/0/0.1**.
- With MLFR FRF.16, multilink bundles are configured as channels on **lsq-0/0/0**—for example, **lsq-0/0/0:0** and **lsq-0/0/0:1**.

After creating multilink bundles, you add constituent links to the bundle. The constituent links are the low-speed physical links that are to be aggregated. You can create 64 multilink bundles, and on each multilink bundle you can add up to 8 constituent links. The following rules apply when you add constituent links to a multilink bundle:

- On each multilink bundle, add only interfaces of the same type. For example, you can add either T1 or E1, but not both.
- Only interfaces with a PPP encapsulation can be added to an MLPPP bundle, and only interfaces with a Frame Relay encapsulation can be added to an MLFR bundle.
- If an interface is a member of an existing bundle and you add it to a new bundle, the interface is automatically deleted from the existing bundle and added to the new bundle.

Configuring a multilink bundle on the two serial links increases the bandwidth by 70 percent from approximately 1 Mbps to 1.7 Mbps and prepends each packet with a multilink header as specified in the FRF.12 standard. To increase the bandwidth further,

you can add up to eight serial links to the bundle. In addition to a higher bandwidth, configuring the multilink bundle provides load balancing and redundancy. If one of the serial links fails, traffic continues to be transmitted on the other links without any interruption. In contrast, independent links require routing policies for load balancing and redundancy. Independent links also require IP addresses for each link as opposed to one IP address for the bundle. In the routing table, the multilink bundle is represented as a single interface.

Related Documentation

- Link and Multilink Services Overview on page 3
- Multilink Interfaces on Channelized MICs Overview on page 8
- Example: Configuring Link Interfaces on Channelized MICs on page 52
- Example: Configuring an MLPPP Bundle on page 42
- Example: Configuring Multilink Frame Relay FRF.15 on page 49
- Example: Configuring Multilink Frame Relay FRF.16 on page 46

PART 2

Configuration

CHAPTER 2

Configuration Tasks

Configuring the Number of Bundles on Link Services PICs

You can combine MLFR FRF.16, MLPPP, and MLFR FRF.15 bundles on a single Link Services PIC. For a sample configuration, see "Example: Configuring a Link Services Interface with Two Links" on page 63.

To configure the number of bundles on a Link Services PIC, include the **mlfr-uni-nni-bundles** statement at the **[edit chassis fpc *slot-number* pic *pic-number*]** hierarchy level:

```
mlfr-uni-nni-bundles number;
```

Each Link Services PIC can accommodate a maximum of 256 MLFR UNI NNI bundles. For more information, see the Junos OS System Basics Configuration Guide.

A link can associate with one link services bundle only. All Link Services PICs support up to 256 single-link bundles and up to 256 DLCIs. For an example configuration, see the configuration examples.

NOTE: When one or more links in a bundle are put in loopback, reassembly buffering and hence processing are reduced so as to not affect other bundles. This prevents packet loss on other bundles, while reducing the reassembly buffers available for the bundle with looped links.

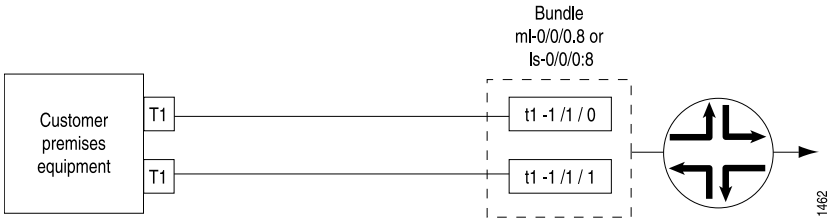
Related Documentation

- Example: Configuring a Link Services Interface with Two Links on page 63
- Example: Configuring a Link Services Interface with MLPPP on page 64
- Example: Configuring a Link Services Interface with MLFR FRF.15 on page 65
- Example: Configuring a Link Services PIC with MLFR FRF.16 on page 66
- Example: Configuring Link and Voice Services Interfaces with a Combination of Bundle Types on page 66

Configuring the Links in a Multilink or Link Services Bundle

To complete a multilink or link services interface configuration, you need to configure both the physical interface and the multilink or link services bundle. For multilink interfaces, you configure the link bundle on the logical unit. For link services interfaces, you configure the link bundle as a channel (see Figure 1 on page 18). The physical interface is usually connected to networks capable of supporting MLPPP or MLFR (FRF.15 or FRF.16).

Figure 1: Multilink Interface Configuration



The following sample configuration refers to the topology in Figure 1 on page 18 and configures a multilink or link services bundle over a T1 connection (for which the T1 physical interface is already configured).

1. To configure a physical T1 link for MLPPP, include the following statements at the **[edit interfaces t1-*fpc/pic/port*]** hierarchy level:

   ```
   unit 0 {
     family mlppp {
       bundle (ml-fpc/pic/port | ls-fpc/pic/port);
     }
   }
   ```

   You do not need to configure an IP address on this link.

   To configure a physical T1 link for MLFR FRF.16, include the following statements at the **[edit interfaces t1-*fpc/pic/port*]** hierarchy level:

   ```
   encapsulation multilink-frame-relay-uni-nni;
   ```

```
unit 0 {
  family mlfr-uni-nni {
    bundle ls-fpc/pic/port:channel;
  }
}
```

You do not need to configure an IP address or a DLCI on this link.

2. To configure the logical address for the MLPPP, MLFR FRF.15, or MLFR FRF.16 bundle, include the **address** and **destination** statements:

```
address address {
  destination address;
}
```

You can include these statements at the following hierarchy levels:

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

When you add statements such as **mrru** to the configuration and commit, the T1 interface becomes part of the multilink bundle.

NOTE: For MLPPP and MLFR (FRF.15 and FRF.16) links, you must specify the subnet address as /32 or /30. Any other subnet designation is treated as a mismatch.

Configuring Encapsulation for Multilink and Link Services Logical Interfaces

Multilink and link services interfaces support the following logical interface encapsulation types:

- MLPPP
- MLFR end-to-end

By default, the logical interface encapsulation type on multilink interfaces is MLPPP. The default logical interface encapsulation type on link services interfaces is MLFR end-to-end. For general information on encapsulation, see the Junos® OS Network Interfaces.

You can also configure physical interface encapsulation on link services interfaces. For more information, see "Configuring Encapsulation for Link Services Physical Interfaces" on page 29.

To configure multilink or link services encapsulation, include the **encapsulation** statement:

```
encapsulation type;
```

You can include this statement at the following hierarchy levels:

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

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

You must also configure the T1, E1, or DS0 physical interface with the same encapsulation type.

CAUTION: When you configure the first MLFR encapsulated unit or delete the last MLFR encapsulated unit on a port, it triggers an interface encapsulation change on the port, which causes an interface flap on the other units within the port that are configured with generic Frame Relay.

Configuring the Drop Timeout Period on Multilink and Link Services Logical Interfaces

By default, the drop timeout parameter is disabled. You can configure a drop timeout value to provide a recovery mechanism if individual links in the multilink or link services bundle drop one or more packets. Drop timeout is not a differential delay tolerance setting, and does not limit the overall latency. However, you need to make sure the value you set is larger than the expected differential delay across the links, so that the timeout period does not elapse under normal jitter conditions, but only when there is actual packet loss. You can configure differential delay tolerance for link services interfaces only. For more information, see "Configuring Differential Delay Alarms on Link Services Physical Interfaces with MLFR FRF.16" on page 30.

To configure the drop timeout value, include the **drop-timeout** statement:

```
drop-timeout milliseconds;
```

You can include this statement at the following hierarchy levels:

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

For link services interfaces, you also can configure the drop timeout value at the physical interface level by including the **drop-timeout** statement at the **[edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options]** hierarchy level:

```
drop-timeout milliseconds;
```

By default, the drop timer has a value of 500 ms for bundles greater than or equal to the T1 bandwidth value, and 1500 ms for other bundles. Any CLI-configured value overrides these defaults. Values can range from 1 through 2000 milliseconds. Values less than 5 milliseconds are not recommended, and a configured value of 0 reverts to the default value of 2000 milliseconds.

NOTE: For multilink or link services interfaces, if a packet or fragment encounters an error condition and is destined for a disabled bundle or link, it does not contribute to the dropped packet and frame counts in the per-bundle statistics. The packet is counted under the global error statistics and is not included in the global output bytes and output packet counts. This unusual accounting happens only if the error conditions are generated inside the multilink interface, not if the packet encounters errors on the wire or elsewhere in the network.

If you configure the **drop-timeout** statement with a value of **0**, it disables any resequencing by the PIC for the specified class of MLPPP traffic. Packets are forwarded with the assumption that they arrived in sequence, and forwarding of fragmented packets is disabled for all classes. Fragments dropped as a result of this setting will increment the counter at the class level.

Alternatively, you can configure the **drop-timeout** statement at the **[edit class-of-service fragmentation-maps *map-name* forwarding-class *class*]** hierarchy level. The behavior and the default and range values are identical, but the setting applies only to the specified forwarding class. Configuration at the bundle level overrides configuration at the class-of-service level.

By default, compression of the inner PPP header in the MLPPP payload is enabled. To disable compression, include the **disable-mlppp-inner-ppp-pfc** statement at the **[edit interfaces *interface-name* unit *logical-unit-number*]** hierarchy level. For example:

```
interfaces lsq-1/2/0 {
    unit 0 {
        encapsulation multilink-ppp;
        disable-mlppp-inner-ppp-pfc;
        multilink-max-classes 4;
        family inet {
            address 10.50.1.2/30;
        }
    }
}
```

For more information about CoS configuration, see the Junos OS Class of Service Configuration Guide. You can view the configured drop-timeout value and the status of inner PPP header compression by issuing the **show interfaces *interface-name* extensive** command.

Limiting Packet Payload Size on Multilink and Link Services Logical Interfaces

For multilink and link services logical interfaces with MLPPP encapsulation only, you can configure a *fragmentation threshold* to limit the size of packet payloads transmitted across the individual links within the multilink circuit. The software splits any incoming packet that exceeds the fragmentation threshold into smaller units suitable for the circuit size; it reassembles the fragments at the other end, but does not affect the output traffic stream. The threshold value affects the payload only; it does not affect the MLPPP header. By default, the fragmentation threshold parameter is disabled.

NOTE: To ensure proper load balancing:

- For Link Services MLFR (FRF.15 and FRF.16) interfaces, do not include the **fragment-threshold** statement in the configuration.
- For MLPPP interfaces, do not include both the **fragment-threshold** statement and the **short-sequence** statement in the configuration.
- For MLFR (FRF.15 and FRF.16) and MLPPP interfaces, if the MTU of links in a bundle is less than the bundle MTU plus encapsulation overhead, then fragmentation is automatically enabled. You should avoid this situation for MLFR (FRF.15 and FRF.16) interfaces and for MLPPP interfaces on which short-sequencing is enabled.

To configure a fragmentation threshold value, include the **fragment-threshold** statement:

```
fragment-threshold bytes;
```

You can include this statement at the following hierarchy levels:

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

For link services interfaces, you also can configure a fragmentation threshold value at the physical interface level by including the **fragment-threshold** statement at the **[edit interfaces ls-***fpc/pic/port***:***channel* **mlfr-uni-nni-bundle-options]** hierarchy level:

```
fragment-threshold bytes;
```

The maximum fragment size can be from 128 through 16,320 bytes. The Junos OS automatically subdivides packet payloads that exceed this value. Any value you set must be a multiple of 64 bytes (*N*x64). The default value, 0, results in no fragmentation.

Configuring the Minimum Number of Active Links on Multilink and Link Services Logical Interfaces

You can set the minimum number of links that must be up for the multilink bundle as a whole to be labeled up. By default, only one link must be up for the bundle to be labeled up. A member link is considered up when the PPP Link Control Protocol (LCP) phase transitions to open state.

The **minimum-links** value should be identical on both ends of the bundle.

To set the minimum number, include the **minimum-links** statement:

```
minimum-links number;
```

You can include this statement at the following hierarchy levels:

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

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

For link services interfaces, you also can configure the minimum number of links at the physical interface level by including the **minimum-links** statement at the **[edit interfaces ls-***fpc/pic/port***:***channel* **mlfr-uni-nni-bundle-options]** hierarchy level:

```
minimum-links number;
```

The number can be from 1 through 8. The maximum number of links supported in a bundle is 8. When 8 is specified, all configured links of a bundle must be up.

Configuring MRRU on Multilink and Link Services Logical Interfaces

The *maximum received reconstructed unit* (*MRRU*) is similar to a maximum transmission unit (MTU), but applies only to multilink bundles; it is the maximum packet size that the multilink interface can process. By default, the MRRU is set to 1500 bytes; you can configure a different MRRU value if the peer equipment allows this. The MRRU accounts for the original payload, for example the Layer 3 protocol payload, but does not include the 2-byte PPP header or the additional MLPPP or MLFR header applied while the individual multilink packets are traversing separate links in the bundle.

To configure a different MRRU value, include the **mrru** statement:

```
mrru bytes;
```

You can include this statement at the following hierarchy levels:

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

For link services interfaces, you also can configure a different MRRU at the physical interface level by including the **mrru** statement at the **[edit interfaces ls-***fpc/pic/port***:***channel* **mlfr-uni-nni-bundle-options]** hierarchy level:

```
mrru bytes;
```

The MRRU size can range from 1500 through 4500 bytes.

NOTE: If you set the MRRU on a bundle to a value larger than the MTU of the individual links within it, you must enable a fragmentation threshold for that bundle. Set the threshold to a value no larger than the smallest MTU of any link included in the bundle.

Determine the appropriate MTU size for the bundle by ensuring that the MTU size does not exceed the sum of the encapsulation overhead and the MTU sizes for the links in the bundle.

You can configure separate **family mtu** values on the following protocol families under bundle interfaces: **inet**, **inet6**, **iso**, and **mpls**. If not configured, the default value of 1500 is used on all except for **mpls** configurations, in which the value 1488 is used.

NOTE: The effective family MTU might be different from the MTU value specified for MLPPP configurations, because it is adjusted downward by the remote MRRU's constraints. The remote MRRU configuration is not supported on M120 routers.

Configuring the Sequence Header Format on Multilink and Link Services Logical Interfaces

For MLPPP, the sequence header format is set to 24 bits by default. You can configure an alternative value of 12 bits, but 24 bits is considered the more robust value for most networks.

To configure a different sequence header value, include the **short-sequence** statement:

```
short-sequence;
```

You can include this statement at the following hierarchy levels:

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

For MLFR FRF.15, the sequence header format is set to 24 bits by default. This is the only valid option.

Configuring DLCIs on Link Services Logical Interfaces

For link services interfaces only, you can configure multiple DLCIs for MLFR FRF.16 or MLPPP bundles.

DLCIs are not supported on multilink interfaces.

Configuring Point-to-Point DLCIs for MLFR FRF.16 and MLPPP Bundles

For link services interfaces only, you can configure multiple point-to-point DLCIs for each MLFR FRF.16 or MLPPP bundle. A channelized interface, such as **ls-1/1/1:0**, denotes a single MLFR FRF.16 bundle. To configure a DLCI, include the **dlci** statement:

```
dlci dlci-identifier;
```

You can include this statement at the following hierarchy levels:

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

The DLCI identifier is a value from 16 through 1022. Numbers 1 through 15 are reserved for future use.

When you configure point-to-point connections, the maximum transmission unit (MTU) sizes on both sides of the connection must be the same.

Configuring Multicast-Capable DLCIs for MLFR FRF.16 Bundles

For link services interfaces only, you can configure multiple multicast-capable DLCIs for each MLFR FRF.16 bundle. A channelized interface, such as **ls-1/1/1:0**, denotes a single MLFR FRF.16 bundle. By default, Frame Relay connections assume unicast traffic. If your Frame Relay switch performs multicast replication, you can configure the link services connection to support multicast traffic by including the **multicast-dlci** statement:

multicast-dlci *dlci-identifier*;

You can include this statement at the following hierarchy levels:

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

The DLCI identifier is a value from 16 through 1022 that defines the Frame Relay DLCI over which the switch expects to receive multicast packets for replication.

You can configure multicast support only on point-to-multipoint link services connections. Multicast-capable DLCIs are not supported on multilink interfaces.

If keepalives are enabled, causing the interface to send Local Management Interface (LMI) messages during idle times, the number of possible DLCI configurations is limited by the MTU selected for the interface. For more information, see "Configuring Keepalives on Link Services Physical Interfaces" on page 31.

Configuring Delay-Sensitive Packet Interleaving on Link Services Logical Interfaces

For link services FRF.15 and MLPPP interfaces only, you can configure link fragment interleaving (LFI). LFI reduces excessive delays of Frame Relay packets by fragmenting long packets into smaller packets and interleaving them with real-time frames. This allows real-time and non-real-time data frames to be carried together on lower-speed links without causing excessive delays to the real-time traffic. When the peer interface receives the smaller fragments, it reassembles the fragments into their original packet. For example, short delay-sensitive packets, such as packetized voice, can race ahead of larger delay-insensitive packets, such as common data packets.

NOTE: All Link Services PICs (4-multilink bundle, 32-multilink bundle, and 128-multilink bundle) support up to 256 link services interfaces with LFI enabled, if those link services interfaces contain only one constituent link each. For the Link Services PIC, multiple-link LFI bundles are simply multilink bundles, and are limited based on the type of PIC (4-multilink bundle, 32-multilink bundle, and 128-multilink bundle).

In addition, the multilink bundles you configure subtract from the total of 256 possible LFI-enabled link services interfaces. For example, if a 32-multilink bundle Link Services PIC has 24 multilink bundles configured and active, then you can configure 256 – 24 = 232 LFI-enabled link services interfaces, each with a single constituent link.

For link services IQ interfaces (**lsq**), the **interleave-fragments** statement is not valid. Instead, you can enable LFI by configuring fragmentation maps. For more information, see Configuring CoS Fragmentation by Forwarding Class on LSQ Interfaces.

You can configure multiple links in a bundle and configure packet interleaving. However, if you use packet interleaving, high-priority, nonmultilink-encapsulated packets use a hash-based algorithm to choose a single link.

For detailed information about link services CoS, see "Configuring CoS on Link Services Interfaces" on page 32.

Per-bundle CoS queuing is supported on link services IQ interfaces (**lsq**). For more information about link services IQ interfaces, see Layer 2 Service Package Capabilities and Interfaces.

The Junos OS supports end-to-end fragmentation in compliance with the FRF.12 *Frame Relay Fragmentation Implementation Agreement* standard. Unlike user-to-network interface (UNI) and network-to-network (NNI) fragmentation, end-to-end supports fragmentation only at the endpoints.

By default, packet interleaving is disabled. To enable packet interleaving, include the **interleave-fragments** statement:

```
interleave-fragments;
```

You can include this statement at the following hierarchy levels:

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

Configuring LFI with DLCI Scheduling

For Link Services and Channelized DS3 IQ PICs, you can configure LFI and DLCI scheduling. For channelized DS3 interfaces, LFI is supported with FRF.15 only, and on M10i and M20 platforms only.

Configuring LFI with DLCI scheduling enables packets entering the Link Services PIC to be fragmented before being transmitted to the Channelized DS3 IQ PIC. Once the fragmented packets enter the Channelized DS3 IQ PIC, they are scheduled at the DLCI level, to allow priority transmission for real-time applications.

For more information about associating a scheduler with a DLCI, see the Junos OS Class of Service Configuration Guide.

Example: Configuring LFI with DLCI Scheduling

Configure packets entering the Link Services PIC to be fragmented before being transmitted to the Channelized DS3 IQ PIC. Once the fragmented packets enter the Channelized DS3 IQ PIC, they are scheduled at the DLCI level, to allow priority transmission for real-time applications.

```
[edit interfaces]
ls-1/0/0 {
    unit 1 {
        encapsulation multilink-frame-relay-end-to-end;
        interleave-fragments;
        family inet {
            address 192.168.5.2/32 {
                destination 192.168.5.3;
            }
        }
    }
    t3-1/0/0:1 {
        per-unit-scheduler;
        unit 0 {
            dlci 16;
            encapsulation multilink-frame-relay-end-to-end;
            family mlfr-end-to-end {
                bundle ls-1/0/0.1;
            }
        }
    }
    [edit class-of-service]
    interfaces {
        t3-1/0/0:1 {
            unit 0 {
                scheduler-map sched-map-logical-0;
                shaping-rate 10m;
            }
            unit 1 {
                scheduler-map sched-map-logical-1;
                shaping-rate 20m;
            }
        }
    }
    scheduler-maps {
        sched-map-logical-0 {
            forwarding-class best-effort scheduler sched-best-effort-0;
            forwarding-class assured-forwarding scheduler sched-bronze-0;
            forwarding-class expedited-forwarding scheduler sched-silver-0;
            forwarding-class network-control scheduler sched-gold-0;
```

```
    }
    sched-map-logical-1 {
      forwarding-class best-effort scheduler sched-best-effort-1;
      forwarding-class assured-forwarding scheduler sched-bronze-1;
      forwarding-class expedited-forwarding scheduler sched-silver-1;
      forwarding-class network-control scheduler sched-gold-1;
    }
    schedulers {
      sched-best-effort-0 {
        transmit-rate 4m;
      }
      sched-bronze-0 {
        transmit-rate 3m;
      }
      sched-silver-0 {
        transmit-rate 2m;
      }
      sched-gold-0 {
        transmit-rate 1m;
      }
      sched-best-effort-1 {
        transmit-rate 8m;
      }
      sched-bronze-1 {
        transmit-rate 6m;
      }
      sched-silver-1 {
        transmit-rate 4m;
      }
      sched-gold-1 {
        transmit-rate 2m;
      }
    }
  }
}
```

Configuring Link Services Physical Interfaces

You configure link services interface properties at the logical unit and physical interface level. Default settings for link services physical interface properties are described in "Default Settings for Link Services Interfaces" on page 29.

The following sections explain how to configure link services physical interfaces:

For information about link services physical interface properties that can also be configured at the logical unit level, see "Multilink and Link Services Logical Interface Configuration Overview" on page 10.

Default Settings for Link Services Interfaces

Table 5 on page 29 lists the default settings for link services statements, together with the other permitted values or value ranges.

Table 5: Link Services Physical Interface Statements for MLFR FRF.16

Option	Default Value	Possible Values
Action red differential delay	**remove-link**	**disable-tx**, **remove-link**
Red differential delay	120 ms	1 through 2000 ms
Yellow differential delay	72 ms	1 through 2000 ms
Drop timeout period	0 ms	0 through 2000 ms
Encapsulation	**multilink-frame-relay-uni-nni**	**multilink-frame-relay-uni-nni**
Fragmentation threshold	0 bytes	128 through 16,320 bytes (*N*x64)
LMI type	itu	ansi, itu
Minimum links	1 link	1 through 8 links
MRRU	1504 bytes	1500 through 4500 bytes
n391 (full status polling counter)	6	1 through 255
n392 (LMI error threshold)	3	1 through 10
n393 (LMI monitored event count)	4	1 through 10
t391 (link integrity verify polling timer)	10	5 through 30
t392 (polling verification timer)	15	5 through 30
Sequence ID format for MLFR	12 bits	12 bits

Configuring Encapsulation for Link Services Physical Interfaces

Link services interfaces support the physical interface encapsulation MLFR UNI NNI. By default, the physical interface encapsulation on link services interfaces is MLFR UNI NNI. Multilink interfaces do not support physical interface encapsulation.

For more information, see the Junos® OS Network Interfaces.

You can also configure logical interface encapsulation on multilink and link services interfaces. For more information, see "Configuring Encapsulation for Multilink and Link Services Logical Interfaces" on page 19.

To explicitly configure link services physical interface encapsulation, include the **encapsulation** statement at the **[edit interfaces ls-*fpc/pic/port*:*channel*]** hierarchy level:

```
encapsulation type;
```

You must also configure the T1, E1, or DS0 physical and physical interface with the same encapsulation type.

Configuring Acknowledgment Timers on Link Services Physical Interfaces

For link services interfaces configured with MLFR FRF.16, each link end point in a bundle initiates a request for bundle operation with its peer by transmitting an add link message. A hello message notifies the peer end point that the local end point is up. Both ends of a link generate a hello message periodically, or as configured with the hello timer. A remove link message notifies the peer that the local end management is removing the link from bundle operation. End points respond to add link, remove link, and hello messages by sending acknowledgment messages.

You can configure the maximum period to wait for an add link acknowledgment, hello acknowledgment, or remove link acknowledgment by including the **acknowledge-timer** statement at the **[edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options]** hierarchy level:

```
acknowledge-timer milliseconds;
```

The acknowledgment timer can be from 1 through 10 milliseconds. The default is 4 milliseconds.

For link services interfaces, you can configure the number of retransmission attempts to be made for consecutive hello or remove link messages after the expiration of the acknowledgment timer by including the **acknowledge-retries** statement at the **[edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options]** hierarchy level:

```
acknowledge-retries number;
```

acknowledgment-retries can be a value from 1 through 5. The default is 2.

You can configure the rate at which hello messages are sent by including the **hello-timer** statement at the **[edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options]** hierarchy level:

```
hello-timer milliseconds;
```

A hello message is transmitted after the specified period (in milliseconds) has elapsed. The hello timer can be from 1 through 180 milliseconds; the default is 10 milliseconds. When the hello timer expires, a link end point generates an add-link message.

Configuring Differential Delay Alarms on Link Services Physical Interfaces with MLFR FRF.16

For link services interfaces configured with MLFR FRF.16, the differential delay between links in a bundle is measured and warning is given when a link has a substantially greater

differential delay than other links in the same bundle. The implementing endpoint can determine if the differential delay is in an acceptable range and decide to remove the link from the bundle, or to stop transmission on the link.

You can configure the yellow differential delay for links in a bundle by including the **yellow-differential-delay** statement at the **[edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options]** hierarchy level:

```
yellow-differential-delay milliseconds;
```

The yellow differential delay can be from 1 through 2000 milliseconds. The default is 72 milliseconds.

You can configure the red differential delay for links in a bundle to give warning by including the **red-differential-delay** statements at the **[edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options]** hierarchy level:

```
red-differential-delay milliseconds;
```

The red differential delay can be from 1 through 2000 milliseconds. The default is 120 milliseconds.

You can configure the action to be taken when differential delay exceeds the red limit by including the **action-red-differential-delay red** statements at the **[edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options]** hierarchy level:

```
action-red-differential-delay (disable-tx | remove-link);
```

The **disable-tx** option disables transmission on the link. The **remove-link** option removes the link from the bundle. The default action is **remove-link**.

You can view these settings in the output of the **show interfaces extensive lsq-*fpc/pic/port*:*channel*** command.

Configuring Keepalives on Link Services Physical Interfaces

You can tune the keepalive settings on the physical link-services interface. By default, the Junos OS uses ITU Q.933 Annex A LMIs for FRF.16. To instead use ITU Annex A LMIs (ANSI), include the **lmi-type ansi** statement at the **[edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options]** hierarchy level. LMI type ANSI is used in the following example:

```
lmi-type ansi;
```

To configure Frame Relay keepalive parameters on a link services interface, include the **n391**, **n392**, **n393**, **t391** and **t392** statements at the **[edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options]** hierarchy level:

```
[edit interfaces ls-fpc/pic/port:channel mlfr-uni-nni-bundle-options]
n391 number;
n392 number;
n393 number;
t391 number;
t392 number;
```

The statements determine the indicated keepalive settings:

- **n391**—Full status polling interval. The data terminal equipment (DTE) sends a status inquiry to the data communication equipment (DCE) at the interval specified by the **t391** statement. This statements sets the frequency at which the DTE requests full status report; for example, the value **10** means that the DTE requests full status report in every tenth inquiry. The intermediate inquiries request a keepalive response only. The range is **1** through **255**, with a default of **6**.
- **n392**—Error threshold, which is the maximum number of errors that can occur during the number of events set by the **n393** statement before the link is marked inoperative. The range is **1** through **10**, with a default of **3**.
- **n393**—Monitored event count. The range is **1** through **10**, with a default of **4**.
- **t391**—The interval at which the DTE requests a keepalive response from the DCE and updates status, depending on the error threshold value. The range is 5 through 30 seconds, with a default of 10 seconds.
- **t392**—The period during which the DCE checks for keepalive responses from the DTE and updates status, depending on the DCE error threshold value. The range is from 5 through 30 seconds, with a default of 15 seconds.

NOTE: **For the LMI to work properly, you must configure one side of a link services bundle to be a DCE.**

Configuring CoS on Link Services Interfaces

For link services IQ (**lsq-**) interfaces, Junos class of service (CoS) is fully supported and functions as described in the Junos OS Class of Service Configuration Guide. For more information and detailed configuration examples, see Layer 2 Service Package Capabilities and Interfaces.

On SRX Series and J Series devices, the **lsq-** interface is an internal interface, which is not associated with a physical interface. For information about link services on SRX Series and J Series devices, see the *Junos OS Interfaces Configuration Guide for Security Devices*.

For information about CoS functions and link services on M Series or T Series routers, see the following sections:

- CoS for Link Services Interfaces on M Series and T Series Routers on page 32
- Example: Configuring CoS on Link Services Interfaces on page 34

CoS for Link Services Interfaces on M Series and T Series Routers

For Link Services PIC interfaces (**ls**) on M Series and T Series routers, queue 0 is the only queue that you should configure to receive fragmented packets. Configure all other queues to be higher-priority queues.

Table 6 on page 33 summarizes how CoS queues work on link services (**ls**) interfaces.

Table 6: Link Services CoS Queues

Supported Bundling Type	Queue 0	Higher-Priority Queues
Hash-based load balancing	No	Yes
MLFR FRF.15	Yes	No
MLFR FRF.16	Yes	No
MLPPP	Yes	No

For M Series and T Series routers, CoS on link services (**ls**) interfaces works as follows:

- On all platforms, the Link Services PIC currently supports up to four queues: 0, 1, 2, and 3.
- Queue 0 uses MLFR FRF.15, MLFR FRF.16, or MLPPP to bundle packets.
- Higher-priority queues (1, 2, and 3) use hash-based load balancing to bundle packets. IP and MPLS header information is included in the hash.
- MLPPP packets traversing link services interfaces using queue 0 are fragmented and distributed across the constituent links. Queue 0 packets are sent on the least utilized link, proportional to its bandwidth. The queue 0 load balancer attempts to maintain even distribution of all traffic across all constituent links. In situations with a small number of high-priority traffic flows (queues 1, 2, and 3), queue 0 traffic might be unevenly distributed.
- For the MLFR FRF.16 protocol, only queue 0 works. If you configure a bundled interface to use MLFR FRF.16 with queue 0, then you must ensure the classifier does not send any traffic to queues 1, 2, and 3 on that interface.
- To carry high-priority traffic correctly on MLFR FRF.16 interfaces, you must configure an output firewall filter that forces all traffic into queue 0 on the ls-***fpc/pic/port.channel*** interface.
- MLFR FRF.15 and MLPPP interfaces support CoS through packet interleaving. The MLFR FRF.16 standard does not support packet interleaving, so all packets destined for an FRF.16 PVC interface must egress from the same queue.
- For constituent link interfaces of Link Services PICs, you can configure standard scheduler maps.
- For input packets and fragments received from constituent links, you can use regular input firewall filters and standard CoS classifiers on the link services interface.
- For packets that pass through a link services interface and are destined for a constituent link interface, all traffic using queue 0 is fragmented. Traffic using higher-priority queues (1, 2, and 3) is not fragmented.
- For MLFR FRF.15 and MLPPP, routing protocol packets smaller than 128 bytes are sent to queue 3; routing protocol packets that exceed 128 bytes are sent to queue 0 and fragmented accordingly. For MLFR FRF.16, queue 0 is used for all packet sizes.

- You must configure output firewall classification for egress traffic on the link services interface, not directly on the constituent link interface directly.
- Inverse multiplexing for ATM (IMA) is not supported on link services interfaces.

For more information, see "Configuring Delay-Sensitive Packet Interleaving on Link Services Logical Interfaces" on page 25 and the Routing Policy Configuration Guide.

Example: Configuring CoS on Link Services Interfaces

Configure CoS on a link services interface and its constituent link interfaces.

NOTE: This example applies to M Series and T Series routers. For examples that apply to SRX Series and J Series devices, see the *Junos OS Interfaces Configuration Guide for Security Devices*.

Packets that do not match the firewall filters are sent to a queue that performs load balancing by sending fragments to all constituent links.

Packets that match the firewall filters are sent to a queue that does not support packet fragmentation and reassembly; instead, this traffic is load-balanced by sending each packet flow to a different constituent link. Each packet that matches a firewall filter is subjected to a hash on the IP source address and the IP destination address to determine the packet flow to which each packet belongs.

When you configure the MLPPP encapsulation type or the multilink FRF.15 Frame Relay end-to-end encapsulation type, routing protocol packets smaller than 128 bytes are sent to the network-control queue on the constituent link interface. This keeps routing protocols operating normally, even when low-speed links are congested by regular packets.

```
[edit interfaces]
ls-7/0/0 {
    unit 0 {
        encapsulation multilink-ppp;
        interleave-fragments;
        family inet {
            filter {
                output lfi_ls_filter;
            }
            address 10.54.0.2/32 {
                destination 10.54.0.1;
            }
        }
    }
}
ge-7/2/0 {
    unit 0 {
        family inet {
            address 192.168.1.1/24;
        }
    }
}
```

```
ce1-7/3/6 {
    no-partition interface-type e1;
}
e1-7/3/6 {
    encapsulation ppp;
    unit 0 {
        family mlppp {
            bundle ls-7/0/0.0;
        }
    }
}
ce1-7/3/7 {
    no-partition interface-type e1;
}
e1-7/3/7 {
    encapsulation ppp;
    unit 0 {
        family mlppp {
            bundle ls-7/0/0.0;
        }
    }
}
[edit class-of-service]
classifiers {
    dscp dscp_default {
        import default;
    }
    inet-precedence inet-precedence_default {
        import default;
    }
}
code-point-aliases {
    dscp {
        af11 001010;
        af12 001100;
        af13 001110;
        af21 010010;
        af22 010100;
        af23 010110;
        af31 011010;
        af32 011100;
        af33 011110;
        af41 100010;
        af42 100100;
        af43 100110;
        be 000000;
        cs1 001000;
        cs2 010000;
        cs3 011000;
        cs4 100000;
        cs5 101000;
        cs6 110000;
        cs7 111000;
        ef 101110;
    }
    inet-precedence {
```

```
        af11 001;
        af21 010;
        af31 011;
        af41 100;
        be 000;
        cs6 110;
        cs7 111;
        ef 101;
        nc1 110;
        nc2 111;
    }
}
forwarding-classes {
    queue 0 be;
    queue 1 ef;
    queue 2 af;
    queue 3 nc;
}
interfaces {
    ge-7/2/0 {
        scheduler-map sched-map;
        unit 0 {
            classifiers {
                dscp dscp_default;
            }
        }
    }
    e1-7/3/6 {
        scheduler-map sched-map;
    }
    e1-7/3/7 {
        scheduler-map sched-map;
    }
    ls-7/0/0 {
        scheduler-map sched-map;
        unit 0 {
            classifiers {
                inet-precedence inet-precedence_default;
            }
        }
    }
}
scheduler-maps {
    sched-map {
        forwarding-class af scheduler af-scheduler;
        forwarding-class be scheduler be-scheduler;
        forwarding-class ef scheduler ef-scheduler;
        forwarding-class nc scheduler nc-scheduler;
    }
}
schedulers {
    af-scheduler {
        transmit-rate percent 25;
        buffer-size percent 25;
    }
    be-scheduler {
```

```
        transmit-rate percent 25;
        buffer-size percent 25;
    }
    ef-scheduler {
        transmit-rate percent 25;
        buffer-size percent 25;
    }
    nc-scheduler {
        transmit-rate percent 25;
        buffer-size percent 25;
    }
}
[edit firewall]
filter lfi_ls_filter {
    term term0 {
        from {
            destination-address {
                192.168.1.3/32;
            }
            precedence 5;
        }
        then {
            count count-192-168-1-3;
            forwarding-class af;
            accept;
        }
    }
    term default {
        then {
            log;
            forwarding-class best effort;
            accept;
        }
    }
}
```

CHAPTER 3

Multilink Interfaces Examples

Example: Configuring a Multilink Interface with MLPPP

```
[edit interfaces]
ml-1/0/0 {
  unit 1 {
    fragment-threshold 128;
    family inet {
      address 192.168.5.1/32 {
        destination 192.168.200.200;
      }
    }
  }
  unit 10 {
    family inet {
      address 10.1.1.3/32 {
        destination 10.1.1.2;
      }
    }
  }
}
t1-5/1/0 {
  unit 0 {
    family mlppp {
      bundle ml-1/0/0.1;
    }
  }
}
t1-5/1/1 {
  unit 0 {
    family mlppp {
```

```
        bundle ml-1/0/0.1;
      }
    }
  }
  t1-5/1/2 {
    unit 0 {
      family mlppp {
        bundle ml-1/0/0.1;
      }
    }
  }
```

Example: Configuring a Multilink Interface with MLPPP over ATM 2 Interfaces

```
[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 2001:DB8:0:1/32 {
            destination 2001:DB8:0:2;
         }
      }
   }
   ...
}
```

Example: Configuring a Multilink Interface with MLFR FRF.15

```
[edit interfaces]
ml-1/0/0 {
   unit 1 {
      encapsulation multilink-frame-relay-end-to-end;
      family inet {
```

```
            address 192.168.5.2/32 {
              destination 192.168.5.3;
            }
          }
        }
        unit 10 {
          encapsulation multilink-frame-relay-end-to-end;
          family inet {
            address 10.1.1.3/32 {
              destination 10.1.1.2;
            }
          }
        }
      }
      t1-5/1/0 {
        unit 0 {
          dlci 16;
          encapsulation multilink-frame-relay-end-to-end;
          family mlfr-end-to-end {
            bundle ml-1/0/0.1;
          }
        }
      }
      t1-5/1/1 {
        unit 0 {
          dlci 17;
          encapsulation multilink-frame-relay-end-to-end;
          family mlfr-end-to-end {
            bundle ml-1/0/0.10;
          }
        }
      }
      t1-5/1/2 {
        unit 0 {
          dlci 26;
          encapsulation multilink-frame-relay-end-to-end;
          family mlfr-end-to-end {
            bundle ml-1/0/0.10;
          }
        }
      }
```

Example: Configuring an MLPPP Bundle

This example shows how to configure an MLPPP bundle to increase traffic bandwidth.

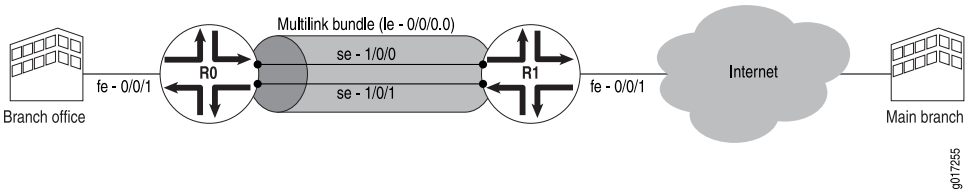
Requirements

Before you begin, you should have two MX Series routers (MX240, MX480, or MX960 routers) configured with at least two serial interfaces that communicate over serial links.

Overview

In this example, you create the MLPPP bundle lsq-0/0/0.0 at the logical unit level of the link services interface lsq-0/0/0 on the MX Series routers R0 and R1. You then add the two serial interfaces se-1/0/0 and se-1/0/1 as constituent links to the multilink bundle. In Figure 2 on page 43, your company's branch office is connected to its main branch using routers R0 and R1. You transmit data and voice traffic on two low-speed 1-Mbps serial links. To increase bandwidth, you configure MLPPP and join the two serial links se-1/0/0 and se-1/0/1 into the multilink bundle lsq-0/0/0.0. Then you configure LFI and CoS on R0 and R1 to enable them to transmit voice packets ahead of data packets.

Figure 2: Configuring MLPPP and LFI on Serial Links



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

For device R0
set interfaces lsq-0/0/0 unit 0 family inet address 10.0.0.10/24
set interfaces se-1/0/0 unit 0 family mlppp bundle lsq-0/0/0.0
set interfaces se-1/0/1 unit 0 family mlppp bundle lsq-0/0/0.0
set interfaces se-1/0/0 serial-options clocking-mode dce clock-rate 2.0mhz
set interfaces se-1/0/1 serial-options clocking-mode dce clock-rate 2.0mhz

For device R1
set interfaces lsq-0/0/0 unit 0 family inet address 10.0.0.9/24
set interfaces se-1/0/0 unit 0 family mlppp bundle lsq-0/0/0.0
set interfaces se-1/0/1 unit 0 family mlppp bundle lsq-0/0/0.0

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For instructions on how to do that, see Using the CLI Editor in Configuration Mode in the CLI User Guide.

To configure MLPPP bundle:

1. Create an interface on both the routers.

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

2. Configure a family inet and define the IP address on device R0.

   ```
   [edit interfaces lsq-0/0/0 unit 0]
   user@host# set family inet address 10.0.0.10/24
   ```

3. Configure a family inet and define the IP address on device R1.

   ```
   [edit interfaces lsq-0/0/0 unit 0]
   user@host# set family inet address 10.0.0.9/24
   ```

4. Specify the names of the constituent links to be added to the multilink bundle on both the routers.

   ```
   [edit interfaces]
   user@host# edit se-1/0/0 unit 0
   user@host# set family mlppp bundle lsq-0/0/0.0
   [edit interfaces]
   user@host# edit se-1/0/1 unit 0
   user@host# set family mlppp bundle lsq-0/0/0.0
   ```

5. Set the serial options to the same values for both interfaces on R0.

   NOTE: R0 is set as a DCE device. The serial options are not set for interfaces on R1. You can set the serial options according to your network setup.

   ```
   [edit interfaces]
   user@host# set se-1/0/0 serial-options clocking-mode dce clock-rate 2.0mhz
   user@host# set se-1/0/1 serial-options clocking-mode dce clock-rate 2.0mhz
   ```

Results From configuration mode, confirm your configuration by entering the **show interfaces lsq-0/0/0**, **show interfaces se-1/0/0**, and **show interfaces se-1/0/1** commands for R0 and R1. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
For device R0
[edit]
  user@host# show interfaces lsq-0/0/0
family inet {
  address 10.0.0.10/24;
    }
  }
[edit]
user@host# show interfaces se-1/0/0
  clocking-mode dce;
    clock-rate 2.0mhz;
    }
    unit 0 {
      family mlppp {
      bundle lsq-0/0/0.0;
    }
  }
[edit]
  user@host# show interfaces se-1/0/1
```

```
serial-options {
  clocking-mode dce;
    clock-rate 2.0mhz;
    }
    unit 0 {
      family mlppp {
      bundle lsq-0/0/0.0;
    }
  }
```

For device R1

```
[edit]
user@host# show interfaces lsq-0/0/0
  family inet {
    address 10.0.0.9/24;
    }
  }
[edit]
  user@host# show interfaces se-1/0/0
  unit 0 {
  family mlppp {
    bundle lsq-0/0/0.0;
  }
}
[edit]
  user@host# show interfaces se-1/0/1
  unit 0 {
  family mlppp {
    bundle lsq-0/0/0.0;
  }
}
```

If you are done configuring the router, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly:

- Verifying the MLPPP Bundle on page 45

Verifying the MLPPP Bundle

Purpose Verify that the constituent links are added to the bundle correctly.

Action From operational mode, enter the **show interfaces lsq-0/0/0 statistics** command.

Related Documentation

- Link and Multilink Services Overview on page 3
- Multilink Interfaces on Channelized MICs Overview on page 8
- Understanding MLPPP Bundles and Link Fragmentation and Interleaving (LFI) on Serial Links on page 12
- Example: Configuring Link Interfaces on Channelized MICs on page 52
- Example: Configuring Multilink Frame Relay FRF.15 on page 49

Example: Configuring Multilink Frame Relay FRF.16

This example shows how to configure MLFR FRF.16 for additional bandwidth, load balancing, and redundancy.

Requirements

Before you begin, you should have two MX Series 3D Universal Edge Routers configured with at least two serial interfaces that communicate over serial links.

Overview

In this example, you aggregate two T1 interfaces to create an MLFR FRF.16 bundle on two MX Series, R0 and R1. You configure the chassis interface and specify the number of MLFR FRF.16 bundles to be created on the interface. You then specify the channel to be configured as a multilink bundle and create interface lsq-0/0/0:0. You set the multilink bundle as an MLFR FRF.16 bundle by specifying the MLFR UNI NNI encapsulation type.

Then you define R0 as a DCE device and R1 as a DTE device. You configure a logical unit on the multilink bundle lsq-0/0/0:0, and set the family type to inet. You then assign a DLCI of 400 and an IP address of 10.0.0.10/24 to the multilink bundle. You create the T1 interfaces, t1-2/0/0 and t1-2/0/1, that are to be added as constituent links to the multilink bundle and define the Frame Relay encapsulation type. Finally, you set the multilink bundle to lsq-0/0/0:0.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
For device R0
set chassis fpc 0 pic 0 mlfr-uni-nni-bundles 1
set interfaces lsq-0/0/0:0 encapsulation multilink-frame-relay-uni-nni
set interfaces lsq-0/0/0 dce
set interfaces lsq-0/0/0 unit 0 dlci 400 family inet address 10.0.0.10/24
set interfaces t1-2/0/0 encapsulation multilink-frame-relay-uni-nni
set interfaces t1-2/0/1 encapsulation multilink-frame-relay-uni-nni
set interfaces t1-2/0/0 unit 0 family mlfr-uni-nni bundle lsq-0/0/0:0
set interfaces t1-2/0/1 unit 0 family mlfr-uni-nni bundle lsq-0/0/0:0
For device R1
set chassis fpc 0 pic 0 mlfr-uni-nni-bundles 1
set interfaces lsq-0/0/0:0 encapsulation multilink-frame-relay-uni-nni
```

```
set interfaces lsq-0/0/0 unit 0 dlci 400 family inet address 10.0.0.9/24
set interfaces t1-2/0/0 encapsulation multilink-frame-relay-uni-nni
set interfaces t1-2/0/1 encapsulation multilink-frame-relay-uni-nni
set interfaces t1-2/0/0 unit 0 family mlfr-uni-nni bundle lsq-0/0/0:0
set interfaces t1-2/0/1 unit 0 family mlfr-uni-nni bundle lsq-0/0/0:0
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For instructions on how to do that, see Using the CLI Editor in Configuration Mode in the CLI User Guide.

To configure an MLFR FRF.16 bundle:

1. Configure a chassis interface.

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

2. Specify the number of MLFR bundles.

   ```
   [edit chassis]
   user@host# set fpc 0 pic 0 mlfr-uni-nni-bundles 1
   ```

3. Create an interface.

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

4. Specify the MLFR encapsulation type.

   ```
   [edit interfaces lsq-0/0/0:0]
   user@host# set encapsulation multilink-frame-relay-uni-nni
   ```

5. Set the router R0 as a DCE device.

   ```
   [edit]
   user@host# edit interfaces lsq-0/0/0
   user@host# set dce
   ```

6. Specify a logical unit on the multilink bundle and set the family type.

   ```
   [edit interfaces lsq-0/0/0]
   user@host# set unit 0 dlci 400 family inet address 10.0.0.10/24
   ```

7. Create the T1 interfaces and set the Frame Relay encapsulation.

   ```
   [edit interfaces]
   user@host# set t1-2/0/0 encapsulation multilink-frame-relay-uni-nni
   user@host# set t1-2/0/1 encapsulation multilink-frame-relay-uni-nni
   ```

8. Specify the multilink bundle to which the interface is to be added as a constituent link on device R0.

   ```
   [edit interfaces t1-2/0/0]
   user@host# set unit 0 family mlfr-uni-nni bundle lsq-0/0/0:0
   ```

9. Specify the multilink bundle to which the interface is to be added as a constituent link on device R1.

   ```
   [edit interfaces t1-2/0/1]
   user@host# set unit 0 family mlfr-uni-nni bundle lsq-0/0/0:0
   ```

Results From configuration mode, confirm your configuration by entering the **show chassis**, **show interfaces lsq-0/0/0**, **show interfaces lsq-0/0/0:0**, **show interfaces t1-2/0/0**, and **show interfaces t1-2/0/1** commands for the routers R0 and R1. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
For device R0
[edit]
  user@host# show chassis
  fpc 0 {
  pic 0 {
  mlfr-uni-nni-bundles 1;
    }
  }
  [edit]
    user@host# show interfaces lsq-0/0/0
    dce;
  unit 0 {
  dlci 400;
    family inet {
    address 10.0.0.10/24;
  }
  }
  [edit]
    user@host# show interfaces lsq-0/0/0:0
  encapsulation multilink-frame-relay-uni-nni;
  [edit]
    user@host# show interfaces t1-2/0/0
    encapsulation multilink-frame-relay-uni-nni;
  unit 0 {
  family mlfr-uni-nni {
    bundle lsq-0/0/0:0;
  }
}
[edit]
  user@host# show interfaces t1-2/0/1
  encapsulation multilink-frame-relay-uni-nni;
unit 0 {
family mlfr-uni-nni {
  bundle lsq-0/0/0:0;
}
}

For device R1
[edit]
  user@host# show chassis
  unit 0 {
  dlci 400;
  family inet {
    address 10.0.0.9/24;
  }
  }
  [edit]
    user@host# show interfaces lsq-0/0/0:0
  encapsulation multilink-frame-relay-uni-nni;
  [edit]
```

```
    user@host# show interfaces t1-2/0/0
    encapsulation multilink-frame-relay-uni-nni;
    unit 0 {
      family mlfr-uni-nni {
    bundle lsq-0/0/0:0;
  }
  }
  [edit]
    user@host# show interfaces t1-2/0/1
    encapsulation multilink-frame-relay-uni-nni;
    unit 0 {
      family mlfr-uni-nni {
    bundle lsq-0/0/0:0;
  }
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly:

- Verifying the MLFR FRF.16 Configuration on page 49

Verifying the MLFR FRF.16 Configuration

Purpose Verify the MLFR FRF.16 configuration.

Action From operational mode, enter the **show interfaces** command.

Related Documentation

- Link and Multilink Services Overview on page 3
- Multilink Interfaces on Channelized MICs Overview on page 8
- Understanding MLPPP Bundles and Link Fragmentation and Interleaving (LFI) on Serial Links on page 12
- Example: Configuring Link Interfaces on Channelized MICs on page 52
- Example: Configuring an MLPPP Bundle on page 42
- Example: Configuring Multilink Frame Relay FRF.15 on page 49

Example: Configuring Multilink Frame Relay FRF.15

This example shows how to configure MLFR FRF.15 for additional bandwidth, load balancing, and redundancy by aggregating low-speed links such as T1, E1, and serial links.

- Requirements on page 50
- Overview on page 50
- Configuration on page 50
- Verification on page 52

Requirements

Before you begin, you should have two MX Series 3D Universal Edge Routers (MX240, MX480, or MX960 routers) configured with at least two serial interfaces that communicate over serial links.

Overview

In this example, you aggregate two T1 links to create the MLFR FRF.15 bundle on two MX Series routers, R0 and R1, and set the interface to lsq-0/0/0. You configure a logical unit on the lsq-0/0/0 interface and set the family type to **inet** with address 10.0.0.4/24. Then you configure an IP address for the multilink bundle on the unit level of the interface.

You define the multilink bundle as an MLFR FRF.15 bundle by specifying the MLFR end-to-end encapsulation type. You specify the names of the constituent links to be added to the multilink bundle as t1-2/0/0 and t1-2/0/1 and set the encapsulation type to **frame-relay**. You then define R0 as a DCE device and R1 as a DTE device. You set the DLCI value to 100 (range is from 16 through 1022). Finally, you set the multilink bundle to lsq-0/0/0.0.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

For device R0

```
set interfaces lsq-0/0/0 unit 0 family inet address 10.0.0.4/24
set interfaces lsq-0/0/0 unit 0 encapsulation multilink-frame-relay-end-to-end
set interfaces t1-2/0/0 encapsulation frame-relay
set interfaces t1-2/0/1 encapsulation frame-relay
set interfaces lsq-0/0/0 dce
set interfaces lsq-0/0/0 unit 0 dlci 100 family mlfr-end-to-end bundle lsq-0/0/0.0
```

For device R1

```
set interfaces lsq-0/0/0 unit 0 family inet address 10.0.0.5/24
set interfaces lsq-0/0/0 unit 0 encapsulation multilink-frame-relay-end-to-end
set interfaces t1-2/0/0 encapsulation frame-relay
set interfaces t1-2/0/1 encapsulation frame-relay
set interfaces lsq-0/0/0 unit 0 dlci 100 family mlfr-end-to-end bundle lsq-0/0/0.0
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For instructions on how to do that, see Using the CLI Editor in Configuration Mode in the CLI User Guide.

To configure the MLFR FRF.15 bundle:

1. Create an interface on both the routers.

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

2. Set a logical unit on the interface and define the family type for the routers R0 and R1.

```
[edit interfaces lsq-0/0/0 unit 0]
user@host# set family inet address 10.0.0.4/24
user@host# set family inet address 10.0.0.5/24
```

3. Define the multilink bundle as an MLFR FRF.15 bundle.

```
[edit interfaces lsq-0/0/0 unit 0]
user@host# set encapsulation multilink-frame-relay-end-to-end
```

4. Specify the names of the constituent links to be added to the multilink bundle.

```
[edit interfaces]
user@host# set t1-2/0/0 encapsulation frame-relay
user@host# set t1-2/0/1 encapsulation frame-relay
```

5. Define the router R0 as a DCE device.

```
[edit interfaces]
user@host# edit lsq-0/0/0
user@host# set dce
```

6. Specify the DLCI as well as the multilink bundle to which the interface is to be added.

```
[edit interfaces lsq-0/0/0]
user@host# set unit 0 dlci 100 family mlfr-end-to-end bundle lsq-0/0/0.0
```

Results From configuration mode, confirm your configuration by entering the **show interfaces lsq-0/0/0**, **show interfaces t1-2/0/0**, and **show interfaces t1-2/0/1** commands for R0 and R1. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
For device R0
[edit]
  user@host# show interfaces lsq-0/0/0
  dce;
unit 0 {
  encapsulation multilink-frame-relay-end-to-end;
    dlci 100;
  family inet {
    address 10.0.0.4/24;
      }
    family mlfr-end-to-end {
    bundle lsq-0/0/0.0;
      }
    }
[edit]
  user@host#show interfaces t1-2/0/0
encapsulation frame-relay;
  [edit]
    user@host# show interfaces t1-2/0/1
  encapsulation frame-relay;

For device R1
[edit]
  user@host# show interfaces lsq-0/0/0
```

```
    unit 0 {
    encapsulation multilink-frame-relay-end-to-end;
      dlci 100;
      family inet {
    address 10.0.0.5/24;
    }
    family mlfr-end-to-end {
      bundle lsq-0/0/0.0;
    }
  }
  [edit]
    user@host# show interfaces t1-2/0/0
  encapsulation frame-relay;
    [edit]
      user@host# show interfaces t1-2/0/1
    encapsulation frame-relay;
```

If you are done configuring the router, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly:

- Verifying the MLFR FRF.15 Configuration on page 52

Verifying the MLFR FRF.15 Configuration

Purpose Verify the MLFR FRF.15 configuration.

Action From operational mode, enter the **show interfaces** command.

Related Documentation

- Link and Multilink Services Overview on page 3
- Multilink Interfaces on Channelized MICs Overview on page 8
- Understanding MLPPP Bundles and Link Fragmentation and Interleaving (LFI) on Serial Links on page 12
- Example: Configuring Link Interfaces on Channelized MICs on page 52
- Example: Configuring an MLPPP Bundle on page 42
- Example: Configuring Multilink Frame Relay FRF.16 on page 46

Example: Configuring Link Interfaces on Channelized MICs

Requirements

This example uses the following hardware and software components:

- Junos OS Release 12.1 or later for MX240, MX480, and MX960 routers
- One MX240, MX480, or MX960 router

Overview

This example provides information about configuring the link interfaces on the following channelized MICs:

- 4-port Channelized SONET/SDH OC3/STM1 (Multi-Rate) MIC with SFP (MIC-3D-4CHOC3-2CHOC12)
- 8-port Channelized SONET/SDH OC3/STM1 (Multi-Rate) MIC with SFP (MIC-3D-8CHOC3-4CHOC12)
- 8-port Channelized DS3/E3 MIC (MIC-3D-8CHDS3-E3-B)

You need to first partition each port on the MICs to configure the link interfaces T1, T3, and DS, and then you configure the link interfaces for bundles. An MLPPP bundle involves "bundling" multiple T1/T3/DS interfaces into a single, logical interface that uses only one IP address. For more information about MLPPP bundles, see "Understanding MLPPP Bundles and Link Fragmentation and Interleaving (LFI) on Serial Links" on page 12. Similarly, you can partition the ports to configure the MICs to the E1/E3 interfaces by setting the framing mode to SDH.

For more information about multilink-based protocols on MX240, MX480, and MX960 routers with Multiservices DPC, see "Multilink Interfaces on Channelized MICs Overview" on page 8.

The following example requires you to navigate various levels in the configuration hierarchy. For instructions on how to do that, see Using the CLI Editor in Configuration Mode in the CLI User Guide.

NOTE: **You can set the values for each parameter according to your requirement. The values given in this example are for illustration purposes only.**

Configuration on 4-port Channelized SONET/SDH OC3/STM1 (Multi-Rate) MIC with SFP

To partition each port on the MIC and configure the link interfaces T1, T3, and DS on it and to configure the link interfaces for bundles, perform the following tasks:

CLI Quick Configuration

To quickly configure synchronization on the aforementioned routers, copy the following commands, paste them in a text file, remove any line breaks, and then copy and paste the commands into the CLI.

```
[edit]

set interfaces coc12-5/2/0 partition 1 interface-type coc1
set interfaces coc12-5/2/0 partition 1 oc-slice 1
set interfaces coc12-5/2/0 partition 2 oc-slice 2 interface-type coc1
set interfaces coc12-5/2/0 partition 3 oc-slice 3 interface-type coc1
set interfaces coc1-5/2/0:1 no-partition interface-type t3
set interfaces coc1-5/2/0:3 no-partition interface-type t3
set interfaces coc1-5/2/0:2 partition 1 interface-type ct1
set interfaces coc1-5/2/0:2 partition 2 interface-type t1
set interfaces coc1-5/2/0:2 partition 3 interface-type ct1
set interfaces coc1-5/2/0:2 partition 4 interface-type t1
set interfaces ct1-5/2/0:2:1 partition 1 timeslots 1 interface-type ds
set interfaces ct1-5/2/0:2:1 partition 2 timeslots 2 interface-type ds
set interfaces ct3-2/0/0 no-partition interface-type t3
set interfaces ct3-2/0/0 partition 1 interface-type t1
set interfaces ct3-2/0/0 partition 2 interface-type t1
set interfaces ct3-2/0/0 partition 3 interface-type t1
set interfaces ct3-2/0/0 partition 4 interface-type ct1
set interfaces ct1-5/2/0:2:1 partition 1 timeslots 1 interface-type ds
set interfaces t1-5/2/0:2:2 unit 0 family mlppp bundle rlsq0.1
set interfaces ds-5/2/0:2:1:1 unit 0 family mlppp bundle rlsq0.0
set interfaces ds-5/2/0:2:1:2 unit 0 family mlppp bundle rlsq0.0
set interfaces t3-5/2/0:3 unit 0 family mlppp bundle rlsq0.2
set interfaces t3-5/2/0:1 unit 0 family mlppp bundle rlsq0.2
set interfaces t1-5/2/0:2:2 encapsulation multilink-frame-relay-uni-nni unit 0 family
mlfr-uni-nni bundle rlsq0:0
set interfaces t1-5/2/0:2:4 encapsulation multilink-frame-relay-uni-nni unit 0 family
mlfr-uni-nni bundle rlsq0:0
set interfaces ds-5/2/0:2:1:1 encapsulation multilink-frame-relay-uni-nni unit 0 family
mlfr-uni-nni bundle rlsq0:0
set interfaces ds-5/2/0:2:1:2 encapsulation multilink-frame-relay-uni-nni unit 0 family
mlfr-uni-nni bundle rlsq0:0
```

set interfaces t1-5/2/0:2:2 encapsulation frame-relay unit 0 dlci 10 family mlfr-end-to-end bundle rlsq0.0
set interfaces t1-5/2/0:2:4 encapsulation frame-relay unit 0 dlci 11 family mlfr-end-to-end bundle rlsq0.0
set interfaces ds-5/2/0:2:1:1 encapsulation frame-relay unit 0 dlci 10 family mlfr-end-to-end bundle rlsq0.0
set interfaces ds-5/2/0:2:1:2 encapsulation frame-relay unit 0 dlci 11 family mlfr-end-to-end bundle rlsq0.0
set interfaces t3-5/2/0:1 encapsulation frame-relay unit 0 dlci 11 family mlfr-end-to-end bundle rlsq0.1
set interfaces t3-5/2/0:3 encapsulation frame-relay unit 0 dlci 10 family mlfr-end-to-end bundle rlsq0.1

Partitioning Ports on the Channelized MICs and Configuring the Link Interfaces T1, T3, and DS

Step-by-Step Procedure

To partition each port on the channelized MICs:

1. Configure the **coc12-5/2/0** interface by setting the **partition** option to **1** with the sublevel interface type set to **coc1**.

   ```
   [edit interfaces]
   user@host# set coc12-5/2/0 partition 1 interface-type coc1
   ```

2. Configure the **coc12-5/2/0** interface with the OC-slice range (OC-slice range specifies the bandwidth size required for the interface type you are configuring) set to **1**.

   ```
   [edit interfaces]
   user@host# set coc12-5/2/0 partition 1 oc-slice 1
   ```

3. Configure the **coc12-5/2/0** interface by setting the **partition** option to **2** with the sublevel interface type set to **coc1** and the OC-slice range set to **2**.

   ```
   [edit interfaces]
   user@host# set coc12-5/2/0 partition 2 oc-slice 2 interface-type coc1
   ```

4. Configure the **coc12-5/2/0** interface by setting the **partition** option to **3** with the sublevel interface type set to **coc1** and the OC-slice range set to **3**.

   ```
   [edit interfaces]
   user@host# set coc12-5/2/0 partition 3 oc-slice 3 interface-type coc1
   ```

5. Configure the **coc1-5/2/0:1** interface as a clear channel by setting the **no-partition** option for the sublevel interface type **t3** . (A clear channel consolidates the entire bandwidth of a channelized interface into a single unpartioned stream that looks like a standard interface.)

   ```
   [edit interfaces]
   user@host# set coc1-5/2/0:1 no-partition interface-type t3
   ```

6. Configure the **coc1-5/2/0:3** interface as a clear channel by setting the **no-partition** option for the sublevel interface type **t3**.

   ```
   [edit interfaces]
   user@host# set coc1-5/2/0:3 no-partition interface-type t3
   ```

7. Configure the **coc1-5/2/0:2** interface by setting the **partition** option to **1** and **3** with the sublevel interface type set to **ct1**. Configure the **coc1-5/2/0:2** interface by setting the **partition** option to **2** and **4** with the sublevel interface type set to **t1**.

```
[edit interfaces]
user@host# set coc1-5/2/0:2 partition 1 interface-type ct1
user@host# set coc1-5/2/0:2 partition 2 interface-type t1
user@host# set coc1-5/2/0:2 partition 3 interface-type ct1
user@host# set coc1-5/2/0:2 partition 4 interface-type t1
```

8. Configure the **ct1-5/2/0:2:1** interface by setting the **partition** option to **1** and **2** with the sublevel interface type set to **ds**. Configure the time slots for the partitions.

```
[edit interfaces]
user@host# set ct1-5/2/0:2:1 partition 1 timeslots 1 interface-type ds
user@host# set ct1-5/2/0:2:1 partition 2 timeslots 2 interface-type ds
```

9. Configure a clear channel on the channelized interface **ct3-2/0/0** by setting the **no-partition** option to the sublevel interface type **t3** (a clear channel consolidates the entire bandwidth of a channelized interface into a single unpartitioned stream that looks like a standard interface).

```
[edit interfaces]
user@host# set ct3-2/0/0 no-partition interface-type t3
```

10. Configure a clear channel on the channelized interface **ct3-2/0/0** by setting the **partition** option to **1**, **2**, and **3** with the sublevel interface type **ds**. Configure the **ct3-2/0/0** interface by setting the **partition** option to **4** with the sublevel interface type **ct1**.

```
[edit interfaces]
user@host# set ct3-2/0/0 partition 1 interface-type t1
user@host# set ct3-2/0/0 partition 2 interface-type t1
user@host# set ct3-2/0/0 partition 3 interface-type t1
user@host# set ct3-2/0/0 partition 4 interface-type ct1
```

11. Configure the **ct1-2/0/0:4** interface by setting the **partition** option to **1** and **2** with the sublevel interface type set to **ds**. Configure the time slots for the partitions.

```
[edit interfaces]
user@host# set ct1-5/2/0:2:1 partition 1 timeslots 1 interface-type ds
user@host# set ct1-5/2/0:2:1 partition 2 timeslots 2 interface-type ds
```

Results Display the results of partitioning each port on the MIC and configuring the link interfaces T1, T3, and DS:

Results for CHOC12/3 interfaces

```
user@host# show interfaces
coc12-5/2/0 {
    partition 1 oc-slice 1 interface-type coc1;
    partition 2 oc-slice 2 interface-type coc1;
    partition 3 oc-slice 3 interface-type coc1;
}
coc1-5/2/0:1 {
    no-partition interface-type t3;
}
coc1-5/2/0:3 {
    no-partition interface-type t3;
```



```
}
coc1-5/2/0:2 {
    partition 1 interface-type ct1;
    partition 2 interface-type t1;
    partition 3 interface-type ct1;
    partition 4 interface-type t1;
}
```

Results for CHDS3 MIC interfaces

```
user@host# show interfaces
ct1-5/2/0:2:1 {
    partition 1 timeslots 1 interface-type ds;
    partition 2 timeslots 2 interface-type ds;
}
ct3-2/0/0 {
    no-partition interface-type t3;
    partition 1 interface-type t1;
    partition 2 interface-type t1;
    partition 3 interface-type t1;
    partition 4 interface-type ct1;
}
ct1-2/0/0:4 {
    partition 1 timeslots 1 interface-type ds;
    partition 2 timeslots 2 interface-type ds;
}
```

Configuring MLPPP, MLFR FRF.15, and MLFR FRF.16 on Link Interfaces for Bundles

Step-by-Step Procedure

To configure MLPPP, MLFR FRF.15, and MLFR FRF.16 on the link interfaces T1, T3, and DS for bundles:

1. Configure the MLPPP encapsulation on the T1 link interfaces **t1-5/2/0:2:2** and **t1-5/2/0:2:4**.

   ```
   [edit interfaces]
   user@host# set t1-5/2/0:2:2 unit 0 family mlppp bundle rlsq0.1
   user@host# set t1-5/2/0:2:4 unit 0 family mlppp bundle rlsq0.1
   ```

2. Configure the MLPPP encapsulation on the DS link interfaces **ds-5/2/0:2:1:1** and **ds-5/2/0:2:1:2**.

   ```
   [edit interfaces]
   user@host# set ds-5/2/0:2:1:1 unit 0 family mlppp bundle rlsq0.0
   user@host# set ds-5/2/0:2:1:2 unit 0 family mlppp bundle rlsq0.0
   ```

3. Configure the MLPPP encapsulation on the T3 link interfaces **t3-5/2/0:3** and **t3-5/2/0:1**.

   ```
   [edit interfaces]
   user@host# set t3-5/2/0:3 unit 0 family mlppp bundle rlsq0.2
   user@host# set t3-5/2/0:1 unit 0 family mlppp bundle rlsq0.2
   ```

4. Configure the MLFR FRF.16 encapsulation on the T1 link interfaces **t1-5/2/0:2:2** and **t1-5/2/0:2:4**.

   ```
   [edit interfaces]
   user@host# set t1-5/2/0:2:2 encapsulation multilink-frame-relay-uni-nni unit 0
     family mlfr-uni-nni bundle rlsq0:0
   ```

```
user@host# set t1-5/2/0:2:4 encapsulation multilink-frame-relay-uni-nni unit 0
  family mlfr-uni-nni bundle rlsq0:0
```

5. Configure the MLFR FRF.16 encapsulation on the DS link interfaces **ds-5/2/0:2:1:1** and **ds-5/2/0:2:1:2**.

```
[edit interfaces]
user@host# set ds-5/2/0:2:1:1 encapsulation multilink-frame-relay-uni-nni unit 0
  family mlfr-uni-nni bundle rlsq0:0
user@host# set ds-5/2/0:2:1:2 encapsulation multilink-frame-relay-uni-nni unit 0
  family mlfr-uni-nni bundle rlsq0:0
```

6. Configure the MLFR FRF.15 encapsulation on the T1 link interfaces **t1-5/2/0:2:2** and **t1-5/2/0:2:4**.

```
[edit interfaces]
user@host# set t1-5/2/0:2:2 encapsulation frame-relay unit 0 dlci 10 family
  mlfr-end-to-end bundle rlsq0.0
user@host# set t1-5/2/0:2:4 encapsulation frame-relay unit 0 dlci 11 family
  mlfr-end-to-end bundle rlsq0.0
```

7. Configure the MLFR FRF.15 encapsulation on the DS link interfaces **ds-5/2/0:2:1:1** and **ds-5/2/0:2:1:2**.

```
[edit interfaces]
user@host# set ds-5/2/0:2:1:1 encapsulation frame-relay unit 0 dlci 10 family
  mlfr-end-to-end bundle rlsq0.0
user@host# set ds-5/2/0:2:1:2 encapsulation frame-relay unit 0 dlci 11 family
  mlfr-end-to-end bundle rlsq0.0
```

8. Configure the MLFR FRF.15 encapsulation on the T3 link interfaces **t3-5/2/0:1** and **t3-5/2/0:3**.

```
[edit interfaces]
user@host# set t3-5/2/0:1 encapsulation frame-relay unit 0 dlci 11 family
  mlfr-end-to-end bundle rlsq0.1
user@host# set t3-5/2/0:3 encapsulation frame-relay unit 0 dlci 10 family
  mlfr-end-to-end bundle rlsq0.1
```

Display the results of the configuration of link interfaces for bundles:

MLPPP on T1 links

```
user@host# show interfaces
t1-5/2/0:2:2 {
  unit 0 {
    family mlppp {
      bundle rlsq0.1;
    }
  }
}
t1-5/2/0:2:4 {
  unit 0 {
    family mlppp {
      bundle rlsq0.1;
    }
  }
}
```

MLPPP on DS links

```
user@host# show interfaces
```

```
ds-5/2/0:2:1:1 {
  unit 0 {
    family mlppp {
      bundle rlsq0.0;
    }
  }
}
ds-5/2/0:2:1:2 {
  unit 0 {
    family mlppp {
      bundle rlsq0.0;
    }
  }
}
```

MLPPP on T3 links

```
user@host# show interfaces
t3-5/2/0:3 {
  unit 0 {
    family mlppp {
      bundle rlsq0.2;
    }
  }
}
t3-5/2/0:1 {
  unit 0 {
    family mlppp {
      bundle rlsq0.2;
    }
  }
}
```

MLFR FRF.15 on T1 links

```
user@host# show interfaces
t1-5/2/0:2:2 {
  encapsulation frame-relay;
  unit 0 {
    dlci 10;
    family mlfr-end-to-end {
      bundle rlsq0.0;
    }
  }
}
t1-5/2/0:2:4 {
  encapsulation frame-relay;
    unit 0 {
    dlci 11;
    family mlfr-end-to-end {
      bundle rlsq0.0;
    }
  }
}
```

MLFR FRF.15 on DS links

```
user@host# show interfaces
ds-5/2/0:2:1:1 {
  encapsulation frame-relay;
  unit 0 {
```

```
      dlci 10;
      family mlfr-end-to-end {
        bundle rlsq0.0;
      }
    }
}
ds-5/2/0:2:1:2 {
  encapsulation frame-relay;
    unit 0 {
    dlci 11;
    family mlfr-end-to-end {
      bundle rlsq0.0;
    }
  }
}
```

MLFR FRF.15 on T3 links

```
user@host# show interfaces
t3-5/2/0:1 {
  encapsulation frame-relay;
  unit 0 {
    dlci 11;
    family mlfr-end-to-end {
      bundle rlsq0.1;
    }
  }
}
t3-5/2/0:3 {
  encapsulation frame-relay;
    unit 0 {
    dlci 10;
    family mlfr-end-to-end {
      bundle rlsq0.1;
    }
  }
}
```

MLFR FRF.16 on T1 links

```
user@host# show interfaces
t1-5/2/0:2:2 {
  encapsulation multilink-frame-relay-uni-nni;
  unit 0 {
    family mlfr-uni-nni {
      bundle rlsq0:0;
    }
  }
}
t1-5/2/0:2:4 {
  encapsulation multilink-frame-relay-uni-nni;
  unit 0 {
    family mlfr-uni-nni {
      bundle rlsq0:0;
    }
  }
}
```

MLFR FRF.16 on DS links

```
user@host# show interfaces
ds-5/2/0:2:1:1 {
  encapsulation multilink-frame-relay-uni-nni;
  unit 0 {
    family mlfr-uni-nni {
      bundle rlsq0:0;
    }
  }
}
ds-5/2/0:2:1:2 {
  encapsulation multilink-frame-relay-uni-nni;
  unit 0 {
    family mlfr-uni-nni {
      bundle rlsq0:0;
    }
  }
}
```

Verification

Confirm that the configuration is working properly.

- Verifying the MLPPP Bundle on page 61
- Verifying the MLFR FRF.15 Configuration on page 61
- Verifying the MLFR FRF.16 Configuration on page 61

Verifying the MLPPP Bundle

Purpose Verify that the constituent links are added to the bundle correctly.

Action From operational mode, enter the **show interfaces lsq-*fpc/pic/port*** command.

Meaning The output displays the constituent links that are added to the bundle. For more information about the **show interfaces lsq-*fpc/pic/port*** operational command, see the Junos OS Operational Mode Commands.

Verifying the MLFR FRF.15 Configuration

Purpose Verify the MLFR FRF.15 configuration.

Action From operational mode, enter the **show interfaces lsq-*fpc/pic/port*** command.

Meaning The output displays the standard status information about the specified link services IQ interface. For more information about the **show interfaces lsq-*fpc/pic/port*** operational command, see the Junos OS Operational Mode Commands.

Verifying the MLFR FRF.16 Configuration

Purpose Verify the MLFR FRF.16 configuration.

Action From operational mode, enter the **show interfaces lsq-*fpc/pic/port*** command.

Meaning The output displays the standard status information about the specified link services IQ interface. For more information about the **show interfaces lsq-*fpc/pic/port*** operational command, see the Junos OS Operational Mode Commands.

Related Documentation

- Link and Multilink Services Overview on page 3
- Multilink Interfaces on Channelized MICs Overview on page 8
- Example: Configuring an MLPPP Bundle on page 42
- Example: Configuring Multilink Frame Relay FRF.15 on page 49
- Example: Configuring Multilink Frame Relay FRF.16 on page 46

CHAPTER 4

Link Interfaces Examples

Example: Configuring a Link Services Interface with Two Links

This example uses the MLFR UNI NNI protocol between Router A and Router B and logically connects link services bundles **ls-1/1/0.3** and **ls-0/0/0.10**, as specified in Table 7 on page 63.

Table 7: Link Services Bundle

Router A	Router B
t1-0/1/0 (ls-1/1/0:3)	t1-0/3/0 (ls-0/0/0:10)
t1-0/1/1 (ls-1/1/0:3)	t1-0/3/1 (ls-0/0/0:10)

For LMI to work properly, you must configure one router to be a DCE.

Configuration on Router A

```
[edit interfaces]
ls-1/1/0:3 {
    dce;
    encapsulation multilink-frame-relay-uni-nni;
    unit 0 {
        dlci 16;
        family inet {
            address 10.3.3.1/32 {
                destination 10.3.3.2;
            }
        }
    }
}
t1-0/1/0 {
    encapsulation multilink-frame-relay-uni-nni;
```

```
    unit 0 {
      family mlfr-uni-nni {
        bundle ls-1/1/0:3;
      }
    }
}
t1-0/1/1 {
    encapsulation multilink-frame-relay-uni-nni;
    unit 0 {
      family mlfr-uni-nni {
        bundle ls-1/1/0:3;
      }
    }
}
```

Configuration on Router B

```
[edit interfaces]
ls-0/0/0:10 {
    encapsulation multilink-frame-relay-uni-nni;
    unit 0 {
      dlci 16;
      family inet {
        address 10.3.3.2/32 {
          destination 10.3.3.1;
        }
      }
    }
}
t1-0/3/0 {
    encapsulation multilink-frame-relay-uni-nni;
    unit 0 {
      family mlfr-uni-nni {
        bundle ls-0/0/0:10;
      }
    }
}
t1-0/3/1 {
    encapsulation multilink-frame-relay-uni-nni;
    unit 0 {
      family mlfr-uni-nni {
        bundle ls-0/0/0:10;
      }
    }
}
```

Example: Configuring a Link Services Interface with MLPPP

```
[edit interfaces]
t1-0/0/0 {
    encapsulation ppp;
    unit 0 {
      family mlppp {
        bundle ls-0/3/0.0;
      }
    }
}
```

```
t1-0/0/1 {
   encapsulation ppp;
   unit 0 {
      family mlppp {
         bundle ls-0/3/0.0;
      }
   }
}
ls-0/3/0 {
   unit 0 {
      encapsulation multilink-ppp;
      family inet {
         address 10.16.1.2/32 {
            destination 10.16.1.1;
         }
      }
      family iso;
      family inet6 {
         address 2001:DB8:1:2/126;
      }
   }
}
```

Example: Configuring a Link Services Interface with MLFR FRF.15

```
[edit interfaces]
t1-0/0/0 {
   encapsulation frame-relay;
   unit 0 {
      dlci 16;
      family mlfr-end-to-end {
         bundle ls-0/3/0.0;
      }
   }
}
t1-0/0/1 {
   encapsulation frame-relay;
   unit 0 {
      dlci 16;
      family mlfr-end-to-end {
         bundle ls-0/3/0.0;
      }
   }
}
ls-0/3/0 {
   unit 0 {
      encapsulation multilink-frame-relay-end-to-end;
      family inet {
         address 10.16.1.2/32 {
            destination 10.16.1.1;
         }
      }
      family iso;
      family inet6 {
         address 2001:DB8:1:2/12;
```

```
    }
  }
}
```

Example: Configuring a Link Services PIC with MLFR FRF.16

```
[edit chassis]
fpc 1 {
  pic 2 {
    mlfr-uni-nni-bundles 5;
  }
}
[edit interfaces]
t1-0/0/0 {
  encapsulation multilink-frame-relay-uni-nni;
  unit 0 {
    family mlfr-uni-nni {
      bundle ls-1/2/0:0;
    }
  }
}
t1-0/0/1 {
  encapsulation multilink-frame-relay-uni-nni;
  unit 0 {
    family mlfr-uni-nni {
      bundle ls-1/2/0:0;
    }
  }
}
ls-1/2/0:0 {
  dce;
  encapsulation multilink-frame-relay-uni-nni;
  unit 0 {
    dlci 26;
    family inet {
      address 10.26.1.1/32 {
        destination 10.26.1.2;
      }
    }
  }
}
```

Example: Configuring Link and Voice Services Interfaces with a Combination of Bundle Types

```
[edit chassis]
fpc 1 {
  pic 3 {
    mlfr-uni-nni-bundles 4;
  }
}
[edit interfaces]
t1-0/2/0:0 {
  encapsulation multilink-frame-relay-uni-nni;
  unit 0 {
```

```
      family mlfr-uni-nni {
        bundle ls-1/3/0:0;
      }
    }
  }
  t1-0/2/0:1 {
    encapsulation multilink-frame-relay-uni-nni;
    unit 0 {
      family mlfr-uni-nni {
        bundle ls-1/3/0:0;
      }
    }
  }
  t1-0/2/0:5 {
    unit 0 {
      family mlppp {
        bundle ls-1/3/0.2;
      }
    }
  }
  t1-0/2/0:6 {
    unit 0 {
      family mlppp {
        bundle ls-1/3/0.2;
      }
    }
  }
  t1-0/2/0:7 {
    encapsulation frame-relay;
    unit 0 {
      dlci 20;
      family mlfr-end-to-end {
        bundle ls-1/3/0.1;
      }
    }
  }
  t1-0/2/0:8 {
    encapsulation frame-relay;
    unit 0 {
      dlci 20;
      family mlfr-end-to-end {
        bundle ls-1/3/0.1;
      }
    }
  }
  t1-0/2/0:10 {
    no-keepalives;
    encapsulation ppp;
    unit 0 {
      family mlppp {
        bundle lsq-1/1/0.0;
      }
    }
  }
  t3-1/0/0 {
    no-keepalives;
```

```
    encapsulation ppp;
    unit 0 {
      family mlppp {
        bundle lsq-1/1/0.2;
      }
    }
}
lsq-1/1/0 {
    unit 0 {
      encapsulation multilink-ppp;
      compression {
        rtp {
          f-max-period 100;
          queues [ q1 q2 ];
          port minimum 2000 maximum 6000;
        }
      }
      family inet {
        address 10.5.5.5/24;
      }
    }
    unit 1 {
      encapsulation multilink-ppp;
      compression {
        rtp {
          port minimum 2000 maximum 6000;
        }
      }
      family inet {
        address 10.6.6.1/24;
      }
    }
    unit 2 {
      encapsulation multilink-ppp;
      compression {
        rtp {
          port minimum 2000 maximum 6000;
        }
      }
      family inet {
        address 10.9.9.1/24;
      }
    }
}
t1-1/2/0 {
    no-keepalives;
    unit 0 {
      family mlppp {
        bundle lsq-1/1/0.1;
      }
    }
}
ls-1/3/0 {
    unit 1 {
      encapsulation multilink-frame-relay-end-to-end;
      family inet {
```

```
        address 10.1.4.1/24;
      }
    }
    unit 2 {
      encapsulation multilink-ppp;
      family inet {
        address 10.7.4.1/24;
      }
    }
  }
  ls-1/3/0:0 {
    encapsulation multilink-frame-relay-uni-nni;
    mlfr-uni-nni-bundle-options {
      debug-flags 15;
    }
    unit 0 {
      dlci 20;
      family inet {
        address 10.5.4.1/24;
      }
    }
  }
  [edit routing-options]
  static {
    route 10.12.12.0/24 next-hop 10.1.1.9;
  }
```

On Router B:

```
  [edit chassis]
  fpc 1 {
    pic 3 {
      mlfr-uni-nni-bundles 4;
    }
  }
  [edit interfaces]
  ge-0/0/0 {
    unit 0 {
      family inet {
        address 10.1.1.1/24;
      }
    }
  }
  so-0/1/1 {
    encapsulation ppp;
    unit 0 {
      family inet {
        address 10.7.7.7/24;
      }
    }
  }
  t1-0/2/0:0 {
    encapsulation multilink-frame-relay-uni-nni;
    unit 0 {
      family mlfr-uni-nni {
        bundle ls-1/3/0:0;
```

```
        }
    }
}
t1-0/2/0:1 {
    encapsulation multilink-frame-relay-uni-nni;
    unit 0 {
        family mlfr-uni-nni {
            bundle ls-1/3/0:0;
        }
    }
}
t1-0/2/0:5 {
    no-keepalives;
    unit 0 {
        family mlppp {
            bundle ls-1/3/0.2;
        }
    }
}
t1-0/2/0:6 {
    no-keepalives;
    unit 0 {
        family mlppp {
            bundle ls-1/3/0.2;
        }
    }
}
t1-0/2/0:7 {
    dce;
    encapsulation frame-relay;
    unit 0 {
        dlci 20;
        family mlfr-end-to-end {
            bundle ls-1/3/0.1;
        }
    }
}
t1-0/2/0:8 {
    dce;
    encapsulation frame-relay;
    unit 0 {
        dlci 20;
        family mlfr-end-to-end {
            bundle ls-1/3/0.1;
        }
    }
}
t1-0/2/0:10 {
    no-keepalives;
    encapsulation ppp;
    unit 0 {
        family mlppp {
            bundle lsq-1/1/0.0;
        }
    }
}
```

```
t3-0/3/0 {
    no-keepalives;
    encapsulation ppp;
    unit 0 {
        family mlppp {
            bundle lsq-1/1/0.2;
        }
    }
}
ge-1/0/0 {
    unit 0 {
        family inet {
            address 10.2.2.1/24;
        }
    }
}
lsq-1/1/0 {
    unit 0 {
        compression {
            rtp {
                port minimum 2000 maximum 6000;
            }
        }
        family inet {
            address 10.5.5.1/24;
        }
    }
    unit 1 {
        encapsulation multilink-ppp;
        compression {
            rtp {
                port minimum 16384 maximum 20102;
            }
        }
        family inet {
            address 10.3.4.1/24;
        }
    }
    unit 2 {
        encapsulation multilink-ppp;
        compression {
            rtp {
                port minimum 2000 maximum 6000;
            }
        }
        family inet {
            address 10.9.9.9/24;
        }
    }
}
t1-1/2/2 {
    no-keepalives;
    unit 0 {
        family mlppp {
            bundle ls-1/3/0.1;
        }
```

```
    }
  }
  t1-1/2/3 {
    no-keepalives;
    unit 0 {
      family mlppp {
        bundle lsq-1/1/0.1;
      }
    }
  }
  ls-1/3/0 {
    unit 1 {
      encapsulation multilink-frame-relay-end-to-end;
      family inet {
        address 10.1.4.4/24;
      }
      family iso;
    }
    unit 2 {
      encapsulation multilink-ppp;
      family inet {
        address 10.7.4.4/24;
      }
    }
  }
  ls-1/3/0:0 {
    dce;
    encapsulation multilink-frame-relay-uni-nni;
    unit 0 {
      dlci 20;
      family inet {
        address 10.5.4.4/24;
      }
    }
  }
  [edit routing-options]
  static {
    route 10.12.12.0/24 next-hop 10.3.4.4;
  }
```

CHAPTER 5

Configuration Statements

acknowledge-retries

Syntax acknowledge-retries *number*;

Hierarchy Level [edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before Junos OS Release 7.4.

Description For link services interfaces only, configure the number of retransmission attempts to be made for consecutive hello or remove link messages following the expiration of the acknowledgment timer.

Options *number*—Number of retransmission attempts to be made following the expiration of the acknowledgment timer.

Range: 1 through 5

Default: 2

Usage Guidelines See "Configuring Acknowledgment Timers on Link Services Physical Interfaces" on page 30.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- action-red-differential-delay on page 75, hello-timer on page 84

acknowledge-timer

Syntax acknowledge-timer *milliseconds*;

Hierarchy Level [edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before Junos OS Release 7.4.

Description For link services interfaces only, configure the maximum time, in milliseconds, to wait for an add link acknowledgment, hello acknowledgment, or remove link acknowledgment message.

Options ***milliseconds***—Time to wait for an add link acknowledgment, hello acknowledgment, or remove link acknowledgment message.

Range: 1 through 10 milliseconds

Default: 4 milliseconds

Usage Guidelines See "Configuring Acknowledgment Timers on Link Services Physical Interfaces" on page 30.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- address (Interfaces) on page 76, hello-timer on page 84

action-red-differential-delay

Syntax action-red-differential-delay (disable-tx | remove-link);

Hierarchy Level [edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before Junos OS Release 7.4.

Description For link services interfaces only, configure the action to be taken when the differential delay exceeds the red limit.

Options **disable-tx**—Disable transmission on the bundle link.

remove-link—Remove the bundle link from service.

Default: **remove-link**

Usage Guidelines See "Configuring Differential Delay Alarms on Link Services Physical Interfaces with MLFR FRF.16" on page 30.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- yellow-differential-delay on page 95

address (Interfaces)

Syntax

```
address address {
  destination address;
}
```

Hierarchy Level

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

Release Information Statement introduced before Junos OS Release 7.4.

Description Configure the interface address.

Options ***address***—Address of the interface.

The remaining statements are explained separately.

Usage Guidelines See "Configuring the Links in a Multilink or Link Services Bundle" on page 18; for a general discussion of **address** statement options, see the Junos® OS Network Interfaces.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Junos® OS Network Interfaces for other statements that do not affect services interfaces.

bundle

Syntax bundle (ml-*fpc/pic/port* | ls-*fpc/pic/port*);

Hierarchy Level

[edit interfaces *interface-name* unit *logical-unit-number* family mlfr-end-to-end],
[edit interfaces *interface-name* unit *logical-unit-number* family mlfr-uni-nni]

Release Information Statement introduced before Junos OS Release 7.4.

Description Associate the multilink interface with the logical interface it is joining.

Options **ml-*fpc/pic/port***—Name of the multilink interface you are linking.

ls-*fpc/pic/port*—Name of the link services interface you are linking.

Usage Guidelines See "Configuring the Links in a Multilink or Link Services Bundle" on page 18.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

destination (Interfaces)

Syntax destination *address*;

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number* tunnel]
[edit interfaces *interface-name* unit *logical-unit-number* family inet address *address*],
[edit interfaces *interface-name* unit *logical-unit-number* tunnel]
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *address*]

Release Information Statement introduced before Junos OS Release 7.4.

Description For CoS on ATM interfaces, specify the remote address of the connection.

For point-to-point interfaces only, specify the address of the interface at the remote end of the connection.

For tunnel and encryption interfaces, specify the remote address of the tunnel.

Options ***address***—Address of the remote side of the connection.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring Linear RED Profiles on ATM Interfaces
- Multilink and Link Services Logical Interface Configuration Overview on page 10
- Configuring Encryption Interfaces
- Configuring Traffic Sampling
- Configuring Flow Monitoring
- Configuring Unicast Tunnels

disable-mlppp-inner-ppp-pfc

Syntax disable-mlppp-inner-ppp-pfc;

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

Release Information Statement introduced in Junos OS Release 8.2.

Description For MLPPP interfaces only, disable compression of the inner PPP header in the MLPPP payload. By default, compression is enabled.

Usage Guidelines See "Configuring the Drop Timeout Period on Multilink and Link Services Logical Interfaces" on page 20.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

dlci

Syntax dlci *dlci-identifier*;

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

Release Information Statement introduced before Junos OS Release 7.4.

Description For Frame Relay and Multilink Frame Relay user-to-network interface (UNI) network-to-network interface (NNI) encapsulation only, and for link services and point-to-point interfaces only, configure the data-link connection identifier (DLCI) for a permanent virtual circuit (PVC) or a switched virtual circuit (SVC).

To configure a DLCI for a point-to-multipoint interface, use the **multipoint-destination** statement to specify the DLCI.

Options *dlci-identifier*—Data-link connection identifier.

Range: 16 through 1022

Usage Guidelines See "Configuring DLCIs on Link Services Logical Interfaces" on page 24; for general information about Frame Relay DLCIs, see the Junos® OS Network Interfaces.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

drop-timeout

Syntax drop-timeout *milliseconds*;

Hierarchy Level [edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options],
[edit interfaces (ls-*fpc/pic/port* | ml-*fpc/pic/port*) unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options],
[edit logical-systems *logical-system-name* interfaces (ls-*fpc/pic/port*| ml-*fpc/pic/port*) unit *logical-unit-number*]

Release Information Statement introduced before Junos OS Release 7.4.

Description For multilink and link services interfaces only, configure the drop timeout period, in milliseconds.

Options ***milliseconds***—Drop timeout period.

Range: 1 through 2000 milliseconds

Default: 500 ms for bundles greater than or equal to the T1 bandwidth value, and 1500 ms for other bundles. Any CLI-configured value overrides these defaults. Setting a value of 0 reverts to the default.

Usage Guidelines See "Configuring the Drop Timeout Period on Multilink and Link Services Logical Interfaces" on page 20.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

encapsulation (Logical Interface)

Syntax encapsulation (atm-mlppp-llc | multilink-frame-relay-end-to-end | multilink-ppp | ...);

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

Release Information Statement introduced before Junos OS Release 7.4.

Description Logical link-layer encapsulation type.

Options

atm-mlppp-llc—For ATM 2 interfaces, use Multilink Point-to-Point Protocol (MLPPP) over ATM Adaptation Layer 5 (AAL5) logical link control (LLC) encapsulation, as described in RFC 2364, *PPP over AAL5*.

multilink-frame-relay-end-to-end—Use Multilink Frame Relay (MLFR) FRF.15 encapsulation. This encapsulation is usedon multilink "link services interfaces and their constituent T1 or E1 interfaces", and is supported on LSQ and redundant LSQ interfaces.

multilink-ppp—Use MLPPP encapsulation. This encapsulation is used only on multilink and link services interfaces and their constituent T1 or E1 interfaces.

Usage Guidelines See "Configuring Encapsulation for Multilink and Link Services Logical Interfaces" on page 19; for information about **encapsulation** statement options used with other interface types, see the Junos® OS Network Interfaces.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

encapsulation (Physical Interface)

Syntax encapsulation (multilink-frame-relay-uni-nni | ...);

Hierarchy Level [edit interfaces *interface-name*],
[edit interfaces rlsq*number:number*]

Release Information Statement introduced before Junos OS Release 7.4.

Description Physical link-layer encapsulation type.

Default MLFR UNI NNI encapsulation (on link services interfaces).

Options **multilink-frame-relay-uni-nni**—Use MLFR UNI NNI encapsulation. This encapsulation is used only on link services interfaces functioning as FRF.16 bundles and their constituent T1 or E1 interfaces, and is supported on LSQ and redundant LSQ interfaces.

Usage Guidelines See "Configuring Encapsulation for Link Services Physical Interfaces" on page 29; for information about **encapsulation** statement options used with other interface types, see the Junos® OS Network Interfaces.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

family

Syntax

```
family family {
  address address {
    destination address;
  }
}
```

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

Release Information Statement introduced before Junos OS Release 7.4.

Description Configure protocol family information for the logical interface.

Options *family*—Protocol family:

- **ccc**—Circuit cross-connect protocol suite
- **inet**—IP version 4 (IPv4)
- **inet6**—IP version 6 (IPv6)
- **iso**—Open Systems Interconnection (OSI) International Organization for Standardization (ISO) protocol suite
- **mlfr-end-to-end**—Multilink Frame Relay FRF.15
- **mlfr-uni-nni**—Multilink Frame Relay FRF.16
- **multilink-ppp**—Multilink Point-to-Point Protocol
- **mpls**—MPLS
- **tcc**—Translational cross-connect protocol suite
- **tnp**—Trivial Network Protocol
- **vpls**—Virtual private LAN service

The remaining statements are explained separately.

Usage Guidelines See the topics in Link and Multilink Properties; for a general discussion of **family** statement options, see the Junos® OS Network Interfaces .

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Junos® OS Network Interfaces for other statements that do not affect services interfaces.

fragment-threshold

Syntax fragment-threshold *bytes*;

Hierarchy Level [edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options],
[edit interfaces (ls-*fpc/pic/port*| ml-*fpc/pic/port*) unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options],
[edit logical-systems *logical-system-name* interfaces (ls-*fpc/pic/port*| ml-*fpc/pic/port*) unit *logical-unit-number*]

Release Information Statement introduced before Junos OS Release 7.4.

Description For multilink and link services interfaces only, set the fragmentation threshold, in bytes.

Options ***bytes***—Maximum size, in bytes, for multilink packet fragments. Any nonzero value must be a multiple of 64 bytes.

Range: 128 through 16,320 bytes

Default: 0 bytes (no fragmentation)

Usage Guidelines See "Limiting Packet Payload Size on Multilink and Link Services Logical Interfaces" on page 21.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

hello-timer

Syntax hello-timer *milliseconds*;

Hierarchy Level [edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before Junos OS Release 7.4.

Description For link services interfaces only, configure the rate at which hello messages are sent. A hello message is transmitted after a period defined in milliseconds has elapsed.

Options ***milliseconds***—The rate at which hello messages are sent.
Range: 1 through 180 milliseconds
Default: 10 milliseconds

Usage Guidelines See "Configuring Acknowledgment Timers on Link Services Physical Interfaces" on page 30.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
- address (Interfaces) on page 76, acknowledge-timer on page 74

interfaces

Syntax interfaces { ... }

Hierarchy Level [edit]

Release Information Statement introduced before Junos OS Release 7.4.

Description Configure interfaces on the router.

Default The management and internal Ethernet interfaces are automatically configured. You must configure all other interfaces.

Usage Guidelines See the Junos® OS Network Interfaces.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

interleave-fragments

Syntax interleave-fragments;

Hierarchy Level [edit interfaces ls-*fpc/pic/port*:*channel* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces ls-*fpc/pic/port* unit *logical-unit-number*]

Release Information Statement introduced before Junos OS Release 7.4.

Description For link services and voice services interfaces only, interleave long packets with high-priority packets.

Allows small delay-sensitive packets, such as voice over IP (VoIP) packets, to interleave with long fragmented packets. This minimizes the latency of delay-sensitive packets.

Usage Guidelines See "Configuring Delay-Sensitive Packet Interleaving on Link Services Logical Interfaces" on page 25.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

lmi-type

Syntax lmi-type (ansi | itu);

Hierarchy Level [edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before Junos OS Release 7.4.

Description Set the Frame Relay Local Management Interface (LMI) type.

Options **ansi**—Use American National Standards Institute (ANSI) T1.167 Annex D LMIs.

itu—Use ITU Q933 Annex A LMIs.
Default: itu

Usage Guidelines See "Configuring Keepalives on Link Services Physical Interfaces" on page 31.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

minimum-links

Syntax minimum-links *number*;

Hierarchy Level [edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options],
[edit interfaces (ls-*fpc/pic/port* | ml-*fpc/pic/port*) unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options],
[edit logical-systems *logical-system-name* interfaces (ls-*fpc/pic/port* | ml-*fpc/pic/port*) unit *logical-unit-number*]

Release Information Statement introduced before Junos OS Release 7.4.

Description For multilink or link services interfaces only, set the minimum number of links that must be up for the bundle to be labeled up. A member link is considered up when the PPP Link Control Protocol (LCP) phase transitions to open state.

The **minimum-links** value should be identical on both ends of the bundle.

Options *number*—Number of links.

Range: 1 through 8

Default: 1

Usage Guidelines See "Configuring the Minimum Number of Active Links on Multilink and Link Services Logical Interfaces" on page 22.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

mlfr-uni-nni-bundle-options

Syntax

```
mlfr-uni-nni-bundle-options {
  acknowledge-retries number;
  acknowledge-timer milliseconds;
  action-red-differential-delay (disable-tx | remove-link);
  cisco-interoperability send-lip-remove-link-for-link-reject;
  drop-timeout milliseconds;
  fragment-threshold bytes;
  hello-timer milliseconds;
  lmi-type (ansi | itu | c-lmi);
  minimum-links number;
  mrru bytes;
  n391 number;
  n392 number;
  n393 number;
  red-differential-delay milliseconds;
  t391 number;
  t392 number;
  yellow-differential-delay milliseconds;
}
```

Hierarchy Level [edit interfaces ls-*fpc/pic/port* :*channel*]

Release Information Statement introduced before Junos OS Release 7.4.

Description Configure link services interface management properties.

The statements are explained separately.

Usage Guidelines See "Configuring Encapsulation for Link Services Physical Interfaces" on page 29.

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
- Configuring Encapsulation for Link Services Physical Interfaces on page 29

mrru

Syntax mrru *bytes*;

Hierarchy Level [edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options],
[edit interfaces (ml-*fpc/pic/port*| ls-*fpc/pic/port*) unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options],
[edit logical-systems *logical-system-name* interfaces (ml-*fpc/pic/port*| ls-*fpc/pic/port*) unit *logical-unit-number*]

Release Information Statement introduced before Junos OS Release 7.4.

Description For multilink or link services interfaces only, set the maximum received reconstructed unit (MRRU). The MRRU is similar to the maximum transmission unit (MTU), but is specific to multilink interfaces.

Options *bytes*—MRRU size.

Range: 1500 through 4500 bytes

Default: 1500 bytes

Usage Guidelines See "Configuring MRRU on Multilink and Link Services Logical Interfaces" on page 23.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

mtu

Syntax mtu *bytes*;

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

Release Information Statement introduced before Junos OS Release 7.4.

Description Maximum transmission unit (MTU) size for the media or protocol. The default MTU size depends on the device type. Not all devices allow you to set an MTU value, and some devices have restrictions on the range of allowable MTU values.

Options ***bytes***—MTU size.

Range: 0 through 5012 bytes

Default: 1500 bytes (**inet**, **inet6**, and **iso** families), 1448 bytes (**mpls**)

Usage Guidelines See "Configuring MRRU on Multilink and Link Services Logical Interfaces" on page 23.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Junos® OS Network Interfaces

multicast-dlci

Syntax multicast-dlci *dlci-identifier*;

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

Release Information Statement introduced before Junos OS Release 7.4.

Description For point-to-multipoint link services interfaces only, enable multicast support on the interface. You can configure multicast support on the interface if the Frame Relay switch performs multicast replication.

Options ***dlci-identifier***—DLCI identifier, a number from 16 through 1022 that defines the Frame Relay DLCI over which the switch expects to receive multicast packets for replication.

Usage Guidelines See "Configuring Multicast-Capable DLCIs for MLFR FRF.16 Bundles" on page 25.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

n391

Syntax n391 *number*;

Hierarchy Level [edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before Junos OS Release 7.4.

Description For link services interfaces only, set the Frame Relay full status polling interval.

Options *number*—Polling interval.
Range: 1 through 255
Default: 6

Usage Guidelines See "Configuring Keepalives on Link Services Physical Interfaces" on page 31.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
- n392 on page 90, n393 on page 91, t391 on page 92, and t392 on page 93

n392

Syntax n392 *number*;

Hierarchy Level [edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before Junos OS Release 7.4.

Description For link services interfaces only, set the Frame Relay error threshold, in number of errors.

Options *number*—Error threshold.
Range: 1 through 10
Default: 3

Usage Guidelines See "Configuring Keepalives on Link Services Physical Interfaces" on page 31.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
- n391 on page 90, n393 on page 91, t391 on page 92, and t392 on page 93

n393

Syntax n393 *number*;

Hierarchy Level [edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before Junos OS Release 7.4.

Description For link services interfaces only, set the Frame Relay monitored event count.

Options *number*—Event count.
Range: 1 through 10
Default: 4

Usage Guidelines See "Configuring Keepalives on Link Services Physical Interfaces" on page 31.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
- n391 on page 90, n392 on page 90, t391 on page 92, and t392 on page 93

red-differential-delay

Syntax red-differential-delay *milliseconds*;

Hierarchy Level [edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before Junos OS Release 7.4.

Description For link services interfaces only, configure the red differential delay among bundle links to give warning when a link has a differential delay that exceeds the configured threshold.

Options *milliseconds*—Red differential delay threshold.
Range: 1 through 2000 milliseconds
Default: 120 milliseconds

Usage Guidelines See "Configuring Differential Delay Alarms on Link Services Physical Interfaces with MLFR FRF.16" on page 30.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
- action-red-differential-delay on page 75, yellow-differential-delay on page 95

short-sequence

Syntax short-sequence;

Hierarchy Level [edit interfaces (ls-*fpc/pic/port* | ml-*fpc/pic/port*) unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces (ls-*fpc/pic/port* | ml-*fpc/pic/port*) unit *logical-unit-number*]

Release Information Statement introduced before Junos OS Release 7.4.

Description For multilink interfaces only, set the length of the packet sequence identification number to 12 bits.

Default If not included in the configuration, the length is set to 24 bits.

Usage Guidelines See "Configuring the Sequence Header Format on Multilink and Link Services Logical Interfaces" on page 24.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

t391

Syntax t391 *number*;

Hierarchy Level [edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before Junos OS Release 7.4.

Description For link services interfaces only, set the Frame Relay link integrity polling interval.

Options *number*—Link integrity polling interval.
Range: 5 through 30 seconds
Default: 10 seconds

Usage Guidelines See "Configuring Keepalives on Link Services Physical Interfaces" on page 31.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- n391 on page 90, n392 on page 90, n393 on page 91, and t392 on page 93

t392

Syntax t392 *number*;

Hierarchy Level [edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before Junos OS Release 7.4.

Description For link services interfaces only, set the Frame Relay polling verification interval.

Options *number*—Polling verification interval.
Range: 5 through 30 seconds
Default: 15 seconds

Usage Guidelines See "Configuring Keepalives on Link Services Physical Interfaces" on page 31.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
- n391 on page 90, n392 on page 90, n393 on page 91, and t391 on page 92

unit (Interfaces)

Syntax

```
unit logical-unit-number {
  disable-mlppp-inner-ppp-pfc;
  dlci dlci-identifier;
  drop-timeout milliseconds;
  encapsulation type;
  fragment-threshold bytes;
  interleave-fragments;
  minimum-links number;
  mrru bytes;
  multicast-dlci dlci-identifier;
  short-sequence;
  family family {
    address address {
      destination address;
    }
    bundle (ml-fpc/pic/port | ls-fpc/pic/port);
  }
}
```

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.

Description Configure a logical interface on the physical device. You must configure a logical interface to be able to use the physical device.

Options *logical-unit-number*—Number of the logical unit.

Range: 0 through 16,384

The remaining statements are explained separately.

Usage Guidelines See Link and Multilink Properties; for a general discussion of logical interface properties, see the Junos® OS Network Interfaces .

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Junos® OS Network Interfaces for other statements that do not affect services interfaces.

yellow-differential-delay

Syntax yellow-differential-delay *milliseconds*;

Hierarchy Level [edit interfaces ls-*fpc/pic/port*:*channel* mlfr-uni-nni-bundle-options]

Release Information Statement introduced before Junos OS Release 7.4.

Description For link services interfaces only, configure the yellow differential delay among bundle links to give warning when a link has a differential delay that exceeds the configured threshold.

Options ***milliseconds***—Yellow differential delay threshold.

Range: 1 through 2000 milliseconds

Default: 72 milliseconds

Usage Guidelines See "Configuring Differential Delay Alarms on Link Services Physical Interfaces with MLFR FRF.16" on page 30.

Required Privilege Level interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- action-red-differential-delay on page 75, red-differential-delay on page 91

PART 3

Administration

CHAPTER 6

Link Services Interface Operational Mode Commands

show interfaces (Link Services)

Syntax For Multilink Frame Relay user-to-user network-to-network interface (UNI NNI):

show interfaces *interface-type :channel*
<brief | detail | extensive | terse>
<descriptions>
<media>
<snmp-index *snmp-index*>
<statistics>

For Multilink Frame Relay end-to-end:

show interfaces *interface-type*
<brief | detail | extensive | terse>
<descriptions>
<media>
<snmp-index *snmp-index*>
<statistics>

Release Information Command introduced before Junos OS Release 7.4.

Description Display status information about the specified link services interface.

Options ***interface-type***—On M Series and T Series routers, the interface type is **ls-*fpc/pic/port***. On J Series routers, the interface type is **ls-*pim*/0/*port***.

brief | detail | extensive | terse—(Optional) Display the specified level of output.

descriptions—(Optional) Display interface description strings.

media—(Optional) Display media-specific information about network interfaces.

snmp-index *snmp-index*—(Optional) Display information for the specified SNMP index of the interface.

statistics—(Optional) Display static interface statistics.

Required Privilege Level view

List of Sample Output show interfaces extensive (MFR UNI NNI) on page 108
show interfaces extensive (MFR End-to-End) on page 110

Output Fields Table 8 on page 100 lists the output fields for the **show interfaces** (link services) command. Output fields are listed in the approximate order in which they appear.

Table 8: Link Services show interfaces Output Fields

Field Name	Field Description	Level of Output
Physical Interface		
Physical interface	Name of the physical interface.	All levels

Table 8: Link Services show interfaces Output Fields *(continued)*

Field Name	Field Description	Level of Output
Enabled	State of the interface. Possible values are described in the "Enabled Field" section under Common Output Fields Description.	All levels
Interface index	Physical interface's index number, which reflects its initialization sequence.	**detail extensive** none
SNMP ifIndex	SNMP index number for the physical interface.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support.	**detail extensive**
Link-level type	Encapsulation being used on the physical interface: **Multilink-Frame-Relay-UNI-NNI** (default), **LinkService**, **Frame-relay**, **Frame-relay-ccc**, or **Frame-relay-tcc**.	All levels
MTU	Maximum transmission unit size on the physical interface.	All levels
Device flags	Information about the physical device. Possible values are described in the "Device Flags" section under Common Output Fields Description.	All levels
Interface flags	Information about the interface. Possible values are described in the "Interface Flags" section under Common Output Fields Description.	All levels
Last flapped	Date, time, and how long ago the interface went from down to up. The format is **Last flapped:** ***year-month-day hour:minute:second timezone*** **(*hour:minute:second* ago)** . For example, **Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago)**.	**detail extensive** none
Statistics last cleared	Time when the statistics for the interface were last set to zero.	**detail extensive**
Link flags	Information about the link. Possible values are described in the "Link Flags" section under Common Output Fields Description.	All levels
Hold-times	Current interface hold time up and hold time down, in milliseconds, in the format **Up *n* ms**, **Down *n* ms**.	**detail extensive**

Table 8: Link Services show interfaces Output Fields *(continued)*

Field Name	Field Description	Level of Output
Multilink Frame Relay UNI NNI bundle options	Multilink Frame Relay UNI NNI only) Configured information about Multilink Frame Relay bundle options. • **Device type**—**DCE** (Data Communication Equipment) or **DTE** (Data Terminal Equipment). • **MRRU**—Configured size of the maximum received reconstructed unit (MRRU): **1500** to **4500** bytes. The default is **1524** bytes. • **Fragmentation threshold**—Configured fragmentation threshold: **128** through **16,320** bytes, in integer multiples of **64** bytes. The default setting is **0**, which disables fragmentation. • **Red differential delay limit**—Red differential delay limit among bundle links has been reached, indicating an action will occur. • **Yellow differential delay limit**—Yellow differential delay among bundle links has been reached, indicating a warning will occur. • **Red differential delay action**—Type of actions taken when the red differential delay exceeds the red limit: **Disable link transmit** or **Remove link from service**. • **Reassembly drop timer**—Drop timeout value to provide a recovery mechanism if individual links in the link services bundle drop one or more packets: **1** through **127** milliseconds. By default, the drop timeout parameter is **0** (disabled). A value that is under **5** ms is not recommended. • **Links needed to sustain bundle**—Minimum number of links to sustain the bundle: **1** through **8**. • **LIP Hello timer**—Link Interleaving Protocol hello timer: **1** through **180** seconds. ◦ **Acknowledgement timer**—Maximum period to wait for an add link acknowledgement, hello acknowledgement, or remove link acknowledgement: **1** through **10** seconds. ◦ **Acknowledgement retries**—Number of retransmission attempts to be made for consecutive hello or remove link messages after the expiration of the acknowledgement timer: **1** through **5.**	**detail extensive** none
Multilink Frame Relay UNI NNI bundle options (continued)	• **Bundle class**—Bundle class ID. • **LMI type**—Multilink Frame Relay UNI NNI LMI type:**ANSI** or **Q.933 ANNEX A**. ◦ **T391 LIV polling timer**—Multilink Frame Relay UNI NNI Full status polling counter: **1** through **255**, with a default value of **6**. ◦ **T392 polling verification timer**—Multilink Frame Relay UNI NNI LMI error threshold. The number of errors required to bring down the link, within the event count specified by **N393**. The range is **1** through **10**, with a default value of **3**. ◦ **N391 full status polling count**—Multilink Frame Relay UNI NNI Full status polling counter: **1** through **255**. ◦ **N392 error threshold**—Multilink Frame Relay UNI NNI LMI error threshold: **1** through **10**. • **N393 monitored event count**—Multilink Frame Relay UNI NNI LMI monitored event count: **1** through **10**, with a default value of **4.**	**detail extensive** none
Traffic statistics	Number and rate of bytes and packets received and transmitted on the physical interface. All references to traffic direction (input or output) are defined with respect to the router. Input fragments received by the router are assembled into input packets; output packets are segmented into output fragments for transmission out of the router.	**detail extensive**

Table 8: Link Services show interfaces Output Fields *(continued)*

Field Name	Field Description	Level of Output
Multilink Frame Relay UNI NNI bundle errors	Information about Multilink Frame Relay bundle errors. • **Packet drops**—Number of packets dropped. • **Fragment drops**—Number of fragments dropped. • **MRRU exceeded**—Number of times a packet was dropped because the configured MRRU value was exceeded. • **Exception events**—Exception events counter.	**detail extensive**

Multilink Frame Relay UNI NNI bundle statistics	Information about Multilink Frame Relay bundles.
	• **Fragments**—Bundle fragment information.
	  ◦ **Input**—Total number and rate of frames and packets received, in **Frames**, **fps** (frames per second), **Bytes**, and **bps** (bits per second).
	  ◦ **Output**—Total number and rate of frames and packets transmitted, in **Frames**, **fps**, **Bytes**, and **bps**.
	• **Packets**—Bundle packet information.
	  ◦ **Input**—Total number and rate of frames and packets received, in **Frames**, **fps** (frames per second), **Bytes**, and **bps** (bits per second).
	  ◦ **Output**—Total number and rate of frames and packets transmitted, in **Frames**, **fps**, **Bytes**, and **bps**.
		detail extensive

Multilink Frame Relay UNI NNI bundle links information	• **Active bundle links**—Number of bundle links that are currently active. • **Removed bundle links**—Number of bundle links that have been removed (RED differential delay action). • **Disabled bundle links**—Number of bundle links that have been disabled (RED differential delay action).	**detail extensive** none
Multilink Frame Relay UNI NNI active bundle links statistics	(Multilink Frame Relay UNI NNI only) Display information for each active bundle link. • **Frames**—Number of multilink control frames received on this bundle link. • **fps**—Rate of multilink control frames received on this bundle link (in frames per second). • **Bytes**—Number of bytes received on this bundle link. • **bps**—Number of bits per second received on this bundle link. • ***interface-name***—Name of the bundle link interface. • **Input**—Total number and rate of frames and packets received. • **Output**—Total number and rate of frames and packets transmitted. • **Current differential delay**—Compare this bundle link's round trip time to the average of all bundle links' round trip times in **ms** (milliseconds). • **Recent high differential delay**—Highest differential delay value from the latest 10 intervals, in milliseconds. • **Times over red diff delay**—Number of times this bundle link exceeded the configured red differential delay limit. • **Times over yellow diff delay**—Number of times this bundle link exceeded the configured yellow differential delay limit.	**detail extensive**

Table 8: Link Services show interfaces Output Fields *(continued)*

Field Name	Field Description	Level of Output
Multilink Frame Relay UNI NNI active bundle links statistics (continued)	• **LIP**—Link Interleaving Protocol information. • **Rcv**—Number of messages received. • **Xmt**—Number of messages transmitted. • **add_lnk**—ADD__LINK message notifies the peer endpoint that the local endpoint supports frame processing. It is generated on both ends of a bundle link when a bundle link endpoint is ready to become operational. • **lnk_ack**—ADD_LINK_ACK message notifies the peer that the local router has received a valid ADD_LINK message. • **lnk_rej**—ADD_LINK_REJ message notifies the peer that the local router has received an invalid ADD_LINK message. • **hello**—HELLO message notifies the peer that the local router is up. Both ends of a link bundle generate this message. • **hel_ack**—HELLO_ACK message notifies the peer that the local router has received a valid HELLO message. • **lnk_rem**—REMOVE_LINK message notifies the peer that the local router has received a REMOVE_LINK message. • **rem_ack**—REMOVE_LINK_ACK message notifies the peer that the local router has received a valid ADD_LINK message.	**detail extensive**
Frame exceptions	For Multilink Frame Relay end-to-end only. Information about framing exceptions. Includes events recorded under **Exception Events** for each logical interface. • **Oversized frames**—Number of frames received that exceed maximum frame length. Maximum length is 4500 Kb (kilobits). • **Errored input frames**—Number of input frame errors. • **Input on disabled link/bundle**—Number of frames received on disabled links. These frames can result either from an inconsistent configuration, or from a bundle or link being brought up or down with traffic actively flowing through it. • **Output for disabled link/bundle**—Number of frames sent for a disabled or unavailable link. These frames can result either from an inconsistent configuration, or from a bundle being brought up or down while traffic is flowing through it. • **Queuing drops**—Total number of packets dropped before traffic enters the link services IQ interface. Indicates that the interface is becoming oversubscribed.	**detail extensive**
Buffering exceptions	For Multilink Frame Relay end-to-end only. Information about buffering exceptions. Includes events recorded under **Exception Events** for each logical interface: • **Packet data buffer overflow**—Packet buffer memory is full. This overflow can occur when the aggregate data rate exceeds the physical link services interface capacity. • **Fragment data buffer overflow**—Fragment buffer memory is full. This overflow can occur when excessive differential delay is experienced across the links within a single bundle, or when the aggregate data rate exceeds the physical link services interface capacity. Check the logical interface exception event counters to determine which bundle is responsible.	**detail extensive**

Table 8: Link Services show interfaces Output Fields *(continued)*

Field Name	Field Description	Level of Output
Assembly exceptions	For Multilink Frame Relay end-to-end only. Information about assembly exceptions. Includes events recorded under **Exception Events** for each logical interface. An assembly exception does not necessarily indicate an operational problem with the physical link services interface itself. If multilink-encapsulated traffic is dropped or reordered after a sequence number has been assigned, the assembling multilink interface records one or more exception events. The multilink interface can drop multilink-encapsulated fragments itself as a result. Any multilink packets or fragments dropped by the physical link services interface itself result in packet or fragment drop counts on individual logical interfaces. If the logical interface drop counts are zero, but exception events are seen, the most likely cause is a problem with the individual link interfaces. Even if the logical interface fragment drop counts are nonzero, excess differential delay or traffic losses on individual interfaces can be the root cause.	**detail extensive**
Assembly exceptions (continued)	• **Fragment timeout**—The drop timer expired while a fragment sequence number was outstanding. Occurs only if the drop timer is enabled. This timeout can occur if the differential delay across the links in a bundle exceeds the drop-timer setting, or if a multilink packet is lost in transit while the drop timer is enabled. These events do not necessarily indicate any problem with the operation of the physical link services interface itself, but can occur when one or more individual links drop traffic. Check the logical interface exception event counters to determine which bundle is responsible. • **Missing sequence number**—A gap was detected in the sequence numbers of fragments on a bundle. These events do not necessarily indicate any problem with the operation of the physical link services interface itself, but can occur when one or more individual links drop traffic. Check the logical interface exception event counters to determine which bundle is responsible. • **Out-of-order sequence number**—Two frames with out-of-order sequence numbers occurred within a single link. This event indicates that an individual link within a bundle reordered traffic, making the multilink interface unable to correctly process the resulting stream. Check the logical interface exception event counters to determine which bundle is responsible. • **Out-of-range sequence number**—Frame was received with an out-of-range sequence number. These events can occur when a large amount of multilink-encapsulated traffic is lost or the multilink peer is reset, so that a large jump in sequence numbers results. A small number of these events can occur when the far end of a bundle is taken down or brought up. Check the logical interface exception event counters to determine which bundle is responsible.	**detail extensive**
Hardware errors	For Multilink Frame Relay end-to-end only. Information about hardware errors: • **Data memory error**—A memory error was detected on the interface DRAM. Indicates possible hardware failure. Contact Juniper Networks technical support. • **Control memory error**—A memory error was detected on the interface DRAM. Indicates possible hardware failure. Contact Juniper Networks technical support.	**detail extensive**
Logical Interface		
Logical interface	Name of the logical interface.	All levels

Table 8: Link Services show interfaces Output Fields *(continued)*

Field Name	Field Description	Level of Output
Index	Logical interface index number, which reflects its initialization sequence.	**detail extensive** none
SNMP ifIndex	Logical interface SNMP interface index number.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support.	**detail extensive**
Flags	Information about the logical interface. Possible values are described in the "Logical Interface Flags" section under Common Output Fields Description.	All levels
Encapsulation	Encapsulation being used: PPP, Multilink - FR or Multilink - PPP	All levels
Bandwidth	Speed at which the interface is running.	All levels
Bundle options	For Multilink Frame Relay end-to-end interfaces only: • **MRRU**—Configured size of the maximum received reconstructed unit (MRRU): **1500** to **4500** bytes. The default is **1524** bytes. • **Drop timer period**—Drop timeout value to provide a recovery mechanism if individual links in link services bundle drop one or more packets: **1** through **127** milliseconds. Values under **5** milliseconds are not recommended. The default setting is **0**, which disables the timer. • **Sequence number format**—(MLPPP) Short sequence number header format. • **Fragmentation threshold**—Configured fragmentation threshold: **128** through **16,320** bytes, in integer multiples of **64** bytes. The default setting is **0**, which disables fragmentation. • **Links needed to sustain bundle**—Minimum number of links to sustain the bundle: **1** through **8**. • **Interleave fragments**—State of the process that interleaves long packets with high-priority ones. Only **Disabled** is currently supported. • **Remote MRRU**—MRRU value received from remote peer. If negotiation has not been initiated, the default value is displayed.	**detail extensive** none
Bundle status (MLPPP) or Multilink class status (MC-MLPPP)	Information about bundle status: • **Remote MRRU**—MRRU value received from remote peer. If negotiation has not been initiated, the default value is displayed. • **Received sequence number**—Sequence number for received packets. • **Transmit sequence number**—Sequence number for transmitted packets. • **Packet drops**—Number and byte count of output packets that were dropped, rather than being encapsulated and sent out of the router as fragments. The packet drop counter is incremented if there is a temporary shortage of packet memory on the AS PIC, which causes packet fragmentation to fail. • **Fragment drops**—Number and byte count of input fragments that were dropped, rather than being reassembled and handled by the router as packets. This counter also includes fragments that have been received successfully but had to be dropped because not all fragments that constituted a packet had been received. The fragment drop counter is incremented when a fragment received on constituent links is dropped. Drop fragments can be triggered by sequence ordering errors, duplicate fragments, timed-out fragments, and bad multilink headers.	**detail extensive** none

Table 8: Link Services show interfaces Output Fields *(continued)*

Field Name	Field Description	Level of Output
Bundle status (MLPPP) or Multilink class status (MC-MLPPP) (continued)	• **MRRU exceeded**—Number of reassembled packets exceeding the MRRU. This counter is not implemented in this release. • **Fragment timeout**—Drop timer expired while a fragment sequence number was outstanding. Occurs only if the drop timer is enabled. This timeout can occur if the differential delay across the links in a bundle exceeds the drop-timer setting, or if a multilink packet is lost in transit while the drop timer is enabled. • **Missing sequence number**—Gap detected in the sequence numbers of fragments on a bundle. • **Out-of-order sequence number**—Two frames with out-of-order sequence numbers within a single link. This event indicates that an individual link within a bundle reordered traffic, making the multilink interface unable to correctly process the resulting stream. • **Out-of-range sequence number**—Frame with an out-of-range sequence number. These events can occur when a large amount of multilink-encapsulated traffic is lost or the multilink peer is reset, so that a large jump in sequence numbers results. A small number of these events can occur when the far end of a bundle is taken down or brought up. • **Packet data buffer overflow**—Packet buffer memory full. This overflow can occur when the aggregate data rate exceeds the physical link services IQ interface capacity. • **Fragment data buffer overflow**—Fragment buffer memory full. This overflow can occur when excessive differential delay is experienced across the links within a single bundle, or when the aggregate data rate exceeds the physical link services IQ capacity.	**detail extensive** none
Bundle errors	Information about bundle errors. • **Packet drops**—Number and byte count of output packets that were dropped, rather than being encapsulated and sent out of the router as fragments. • **Fragment drops**—Number and byte count of input fragments that were dropped, rather than being reassembled and handled by the router as packets. • **MRRU exceeded**—Number of reassembled packets exceeding the MRRU. • **Exception events**—Number of exceptional events encountered other than MRRU exceeded errors. These events are categorized under the physical interface: **Frame exceptions**, **Buffering exceptions**, and **Fragment exceptions**. Exception events do not necessarily indicate that the multilink interface is not operating properly. Individual link failures can produce exceptional events.	**detail extensive**
Statistics	Information about fragments and packets received and sent by the router. All references to traffic direction (input or output) are defined with respect to the router. Input fragments received by the router are assembled into input packets; output packets are segmented into output fragments for transmission out of the router. • **Bundle**—Information about bundles. • **Link**—Information about links used in the multilink operation.	**detail extensive**
Protocol	Protocol family configured on the logical interface.	**detail extensive** none
MTU	MTU size on the logical interface. If the MTU value is negotiated down to meet the MRRU requirement on the remote side, this value is marked **Adjusted**.	**detail extensive** none

Table 8: Link Services show interfaces Output Fields *(continued)*

Field Name	Field Description	Level of Output
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Route table	Routing table in which this address exists. For example, **Route table:0** refers to inet.0.	**detail extensive**
Flags	Information about the protocol family flags. Possible values are described in the "Family Flags" section under Common Output Fields Description.	**detail extensive** none
Addresses, Flags	Information about the address flags. Possible values are described in the "Addresses Flags" section under Common Output Fields Description.	**detail extensive** none
Destination	IP address of the remote side of the connection.	**detail extensive** none
Local	IP address of the logical interface.	**detail extensive** none
Broadcast	Broadcast address on the logical interface.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support.	**detail extensive**

Sample Output

show interfaces extensive (MFR UNI NNI)

```
user@host> show interfaces ls-1/3/0:0 extensive
Physical interface: ls-1/3/0:0, Enabled, Physical link is Up
  Interface index: 25, SNMP ifIndex: 35, Generation: 124
  Link-level type: Multilink-FR-UNI-NNI, MTU: 1524
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps
  Last flapped   : 2002-11-01 15:26:25 PST (00:34:49 ago)
  Statistics last cleared: Never
  Link flags     : None
  Hold-times     : Up 0 ms, Down 0 ms
  Multilink Frame Relay UNI NNI bundle options:
    Device type                       DTE
    MRRU                              1524
    Fragmentation threshold           1500
    Red differential delay limit      10
    Yellow differential delay limit   6
    Red differential delay action     Disable link transmit
    Reassembly drop timer             0
    Links needed to sustain bundle    1
    LIP Hello timer                   10
        Acknowledgement timer         4
        Acknowledgement retries       2
    Bundle class                      A
    LMI type                          Q.933 Annex A
      T391 LIV polling timer          10
      T392 polling verification timer 15
      N391 full status polling count  6
      N392 error threshold            3
      N393 monitored event count      4
  Traffic statistics:
   Input  bytes  :                    0
```

```
 Output bytes  :                    0
 Input  packets:                    0
 Output packets:                    0
Multilink Frame Relay UNI NNI bundle errors:
  Packet drops                    0 (0 bytes)
  Fragment drops                  0 (0 bytes)
  MRRU exceeded                   0
  Exception events                0
Multilink Frame Relay UNI NNI bundle statistics
                  Frames        fps         Bytes          bps
  Fragments:
    Input :            0          0             0            0
    Output:          824          0         17304          320
  Packets:
    Input :            0          0             0            0
    Output:          824          0         17304          320
Multilink Frame Relay UNI NNI bundle links info:
    Active bundle links       4
    Removed bundle links      0
    Disabled bundle links     0
Multilink Frame Relay UNI NNI active bundle links statistics:
                  Frames        fps         Bytes          bps
  t1-0/2/0:0.0
    Input :            0          0             0            0
    Output:          206          0          4326           80
    Current differential delay       0.2 ms
    Recent high differential delay   3.8 ms
    Times over red diff delay        0
    Times over yellow diff delay     0
    LIP:add_lnk lnk_ack lnk_rej    hello hel_ack lnk_rem rem_ack
    Rcv:      2       2       0      206     207       0       0
    Xmt:      2       1       0      207     206       0       0
  t1-0/2/0:1.0
    Input :            0          0             0            0
    Output:          206          0          4326           80
    Current differential delay       0.2 ms
    Recent high differential delay   3.7 ms
    Times over red diff delay        0
    Times over yellow diff delay     0
    LIP:add_lnk lnk_ack lnk_rej    hello hel_ack lnk_rem rem_ack

    Rcv:      2       2       0      206     207       0       0
    Xmt:      2       1       0      207     206       0       0
  t1-0/2/0:2.0
    Input :            0          0             0            0
    Output:          206          0          4326           80
    Current differential delay       0.4 ms
    Recent high differential delay   3.8 ms
    Times over red diff delay        0
    Times over yellow diff delay     0
    LIP:add_lnk lnk_ack lnk_rej    hello hel_ack lnk_rem rem_ack
    Rcv:      2       2       0      206     207       0       0
    Xmt:      2       1       0      207     206       0       0
  t1-0/2/0:3.0
    Input :            0          0             0            0
    Output:          206          0          4326           80
    Current differential delay       0.3 ms
    Recent high differential delay   3.8 ms
    Times over red diff delay        0
    Times over yellow diff delay     0
    LIP:add_lnk lnk_ack lnk_rej    hello hel_ack lnk_rem rem_ack
```

```
    Rcv:      2       2       0      206     207       0       0
    Xmt:      2       1       0      207     206       0       0
  Logical interface ls-1/3/0:0.0 (Index 5) (SNMP ifIndex 28) (Generation 10)
    Flags: Point-To-Point SNMP-Traps Encapsulation: Multilink-FR-UNI-NNI
    Bandwidth: 622080kbps
    Bundle errors:
      Packet drops                    0 (0 bytes)
      Fragment drops                  0 (0 bytes)
      MRRU exceeded                   0
      Exception events                0
    Statistics         Frames        fps         Bytes          bps
    Bundle:
      Fragments:
        Input :             0          0             0            0
        Output:           824          0         17304          320
      Packets:
        Input :             0          0             0            0
        Output:           824          0         17304          320
    Link:
      t1-0/2/0:0.0
        Input :             0          0             0            0
        Output:           206          0          4326           80
      t1-0/2/0:1.0
        Input :             0          0             0            0
        Output:           206          0          4326           80
      t1-0/2/0:2.0
        Input :             0          0             0            0
        Output:           206          0          4326           80
      t1-0/2/0:3.0
        Input :             0          0             0            0
        Output:           206          0          4326           80
    Protocol inet, MTU: 1500 [Adjusted], Generation: 15, Route table: 0
      Flags: User-MTU, MTU-Protocol-Adjusted
      Addresses, Flags: Is-Preferred Is-Primary
        Destination: 1.1.1.1, Local: 1.1.1.2, Broadcast: Unspecified,
        Generation: 10
```

show interfaces extensive (MFR End-to-End)

```
user@host> show interfaces ls-0/3/0 extensive
Physical interface: ls-0/3/0, Enabled, Physical link is Up
  Interface index: 264, SNMP ifIndex: 104, Generation: 525
  Link-level type: LinkService, MTU: 1524
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps
  Last flapped   : 2002-10-16 17:53:49 PDT (00:22:00 ago)
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :                73471                 264 bps
   Output bytes  :                80335                   0 bps
   Input  packets:                  822                   0 pps
   Output packets:                  819                   0 pps
  Frame exceptions:
    Oversized frames                 0
    Errored input frames             0
    Input on disabled link/bundle    0
    Output for disabled link/bundle  4
    Queuing drops                    3
  Buffering exceptions:
    Packet data buffer overflow      0
    Fragment data buffer overflow    0
  Assembly exceptions:
    Fragment timeout                 0
```

```
  Missing sequence number           0
  Out-of-order sequence number      0
  Out-of-range sequence number      0
Hardware errors (sticky):
  Data memory error                 0
  Control memory error              0
Logical interface ls-0/3/0.0 (Index 5) (SNMP ifIndex 527) (Generation 47)
  Flags: Point-To-Point SNMP-Traps Encapsulation: Multilink-PPP
  Bandwidth: 1536kbps
  Bundle options:
    MRRU                            1524
    Drop timer period               0
    Sequence number format          long (24 bits)
    Fragmentation threshold         0
    Links needed to sustain bundle  1
    Interleave fragments            Disabled
  Bundle status:
    Remote MRRU                     1500
    Received sequence number        0x19ec14
    Transmit sequence number        0x38cfa8
    Packet drops                    0 (0 bytes)
    Fragment drops                  0 (0 bytes)
    MRRU exceeded                   0
    Fragment timeout                0
    Missing sequence number         0
    Out-of-order sequence number    0
    Out-of-range sequence number    0
    Packet data buffer overflow     0
    Fragment data buffer overflow   0
  Bundle errors:
    Packet drops                    2 (68 bytes)
    Fragment drops                  0 (0 bytes)
    MRRU exceeded                   0
    Exception events                0
  Statistics         Frames        fps         Bytes          bps
  Bundle:
    Fragments:
      Input :           172          0         15544          288
      Output:           165          0         16645            0
    Packets:
      Input :           143          0         12885          288
      Output:           134          0         12276            0
  Link:
    t1-0/0/0.0
      Input :           143          0         12885          288
      Output:           134          0         12276            0
  Protocol inet, MTU: 1500, Generation: 76, Route table: 0
    Flags: None
    Addresses, Flags: Is-Preferred Is-Primary
      Destination: 10.16.1.2, Local: 10.16.1.1, Broadcast:
      Unspecified, Generation: 81
  Protocol iso, MTU: 1500 [Adjusted], Generation: 77, Route table: 0
    Flags: Is-Primary
  Protocol inet6, MTU: 1500, Generation: 78, Route table: 0
    Flags: Is-Primary
    Addresses, Flags: Is-Default Is-Preferred Is-Primary
      Destination: 8016::1:0/126, Local: 8016::1:1,
      Broadcast: Unspecified, Generation: 83
    Addresses, Flags: Is-Preferred
      Destination: fe80::/64, Local: fe80::2a0:a5ff:fe12:4777,
```

```
Broadcast: Unspecified,
Generation: 85
```

show interfaces (Multilink Services)

Syntax
show interfaces ml-*fpc/pic/port*
<brief | detail | extensive | terse>
<descriptions>
<media>
<snmp-index>
<statistics>

Release Information
Command introduced before Junos OS Release 7.4.

Description
(M Series and T Series routers only) Display status information about the specified multilink services interface.

Options
ml-*fpc/pic/port*—Display standard status information about the specified multilink services interface.

brief | detail | extensive | terse—(Optional) Display the specified level of output.

descriptions—(Optional) Display interface description strings.

media—(Optional) Display media-specific information about network interfaces.

snmp-index—(Optional) Display the SNMP index of interface.

statistics—(Optional) Display static interface statistics.

Required Privilege Level
view

List of Sample Output
show interfaces extensive (Multilink Services) on page 119

Output Fields
Table 9 on page 113 lists the output fields for the **show interfaces** (Multilink Services) command. Output fields are listed in the approximate order in which they appear.

Table 9: Multilink Services show interfaces Output Fields

Field Name	Field Description	Level of Output
Physical Interface		
Physical interface	Name of the physical interface.	All levels
Enabled	State of the interface. Possible values are described in the "Enabled Field" section under Common Output Fields Description.	All levels
Interface index	Physical interface's index number, which reflects its initialization sequence.	**detail extensive** none
SNMP ifIndex	SNMP index number for the physical interface.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**

Table 9: Multilink Services show interfaces Output Fields *(continued)*

Field Name	Field Description	Level of Output
Link-level type	Encapsulation being used on the physical interface: **Multilink**.	All levels
MTU	MTU size on the physical interface.	All levels
Device flags	Information about the physical device. Possible values are described in the "Device Flags" section under Common Output Fields Description.	All levels
Interface flags	Information about the interface. Possible values are described in the "Interface Flags" section under Common Output Fields Description.	All levels
Last flapped	Date, time, and how long ago the interface went from down to up. The format is **Last flapped:** ***year-month-day hour:minute:second timezone*** **(*hour:minute:second* ago)**. For example, **Last flapped: 2002-04-26 10:52:40 PDT (04:33:20 ago)**.	**detail extensive** none
Statistics last cleared	Time when the statistics for the interface were last set to zero.	**detail extensive**
Traffic statistics	Number and rate of bytes and packets received and transmitted on the physical interface. All references to traffic direction (input or output) are defined with respect to the router. Input fragments received by the router are assembled into input packets; output packets are segmented into output fragments for transmission out of the router.	**detail extensive**
Frame exceptions	Information about framing exceptions. Includes events recorded under **Exception Events** for each logical interface: • **Oversized frames**—Number of frames received that exceed maximum frame length. Maximum length is 4500 Kb (kilobits). • **Errored input frames**—Number of input frame errors. • **Input on disabled link/bundle**—Number of frames received on disabled links. These can result either from an inconsistent configuration, or from a bundle or link being brought up or down with traffic actively flowing through it. • **Output for disabled link/bundle**—Number of frames sent for a disabled or unavailable link. These can result either from an inconsistent configuration, or from a bundle being brought up or down with traffic actively flowing through it. • **Queuing drops**—Total number of packets dropped before traffic enters the link services IQ interface. Indicates that the interface is becoming oversubscribed.	**extensive**
Buffering exceptions	Information about buffering exceptions. Includes events recorded under **Exception Events** for each logical interface: • **Packet data buffer overflow**—Packet buffer memory is full. This overflow can occur when the aggregate data rate exceeds the physical multilink services interface capacity. • **Fragment data buffer overflow**—Fragment buffer memory is full. This overflow can occur when excessive differential delay is experienced across the links within a single bundle, or when the aggregate data rate exceeds the physical multilink services interface capacity. Check the logical interface exception event counters to determine which bundle is responsible.	**extensive**

Table 9: Multilink Services show interfaces Output Fields *(continued)*

Field Name	Field Description	Level of Output
Assembly exceptions	Information about assembly exceptions. Includes events recorded under **Exception Events** for each logical interface. An assembly exception does not necessarily indicate an operational problem with the Multilink PIC itself. If multilink-encapsulated traffic is dropped or reordered after a sequence number has been assigned, the assembling multilink interface records one or more exception events. The multilink interface can drop multilink-encapsulated fragments itself as a result. Any multilink packets or fragments dropped by the Multilink PIC itself result in packet or fragment drop counts on individual logical interfaces. If the logical interface drop counts are zero, but exception events are seen, the most likely cause is a problem with the individual link interfaces. Even if the logical interface fragment drop counts are nonzero, excess differential delay or traffic losses on individual interfaces can be the root cause. • **Fragment timeout**—Drop-timer expired while a fragment sequence number was outstanding. Occurs only if drop-timer is enabled. This can occur if the differential delay across the links in a bundle exceeds the drop-timer setting, or if a multilink packet is lost in transit while the drop timer is enabled. These events do not necessarily indicate any problem with the operation of the Multilink PIC itself. If one or more individual links drop traffic, these events can occur. Check the logical interface exception event counters to determine which bundle is responsible. • **Missing sequence number**—A gap was detected in the sequence numbers of fragments on a bundle. These events do not necessarily indicate any problem with the operation of the Multilink PIC itself. If one or more individual links drop traffic, these events can occur. Check the logical interface exception event counters to determine which bundle is responsible. • **Out-of-order sequence number**—Two frames with out-of-order sequence numbers occurred within a single link. This event indicates that an individual link within a bundle reordered traffic, making the multilink interface unable to correctly process the resulting stream. Check the logical interface exception event counters to determine which bundle is responsible. • **Out-of-range sequence number**—Frame was received with out-of-range sequence number. These events can occur when a large amount of multilink-encapsulated traffic is lost, or the multilink peer is reset, so that a large jump in sequence numbers results. A small number of these events can occur when the far end of a bundle is taken down or brought up. Check the logical interface exception event counters to determine which bundle is responsible.	**extensive**
Hardware errors	Information about hardware errors: • **Data memory error**—A memory error was detected on the interface DRAM. Indicates possible hardware failure. Contact Juniper Networks technical support. • **Control memory error**—A memory error was detected on the interface DRAM. Indicates possible hardware failure. Contact Juniper Networks technical support.	**extensive**
Logical Interface		
Logical interface	Logical interface name.	All levels

Table 9: Multilink Services show interfaces Output Fields *(continued)*

Field Name	Field Description	Level of Output
Index	Logical interface index number, which reflects its initialization sequence.	**detail extensive** none
SNMP ifIndex	SNMP interface index number.	**detail extensive** none
Encapsulation	Encapsulation being used: PPP or Multilink PPP.	All levels
Bandwidth	Speed at which the interface is running.	All levels
Flags	Logical interface flags. Possible values are described in the "Logical Interface Flags" section under Common Output Fields Description.	**detail extensive** none
Bundle options	Information about configured bundle options: • **MRRU**—Configured size of the MRRU (maximum received reconstructed unit). It can be **1500** to **4500** bytes. • **Drop timer period**—Configured drop timeout period. It can be **0** through **127** ms. A value of **0** disables the timer. The default setting is **0**. • **Sequence number format**—Configured size of the sequence header: **12** or **24** bits. The default is **24** bits. • **Fragmentation threshold**—Configured fragmentation threshold. A value of 0 results in no fragmentation. Nonzero values can be **128** through **16,320** bytes, in integer multiples of **64** bytes. The default is **0**. • **Links needed to sustain bundle**—Minimum number of links to sustain the bundle: **1** through **8**.	**detail extensive** none

Table 9: Multilink Services show interfaces Output Fields *(continued)*

Field Name	Field Description	Level of Output
Bundle status (MLPPP) or **Multilink class status (MC-MLPPP)**	Information about bundle status: • **Remote MRRU**—MRRU value received from remote peer. If negotiation has not been initiated, the default value is displayed. • **Received sequence number**—Sequence number for received packets. • **Transmitted sequence number**—Sequence number for transmitted packets. • **Packet drops**—Number and byte count of output packets that were dropped, rather than being encapsulated and sent out of the router as fragments. The packet drop counter is incremented if there is a temporary shortage of packet memory on the AS PIC, which causes packet fragmentation to fail. • **Fragment drops**—Number and byte count of input fragments that were dropped, rather than being reassembled and handled by the router as packets. This counter also includes fragments that have been received successfully but had to be dropped because not all fragments that constituted a packet had been received. The fragment drop counter is incremented when a fragment received on constituent links is dropped. Drop fragments can be triggered by sequence ordering errors, duplicate fragments, timed-out fragments, and bad multilink headers. • **MRRU exceeded**—Number of reassembled packets exceeding the MRRU. This counter is not implemented in this release. • **Fragment timeout**—Drop timer expired while a fragment sequence number was outstanding. Occurs only if the drop timer is enabled. This timeout can occur if the differential delay across the links in a bundle exceeds the drop-timer setting, or if a multilink packet is lost in transit while the drop timer is enabled. • **Missing sequence number**—Gap detected in the sequence numbers of fragments on a bundle. • **Out-of-order sequence number**—Two frames with out-of-order sequence numbers within a single link. This event indicates that an individual link within a bundle reordered traffic, making the multilink interface unable to correctly process the resulting stream. • **Out-of-range sequence number**—Frame with an out-of-range sequence number. These events can occur when a large amount of multilink-encapsulated traffic is lost or the multilink peer is reset, so that a large jump in sequence numbers results. A small number of these events can occur when the far end of a bundle is taken down or brought up. • **Packet data buffer overflow**—Packet buffer memory full. This overflow can occur when the aggregate data rate exceeds the physical link services IQ interface capacity. • **Fragment data buffer overflow**—Fragment buffer memory full. This overflow can occur when excessive differential delay is experienced across the links within a single bundle, or when the aggregate data rate exceeds the physical link services IQ capacity.	**detail extensive**
Remote MRRU	MRRU value received from remote peer. If negotiation has not been initiated, the default value is displayed.	**detail extensive** none

Table 9: Multilink Services show interfaces Output Fields *(continued)*

Field Name	Field Description	Level of Output
Bundle errors	Information about bundle errors: • **Packet drops**—Number and byte count of output packets dropped, rather than being encapsulated and sent out of the router as fragments. • **Fragment drops**—Number and byte count of input fragments dropped, rather than being reassembled and handled by the router as packets. • **MRRU exceeded**—Number of reassembled packets exceeding the MRRU. • **Exception events**—Number of exceptional events encountered while handling traffic on the bundle, other than MRRU exceeded errors. These events are categorized under the physical interface: **Frame exceptions**, **Buffering exceptions**, and **Fragment exceptions**. Exception events do not necessarily indicate that the multilink interface is not operating properly. Individual link failures can produce exceptional events.	**detail extensive**
Statistics	Information about fragments and packets received and sent by the router. All references to traffic direction (input or output) are defined with respect to the router. Input fragments received by the router are assembled into input packets; output packets are segmented into output fragments for transmission out of the router. • **Bundle**—Information about bundles. • **Link**—Information about links used in the multilink operation.	**detail extensive**
Protocol	Protocol family configured on the logical interface.	**detail extensive** none
MTU	MTU size on the logical interface. If the MTU value is negotiated down to meet the MRRU requirement on the remote side, this value is marked **Adjusted**.	**detail extensive** none
Flags	Information about the protocol family flags. Possible values are described in the “Family Flags” section under Common Output Fields Description.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**
Route table	Route table in which this address exists. For example, **Route table:0** refers to inet.0.	**detail extensive**
Addresses, Flags	Information about the address flags. Possible values are described in the “Addresses Flags” section under Common Output Fields Description.	**detail extensive** none
Destination	IP address of the remote side of the connection.	**detail extensive** none
Local	IP address of the logical interface.	**detail extensive** none
Broadcast	Broadcast address on the logical interface.	**detail extensive** none
Generation	Unique number for use by Juniper Networks technical support only.	**detail extensive**

Sample Output

show interfaces extensive (Multilink Services)

```
user@host> show interfaces ml-0/3/0 extensive
Physical interface: ml-0/3/0, Enabled, Physical link is Up
  Interface index: 273, SNMP ifIndex: 196, Generation: 535
  Link-level type: Multilink, MTU: 4474
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps
  Last flapped   : 2002-04-25 14:21:34 PDT (21:06:59 ago)
  Statistics last cleared: Never
  Traffic statistics:
   Input  bytes  :                3535                    0 bps
   Output bytes  :                4135                    0 bps
   Input  packets:                  87                    0 pps
   Output packets:                 103                    0 pps
  Frame exceptions:
    Oversized frames                0
    Errored input frames            0
    Input on disabled link/bundle   0
    Output for disabled link/bundle 0
    Queuing drops                   0
  Buffering exceptions:
    Packet data buffer overflow     0
    Fragment data buffer overflow   0
  Assembly exceptions:
    Fragment timeout                0
    Missing sequence number         0
    Out-of-order sequence number    0
    Out-of-range sequence number    0
  Hardware errors (sticky):
    Data memory error               0
    Control memory error            0

  Logical interface ml-0/3/0.1 (Index 110) (SNMP ifIndex 674)
(Generation 402)
    Flags: Point-To-Point SNMP-Traps Encapsulation: Multilink-PPP
    Bandwidth: 12288kbps
    Bundle options:
      MRRU                          1524
      Drop timer period             0
      Sequence number format        long (24 bits)
      Fragmentation threshold       0
      Links needed to sustain bundle  1
    Bundle status:
      Remote MRRU                   1500
      Received sequence number      0x19ec14
      Transmit sequence number      0x38cfa8
      Packet drops                  0 (0 bytes)
      Fragment drops                0 (0 bytes)
      MRRU exceeded                 0
      Fragment timeout              0
      Missing sequence number       0
      Out-of-order sequence number  0
      Out-of-range sequence number  0
      Packet data buffer overflow   0
      Fragment data buffer overflow  0
    Bundle errors:
      Packet drops                  0 (0 bytes)
      Fragment drops                0 (0 bytes)
      MRRU exceeded                 0
```

```
  Exception events                0
Statistics         Frames        fps         Bytes          bps
Bundle:
  Fragments:
    Input :             5          0           450            0
    Output:             6          0           499            0
  Packets:
    Input :             5          0           450            0
    Output:            12          0          1202            0
Link:
  t1-0/1/0:11.0
    Input :             1          0            90            0
    Output:             1          0            92            0
  t1-0/1/0:12.0
    Input :             1          0            90            0
    Output:             1          0            92            0
  t1-0/1/0:10.0
    Input :             1          0            90            0
    Output:             1          0            92            0
  t1-0/1/0:14.0
    Input :             1          0            90            0
    Output:             1          0            92            0
  t1-0/1/0:13.0
    Input :             1          0            90            0
    Output:             1          0            92            0
  t1-0/1/0:8.0
    Input :             0          0             0            0
    Output:             0          0             0            0
  t1-0/1/0:9.0
    Input :             0          0             0            0
    Output:             0          0             0            0
Protocol inet, MTU: 1500 [Adjusted], Flags: Generation: 752 Route table: 0
  Addresses, Flags: Is-Preferred Is-Primary, MTU-Protocol-Adjusted
    Destination: 1.1.2.2, Local: 1.1.2.1, Broadcast: Unspecified,
    Generation: 1090
Protocol iso, MTU: 1500 [Adjusted], Flags: Is-Primary,
Generation: 753 Route table: 0
```

PART 4

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