



Junos[®] OS

Link and Multilink Services Interfaces Feature Guide for Routing Devices



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Junos® OS Link and Multilink Services Interfaces Feature Guide for Routing Devices
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About the Documentation

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- Supported Platforms on page xi
- Using the Examples in This Manual on page xi
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- Documentation Feedback on page xv
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Documentation and Release Notes

To obtain the most current version of all Juniper Networks® technical documentation, see the product documentation page on the Juniper Networks website at <http://www.juniper.net/techpubs/>.

If the information in the latest release notes differs from the information in the documentation, follow the product Release Notes.

Juniper Networks Books publishes books by Juniper Networks engineers and subject matter experts. These books go beyond the technical documentation to explore the nuances of network architecture, deployment, and administration. The current list can be viewed at <http://www.juniper.net/books>.

Supported Platforms

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

- M Series
- MX 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.xml;
    }
  }
}
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.xml; }
```

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 [CLI Explorer](#).

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.
	Tip	Indicates helpful information.
	Best practice	Alerts you to a recommended use or implementation.

Table 2 on page xiv 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
<i>Italic text like this</i>	<ul style="list-style-type: none"> Introduces or emphasizes important new terms. Identifies guide names. Identifies RFC and Internet draft titles. 	<ul style="list-style-type: none"> A policy <i>term</i> is a named structure that defines match conditions and actions. <i>Junos OS CLI User Guide</i> RFC 1997, <i>BGP Communities Attribute</i>
<i>Italic text like this</i>	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 <i>domain-name</i>
Text like this	Represents names of configuration statements, commands, files, and directories; configuration hierarchy levels; or labels on routing platform components.	<ul style="list-style-type: none"> 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)	Encloses optional keywords or variables.	stub <default-metric <i>metric</i> >;
(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 (<i>string1</i> <i>string2</i> <i>string3</i>)
# (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)	Encloses a variable for which you can substitute one or more values.	community name members [community-ids]
Indentation and braces ({ })	Identifies a level in the configuration hierarchy.	[edit] routing-options { static { route default { nexthop <i>address</i> ; retain; } } }
;(semicolon)	Identifies a leaf statement at a configuration hierarchy level.	

GUI Conventions

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

Convention	Description	Examples
Bold text like this	Represents graphical user interface (GUI) items you click or select.	<ul style="list-style-type: none"> In the Logical Interfaces box, select All Interfaces. To cancel the configuration, click Cancel.
> (bold right angle bracket)	Separates levels in a hierarchy of menu selections.	In the configuration editor hierarchy, select Protocols>Ospf .

Documentation Feedback

We encourage you to provide feedback, comments, and suggestions so that we can improve the documentation. You can provide feedback by using either of the following methods:

- Online feedback rating system—On any page of the Juniper Networks TechLibrary site at <http://www.juniper.net/techpubs/index.html>, simply click the stars to rate the content, and use the pop-up form to provide us with information about your experience. Alternately, you can use the online feedback form at <http://www.juniper.net/techpubs/feedback/>.
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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 Partner Support Service 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

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- 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:
<http://kb.juniper.net/InfoCenter/>
- 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>.

CHAPTER 1

Overview

- [Link and Multilink Services Overview on page 17](#)
- [Multilink and Link Services PICs Overview on page 20](#)
- [Multilink Interfaces on Channelized MICs Overview on page 21](#)
- [Multilink and Link Services Logical Interface Configuration Overview on page 23](#)

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 21](#).



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, 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 *Class of Service Feature Guide for Routing Devices*. 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 25](#)
 - [Example: Configuring an MLPPP Bundle on page 58](#)
 - [Example: Configuring Multilink Frame Relay FRF.15 on page 93](#)
 - [Example: Configuring Multilink Frame Relay FRF.16 on page 89](#)

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 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 20](#). 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.

Related Documentation

- [Link and Multilink Services Overview on page 17](#)
- [Multilink Interfaces on Channelized MICs Overview on page 21](#)
- [Multilink and Link Services Logical Interface Configuration Overview on page 23](#)
- [Understanding MLPPP Bundles and Link Fragmentation and Interleaving \(LFI\) on Serial Links on page 25](#)
- [Configuring the Number of Bundles on Link Services PICs on page 26](#)
- [Configuring the Links in a Multilink or Link Services Bundle on page 27](#)

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 20.](#)

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 17](#)
 - [Example: Configuring Link Interfaces on Channelized MICs on page 44](#)
 - [Example: Configuring an MLPPP Bundle on page 58](#)
 - [Example: Configuring Multilink Frame Relay FRF.15 on page 93](#)
 - [Example: Configuring Multilink Frame Relay FRF.16 on page 89](#)

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 23](#).

For general information about logical unit properties or **family inet** properties, see the *Junos OS Network Interfaces Library for Routing Devices*. 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 27](#).



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 Library for Routing Devices*.

Default Settings for Multilink and Link Services Logical Interfaces

Table 4 on page 23 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×64)

Table 4: Multilink and Link Services Logical Interface Statements (*continued*)

Option	Default Value	Possible Values
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 34 for statements that apply to link services physical interfaces only.

Related Documentation

- [Configuring Encapsulation for Multilink and Link Services Logical Interfaces on page 37](#)
- [Configuring the Drop Timeout Period on Multilink and Link Services Logical Interfaces on page 38](#)
- [Limiting Packet Payload Size on Multilink and Link Services Logical Interfaces on page 40](#)
- [Configuring the Minimum Number of Active Links on Multilink and Link Services Logical Interfaces on page 41](#)
- [Configuring MRRU on Multilink and Link Services Logical Interfaces on page 42](#)
- [Configuring the Sequence Header Format on Multilink and Link Services Logical Interfaces on page 43](#)
- [Configuring DLCIs on Link Services Logical Interfaces on page 87](#)
- [Configuring Delay-Sensitive Packet Interleaving on Link Services Logical Interfaces on page 82](#)

CHAPTER 2

Achieving Greater Bandwidth, Load Balancing, and Redundancy with Multilink Bundles

- [Understanding MLPPP Bundles and Link Fragmentation and Interleaving \(LFI\) on Serial Links on page 25](#)
- [Configuring the Number of Bundles on Link Services PICs on page 26](#)
- [Configuring the Links in a Multilink or Link Services Bundle on page 27](#)
- [Example: Configuring a Link Services Interface with Two Links on page 28](#)
- [Unified ISSU on Inline LSQ Interfaces Overview on page 30](#)

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 multilink 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. Depending on the system license and hardware, you can create up to 1023 multilink bundles per Chassis, and on each multilink bundle add up to 8 constituent links. See [Junos Software Feature Licenses](#) and [“Multilink and Link Services PICs Overview” on page 20](#) for more information.

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.

Starting with Junos OS Release 13.3, if you attempt to delete or deactivate a static inline service (**si**) MLPPP bundle interface that is still referenced by a member link interface, which could be PPPoE (**pp0**) or **si** logical interfaces, and commit the configuration, the commit operation fails. You must reactivate such MLPPP bundle interface before committing the settings. Alternatively, you must ensure that member links do not refer a static MLPPP bundle before you delete or deactivate the bundle. This method of deactivation and reactivation of an MLPPP bundle is not applicable for interfaces other than **si**- interfaces, such as link services IQ (**lsq**-) and virtual LSQ redundancy (**rlsq**-) interfaces.

Related Documentation

- [Multilink Interfaces on Channelized MICs Overview on page 21](#)
- [Example: Configuring Link Interfaces on Channelized MICs on page 44](#)
- [Example: Configuring an MLPPP Bundle on page 58](#)
- [Example: Configuring Multilink Frame Relay FRF.15 on page 93](#)
- [Example: Configuring Multilink Frame Relay FRF.16 on page 89](#)

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 28](#).

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 Administration Library*.

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.

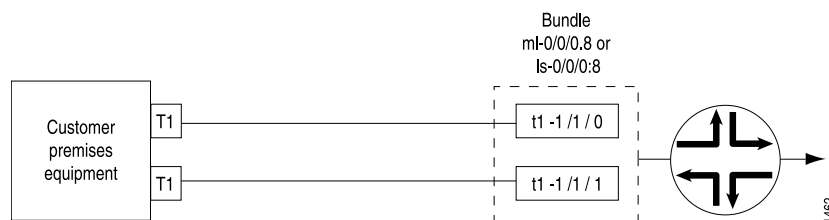
Related Documentation

- [Example: Configuring a Link Services Interface with Two Links on page 28](#)
- [Example: Configuring a Link Services Interface with MLPPP on page 61](#)
- [Example: Configuring a Link Services Interface with MLFR FRF.15 on page 96](#)
- [Example: Configuring a Link Services PIC with MLFR FRF.16 on page 97](#)
- [Example: Configuring Link and Voice Services Interfaces with a Combination of Bundle Types on page 118](#)

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 27](#)). 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 27](#) 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.

Related Documentation

- [Link and Multilink Services Overview on page 17](#)
- [Configuring the Number of Bundles on Link Services PICs on page 26](#)
- [Example: Configuring an MLPPP Bundle on page 58](#)

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 5 on page 28](#).

Table 5: 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)

Table 5: Link Services Bundle (*continued*)

Router A	Router B
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;
        }
    }
}
```

- Related Documentation**
- [encapsulation \(Physical Interface\) on page 136](#)
 - [Configuring Link Services Physical Interfaces on page 33](#)

Unified ISSU on Inline LSQ Interfaces Overview

Starting with Junos OS Release 15.1, unified in-service software upgrade (ISSU) is supported on inline link services intelligent queuing (LSQ) interfaces on MX Series routers. Unified ISSU enables an upgrade between two Junos OS releases with no disruption on the control plane and with minimal disruption of traffic. Inline Multilink PPP (MLPPP), Multilink Frame Relay (FRF.16), and Multilink Frame Relay End-to-End (FRF.15) for time-division multiplexing (TDM) WAN interfaces provide bundling services through the Packet Forwarding Engine without requiring a PIC or Dense Port Concentrator (DPC). The inline LSQ logical interface (*lsq-slot/pic/0*) is a virtual service logical interface that resides on the Packet Forwarding Engine to provide bundling services for Layer 2 packets that do not need a services PIC.

Unified ISSU support for inline LSQ interfaces provides backward compatibility with Junos OS releases in which this support is not available. You can perform a unified ISSU process between a Junos OS release that supports unified ISSU for inline LSQ interfaces and a Junos OS release in which unified ISSU support for inline LSQ interfaces is not available. This backward compatibility does not apply to the scenario where part of the software (such as the kernel software) is upgraded while another part (such as the Packet Forwarding Engine software) is not upgraded. Unified ISSU infrastructure provides APIs to store persistent data, perform cold boot (without resetting power), and manage post-ISSU reboot connectivity and synchronization with Routing Engine kernel and other processes. Unified ISSU is also supported for redundant LSQ (*rlsq-*) interfaces configured in hot-standby and warm-standby mode.

The following line cards on MX Series routers support unified ISSU for inline LSQ interfaces:

- 8-port Channelized DS3/E3 MIC (MIC-3D-8CHDS3-E3-B)
- 8-port Channelized SONET/SDH OC3/STM1 (Multi-Rate) MIC with SFP (MIC-3D-8CHOC3-4CHOC12)
- 4-port Channelized SONET/SDH OC3/STM1 (Multi-Rate) MIC with SFP1 (MIC-3D-4CHOC3-2CHOC12)

- MPC Type 1 3D Q (MX-MPC1-3D-Q)
- MPC Type 2 3D Q (MX-MPC2-3D-Q)

LSQ interfaces support the following three types of multilink data traffic:

- Complete multilink packets (for which bandwidth and encapsulation are set)—These packets do not require the reassembly memory.
- Fragmented multilink packets—These packets require reassembly memory to form a complete packets until all the fragments of all packets arrive.
- Link fragment interleaving (LFI) packets—These packets do not have any multilink header.

There are two time intervals or durations called dark windows during the unified ISSU process. These dark windows denote the brief traffic disruption and outage in handling of packets that can occur when the Packet Forwarding Engines restart owing to the upgraded software being installed on them. The duration of these traffic disconnections vary in length based on several factors, such as the platform and the Junos OS version being upgraded. The following two dark windows are observed:

- The first dark window is during the unified ISSU boot phase. During this time period, host-bound packets are affected because the new microkernel image is being initialized and the path to the host is not discovered yet. The aging calculations for reassembly and fragmentation are stopped, which causes the fragmented traffic types to be dropped. However, LFI packets and complete multilink packets are not disrupted.
- The second dark window occurs during the hardware synchronization phase. During this time period, the hardware learns all the new states from the software. ASICs reinitialize themselves with the new configurations. During this period, all kinds of traffic drops are permissible. The duration for this dark window is approximately 4–5 seconds. During the second dark window, because packets are dropped at the fragmentation side, a receive-ml-seq number mismatch occurs at the other end of the connection (reassembly or receiver side). This behavior can cause additional packet drops.

During a unified ISSU, a switchover from the primary LSQ interface to the secondary lsq interface does not occur and the bundle remains up. The impact on fragmented packets (to be reassembled) remains the same as the packets on LSQ interfaces. LFI and non-fragmented packets are traversed until the second dark window starts. The dark window duration for rlsq- interfaces is the same as that for LSQ interfaces. No particular attribute is maintained only on the local MPC hardware. All of the QoS functionalities behave in the same manner as the pre-unified ISSU phase.

During the unified ISSU process, none of the multilink counters are updated (except the multilink sequence number). The counters are reset and incremented from zero after unified ISSU is completed. The receive-ml-seq and send ml-seq counters need to be updated for reassembly to take place properly but the update of these counters is not exported to the Packet Forwarding Engine microkernel or the Routing Engine.

It is assumed that bundle links do not flap during the unified ISSU window. The following operations occur at the fragmentation and reassembly ends during a unified ISSU process:

When unified ISSU is completed, the send multilink sequence (send-ml-seq) number starts from zero and it causes the receive multilink sequence (receive-ml-seq) number mismatch at the other end of the connection, resulting in additional packet drops. Consider the case where LSQ bundles and links can be hosted on different Packet Forwarding Engines in a dual Packet Forwarding Engine setup. In this scenario, it is possible that these two Packet Forwarding Engines are in different states of the ISSU process, where dark windows for both of them might follow different timelines. This condition adds to more drops.

At the reassembly side:

1. The reassembly is stopped at the unified ISSU preparation or initialization phase, which can cause a longer dark window for fragmented packets. At the time of unified ISSU, reassembly memory is used for unified ISSU processing and is not available, starting from the unified ISSU preparation phase up to the unified ISSU hardware synchronization stage.
2. The two activities of link-load calculations and aging of fragments might impact the traversal of packets during unified ISSU.

At the fragmentation side:

1. The ml-seq number counter, which is needed for multilink fragmentation to work, is not part of the unified ISSU counters.
2. The host-generated packets (that are Layer 2-rewrite packets) are transferred as part of the fabric header and saved as binary large objects (BLOBs).
3. For LFI traffic, hash calculation must work properly for the links to be load-balanced. If the media link state changes during unified ISSU, the bundle state might also be affected.

Related Documentation

- *Enabling Inline LSQ Services*

CHAPTER 3

Configuring the Physical and Logical Interfaces in a Multilink Configuration

- [Configuring Link Services Physical Interfaces on page 33](#)
- [Configuring Encapsulation for Multilink and Link Services Logical Interfaces on page 37](#)
- [Configuring the Drop Timeout Period on Multilink and Link Services Logical Interfaces on page 38](#)
- [Limiting Packet Payload Size on Multilink and Link Services Logical Interfaces on page 40](#)
- [Configuring the Minimum Number of Active Links on Multilink and Link Services Logical Interfaces on page 41](#)
- [Configuring MRRU on Multilink and Link Services Logical Interfaces on page 42](#)
- [Configuring the Sequence Header Format on Multilink and Link Services Logical Interfaces on page 43](#)
- [Example: Configuring Link Interfaces on Channelized MICs on page 44](#)

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 34.

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

- [Default Settings for Link Services Interfaces on page 34](#)
- [Configuring Encapsulation for Link Services Physical Interfaces on page 34](#)
- [Configuring Acknowledgment Timers on Link Services Physical Interfaces on page 35](#)
- [Configuring Differential Delay Alarms on Link Services Physical Interfaces with MLFR FRF.16 on page 35](#)
- [Configuring Keepalives on Link Services Physical Interfaces on page 36](#)

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 23.

Default Settings for Link Services Interfaces

Table 6 on page 34 lists the default settings for link services statements, together with the other permitted values or value ranges.

Table 6: 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 (Nx64)
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 Library for Routing Devices*.

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 37](#).

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 statement 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.

Related Documentation

- [Link and Multilink Services Overview on page 17](#)
- [Example: Configuring a Link Services Interface with Two Links on page 28](#)

Configuring Encapsulation for Multilink and Link Services Logical Interfaces



NOTE: Only MLPPP is supported on ACX Series routers. MLFR is not supported on ACX Series routers.

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 Library for Routing Devices*.

You can also configure physical interface encapsulation on link services interfaces. For more information, see [“Configuring Encapsulation for Link Services Physical Interfaces” on page 34](#).

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.



NOTE: ACX Series routers do not support DS0 physical interface as member links.



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.

Related Documentation

- [Link and Multilink Services Overview on page 17](#)
- [Configuring the Drop Timeout Period on Multilink and Link Services Logical Interfaces on page 38](#)
- [Limiting Packet Payload Size on Multilink and Link Services Logical Interfaces on page 40](#)
- [Example: Configuring a Link Services Interface with MLPPP on page 61](#)
- [encapsulation \(Logical Interface\) on page 135](#)

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 35](#).

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 *Class of Service Feature Guide for Routing Devices*. 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.

- Related Documentation**
- [Link and Multilink Services Overview on page 17](#)
 - [Configuring Encapsulation for Multilink and Link Services Logical Interfaces on page 37](#)
 - [Limiting Packet Payload Size on Multilink and Link Services Logical Interfaces on page 40](#)
 - [Configuring the Minimum Number of Active Links on Multilink and Link Services Logical Interfaces on page 41](#)

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 (Nx64). The default value, 0, results in no fragmentation.

Related Documentation

- [Link and Multilink Services Overview on page 17](#)
- [Configuring Encapsulation for Multilink and Link Services Logical Interfaces on page 37](#)
- [Configuring the Drop Timeout Period on Multilink and Link Services Logical Interfaces on page 38](#)
- [Example: Configuring a Multilink Interface with MLPPP on page 55](#)
- [fragment-threshold on page 138](#)

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



NOTE: Only MLPPP is supported on ACX Series routers. MLFR is not supported on ACX Series routers.

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.

Related Documentation

- [Link and Multilink Services Overview on page 17](#)
- [Configuring Encapsulation for Multilink and Link Services Logical Interfaces on page 37](#)
- [Configuring the Drop Timeout Period on Multilink and Link Services Logical Interfaces on page 38](#)
- [Limiting Packet Payload Size on Multilink and Link Services Logical Interfaces on page 40](#)
- [Configuring MRRU on Multilink and Link Services Logical Interfaces on page 42](#)

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.



NOTE: Only MLPPP is supported on ACX Series routers. MLFR is not supported on ACX Series routers.

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*]**



NOTE: ACX Series routers do not support logical systems.

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: ACX Series routers do not support **family inet6** on MLPPP interfaces.



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.

Related Documentation

- [Link and Multilink Services Overview on page 17](#)
- [Configuring Encapsulation for Multilink and Link Services Logical Interfaces on page 37](#)
- [Configuring the Drop Timeout Period on Multilink and Link Services Logical Interfaces on page 38](#)
- [Limiting Packet Payload Size on Multilink and Link Services Logical Interfaces on page 40](#)
- [Configuring the Minimum Number of Active Links on Multilink and Link Services Logical Interfaces on page 41](#)

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



NOTE: Only MLPPP is supported on ACX Series routers. MLFR is not supported on ACX Series routers.

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.

Related Documentation

- [Link and Multilink Services Overview on page 17](#)
- [Configuring the Drop Timeout Period on Multilink and Link Services Logical Interfaces on page 38](#)
- [Limiting Packet Payload Size on Multilink and Link Services Logical Interfaces on page 40](#)
- [Configuring the Minimum Number of Active Links on Multilink and Link Services Logical Interfaces on page 41](#)
- [Configuring MRRU on Multilink and Link Services Logical Interfaces on page 42](#)
- [Configuring DLCIs on Link Services Logical Interfaces on page 87](#)

Example: Configuring Link Interfaces on Channelized MICs

- [Requirements on page 44](#)
- [Overview on page 44](#)
- [Configuration on 4-Port Channelized SONET/SDH OC3/STM1 \(Multi-Rate\) MIC with SFP on page 45](#)
- [Verification on page 53](#)

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 25](#). 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 21](#).

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:

- [Partitioning Ports on the Channelized MICs and Configuring the Link Interfaces T1, T3, and DS on page 46](#)
- [Configuring MLPPP, MLFR FRF.15, and MLFR FRF.16 on Link Interfaces for Bundles on page 49](#)
- [Results on page 50](#)

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 unpartitioned 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:
- 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

```
 - 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

```
 - 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

```
 - 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

```
 - 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
```

Results

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 53](#)
- [Verifying the MLFR FRF.15 Configuration on page 53](#)
- [Verifying the MLFR FRF.16 Configuration on page 53](#)

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 [CLI Explorer](#).

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 [CLI Explorer](#).

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 [CLI Explorer](#).

- Related Documentation**
- [Link and Multilink Services Overview on page 17](#)
 - [Multilink Interfaces on Channelized MICs Overview on page 21](#)
 - [Example: Configuring an MLPPP Bundle on page 58](#)
 - [Example: Configuring Multilink Frame Relay FRF.15 on page 93](#)
 - [Example: Configuring Multilink Frame Relay FRF.16 on page 89](#)

CHAPTER 4

Bundling Multiple PPP Links on a Single Link Using MLPPP

- [Example: Configuring a Multilink Interface with MLPPP on page 55](#)
- [Example: Configuring a Multilink Interface with MLPPP over ATM 2 Interfaces on page 56](#)
- [Example: Configuring an MLPPP Bundle on page 58](#)
- [Example: Configuring a Link Services Interface with MLPPP on page 61](#)
- [Example: Configuring Inline MLPPP and Multilink Frame Relay End-to-End \(FRF.15\) for WAN Interfaces on page 62](#)
- [Enabling MLPPP Link Fragmentation and Interleaving on page 78](#)
- [Configuring Delay-Sensitive Packet Interleaving on Link Services Logical Interfaces on page 82](#)

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;
      }
    }
  }
}
tl-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;
    }
  }
}
```

- Related Documentation**
- [Link and Multilink Services Overview on page 17](#)
 - [Limiting Packet Payload Size on Multilink and Link Services Logical Interfaces on page 40](#)
 - [fragment-threshold on page 138](#)

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;
            }
        }
    }
}

```

```

    }
    ...
  }

```

Related Documentation

- [Configuring Encapsulation for Multilink and Link Services Logical Interfaces on page 37](#)
- [Example: Configuring a Multilink Interface with MLPPP over ATM 2 Interfaces on page 56](#)
- [encapsulation \(Logical Interface\) on page 135](#)

Example: Configuring an MLPPP Bundle

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

- [Requirements on page 58](#)
- [Overview on page 58](#)
- [Configuration on page 58](#)
- [Verification on page 61](#)

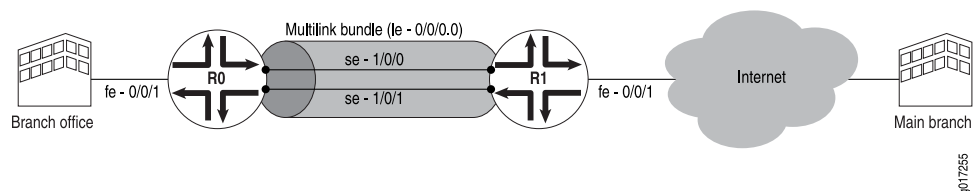
Requirements

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 58](#), 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 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-0/0/0 statistics** command.

Related Documentation

- [Link and Multilink Services Overview on page 17](#)
- [Multilink Interfaces on Channelized MICs Overview on page 21](#)
- [Understanding MLPPP Bundles and Link Fragmentation and Interleaving \(LFI\) on Serial Links on page 25](#)
- [Example: Configuring Link Interfaces on Channelized MICs on page 44](#)
- [Example: Configuring Multilink Frame Relay FRF.15 on page 93](#)
- [Example: Configuring Multilink Frame Relay FRF.16 on page 89](#)

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;  
    }  
}  
}
```

Related Documentation

- [Configuring Encapsulation for Multilink and Link Services Logical Interfaces on page 37](#)
- [encapsulation \(Logical Interface\) on page 135](#)

Example: Configuring Inline MLPPP and Multilink Frame Relay End-to-End (FRF.15) for WAN Interfaces

Inline Multilink PPP (MLPPP), Multilink Frame Relay (FRF.16), and Multilink Frame Relay End-to-End (FRF.15) for time-division multiplexing (TDM) WAN interfaces provide bundling services through the Packet Forwarding Engine without requiring a PIC or Dense Port Concentrator (DPC).

This example shows how to configure a Multilink PPP (MLPPP) bundle and Multilink Frame Relay End-to-End (FRF.15) for additional bandwidth, load balancing, and redundancy by aggregating low-speed links such as T1 (WAN interfaces).

- [Requirements on page 62](#)
- [Overview on page 62](#)
- [Configuration on page 63](#)
- [Verification on page 68](#)

Requirements

This example uses the following hardware and software components:

- Two MX Series Routers
- Junos OS Release 14.1 or later release

Before you begin, configure two MX Series routers (the MX240, MX480, or MX960) with at least two WAN interfaces that communicate over T1 links.

Overview

Traditionally, bundling services are used to bundle multiple low-speed links to create a higher bandwidth pipe. This combined bandwidth is available to traffic from all links and supports link fragmentation and interleaving (LFI) on the bundle, reducing high-priority packet transmission delay.

This support includes multiple links on the same bundle as well as multiclass extension for MLPPP. Through this service you can enable bundling services without additional DPC slots to support Service DPC and free up the slots for other MICs.

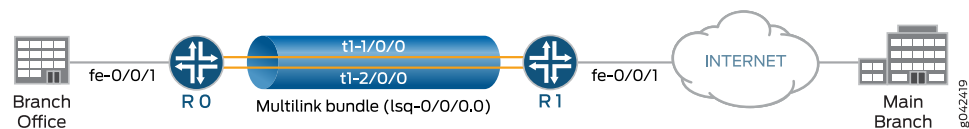
Configuring inline MLPPP for WAN interfaces benefits the following services:

- CE-PE link for Layer 3 VPN and DIA service with public switched telephone networks (PSTN)-based access networks
- PE-P link when PSTN is used for MPLS networks

In this example, to increase bandwidth, you configure MLPPP and join the T1 links into the multilink bundle. You aggregate T1 links to create the MLFR FRF.15 bundle on two MX Series routers, R0 and R1, and set the interface to **lsq-**. You configure logical units on the **lsq-** interface and set the family type to **inet** and an IP address. 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 and set the encapsulation type to **frame-relay**. You then define Router R0 as a DCE device and Router R1 as a DTE device. You set the DLCI value (range is from 16 through 1022). Finally, you set the multilink bundle to **lsq-**.

Topology

Figure 3: Configuring Inline MLPPP and Multilink Frame Relay End-End (FRF.15) for WAN Interfaces



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.

Device R0

```
set chassis fpc 1 pic 0 multi-link-layer-2-inline
set interfaces lsq-1/0/0 unit 0 encapsulation multilink-ppp
set interfaces lsq-1/0/0 unit 0 family inet address 192.0.2.1/24
set interfaces lsq-1/0/0 unit 1 encapsulation multilink-frame-relay-end-to-end
set interfaces lsq-1/0/0 unit 1 family inet address 198.51.100.1/24
set interfaces t1-1/0/0:1 unit 0 family mlppp bundle lsq-1/0/0.0
set interfaces t1-1/0/0:2 unit 0 family mlppp bundle lsq-1/0/0.0
set interfaces t1-1/0/0:3 dce
set interfaces t1-1/0/0:4 dce
set interfaces t1-1/0/0:3 encapsulation frame-relay
set interfaces t1-1/0/0:4 encapsulation frame-relay
set interfaces t1-1/0/0:3 unit 0 dlci 1 family mlfr-end-to-end bundle lsq-1/0/0.1
set interfaces t1-1/0/0:4 unit 0 dlci 2 family mlfr-end-to-end bundle lsq-1/0/0.1
```

Device R1

```
set chassis fpc 2 pic 0 multi-link-layer-2-inline
set interfaces lsq-2/0/0 unit 0 encapsulation multilink-ppp
```

```
set interfaces lsq-2/0/0 unit 0 family inet address 192.0.2.2/24
set interfaces lsq-2/0/0 unit 1 encapsulation multilink-frame-relay-end-to-end
set interfaces lsq-2/0/0 unit 1 family inet address 198.51.100.2/24
set interfaces t1-2/0/0:1 unit 0 family mlppp bundle lsq-2/0/0.0
set interfaces t1-2/0/0:2 unit 0 family mlppp bundle lsq-2/0/0.0
set interfaces t1-2/0/0:3 encapsulation frame-relay
set interfaces t1-2/0/0:4 encapsulation frame-relay
set interfaces t1-2/0/0:3 unit 0 dlci 1 family mlfr-end-to-end bundle lsq-2/0/0.1
set interfaces t1-2/0/0:4 unit 0 dlci 2 family mlfr-end-to-end bundle lsq-2/0/0.1
```

To Configure Router R0

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure inline MLPPP and Multilink Frame Relay End-to-End (FRF.15) for WAN Interfaces:

1. Enable inline Layer 2 bundling services.

```
[edit]
user@R0# set chassis fpc 1 pic 0 multi-link-layer-2-inline
```

2. Create the interface, specify a logical unit on the multilink bundle, and set the family type.

```
[edit]
user@R0# set interfaces lsq-1/0/0 unit 0 family inet address 192.0.2.1/24
```

3. Specify the *encapsulation* type as MLPPP.

```
[edit]
user@R0# set interfaces lsq-1/0/0 unit 0 encapsulation multilink-ppp
```

4. Create the interface, specify another logical unit on the multilink bundle, and set the family type.

```
[edit]
user@R0# set interfaces lsq-1/0/0 unit 1 family inet address 198.51.100.1/24
```

5. Specify another unit and define the multilink bundle as an MLFR FRF.15 bundle.

```
[edit]
user@R0# set interfaces lsq-1/0/0 unit 1 encapsulation
multilink-frame-relay-end-to-end
```

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

```
[edit]
user@R0# set interfaces t1-1/0/0:1 unit 0 family mlppp bundle lsq-1/0/0.0
user@R0# set interfaces t1-1/0/0:2 unit 0 family mlppp bundle lsq-1/0/0.0
```


7. Define the router as a DCE device.

```
[edit]
user@R0# set interfaces t1-1/0/0:3 dce
user@R0# set interfaces t1-1/0/0:4 dce
```
8. Specify the DLCI as well as the multilink bundle to which the interface is to be added.

```
[edit ]
user@R0# set interfaces t1-1/0/0:3 unit 0 dlci 1 family mlfr-end-to-end bundle
lsq-1/0/0.1
user@R0# set interfaces t1-1/0/0:4 unit 0 dlci 2 family mlfr-end-to-end bundle
lsq-1/0/0.1
```
9. Specify the names of the constituent links to be added to the multilink bundle.

```
[edit]
user@R0# set interfaces t1-1/0/0:3 encapsulation frame-relay
user@R0# set interfaces t1-1/0/0:4 encapsulation frame-relay
```

To Configure Router R1

Step-by-Step Procedure

To configure inline MLPPP and Multilink Frame Relay End-to-End (FRF.15) for WAN Interfaces:

1. Enable inline Layer 2 bundling services.

```
[edit]
user@R1# set chassis fpc 2pic 0 multi-link-layer-2-inline
```
2. Create the interface, specify a logical unit on the multilink bundle and set the family type.

```
[edit]
user@R1# set interfaces lsq-2/0/0 unit 0 family inet address 192.0.2.2/24
```
3. Specify the encapsulation type as MLPPP.

```
[edit]
user@R1# set interfaces lsq-2/0/0 unit 0 encapsulation multilink-ppp
```
4. Create the interface, specify another logical unit on the multilink bundle and set the family type.

```
[edit]
user@R1# set interfaces lsq-2/0/0 unit 1 family inet address 198.51.100.2/24
```
5. Specify another unit and define the multilink bundle as an MLFR FRF.15 bundle.

```
[edit]
user@R1# set interfaces lsq-2/0/0 unit 1 encapsulation
multilink-frame-relay-end-to-end
```

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

```
[edit]
user@R1# set interfaces t1-2/0/0:1 unit 0 family mlppp bundle lsq-2/0/0.0
user@R1# set interfaces t1-2/0/0:2 unit 0 family mlppp bundle lsq-2/0/0.0
```
7. Specify the DLCI as well as the multilink bundle to which the interface is to be added.

```
[edit ]
user@R1# set interfaces t1-2/0/0:3 unit 0 dlc1 1 family mlfr-end-to-end bundle
lsq-2/0/0.1
user@R1# set interfaces t1-2/0/0:4 unit 0 dlc1 2 family mlfr-end-to-end bundle
lsq-2/0/0.1
```
8. Specify the names of the constituent links to be added to the multilink bundle.

```
[edit]
user@R1# set interfaces t1-2/0/0:3 encapsulation frame-relay
user@R1# set interfaces t1-2/0/0:4 encapsulation frame-relay
```

Results

For Router R0, from configuration mode, confirm your configuration by entering the **show chassis**, **show interfaces lsq-1/0/0**, **show interfaces t1-1/0/0:1**, **show interfaces t1-1/0/0:2**, **show interfaces t1-1/0/0:3**, and **show interfaces t1-1/0/0:4** commands.

For Router R1, from configuration mode, confirm your configuration by entering the **show chassis**, **show interfaces lsq-2/0/0**, **show interfaces t1-2/0/0:1**, **show interfaces t1-2/0/0:2**, **show interfaces t1-2/0/0:3**, and **show interfaces t1-2/0/0:4** commands.

If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

For Router R0:

```
[edit]
user@R0# show chassis
fpc 1 {
  pic 0 {
    multi-link-layer-2-inline;
  }
}

[edit]
user@R0# show interfaces lsq-1/0/0
unit 0 {
  encapsulation multilink-ppp;
  family inet {
    address 192.0.2.1/24;
  }
}
unit 1 {
  encapsulation multilink-frame-relay-end-to-end;
  family inet {
```

```

        address 198.51.100.1/24;
    }
}

[edit]
user@R0# show interfaces t1-1/0/0:1
unit 0 {
    family mlppp {
        bundle lsq-1/0/0.0;
    }
}

[edit]
user@R0# show interfaces t1-1/0/0:2
unit 0 {
    family mlppp {
        bundle lsq-1/0/0.0;
    }
}

[edit]
user@R0# show interfaces t1-1/0/0:3
dce;
encapsulation frame-relay;
unit 0 {
    dlci 1;
    family mlfr-end-to-end {
        bundle lsq-1/0/0.1;
    }
}

[edit]
user@R0# show interfaces t1-1/0/0:4
dce;
encapsulation frame-relay;
unit 0 {
    dlci 2;
    family mlfr-end-to-end {
        bundle lsq-1/0/0.1;
    }
}

```

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

For Router R1:

```

[edit]
user@R1# show chassis
fpc 2 {
    pic 0 {
        multi-link-layer-2-inline;
    }
}

[edit]
user@R1# show interfaces lsq-2/0/0
unit 0 {
    encapsulation multilink-ppp;
}

```

```
family inet {
    address 192.0.2.2/24;
}
}
unit 1 {
    encapsulation multilink-frame-relay-end-to-end;
    family inet {
        address 198.51.100.2/24;
    }
}

[edit]
user@R1# show interfaces t1-2/0/0:1
unit 0 {
    family mlppp {
        bundle lsq-2/0/0.0;
    }
}

[edit]
user@R1# show interfaces t1-2/0/0:2
unit 0 {
    family mlppp {
        bundle lsq-2/0/0.0;
    }
}

[edit]
user@R1# show interfaces t1-2/0/0:3
encapsulation frame-relay;
unit 0 {
    dlci 1;
    family mlfr-end-to-end {
        bundle lsq-2/0/0.1;
    }
}

[edit]
user@R1# show interfaces t1-2/0/0:4
encapsulation frame-relay;
unit 0 {
    dlci 2;
    family mlfr-end-to-end {
        bundle lsq-2/0/0.1;
    }
}
```

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

Verification

Verifying the MLPPP Bundle and the MLFR FRF.15 Configuration

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

Action From operational mode, run the **show interfaces lsq-1/0/0 extensive** command.

Sample Output

```

user@R0> show interfaces lsq-1/0/0:0 extensive
Physical interface: lsq-1/0/0, Enabled, Physical link is Up
Interface index: 292, SNMP ifIndex: 1065, Generation: 4986
Link-level type: LinkService, MTU: 1504
Device flags : Present Running
Interface flags: Point-To-Point SNMP-Traps Internal: 0x4000
Last flapped : Never
Statistics last cleared: Never
Traffic statistics:
  Input bytes :                0                0 bps
  Output bytes :                0                0 bps
  Input packets:                0                0 pps
  Output packets:              0                0 pps
IPv6 transit statistics:
  Input bytes :                0
  Output bytes :                0
  Input packets:                0
  Output packets:              0
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
Egress queues: 8 supported, 4 in use
Queue counters:      Queued packets  Transmitted packets  Dropped packets

  0                    0                0                0
  1                    0                0                0
  2                    0                0                0
  3                    0                0                0

Queue number:      Mapped forwarding classes
  0                best-effort
  1                expedited-forwarding
  2                assured-forwarding
  3                network-control

Logical interface lsq-1/0/0.0 (Index 327) (SNMP ifIndex 113518) (Generation
6213)
Flags: Hardware-Down Up Point-To-Point SNMP-Traps 0x4000 Encapsulation:
Multilink-PPP
Last flapped: 2014-04-24 04:37:39 PDT (00:08:50 ago)
Bandwidth: 0

```

```

Bundle links information:
  Active bundle links      0
  Removed bundle links    2
  Disabled bundle links    0
Bundle options:
  MRRU                     1504
  Remote MRRU              N/A
  Drop timer period        32767
  Inner PPP Protocol field compression enabled
  Sequence number format   long (24 bits)
  Fragmentation threshold  0
  Links needed to sustain bundle 1
  Multilink classes        0
  Link layer overhead      4.0 %
Multilink class 0 status:
  Received sequence number 0x0
  Transmit sequence number 0xffffffff
  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
  Multilink class drop timeout 0 (ms)
Statistics      Frames      fps      Bytes      bps
Bundle:
  Multilink:
    Input :      0      0      0      0
    Output:      0      0      0      0
  Network:
    Input :      0      0      0      0
    Output:      0      0      0      0
IPV6 Transit Statistics      Packets      Bytes
  Network:
    Input :      0      0
    Output:      0      0
Link:
  t1-1/0/0:1.0
    Up time: 00:00:00
    Input :      0      0      0      0
    Output:      0      0      0      0
  t1-1/0/0:2.0
    Up time: 00:00:00
    Input :      0      0      0      0
    Output:      0      0      0      0
Multilink detail statistics:
Bundle:
  Fragments:
    Input :      0      0      0      0
    Output:      0      0      0      0
  Non-fragments:
    Input :      0      0      0      0
    Output:      0      0      0      0
  LFI:
    Input :      0      0      0      0
    Output:      0      0      0      0
NCP state: inet: Not-configured, inet6: Not-configured, iso: Not-configured,
mpls: Not-configured

```

Protocol inet, MTU: 1500, Generation: 6263, Route table: 0
 Flags: Sendbcst-pkt-to-re, Protocol-Down
 Addresses, Flags: Dest-route-down Is-Preferred Is-Primary
 Destination: 192.0.2/24, Local: 192.0.2.1, Broadcast: Unspecified,
 Generation: 4211

Logical interface lsq-1/0/0.1 (Index 328) (SNMP ifIndex 113519) (Generation 6214)

Flags: Up Point-To-Point SNMP-Traps 0x4000 Encapsulation: Multilink-FR
 Last flapped: 2014-04-24 04:46:00 PDT (00:00:29 ago)

Bandwidth: 3072kbps

Bundle links information:

Active bundle links 2
 Removed bundle links 0
 Disabled bundle links 0

Bundle options:

MRRU 1504
 Drop timer period 32767
 Inner PPP Protocol field compression enabled
 Sequence number format short (12 bits)
 Fragmentation threshold 0
 Links needed to sustain bundle 1
 Multilink classes 0
 Link layer overhead 4.0 %

Multilink class 0 status:

Received sequence number 0x0
 Transmit sequence number 0xffffffff
 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
 Multilink class drop timeout 0 (ms)

Statistics	Frames	fps	Bytes	bps
------------	--------	-----	-------	-----

Bundle:

Multilink:

Input :	0	0	0	0
Output:	0	0	0	0

Network:

Input :	0	0	0	0
Output:	0	0	0	0

Link:

t1-1/0/0:3.0

Up time: 00:00:29

Input :	0	0	0	0
Output:	0	0	0	0

t1-1/0/0:4.0

Up time: 00:00:29

Input :	0	0	0	0
Output:	0	0	0	0

Multilink detail statistics:

Bundle:

Fragments:

Input :	0	0	0	0
Output:	0	0	0	0

Non-fragments:

Input :	0	0	0	0
---------	---	---	---	---

```

      Output:          0          0          0          0
    LFI:
      Input :          0          0          0          0
      Output:         0          0          0          0
    Protocol inet, MTU: 1500, Generation: 6264, Route table: 0
    Flags: Sendbroadcast-pkt-to-re
    Addresses, Flags: Is-Preferred Is-Primary
      Destination: 198.51.100/24, Local: 198.51.100.1, Broadcast: Unspecified,
    Generation: 4213

```

From the operational mode, enter the **show interfaces lsq-2/0/0 extensive** command.

```

user@R1> show interfaces lsq-2/0/0 extensive
Physical interface: lsq-2/0/0, Enabled, Physical link is Up
  Interface index: 262, SNMP ifIndex: 44421, Generation: 270
  Encapsulation: Multilink-PPPLink-level type: LinkService, MTU: 1504
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps Internal: 0x4000
  Last flapped   : Never
  Statistics last cleared: Never
  Traffic statistics:
    Input bytes   :          0          0 bps
    Output bytes  :          0          0 bps
    Input packets :          0          0 pps
    Output packets:          0          0 pps
  IPv6 transit statistics:
    Input bytes   :          0
    Output bytes  :          0
    Input packets :          0
    Output packets:          0
  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
  Egress queues: 8 supported, 4 in use
  Queue counters:
    Queued packets  Transmitted packets  Dropped packets

    0                0                0                0

    1                0                0                0

    2                0                0                0

    3                0                0                0

  Queue number:      Mapped forwarding classes
    0                best-effort

```



```

1          expedited-forwarding
2          assured-forwarding
3          network-control

```

Logical interface lsq-2/0/0.0 (Index 354) (SNMP ifIndex 44422) (Generation 167)

Flags: Up Point-To-Point SNMP-Traps 0x4000 Encapsulation:

Multilink-PPPEncapsulation: Multilink-PPP

Last flapped: 2014-04-24 04:50:19 PDT (00:00:51 ago)

Bandwidth: 3072kbps

Bundle links information:

```

Active bundle links      2
Removed bundle links     0
Disabled bundle links    0

```

Bundle options:

```

MRRU                      1504
Remote MRRU               1504
Drop timer period         32767
Inner PPP Protocol field compression enabled
Sequence number format    long (24 bits)
Fragmentation threshold   0
Links needed to sustain bundle 1
Multilink classes         0
Link layer overhead       4.0 %

```

Multilink class 0 status:

```

Received sequence number  0x0
Transmit sequence number  0xffffffff
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
Multilink class drop timeout 0 (ms)

```

Statistics	Frames	fps	Bytes	bps
------------	--------	-----	-------	-----

Bundle:

Multilink:

Input :	0	0	0	0
Output:	0	0	0	0

Network:

Input :	0	0	0	0
Output:	0	0	0	0

IPv6 Transit Statistics

	Packets	Bytes
Network:		
Input :	0	0
Output:	0	0

Link:

t1-2/0/0:1.0

Up time: 00:00:51

Input :	0	0	0	0
Output:	0	0	0	0

t1-2/0/0:2.0

Up time: 00:00:48

Input :	0	0	0	0
Output:	0	0	0	0

Multilink detail statistics:

Bundle:

Fragments:

```

      Input :          0          0          0          0
      Output:          0          0          0          0
Non-fragments:
      Input :          0          0          0          0
      Output:          0          0          0          0
LFI:
      Input :          0          0          0          0
      Output:          0          0          0          0
NCP state: inet: Opened, inet6: Not-configured, iso: Not-configured, mpls:
Not-configured
Protocol inet, MTU: 1500, Generation: 199, Route table: 0
Flags: Sendbcst-pkt-to-re
Addresses, Flags: Is-Preferred Is-Primary
Destination: 192.0.2/24, Local: 192.0.2.2, Broadcast: Unspecified,
Generation: 153

Logical interface lsq-4/0/0.1 (Index 355) (SNMP ifIndex 44423) (Generation 168)

Flags: Up Point-To-Point SNMP-Traps 0x4000 Encapsulation: Multilink-FR
Last flapped: 2014-04-24 04:50:19 PDT (00:00:51 ago)
Bandwidth: 3072kbps
Bundle links information:
  Active bundle links      2
  Removed bundle links     0
  Disabled bundle links    0
Bundle options:
  MRRU                      1504
  Drop timer period         32767
  Inner PPP Protocol field compression enabled
  Sequence number format    short (12 bits)
  Fragmentation threshold   0
  Links needed to sustain bundle 1
  Multilink classes         0
  Link layer overhead       4.0 %
Multilink class 0 status:
  Received sequence number  0x0
  Transmit sequence number  0xffffffff
  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
  Multilink class drop timeout 0 (ms)
Statistics      Frames      fps      Bytes      bps
Bundle:
Multilink:
  Input :        0          0          0          0
  Output:        0          0          0          0
Network:
  Input :        0          0          0          0
  Output:        0          0          0          0
Link:
t1-2/0/0:3.0
  Up time: 00:00:51
  Input :        0          0          0          0
  Output:        0          0          0          0
t1-2/0/0:4.0

```

```

Up time: 00:00:51
Input :      0      0      0      0
Output:      0      0      0      0
Multilink detail statistics:
Bundle:
Fragments:
Input :      0      0      0      0
Output:      0      0      0      0
Non-fragments:
Input :      0      0      0      0
Output:      0      0      0      0
LFI:
Input :      0      0      0      0
Output:      0      0      0      0
Protocol inet, MTU: 1500, Generation: 200, Route table: 0
Flags: Sendbcst-pkt-to-re
Addresses, Flags: Is-Preferred Is-Primary
Destination: 198.51.100/24, Local: 198.51.100.2, Broadcast: Unspecified,
Generation: 155

```

From operational mode, enter the **show interfaces lsq-1/0/0 statistics** command.

```

user@R0> show interfaces lsq-1/0/0 statistics
Physical interface: lsq-1/0/0, Enabled, Physical link is Up
Interface index: 292, SNMP ifIndex: 1065
Link-level type: LinkService, MTU: 1504
Device flags   : Present Running
Interface flags: Point-To-Point SNMP-Traps Internal: 0x4000
Last flapped   : Never
Statistics last cleared: Never
Input rate     : 0 bps (0 pps)
Output rate    : 0 bps (0 pps)

Logical interface lsq-1/0/0.0 (Index 327) (SNMP ifIndex 113518)
Flags: Up Point-To-Point SNMP-Traps 0x4000 Encapsulation: Multilink-PPP
Last flapped: 2014-04-24 04:50:19 PDT (00:01:59 ago)
Bandwidth: 3072kbps
Bundle links information:
Active bundle links      2
Removed bundle links     0
Disabled bundle links    0
Statistics               Frames      fps      Bytes      bps
Bundle:
Multilink:
Input :      0      0      0      0
Output:      0      0      0      0
Network:
Input :      0      0      0      0
Output:      0      0      0      0
IPV6 Transit Statistics      Packets      Bytes
Network:
Input :      0      0
Output:      0      0
Link:
t1-1/0/0:1.0
Up time: 00:01:59
Input :      0      0      0      0
Output:      0      0      0      0
t1-1/0/0:2.0
Up time: 00:01:56

```

```

        Input :          0          0          0          0
        Output:          0          0          0          0
NCP state: inet: Opened, inet6: Not-configured, iso: Not-configured, mpls:
Not-configured
  Protocol inet, MTU: 1500
    Flags: Sendbroadcast-pkt-to-re
    Addresses, Flags: Is-Preferred Is-Primary
      Destination: 192.0.2/24, Local: 192.0.2.1

Logical interface lsq-1/0/0.1 (Index 328) (SNMP ifIndex 113519)
  Flags: Up Point-To-Point SNMP-Traps 0x4000 Encapsulation: Multilink-FR
  Last flapped: 2014-04-24 04:50:29 PDT (00:01:49 ago)
  Bandwidth: 3072kbps
  Bundle links information:
    Active bundle links      2
    Removed bundle links     0
    Disabled bundle links    0
  Statistics
  Bundle:
    Multilink:
      Input :          0          0          0          0
      Output:          0          0          0          0
    Network:
      Input :          0          0          0          0
      Output:          0          0          0          0
  Link:
    t1-1/0/0.3.0
      Up time: 00:01:49
      Input :          0          0          0          0
      Output:          0          0          0          0
    t1-1/0/0.4.0
      Up time: 00:01:49
      Input :          0          0          0          0
      Output:          0          0          0          0
  Protocol inet, MTU: 1500
    Flags: Sendbroadcast-pkt-to-re
    Addresses, Flags: Is-Preferred Is-Primary
      Destination: 198.51.100/24, Local: 198.51.100.1

```

From operational mode, enter the **show interfaces lsq-2/0/0 statistics** command.

```

user@R1> show interfaces lsq-2/0/0 statistics
Physical interface: lsq-2/0/0, Enabled, Physical link is Up
  Interface index: 262, SNMP ifIndex: 44421
  Link-level type: LinkService, MTU: 1504
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps Internal: 0x4000
  Last flapped   : Never
  Statistics last cleared: Never
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)

Logical interface lsq-2/0/0.0 (Index 354) (SNMP ifIndex 44422)
  Flags: Up Point-To-Point SNMP-Traps 0x4000 Encapsulation: Multilink-PPP
  Last flapped: 2014-04-24 04:50:19 PDT (00:04:33 ago)
  Bandwidth: 3072kbps
  Bundle links information:
    Active bundle links      2
    Removed bundle links     0
    Disabled bundle links    0

```

```

Statistics          Frames          fps          Bytes          bps
Bundle:
Multilink:
  Input :           0           0           0           0
  Output:           0           0           0           0
Network:
  Input :           0           0           0           0
  Output:           0           0           0           0
IPv6 Transit Statistics          Packets          Bytes
Network:
  Input :           0           0
  Output:           0           0
Link:
t1-2/0/0:1.0
  Up time: 00:04:33
  Input :           0           0           0           0
  Output:           0           0           0           0
t1-2/0/0:2.0
  Up time: 00:04:30
  Input :           0           0           0           0
  Output:           0           0           0           0
NCP state: inet: Opened, inet6: Not-configured, iso: Not-configured, mpls:
Not-configured
Protocol inet, MTU: 1500
Flags: Sendbcst-pkt-to-re
Addresses, Flags: Is-Preferred Is-Primary
Destination: 192.0.2/24, Local: 192.0.2.2

Logical interface lsq-2/0/0.1 (Index 355) (SNMP ifIndex 44423)
Flags: Up Point-To-Point SNMP-Traps 0x4000 Encapsulation: Multilink-FR
Last Flapped: 2014-04-24 04:50:19 PDT (00:04:33 ago)
Bandwidth: 3072kbps
Bundle links information:
  Active bundle links      2
  Removed bundle links     0
  Disabled bundle links    0
Statistics          Frames          fps          Bytes          bps
Bundle:
Multilink:
  Input :           0           0           0           0
  Output:           0           0           0           0
Network:
  Input :           0           0           0           0
  Output:           0           0           0           0
Link:
t1-2/0/0:3.0
  Up time: 00:04:33
  Input :           0           0           0           0
  Output:           0           0           0           0
t1-2/0/0:4.0
  Up time: 00:04:33
  Input :           0           0           0           0
  Output:           0           0           0           0
Protocol inet, MTU: 1500
Flags: Sendbcst-pkt-to-re
Addresses, Flags: Is-Preferred Is-Primary
Destination: 198.51.100/24, Local: 198.51.100.2

```

- Related Documentation**
- [Inline MLPPP for WAN Interfaces Overview](#)
 - [Enabling MLPPP Link Fragmentation and Interleaving on page 78](#)
 - [Example: Configuring Multilink Frame Relay FRF.15 on page 93](#)
 - [Link and Multilink Services Interfaces Feature Guide for Routing Devices](#)
 - [mlfr-uni-nni-bundles-inline](#)
 - [multi-link-layer-2-inline](#)
 - [pic \(MX Series Routers\)](#)
 - [show interfaces \(Link Services IQ\) on page 169](#)

Enabling MLPPP Link Fragmentation and Interleaving

MLPPP enables you to bundle multiple PPP links into a single multilink bundle. MLPPP bundle support on an inline LSQ interface is identical to a non-inline LSQ interface, because the configuration to enable fragmentation, link fragmentation and interleaving (LFI), and timeout is identical.

Priority scheduling on a multilink bundle determines the order in which an output interface transmits traffic from an output queue. The queues are serviced in a weighted round-robin fashion. But when a queue containing large packets starts using the multilink bundle, small and delay-sensitive packets must wait their turn for transmission. Because of this delay, some slow links, such as T1 and E1, can become useless for delay-sensitive traffic.

Link fragmentation and interleaving (LFI) solves this problem. It reduces delay and jitter on links by fragmenting large packets and interleaving delay-sensitive packets with the resulting smaller packets for simultaneous transmission across multiple links of a multilink bundle.

To configure schedule maps and fragmentation maps for MLPPP LFI:

1. Assign each forwarding class to an internal queue number by including the **forwarding-classes** statement at the **[edit class-of-service]** hierarchy level.

```
[edit class-of-service]
forwarding-classes {
  queue queue-number class-name;
}
```

For example, to set four output transmission queues:

```
[edit class-of-service]
user@host# set forwarding-classes queue 0 be
user@host# set forwarding-classes queue 1 ef
user@host# set forwarding-classes queue 2 af
user@host# set forwarding-classes queue 3 nc
```

2. To set a per-forwarding class fragmentation threshold, include the **fragment-threshold** statement in the **fragmentation-maps**.

```
[edit class-of-service]
fragmentation-maps {
  map-name{
    forwarding-class class-name {
      fragment-threshold bytes;
    }
  }
}
```

For example, to create two fragmentation maps and set a per-forwarding class fragmentation threshold:

```
[edit class-of-service]
user@host# set fragmentation-maps fragmap-1 forwarding-class af
fragment-threshold 320
user@host# set fragmentation-maps fragmap-1 forwarding-class be
fragment-threshold 256
user@host# set fragmentation-maps fragmap-1 forwarding-class ef
fragment-threshold no-fragmentation
user@host# set fragmentation-maps fragmap-2 forwarding-class af
fragment-threshold 192
user@host# set fragmentation-maps fragmap-2 forwarding-class be
fragment-threshold 320
user@host# set fragmentation-maps fragmap-2 forwarding-class ef
fragment-threshold 192
user@host# set fragmentation-maps fragmap-2 forwarding-class nc
fragment-threshold no-fragmentation
```

The **fragment-threshold** statement in the LSQ bundle logical interface configuration applies to all forwarding classes. The **fragment-threshold** statement in **fragmentation-maps** for a particular **forwarding class**, if present, overrides the statement configured in the LSQ bundle logical interface for that class. If **fragment-threshold** is not configured anywhere in the configuration, packets are still fragmented if **fragment-threshold** exceeds the smallest maximum transmission unit (MTU) or maximum received reconstructed unit (MRRU) of all links in the bundle.

3. Configure transmission scheduling parameters.

```
[edit class-of-service scheduler scheduler-name]
schedulers {
  scheduler-name {
    priority priority-level;
    transmit-rate (percent percentage | rate | remainder) <exact | rate-limit>;
  }
}
```

For example, to set the transmit-rate percentage and the priority-level:

```
[edit class-of-service scheduler af-scheduler]
user@host# set transmit-rate percent 30
user@host# set priority low

[edit class-of-service scheduler be-scheduler]
user@host# set transmit-rate percent 20
user@host# set priority low

[edit class-of-service scheduler ef-scheduler]
```

```
user@host# set transmit-rate percent 35
user@host# set priority strict-high

[edit class-of-service scheduler nc-scheduler]
user@host# set transmit-rate percent 15
user@host# set priority high
```

4. After defining a scheduler, associate it with a specified forwarding class by including it in a *scheduler-map*.

```
[edit class-of-service]
scheduler-maps {
  map-name {
    forwarding-class class-name scheduler scheduler-name;
  }
}
```

For example, to associate the af-scheduler, be-scheduler, ef-scheduler, and nc-scheduler schedulers, with the af, be, ef, and nc forwarding-classes:

```
[edit class-of-service]
user@host# set scheduler-maps sched-map1 forwarding-class af scheduler
af-scheduler
user@host# set scheduler-maps sched-map1 forwarding-class be scheduler
be-scheduler
user@host# set scheduler-maps sched-map1 forwarding-class ef scheduler
ef-scheduler
user@host# set scheduler-maps sched-map1 forwarding-class nc scheduler
nc-scheduler
```

5. Configure traffic shaping and scheduling profiles.

```
[edit class-of-service]
traffic-control-profiles {
  profile-name {
    guaranteed-rate (percent percentage | rate) <burst-size bytes>;
    scheduler-map map-name;
    shaping-rate (percent percentage | rate) <burst-size bytes>;
  }
}
```

For example, to set the traffic-control policies:

```
[edit class-of-service traffic-control-policies m1-tcp1]
user@host# set guaranteed-rate 1m
user@host# set scheduler-map sched-map1
user@host# set shaping-rate 1m
```

6. Configure interface-specific CoS properties for incoming packets.

```
[edit class-of-service]
interfaces {
  interface-name {
    unit logical-unit-number {
      fragmentation-map map-name;
      output-traffic-control-profile profile-name;
    }
  }
}
```



```

    }
}

```

For example, to apply the specified CoS traffic control profile (traffic scheduling and shaping configuration objects) to the output traffic at the logical interface:

```

[edit class-of-service]
user@host# set interfaces lsq-0/1/0 unit 100 fragmentation-map fragmap-1
output-traffic-control-profile m1-tcp1

```

The following partial configuration shows when the fragment threshold for low priority queues inherits from the fragment threshold configured in the bundle IFL and will have the value of 640.

```

[edit class-of-service]
forwarding-classes {
  queue 0 be;
  queue 1 ef;
  queue 2 af;
  queue 3 nc;
}
fragmentation-maps {
  fragmap-3 {
    forwarding-class ef {
      no-fragmentation;
    }
  }
}
schedulers {
  af-scheduler {
    transmit-rate percent 30;
    priority low;
  }
  be-scheduler {
    transmit-rate percent 20;
    priority low;
  }
  ef-scheduler {
    transmit-rate percent 35 rate-limit;
    priority strict-high;
  }
  nc-scheduler {
    transmit-rate percent 15;
    priority high;
  }
}
....

```

Related Documentation

- [Link and Multilink Services Interfaces Feature Guide for Routing Devices](#)
- [Understanding MLPPP Bundles and Link Fragmentation and Interleaving \(LFI\) on Serial Links on page 25](#)
- [Inline MLPPP for WAN Interfaces Overview](#)

- [Example: Configuring Inline MLPPP and Multilink Frame Relay End-to-End \(FRF.15\) for WAN Interfaces on page 62](#)
- [Example: Configuring Inline Multilink Frame Relay \(FRF.16\) for WAN Interfaces on page 98](#)

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 113](#).

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 *Class of Service Feature Guide for Routing Devices*.

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;
  }
}
}
```

- Related Documentation**
- [Link and Multilink Services Overview on page 17](#)
 - [Configuring the Minimum Number of Active Links on Multilink and Link Services Logical Interfaces on page 41](#)
 - [Configuring MRRU on Multilink and Link Services Logical Interfaces on page 42](#)
 - [Configuring the Sequence Header Format on Multilink and Link Services Logical Interfaces on page 43](#)
 - [Configuring DLCIs on Link Services Logical Interfaces on page 87](#)

CHAPTER 5

Bundling Multiple Frame Relay DLCIs into a Single Link Using MLFR

- [Configuring DLCIs on Link Services Logical Interfaces on page 87](#)
- [Example: Configuring a Multilink Interface with MLFR FRF.15 on page 88](#)
- [Example: Configuring Multilink Frame Relay FRF.16 on page 89](#)
- [Example: Configuring Multilink Frame Relay FRF.15 on page 93](#)
- [Example: Configuring a Link Services Interface with MLFR FRF.15 on page 96](#)
- [Example: Configuring a Link Services PIC with MLFR FRF.16 on page 97](#)
- [Example: Configuring Inline Multilink Frame Relay \(FRF.16\) for WAN Interfaces on page 98](#)

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 **dlsi** statement:

```
dlsi dlsi-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 36](#).

Related Documentation

- [Link and Multilink Services Overview on page 17](#)
- [Limiting Packet Payload Size on Multilink and Link Services Logical Interfaces on page 40](#)
- [Configuring the Minimum Number of Active Links on Multilink and Link Services Logical Interfaces on page 41](#)
- [Configuring MRRU on Multilink and Link Services Logical Interfaces on page 42](#)
- [Configuring the Sequence Header Format on Multilink and Link Services Logical Interfaces on page 43](#)

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 {
    dlc1 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 {
    dlc1 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 {
    dlc1 26;
    encapsulation multilink-frame-relay-end-to-end;
    family mlfr-end-to-end {
      bundle ml-1/0/0.10;
    }
  }
}
}

```

- Related Documentation**
- [Configuring Encapsulation for Multilink and Link Services Logical Interfaces on page 37](#)
 - [encapsulation \(Logical Interface\) on page 135](#)

Example: Configuring Multilink Frame Relay FRF.16

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

- [Requirements on page 90](#)
- [Overview on page 90](#)
- [Configuration on page 90](#)
- [Verification on page 93](#)

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 93](#)

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 17](#)
- [Multilink Interfaces on Channelized MICs Overview on page 21](#)
- [Understanding MLPPP Bundles and Link Fragmentation and Interleaving \(LFI\) on Serial Links on page 25](#)
- [Example: Configuring Link Interfaces on Channelized MICs on page 44](#)
- [Example: Configuring an MLPPP Bundle on page 58](#)
- [Example: Configuring Multilink Frame Relay FRF.15 on page 93](#)

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 94](#)
- [Overview on page 94](#)
- [Configuration on page 94](#)
- [Verification on page 96](#)

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 dci 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;
  dci 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 96](#)

Verifying the MLFR FRF.15 Configuration

Purpose	Verify the MLFR FRF.15 configuration.
Action	From operational mode, enter the show interfaces command.
Related Documentation	<ul style="list-style-type: none">• Link and Multilink Services Overview on page 17• Multilink Interfaces on Channelized MICs Overview on page 21• Understanding MLPPP Bundles and Link Fragmentation and Interleaving (LFI) on Serial Links on page 25• Example: Configuring Link Interfaces on Channelized MICs on page 44• Example: Configuring an MLPPP Bundle on page 58• Example: Configuring Multilink Frame Relay FRF.16 on page 89

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

```
[edit interfaces]
```

```
t1-0/0/0 {
```



```

encapsulation frame-relay;
unit 0 {
    dlc1 16;
    family mlfr-end-to-end {
        bundle ls-0/3/0.0;
    }
}
}
t1-0/0/1 {
    encapsulation frame-relay;
    unit 0 {
        dlc1 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;
        }
    }
}
}

```

Related Documentation • [encapsulation \(Logical Interface\) on page 135](#)

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;
            }
        }
    }
}
```

- Related Documentation**
- [Configuring Link Services Physical Interfaces on page 33](#)
 - [encapsulation \(Physical Interface\) on page 136](#)

Example: Configuring Inline Multilink Frame Relay (FRF.16) for WAN Interfaces

Inline Multilink PPP (MLPPP), Multilink Frame Relay (FRF.16), and Multilink Frame Relay End-to-End (FRF.15) for time-division multiplexing (TDM) WAN interfaces provide bundling services through the Packet Forwarding Engine without requiring a PIC or Dense Port Concentrator (DPC).

Traditionally, bundling services are used to bundle multiple low-speed links to create a higher bandwidth pipe. This combined bandwidth is available to traffic from all links and supports link fragmentation and interleaving (LFI) on the bundle, reducing high priority packet transmission delay.

This support includes multiple links on the same bundle as well as multiclass extension for MLPPP. Through this service you can enable bundling services without additional DPC slots to support Service DPC and free up the slots for other MICs.

This example shows how to configure Multilink Frame Relay (FRF.16) for additional bandwidth, load balancing, and redundancy by aggregating low-speed links such as T1 (WAN interfaces).

- [Requirements on page 98](#)
- [Overview on page 99](#)
- [Configuration on page 99](#)
- [Verification on page 103](#)

Requirements

This example uses the following hardware and software components:

- Two MX Series Routers

- Junos OS Release 14.1 or later release

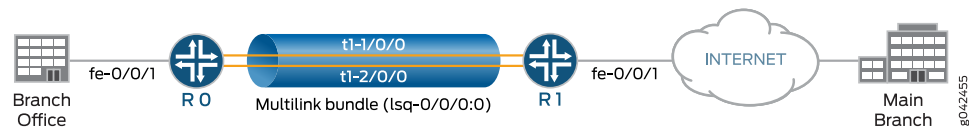
Before you begin, configure two MX Series routers (the MX240, MX480, or MX960) with at least two WAN interfaces that communicate over T1 links.

Overview

In this example, you aggregate T1 interfaces to create an MFR FRF.16 bundle on two MX Series routers, R0 and R1. You configure the chassis interface and specify the number of MFR 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-**. You set the multilink bundle as an MFR FRF.16 bundle by specifying the **multilink-frame-relay-uni-nni** encapsulation type. Then you define Router R0 as a DCE device and Router R1 as a DTE device. You configure a logical unit on the multilink bundle **lsq-**, and set the family type to **inet**. You create the T1 interfaces, 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-**.

Topology

Figure 4: Configuring Inline Multilink Frame Relay (FRF.16) for WAN Interfaces



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.

Device R0

```
set chassis fpc 1 pic 0 mlfr-uni-nni-bundles-inline 1
set interfaces lsq-1/0/0:0 dce
set interfaces lsq-1/0/0:0 encapsulation multilink-frame-relay-uni-nni
set interfaces lsq-1/0/0:0 unit 0 dlci 10
set interfaces lsq-1/0/0:0 unit 1 dlci 20
set interfaces lsq-1/0/0:0 unit 0 family inet address 10.1.1.24
set interfaces lsq-1/0/0:0 unit 1 family inet address 192.0.2.1/24
set interfaces t1-1/0/0:5 encapsulation multilink-frame-relay-uni-nni
set interfaces t1-1/0/0:6 encapsulation multilink-frame-relay-uni-nni
set interfaces t1-1/0/0:5 unit 0 family mlfr-uni-nni bundle lsq-1/0/0:0
set interfaces t1-1/0/0:6 unit 0 family mlfr-uni-nni bundle lsq-1/0/0:0
```

Device R1

```
set chassis fpc 2 pic 0 mlfr-uni-nni-bundles-inline 1
```

```
set interfaces lsq-2/0/0:0 encapsulation multilink-frame-relay-uni-nni
set interfaces lsq-2/0/0:0 unit 0 dlci 10
set interfaces lsq-2/0/0:0 unit 1 dlci 20
set interfaces lsq-2/0/0:0 unit 0 family inet address 10.1.1.2/24
set interfaces lsq-2/0/0:0 unit 1 family inet address 192.0.2.2/24
set interfaces t1-2/0/0:5 encapsulation multilink-frame-relay-uni-nni
set interfaces t1-2/0/0:6 encapsulation multilink-frame-relay-uni-nni
set interfaces t1-2/0/0:5 unit 0 family mlfr-uni-nni bundle lsq-2/0/0:0
set interfaces t1-2/0/0:6 unit 0 family mlfr-uni-nni bundle lsq-2/0/0:0
```

To Configure Router R0

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure inline Multilink Frame Relay (FRF.16) for WAN Interfaces:

1. Configure a chassis interface and specify the number of MFR bundles.

```
[edit]
user@R0# set chassis fpc 1 pic 0 mlfr-uni-nni-bundles-inline 1
```
2. Create the interface and specify the MFR encapsulation type.

```
[edit]
user@R0# set interfaces lsq-1/0/0:0 encapsulation multilink-frame-relay-uni-nni
```
3. Set Router R0 as a DCE device.

```
[edit ]
user@R0# set interfaces lsq-1/0/0:0 dce
```
4. Specify the DLCI value.

```
[edit]
user@R0# set interfaces lsq-1/0/0:0 unit 0 dlci 10
user@R0# set interfaces lsq-1/0/0:0 unit 1 dlci 20
```
5. Specify a logical unit on the multilink bundle and set the family type.

```
[edit]
user@R0# set interfaces lsq-1/0/0:0 unit 0 family inet address 10.1.1.1/24
user@R0# set interfaces lsq-1/0/0:0 unit 1 family inet address 192.0.2.1/24
```
6. Create the T1 interfaces and set the Frame Relay encapsulation.

```
[edit]
user@R0# set interfaces t1-1/0/0:5 encapsulation multilink-frame-relay-uni-nni
user@R0# set interfaces t1-1/0/0:6 encapsulation multilink-frame-relay-uni-nni
```
7. Specify the multilink bundle to which the interface is to be added as a constituent link on Router R0.

```
[edit]
user@R0# set interfaces t1-1/0/0:5 unit 0 family mlfr-uni-nni bundle lsq-1/0/0:0
user@R0# set interfaces t1-1/0/0:6 unit 0 family mlfr-uni-nni bundle lsq-1/0/0:0
```

To Configure Router R1

Step-by-Step Procedure

To configure inline Multilink Frame Relay (FRF.16) for WAN Interfaces:

1. Configure a chassis interface and specify the number of MFR bundles.

```
[edit]
user@R1# set chassis fpc 2 pic 0 mlfr-uni-nni-bundles-inline 1
```
2. Create the interface and specify the MFR encapsulation type.

```
[edit]
user@R1# set interfaces lsq-2/0/0:0 encapsulation multilink-frame-relay-uni-nni
```
3. Specify the DLCI value.

```
[edit]
user@R0# set interfaces lsq-2/0/0:0 unit 0 dlci 10
user@R0# set interfaces lsq-2/0/0:0 unit 1 dlci 20
```
4. Specify a logical unit on the multilink bundle and set the family type.

```
[edit]
user@R0# set interfaces lsq-2/0/0:0 unit 0 family inet address 10.1.1.2/24
user@R0# set interfaces lsq-2/0/0:0 unit 1 family inet address 192.0.2.2/24
```
5. Create the T1 interfaces and set the Frame Relay encapsulation.

```
[edit]
user@R1# set interfaces t1-2/0/0:5 encapsulation multilink-frame-relay-uni-nni
user@R1# set interfaces t1-2/0/0:6 encapsulation multilink-frame-relay-uni-nni
```
6. Specify the multilink bundle to which the interface is to be added as a constituent link on Router R1.

```
[edit]
user@R1# set interfaces t1-2/0/0:5 unit 0 family mlfr-uni-nni bundle lsq-2/0/0:0
user@R1# set interfaces t1-2/0/0:6 unit 0 family mlfr-uni-nni bundle lsq-2/0/0:0
```

Results

For Router R0, from configuration mode, confirm your configuration by entering the **show chassis**, **show interfaces lsq-1/0/0:0**, **show interfaces t1-1/0/0:5**, and **show interfaces t1-1/0/0:6** commands.

For Router R1, from configuration mode, confirm your configuration by entering the **show chassis**, **show interfaces lsq-2/0/0:0**, **show interfaces t1-2/0/0:5**, and **show interfaces t1-2/0/0:6** commands.

If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

For Router R0:

```
[edit]
user@R0# show chassis
fpc 1 {
  pic 0 {
    mlfr-uni-nni-bundles-inline 1;
  }
}

[edit]
user@R0# show interfaces lsq-1/0/0:0
dce;
encapsulation multilink-frame-relay-uni-nni;
unit 0 {
  dlci 10;
  family inet {
    address 10.1.1.1/24;
  }
}
unit 1 {
  dlci 20;
  family inet {
    address 192.0.2.1/24;
  }
}

[edit]
user@R0# show interfaces t1-1/0/0:5
encapsulation multilink-frame-relay-uni-nni;
unit 0 {
  family mlfr-uni-nni {
    bundle lsq-1/0/0:0;
  }
}

[edit]
user@R0# show interfaces t1-1/0/0:6
encapsulation multilink-frame-relay-uni-nni;
unit 0 {
  family mlfr-uni-nni {
    bundle lsq-1/0/0:0;
  }
}
```

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

For Router R1:

```
[edit]
```

```

user@R1# show chassis
fpc 2{
  pic 0 {
    mlfr-uni-nni-bundles-inline 1;
  }
}

[edit]
user@R1# show interfaces lsq-2/0/0:0
encapsulation multilink-frame-relay-uni-nni;
unit 0 {
  dlci 10;
  family inet {
    address 10.1.1.2/24;
  }
}
unit 1 {
  dlci 20;
  family inet {
    address 192.0.2.2/24;
  }
}

[edit]
user@R1# show interfaces t1-2/0/0:5
encapsulation multilink-frame-relay-uni-nni;
unit 0 {
  family mlfr-uni-nni {
    bundle lsq-2/0/0:0;
  }
}

[edit]
user@R1# show interfaces t1-2/0/0:6
encapsulation multilink-frame-relay-uni-nni;
unit 0 {
  family mlfr-uni-nni {
    bundle lsq-2/0/0:0;
  }
}

```

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

Verification

Verifying the MFR FRF.16 Configuration

Purpose Verify the MFR FRF.16 configuration.

Action From operational mode, run the **show interfaces lsq-1/0/0:0 extensive** command.

Sample Output

```

user@R0> show interfaces lsq-1/0/0:0 extensive
Physical interface: lsq-1/0/0:0, Enabled, Physical link is Up
Interface index: 261, SNMP ifIndex: 122042, Generation: 4955

```

```

Link-level type: Multilink-FR-UNI-NNI, MTU: 1508
Device flags   : Present Running
Interface flags: Point-To-Point SNMP-Traps Internal: 0x4000
Last flapped   : Never
Statistics last cleared: Never
Hold-times     : Up 0 ms, Down 0 ms
Multilink Frame Relay UNI NNI bundle options:
  Device type           DCE
  MRRU                  1508
  Bandwidth             3072kbps
  Fragmentation threshold 0
  Red differential delay limit 120
  Yellow differential delay limit 72
  Red differential delay action Remove link
  Reassembly drop timer 65535
  Links needed to sustain bundle 1
  Link layer overhead 4.0 %
  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
Q.933 Annex A LMI settings: n392dce 3, n393dce 4, t392dce 15 seconds
LMI statistics:
  Input : 52 (last seen 00:00:01 ago)
  Output: 54 (last sent 00:00:01 ago)
DTE statistics:
  Enquiries sent           : 0
  Full enquiries sent      : 0
  Enquiry responses received : 0
  Full enquiry responses received : 0
DCE statistics:
  Enquiries received       : 44
  Full enquiries received  : 8
  Enquiry responses sent   : 46
  Full enquiry responses sent : 8
Common statistics:
  Unknown messages received : 0
  Asynchronous updates received : 0
  Out-of-sequence packets received : 0
  Keepalive responses timedout : 1
Interface transmit statistics: Disabled
Traffic statistics:
  Input bytes : 0 0 bps
  Output bytes : 0 0 bps
  Input packets: 0 0 pps
  Output packets: 0 0 pps
IPv6 transit 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

Multilink:
  Input :          0          0          0          0
  Output:          0          0          0          0
Network:
  Input :          0          0          0          0
  Output:          0          0          0          0
Multilink Frame Relay UNI NNI bundle links information:
  Active bundle links      2
  Removed bundle links     0
  Disabled bundle links    0
Multilink Frame Relay UNI NNI active bundle links statistics:
      Frames      fps      Bytes      bps

t1-1/0/0:5
  Up time: 00:08:18
  Input :          0          0          0          0
  Output:          0          0          0          0
  Current differential delay      0.1 ms
  Recent high differential delay  0.8 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      1      0      50      49      0      0
  Xmt:     16      2      0      49      50      1      0

t1-1/0/0:6
  Up time: 00:08:18
  Input :          0          0          0          0
  Output:          0          0          0          0
  Current differential delay      0.0 ms
  Recent high differential delay  0.7 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      1      0      50      49      0      0
  Xmt:     16      2      0      49      50      1      0

Logical interface lsq-1/0/0:0.0 (Index 336) (SNMP ifIndex 122044) (Generation
6209)
  Flags: Up Point-To-Point SNMP-Traps Encapsulation: Multilink-FR-UNI-NNI
  Last flapped: 2014-04-24 04:13:05 PDT (00:08:18 ago)
  Multilink class 0 status:
    Received sequence number      0x0
    Transmit sequence number     0xffffffff
  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
    Multilink class drop timeout  0 (ms)
  Statistics      Frames      fps      Bytes      bps
  Bundle:
    Multilink:
      Input :          0          0          0          0
      Output:          0          0          0          0

```

```

Network:
  Input :          0          0          0          0
  Output:          0          0          0          0
Link:
  t1-1/0/0:5
    Up time: 00:08:18
    Input :          0          0          0          0
    Output:          0          0          0          0
  t1-1/0/0:6
    Up time: 00:08:18
    Input :          0          0          0          0
    Output:          0          0          0          0
Multilink detail statistics:
Bundle:
  Fragments:
    Input :          0          0          0          0
    Output:          0          0          0          0
  Non-fragments:
    Input :          0          0          0          0
    Output:          0          0          0          0
Protocol inet, MTU: 1500, Generation: 6258, Route table: 0
Flags: Sendbcast-pkt-to-re
Addresses, Flags: Is-Preferred Is-Primary
  Destination: 10.1.1/24, Local: 10.1.1.1, Broadcast: Unspecified,
Generation: 4209
DLCI 10
  Flags: Active
  Total down time: 01:15:17 sec, Last down: 01:23:28 ago
  Traffic statistics:
    Input bytes :          0
    Output bytes :          0
    Input packets:          0
    Output packets:          0

Logical interface lsq-1/0/0:0.1 (Index 337) (SNMP ifIndex 122067) (Generation
6210)
  Flags: Up Point-To-Point SNMP-Traps Encapsulation: Multilink-FR-UNI-NNI
  Last flapped: 2014-04-24 04:13:05 PDT (00:08:18 ago)
  Multilink class 0 status:
    Received sequence number      0x0
    Transmit sequence number      0xffffffff
    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
    Multilink class drop timeout    0 (ms)
  Statistics      Frames      fps      Bytes      bps
Bundle:
  Multilink:
    Input :          0          0          0          0
    Output:          0          0          0          0
  Network:
    Input :          0          0          0          0
    Output:          0          0          0          0
Link:
  t1-1/0/0:5

```

```

    Up time: 00:08:18
    Input :          0          0          0          0
    Output:          0          0          0          0
t1-1/0/0:6
    Up time: 00:08:18
    Input :          0          0          0          0
    Output:          0          0          0          0
Multilink detail statistics:
Bundle:
  Fragments:
    Input :          0          0          0          0
    Output:          0          0          0          0
  Non-fragments:
    Input :          0          0          0          0
    Output:          0          0          0          0
Protocol inet, MTU: 1500, Generation: 6260, Route table: 0
Flags: Sendbcst-pkt-to-re
Addresses, Flags: Is-Preferred Is-Primary
  Destination: 192.0.2/24, Local: 192.0.2.1, Broadcast: Unspecified,
Generation: 4207
DLCI 20
  Flags: Active
  Total down time: 01:15:17 sec, Last down: 01:23:28 ago
  Traffic statistics:
    Input bytes :          0
    Output bytes :          0
    Input packets:          0
    Output packets:          0
DLCI statistics:
  Active DLCI :2  Inactive DLCI :0

```

From the operational mode, enter the **show interfaces lsq-2/0/0:0 extensive** command.

```

user@R1> show interfaces lsq-2/0/0:0 extensive
Physical interface: lsq-2/0/0:0, Enabled, Physical link is Up
Interface index: 232, SNMP ifIndex: 44389, Generation: 235
Link-level type: Multilink-FR-UNI-NNI, MTU: 1508
Device flags : Present Running
Interface flags: Point-To-Point SNMP-Traps Internal: 0x4000
Last flapped : Never
Statistics last cleared: Never
Hold-times : Up 0 ms, Down 0 ms
Multilink Frame Relay UNI NNI bundle options:
  Device type DTE
  MRRU 1508
  Bandwidth 3072kbps
  Fragmentation threshold 0
  Red differential delay limit 120
  Yellow differential delay limit 72
  Red differential delay action Remove link
  Reassembly drop timer 65535
  Links needed to sustain bundle 1
  Link layer overhead 4.0 %
  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

```

Q.933 Annex A LMI settings: n391dte 6, n392dte 3, n393dte 4, t391dte 10 seconds

LMI statistics:

```

Input : 80 (last seen 00:00:10 ago)
Output: 100 (last sent 00:00:10 ago)

```

DTE statistics:

```

Enquiries sent           : 82
Full enquiries sent      : 16
Enquiry responses received : 67
Full enquiry responses received : 13

```

DCE statistics:

```

Enquiries received       : 0
Full enquiries received  : 0
Enquiry responses sent    : 0
Full enquiry responses sent : 0

```

Common statistics:

```

Unknown messages received : 0
Asynchronous updates received : 0
Out-of-sequence packets received : 0
Keepalive responses timedout : 1

```

Interface transmit statistics: Disabled

Traffic statistics:

```

Input bytes : 0 0 bps
Output bytes : 0 0 bps
Input packets: 0 0 pps
Output packets: 0 0 pps

```

IPv6 transit 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
Multilink:				
Input :	0	0	0	0
Output:	0	0	0	0
Network:				
Input :	0	0	0	0
Output:	0	0	0	0

Multilink Frame Relay UNI NNI bundle links information:

```

Active bundle links 2
Removed bundle links 0
Disabled bundle links 0

```

Multilink Frame Relay UNI NNI active bundle links statistics:

	Frames	fps	Bytes	bps
t1-2/0/0:5				
Up time: 00:12:57				
Input :	0	0	0	0
Output:	0	0	0	0
Current differential delay		0.0 ms		
Recent high differential delay		2.8 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:      1      2      0      77      78      0      0
Xmt:      14      1      0      78      77      0      0
t1-2/0/0:6
Up time: 00:12:57
Input :      0      0      0      0
Output:      0      0      0      0
Current differential delay        0.0 ms
Recent high differential delay    2.8 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:      1      2      0      77      78      0      0
Xmt:      14      1      0      78      77      0      0

```

Logical interface lsq-2/0/0:0.0 (Index 348) (SNMP ifIndex 44399) (Generation 161)

Flags: Up Point-To-Point SNMP-Traps Encapsulation: Multilink-FR-UNI-NNI

Last flapped: 2014-04-24 04:13:05 PDT (00:12:57 ago)

Multilink class 0 status:

```

Received sequence number      0x0
Transmit sequence number      0xffffffff
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
Multilink class drop timeout  0 (ms)

```

Statistics	Frames	fps	Bytes	bps
------------	--------	-----	-------	-----

Bundle:

Multilink:

Input :	0	0	0	0
Output:	0	0	0	0

Network:

Input :	0	0	0	0
Output:	0	0	0	0

Link:

t1-2/0/0:5

Up time: 00:12:57				
Input :	0	0	0	0
Output:	0	0	0	0

t1-2/0/0:6

Up time: 00:12:57				
Input :	0	0	0	0
Output:	0	0	0	0

Multilink detail statistics:

Bundle:

Fragments:

Input :	0	0	0	0
Output:	0	0	0	0

Non-fragments:

Input :	0	0	0	0
Output:	0	0	0	0

Protocol inet, MTU: 1500, Generation: 193, Route table: 0

Flags: Sendbcst-pkt-to-re

Addresses, Flags: Is-Preferred Is-Primary

```

    Destination: 10.1.1/24, Local: 10.1.1.2, Broadcast: Unspecified,
Generation: 149
  DLCI 10
    Flags: Active, DCE-Configured
    Total down time: 00:03:18 sec, Last down: 00:15:38 ago
    Traffic statistics:
      Input bytes : 0
      Output bytes : 0
      Input packets: 0
      Output packets: 0

Logical interface lsq-2/0/0:0.1 (Index 349) (SNMP ifIndex 44400) (Generation
162)
  Flags: Up Point-To-Point SNMP-Traps Encapsulation: Multilink-FR-UNI-NNI
  Last flapped: 2014-04-24 04:13:05 PDT (00:12:57 ago)
  Multilink class 0 status:
    Received sequence number 0x0
    Transmit sequence number 0xffffffff
    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
    Multilink class drop timeout 0 (ms)
  Statistics
  Bundle:
    Multilink:
      Input : 0 0 0 0
      Output: 0 0 0 0
    Network:
      Input : 0 0 0 0
      Output: 0 0 0 0
  Link:
    t1-2/0/0:5
      Up time: 00:12:57
      Input : 0 0 0 0
      Output: 0 0 0 0
    t1-2/0/0:6
      Up time: 00:12:57
      Input : 0 0 0 0
      Output: 0 0 0 0
  Multilink detail statistics:
  Bundle:
    Fragments:
      Input : 0 0 0 0
      Output: 0 0 0 0
    Non-fragments:
      Input : 0 0 0 0
      Output: 0 0 0 0
  Protocol inet, MTU: 1500, Generation: 194, Route table: 0
  Flags: Sendbcst-pkt-to-re
  Addresses, Flags: Is-Preferred Is-Primary
    Destination: 192.0.2/24, Local: 192.0.2.2, Broadcast: Unspecified,
Generation: 151
  DLCI 20
    Flags: Active, DCE-Configured
    Total down time: 00:03:18 sec, Last down: 00:15:38 ago

```

```
Traffic statistics:
  Input bytes   :          0
  Output bytes  :          0
  Input packets :          0
  Output packets:          0
DLCI statistics:
  Active DLCI   :2  Inactive DLCI :0
```

- Related Documentation**
- *Inline MLPPP for WAN Interfaces Overview*
 - [Enabling MLPPP Link Fragmentation and Interleaving on page 78](#)
 - [Example: Configuring Multilink Frame Relay FRF.16 on page 89](#)
 - *Link and Multilink Services Interfaces Feature Guide for Routing Devices*
 - *mlfr-uni-nni-bundles-inline*
 - *multi-link-layer-2-inline*
 - *pic (MX Series Routers)*
 - [show interfaces \(Link Services IQ\) on page 169](#)

CHAPTER 6

Configuring Additional Services on Link Services Interfaces

- [Configuring CoS on Link Services Interfaces on page 113](#)
- [Example: Configuring Link and Voice Services Interfaces with a Combination of Bundle Types on page 118](#)

Configuring CoS on Link Services Interfaces

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

On SRX 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 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 113](#)
- [Example: Configuring CoS on Link Services Interfaces on page 115](#)

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 7 on page 113](#) summarizes how CoS queues work on link services (**ls**) interfaces.

Table 7: Link Services CoS Queues

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

Table 7: Link Services CoS Queues (*continued*)

Supported Bundling Type	Queue 0	Higher-Priority Queues
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 82](#) and the *Routing Policies, Firewall Filters, and Traffic Policers Feature 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 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;
    }
  }
}
cel-7/3/6 {
  no-partition interface-type e1;
}
e1-7/3/6 {
```

```
encapsulation ppp;
unit 0 {
    family mppp {
        bundle ls-7/0/0.0;
    }
}
cel-7/3/7 {
    no-partition interface-type e1;
}
e1-7/3/7 {
    encapsulation ppp;
    unit 0 {
        family mppp {
            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;
        }
    }
}
```

- Related Documentation**
- [Link and Multilink Services Overview on page 17](#)
 - [Configuring Link Services Physical Interfaces on page 33](#)

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;
}
```

- Related Documentation**
- [Configuring Link Services Physical Interfaces on page 33](#)
 - [encapsulation \(Physical Interface\) on page 136](#)

CHAPTER 7

Configuration Statements

- [acknowledge-retries on page 126](#)
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acknowledge-retries

Syntax	<code>acknowledge-retries <i>number</i>;</code>
Hierarchy Level	[edit interfaces <i>ls-fpc/pic/port:channel</i> 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	<i>number</i> —Number of retransmission attempts to be made following the expiration of the acknowledgment timer. Range: 1 through 5 Default: 2
Required Privilege Level	interface —To view this statement in the configuration. interface-control —To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• action-red-differential-delay on page 128, hello-timer on page 139• Configuring Acknowledgment Timers on Link Services Physical Interfaces on page 35

acknowledge-timer

Syntax	<code>acknowledge-timer <i>milliseconds</i>;</code>
Hierarchy Level	[edit interfaces <i>ls-fpc/pic/port:channel</i> 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	<p><i>milliseconds</i>—Time to wait for an add link acknowledgment, hello acknowledgment, or remove link acknowledgment message.</p> <p>Range: 1 through 10 milliseconds</p> <p>Default: 4 milliseconds</p>
Required Privilege Level	<p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • address (Interfaces) on page 129 • hello-timer on page 139 • Configuring Acknowledgment Timers on Link Services Physical Interfaces on page 35

action-red-differential-delay

Syntax	<code>action-red-differential-delay (disable-tx remove-link);</code>
Hierarchy Level	[edit interfaces <i>ls-fpc/pic/port:channel</i> 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
Required Privilege Level	interface —To view this statement in the configuration. interface-control —To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• yellow-differential-delay on page 154• Configuring Differential Delay Alarms on Link Services Physical Interfaces with MLFR FRF.16 on page 35

address (Interfaces)

Syntax	<pre>address address { destination address; }</pre>
Hierarchy Level	[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family inet], [edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family inet]
Release Information	Statement introduced before Junos OS Release 7.4.
Description	Configure the interface address.
Options	<p>address—Address of the interface.</p> <p>The remaining statements are explained separately. See CLI Explorer.</p>
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none"> • <i>Junos OS Network Interfaces Library for Routing Devices</i> for other statements that do not affect services interfaces. • Configuring the Links in a Multilink or Link Services Bundle on page 27 • <i>Junos OS Network Interfaces Library for Routing Devices</i>

bundle

Syntax	<code>bundle (ml-<i>fpc/pic/port</i> ls-<i>fpc/pic/port</i>);</code>
Hierarchy Level	[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family mlfr-end-to-end], [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> 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-<i>fpc/pic/port</i> —Name of the multilink interface you are linking. ls-<i>fpc/pic/port</i> —Name of the link services interface you are linking.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Configuring the Links in a Multilink or Link Services Bundle on page 27

destination (Interfaces)

Syntax	<code>destination address;</code>
Hierarchy Level	<p>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> tunnel],</p> <p>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family inet address <i>address</i>],</p> <p>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> tunnel],</p> <p>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family inet address <i>address</i>]</p>
Release Information	Statement introduced before Junos OS Release 7.4.
Description	<p>For CoS on ATM interfaces, specify the remote address of the connection.</p> <p>For point-to-point interfaces only, specify the address of the interface at the remote end of the connection.</p> <p>For tunnel and encryption interfaces, specify the remote address of the tunnel.</p>
Options	<i>address</i> —Address of the remote side of the connection.
Required Privilege Level	<p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • <i>Configuring Linear RED Profiles on ATM Interfaces</i> • Multilink and Link Services Logical Interface Configuration Overview on page 23 • <i>Configuring Encryption Interfaces</i> • <i>Configuring Traffic Sampling</i> • <i>Configuring Flow Monitoring</i> • <i>Configuring Unicast Tunnels</i>

disable-mlppp-inner-ppp-pfc

Syntax	disable-mlppp-inner-ppp-pfc;
Hierarchy Level	[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i>], [edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i>]
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.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Configuring the Drop Timeout Period on Multilink and Link Services Logical Interfaces on page 38

dlci

Syntax	<code>dlci <i>dlci-identifier</i>;</code>
Hierarchy Level	[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i>], [edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i>]
Release Information	Statement introduced before Junos OS Release 7.4.
Description	<p>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).</p> <p>To configure a DLCI for a point-to-multipoint interface, use the multipoint-destination statement to specify the DLCI.</p>
Options	<p><i>dlci-identifier</i>—Data-link connection identifier.</p> <p>Range: 16 through 1022</p>
Required Privilege Level	<p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • Configuring DLCIs on Link Services Logical Interfaces on page 87 • <i>Junos OS Network Interfaces Library for Routing Devices</i> • <i>Data-Link Connection Identifiers on Channelized Interfaces</i> • <i>Configuring Frame Relay DLCIs</i> • <i>Junos OS Services Interfaces Library for Routing Devices</i> • <i>encapsulation (Logical Interface)</i> • <i>multicast-dlci</i> • <i>multipoint-destination</i>

drop-timeout

Syntax	<code>drop-timeout <i>milliseconds</i>;</code>
Hierarchy Level	[edit interfaces <i>ls-fpc/pic/port:channel</i> mlfr-uni-nni-bundle-options], [edit interfaces (<i>ls-fpc/pic/port</i> <i>ml-fpc/pic/port</i>) unit <i>logical-unit-number</i>], [edit logical-systems <i>logical-system-name</i> interfaces <i>ls-fpc/pic/port:channel</i> mlfr-uni-nni-bundle-options], [edit logical-systems <i>logical-system-name</i> interfaces (<i>ls-fpc/pic/port</i> <i>ml-fpc/pic/port</i>) unit <i>logical-unit-number</i>]
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	<i>milliseconds</i> —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.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Configuring the Drop Timeout Period on Multilink and Link Services Logical Interfaces on page 38

encapsulation (Logical Interface)

Syntax	<code>encapsulation (atm-mlppp-llc multilink-frame-relay-end-to-end multilink-ppp ...);</code>
Hierarchy Level	<code>[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i>],</code> <code>[edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i>]</code>
Release Information	Statement introduced before Junos OS Release 7.4.
Description	Logical link-layer encapsulation type.
Options	<p>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, <i>PPP over AAL5</i>.</p> <p>multilink-frame-relay-end-to-end—Use Multilink Frame Relay (MLFR) FRF.15 encapsulation. This encapsulation is used on multilink “link services interfaces and their constituent T1 or E1 interfaces”, and is supported on LSQ and redundant LSQ interfaces.</p> <p>multilink-ppp—Use MLPPP encapsulation. This encapsulation is used only on multilink and link services interfaces and their constituent T1 or E1 interfaces.</p>
Required Privilege Level	<p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • Configuring Encapsulation for Multilink and Link Services Logical Interfaces on page 37 • <i>Junos OS Network Interfaces Library for Routing Devices</i>

encapsulation (Physical Interface)

Syntax	encapsulation (multilink-frame-relay-uni-nni ...);
Hierarchy Level	[edit interfaces <i>interface-name</i>], [edit interfaces rlsqnumber: <i>number</i>]
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.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Configuring Encapsulation for Link Services Physical Interfaces on page 34• <i>Junos OS Network Interfaces Library for Routing Devices</i>

family

Syntax	<pre>family <i>family</i> { <i>address</i> <i>address</i> { <i>destination</i> <i>address</i>; } }</pre>
Hierarchy Level	[edit interfaces <i>interface-name</i> <i>unit</i> <i>logical-unit-number</i>]
Release Information	<p>Statement introduced before Junos OS Release 7.4.</p> <p>Statement introduced in Junos OS Release 15.1X53-D10 for QFX10000 switches.</p>
Description	Configure protocol family information for the logical interface.
Options	<p><i>family</i>—Protocol family:</p> <ul style="list-style-type: none"> • 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 <p>The remaining statements are explained separately. See CLI Explorer.</p>
Required Privilege Level	<p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • <i>Link and Multilink Services Interfaces Feature Guide for Routing Devices</i> • <i>Junos OS Network Interfaces Library for Routing Devices</i>

fragment-threshold

Syntax	<code>fragment-threshold <i>bytes</i>;</code>
Hierarchy Level	<code>[edit interfaces <i>ls-fpc/pic/port:channel</i> mlfr-uni-nni-bundle-options],</code> <code>[edit interfaces (<i>ls-fpc/pic/port</i> <i>ml-fpc/pic/port</i>) unit <i>logical-unit-number</i>],</code> <code>[edit logical-systems <i>logical-system-name</i> interfaces <i>ls-fpc/pic/port:channel</i></code> <code>mlfr-uni-nni-bundle-options],</code> <code>[edit logical-systems <i>logical-system-name</i> interfaces (<i>ls-fpc/pic/port</i> <i>ml-fpc/pic/port</i>) unit</code> <code><i>logical-unit-number</i>]</code>
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)
Required Privilege Level	interface —To view this statement in the configuration. interface-control —To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Limiting Packet Payload Size on Multilink and Link Services Logical Interfaces on page 40• Example: Configuring a Multilink Interface with MLPPP on page 55

hello-timer

Syntax	<code>hello-timer <i>milliseconds</i>;</code>
Hierarchy Level	<code>[edit interfaces ls-<i>fpc</i>/<i>pic</i>/<i>port</i>:<i>channel</i> <i>mlfr-uni-nni-bundle-options</i>]</code>
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	<p><i>milliseconds</i>—The rate at which hello messages are sent.</p> <p>Range: 1 through 180 milliseconds</p> <p>Default: 10 milliseconds</p>
Required Privilege Level	<p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • Configuring Acknowledgment Timers on Link Services Physical Interfaces on page 35 • address (Interfaces) on page 129, acknowledge-timer on page 127

interfaces

Syntax	<code>interfaces { ... }</code>
Hierarchy Level	<code>[edit]</code>
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.
Required Privilege Level	<p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • Junos OS Network Interfaces Library for Routing Devices

interleave-fragments

Syntax	interleave-fragments;
Hierarchy Level	[edit interfaces <i>ls-fpc/pic/port:channel</i> unit <i>logical-unit-number</i>], [edit logical-systems <i>logical-system-name</i> interfaces <i>ls-fpc/pic/port</i> unit <i>logical-unit-number</i>]
Release Information	Statement introduced before Junos OS Release 7.4.
Description	<p>For link services and voice services interfaces only, interleave long packets with high-priority packets.</p> <p>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.</p>
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Configuring Delay-Sensitive Packet Interleaving on Link Services Logical Interfaces on page 82

lmi-type

Syntax	lmi-type (ansi itu);
Hierarchy Level	[edit interfaces <i>ls-fpc/pic/port:channel</i> 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	<p>ansi—Use American National Standards Institute (ANSI) T1.167 Annex D LMIs.</p> <p>itu—Use ITU Q933 Annex A LMIs.</p> <p>Default: itu</p>
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Configuring Keepalives on Link Services Physical Interfaces on page 36

minimum-links

Syntax	<code>minimum-links <i>number</i>;</code>
Hierarchy Level	<p>[edit interfaces <i>ls-fpc/pic/port:channel</i> mlfr-uni-nni-bundle-options],</p> <p>[edit interfaces (<i>ls-fpc/pic/port</i> <i>ml-fpc/pic/port</i>) unit <i>logical-unit-number</i>],</p> <p>[edit logical-systems <i>logical-system-name</i> interfaces <i>ls-fpc/pic/port:channel</i> mlfr-uni-nni-bundle-options],</p> <p>[edit logical-systems <i>logical-system-name</i> interfaces (<i>ls-fpc/pic/port</i> <i>ml-fpc/pic/port</i>) unit <i>logical-unit-number</i>]</p>
Release Information	Statement introduced before Junos OS Release 7.4.
Description	<p>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.</p> <p>The minimum-links value should be identical on both ends of the bundle.</p>
Options	<p><i>number</i>—Number of links.</p> <p>Range: 1 through 8</p> <p>Default: 1</p>
Required Privilege Level	<p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • Configuring the Minimum Number of Active Links on Multilink and Link Services Logical Interfaces on page 41

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-interopability 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 remaining statements are explained separately. See [CLI Explorer](#).

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 34](#)

mrru

Syntax	<code>mrru bytes;</code>
Hierarchy Level	[edit interfaces <i>ls-fpc/pic/port:channel</i> mlfr-uni-nni-bundle-options], [edit interfaces (<i>ml-fpc/pic/port</i> <i>ls-fpc/pic/port</i>) unit <i>logical-unit-number</i>], [edit logical-systems <i>logical-system-name</i> interfaces <i>ls-fpc/pic/port:channel</i> mlfr-uni-nni-bundle-options], [edit logical-systems <i>logical-system-name</i> interfaces (<i>ml-fpc/pic/port</i> <i>ls-fpc/pic/port</i>) unit <i>logical-unit-number</i>]
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
Required Privilege Level	interface —To view this statement in the configuration. interface-control —To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none"> Configuring MRRU on Multilink and Link Services Logical Interfaces on page 42

mtu

Syntax	<code>mtu bytes;</code>
Hierarchy Level	[edit interfaces <i>interface-name</i>], [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family <i>family</i>], [edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family <i>family</i>]
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)
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Configuring MRRU on Multilink and Link Services Logical Interfaces on page 42• <i>Junos OS Network Interfaces Library for Routing Devices</i>

multicast-dlci

Syntax	<code>multicast-dlci <i>dlci-identifier</i>;</code>
Hierarchy Level	[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i>], [edit logical-systems <i>logical-system-name</i> interfaces <i>interface-name</i> unit <i>logical-unit-number</i>]
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	<i>dlci-identifier</i> —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.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none"> • Configuring Multicast-Capable DLCIs for MLFR FRF.16 Bundles on page 88 • <i>Configuring a Multicast-Capable Frame Relay Connection</i> • <i>dlci</i> • <i>multipoint-destination</i> • <i>Junos OS Services Interfaces Library for Routing Devices</i>

n391

Syntax	<code>n391 number;</code>
Hierarchy Level	[edit interfaces <i>ls-fpc/pic/port:channel</i> 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	<i>number</i> —Polling interval. Range: 1 through 255 Default: 6
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Configuring Keepalives on Link Services Physical Interfaces on page 36• n392 on page 147• n393 on page 148• t391 on page 151• t392 on page 152

n392

Syntax	<code>n392 number;</code>
Hierarchy Level	[edit interfaces <i>ls-fpc/pic/port:channel</i> 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	<i>number</i> —Error threshold. Range: 1 through 10 Default: 3
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Configuring Keepalives on Link Services Physical Interfaces on page 36• n391 on page 146• n393 on page 148• t391 on page 151• t392 on page 152

n393

Syntax	<code>n393 number;</code>
Hierarchy Level	[edit interfaces ls- <i>fpc/pic/port:channel</i> 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	<i>number</i> —Event count. Range: 1 through 10 Default: 4
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Configuring Keepalives on Link Services Physical Interfaces on page 36• n391 on page 146• n392 on page 147• t391 on page 151• t392 on page 152

red-differential-delay

Syntax	<code>red-differential-delay <i>milliseconds</i>;</code>
Hierarchy Level	[edit interfaces <i>ls-fpc/pic/port:channel</i> 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	<p><i>milliseconds</i>—Red differential delay threshold.</p> <p>Range: 1 through 2000 milliseconds</p> <p>Default: 120 milliseconds</p>
Required Privilege Level	<p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • Configuring Differential Delay Alarms on Link Services Physical Interfaces with MLFR FRF.16 on page 35 • action-red-differential-delay on page 128, • yellow-differential-delay on page 154

short-sequence

Syntax	short-sequence;
Hierarchy Level	[edit interfaces (ls- <i>fpc/pic/port</i> ml- <i>fpc/pic/port</i>) unit <i>logical-unit-number</i>], [edit logical-systems <i>logical-system-name</i> interfaces (ls- <i>fpc/pic/port</i> ml- <i>fpc/pic/port</i>) unit <i>logical-unit-number</i>]
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.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Configuring the Sequence Header Format on Multilink and Link Services Logical Interfaces on page 43

t391

Syntax	t391 <i>number</i> ;
Hierarchy Level	[edit interfaces ls- <i>fpc/pic/port:channel</i> 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	<i>number</i> —Link integrity polling interval. Range: 5 through 30 seconds Default: 10 seconds
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Configuring Keepalives on Link Services Physical Interfaces on page 36• n391 on page 146• n392 on page 147• t392 on page 152• n393 on page 148

t392

Syntax	t392 <i>number</i> ;
Hierarchy Level	[edit interfaces ls- <i>fpc/pic/port:channel</i> 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	<i>number</i> —Polling verification interval. Range: 5 through 30 seconds Default: 15 seconds
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Configuring Keepalives on Link Services Physical Interfaces on page 36• n391 on page 146• n392 on page 147• n393 on page 148• t391 on page 151

unit (Interfaces)

Syntax	<pre> 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); } } </pre>
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	<p>logical-unit-number—Number of the logical unit.</p> <p>Range: 0 through 16,384</p> <p>The remaining statements are explained separately. See CLI Explorer.</p>
Required Privilege Level	<p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • <i>Link and Multilink Services Interfaces Feature Guide for Routing Devices</i> • <i>Junos OS Network Interfaces Library for Routing Devices</i> for other statements that do not affect services interfaces.

yellow-differential-delay

Syntax	<code>yellow-differential-delay <i>milliseconds</i>;</code>
Hierarchy Level	[edit interfaces <i>ls-fpc/pic/port:channel</i> 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	<i>milliseconds</i> —Yellow differential delay threshold. Range: 1 through 2000 milliseconds Default: 72 milliseconds
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Configuring Differential Delay Alarms on Link Services Physical Interfaces with MLFR FRF.16 on page 35• action-red-differential-delay on page 128• red-differential-delay on page 149

CHAPTER 8

Operational Commands

- `show interfaces` (Link Services)
- `show interfaces` (Link Services IQ)
- `show interfaces` (Multilink Services)

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*.

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

channel—Channel number of the link services interface.

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 164](#)
[show interfaces extensive \(MFR End-to-End\) on page 166](#)

Output Fields [Table 8 on page 157](#) 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
Enabled	State of the interface. Possible values are described in the “Enabled Field” section under <i>Common Output Fields Description</i> .	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 <i>Common Output Fields Description</i> .	All levels
Interface flags	Information about the interface. Possible values are described in the “Interface Flags” section under <i>Common Output Fields Description</i> .	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 <i>Common Output Fields Description</i> .	All levels
Hold-times	Current interface hold time up and hold time down, in milliseconds, in the format Up <i>n</i> ms, Down <i>n</i> 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	<p>Multilink Frame Relay UNI NNI only) Configured information about Multilink Frame Relay bundle options.</p> <ul style="list-style-type: none"> • 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. <ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • Bundle class—Bundle class ID. • LMI type—Multilink Frame Relay UNI NNI LMI type: ANSI or Q.933 ANNEX A. <ul style="list-style-type: none"> • 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	<p>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.</p>	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. <ul style="list-style-type: none"> • 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. <ul style="list-style-type: none"> • Fragments—Bundle fragment information. <ul style="list-style-type: none"> • 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. <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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. <ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> 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	<p>For Multilink Frame Relay end-to-end only. Information about framing exceptions. Includes events recorded under Exception Events for each logical interface.</p> <ul style="list-style-type: none"> 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	<p>For Multilink Frame Relay end-to-end only. Information about buffering exceptions. Includes events recorded under Exception Events for each logical interface:</p> <ul style="list-style-type: none"> 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	<p>For Multilink Frame Relay end-to-end only. Information about assembly exceptions. Includes events recorded under Exception Events for each logical interface.</p> <p>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.</p>	detail extensive
Assembly exceptions (continued)	<ul style="list-style-type: none"> • 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	<p>For Multilink Frame Relay end-to-end only. Information about hardware errors:</p> <ul style="list-style-type: none"> • 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 <i>Common Output Fields Description</i> .	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: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • 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	<p>Information about bundle errors.</p> <ul style="list-style-type: none"> • 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	<p>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.</p> <ul style="list-style-type: none"> • 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 <i>Common Output Fields Description</i> .	detail extensive none
Addresses, Flags	Information about the address flags. Possible values are described in the “Addresses Flags” section under <i>Common Output Fields Description</i> .	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: 192.0.2.1, Local: 192.0.2.2, 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: 2001:db8::1:0/126, Local: 2001:db8::1:1,

```

```
Broadcast: Unspecified, Generation: 83
Addresses, Flags: Is-Preferred
Destination: 2001:db8::/64, Local: 2001:db8::2a0:a5ff:fe12:4777,
Broadcast: Unspecified,
Generation: 85
```


show interfaces (Link Services IQ)

Syntax	<pre>show interfaces lsq-<i>fpc/pic/port</i> <brief detail extensive terse> <descriptions> <l2-statistics> <media> <snmp-index <i>snmp-index</i>> <statistics></pre>
Release Information	<p>Command introduced before Junos OS Release 7.4.</p> <p>l2-statistics option introduced with Junos OS Release 12.1.</p>
Description	(M Series, MX Series, and T Series routers only) Display status information about the specified link services intelligent queuing (IQ) interface.
Options	<p>lsq-<i>fpc/pic/port</i>—Display standard status information about the specified link services IQ interface.</p> <p>brief detail extensive terse—(Optional) Display the specified level of output.</p> <p>descriptions—(Optional) Display interface description strings.</p> <p>l2-statistics—(Optional) Display Layer 2 queue statistics for Multilink Point-to-Point Protocol (MLPPP), FRF.15, and FRF.16 bundles.</p> <p>media—(Optional) Display media-specific information about network interfaces.</p> <p>snmp-index <i>snmp-index</i>—(Optional) Display information for the specified SNMP index of the interface.</p> <p>statistics—(Optional) Display static interface statistics.</p>
Additional Information	Link services IQ interfaces are similar to link services interfaces. The important difference is that link services IQ interfaces fully support Junos OS class-of-service (CoS) components.
Required Privilege Level	view
Related Documentation	<ul style="list-style-type: none"> • Link and Multilink Services Overview on page 17 • Multilink Interfaces on Channelized MICs Overview on page 21
List of Sample Output	<p>show interfaces extensive (MLPPP on Link Services IQ) on page 184</p> <p>show interfaces extensive (Multiclass MLPPP on Link Services IQ) on page 185</p> <p>show interfaces extensive (MLPPP on Link Services IQ Bundle) on page 187</p> <p>show interfaces extensive (MFR on Link Services IQ Bundle) on page 188</p>

[show interfaces extensive \(Multiclass MLPPP on Link Services IQ\) on page 190](#)

Output Fields [Table 9 on page 170](#) lists the output fields for the **show interfaces** (link services IQ) command. Output fields are listed in the approximate order in which they appear.

Table 9: show interfaces (Link Services IQ) 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 <i>Common Output Fields Description</i> .	All levels
Interface index	Physical interface 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 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 <i>Common Output Fields Description</i> .	All levels
Interface flags	Information about the interface. Possible values are described in the “Interface Flags” section under <i>Common Output Fields Description</i> .	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

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

Field Name	Field Description	Level of Output
Multilink Frame Relay UNI NNI bundle options	<p>(Multilink Frame Relay UNI NNI only) Configured information about Multilink Frame Relay bundle options.</p> <ul style="list-style-type: none"> • 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. • Bandwidth—Speed at which the interface is running. • 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: <i>Disable link transmit</i> or <i>Remove link from service</i>. • Link layer overhead—Percentage of bundle bandwidth to be set aside for link layer overhead. • 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 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. <ul style="list-style-type: none"> • 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

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

Field Name	Field Description	Level of Output
Multilink Frame Relay UNI NNI bundle options (continued)	<ul style="list-style-type: none"> • Bundle class—Bundle class ID. • LMI type—Multilink Frame Relay UNI NNI LMI type: ANSI, Q.933 ANNEX A, or Consortium. <ul style="list-style-type: none"> • 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 <i>N393</i>. 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. • Consortium LMI Settings <ul style="list-style-type: none"> • n391dte—DTE full status polling interval in seconds: 1 through 255. • n392dce—DCE error threshold: 1 through 10. • n392dte—DTE error threshold: 1 through 10. • n393dce—DCE monitored event count: 1 through 10. • n393dte—DTE monitored event count: 1 through 10. • t391dte—DTE polling verification timer (in seconds): 5 through 30. • t392dce—DCE polling verification timer (in seconds): 5 through 30. 	detail extensive none
LMI	<p>Local Management Interface packet statistics:</p> <ul style="list-style-type: none"> • Input—Number of packets arriving on the interface (nn) and timestamp of the most recent packet arrival, in the format: Input: nn (last seen hh:mm:ss ago) • Output—Number of packets sent out on the interface (nn) and how much time has passed since the last packet was sent, in the format: Output: nn (last seen hh:mm:ss ago) 	detail extensive none
DTE Statistics	<p>Statistics about information transferred from the data terminal equipment (DTE) to the data communications equipment (DCE).</p> <ul style="list-style-type: none"> • Enquiries sent—Number of link status enquiries sent from the DTE to the DCE. • Full enquiries sent—Number of full enquiries sent from the DTE to the DCE. • Enquiry responses received—Number of enquiry responses received by the DCE from the DTE. • Full enquiry responses received—Number of full enquiry responses received by DCE from the DTE. 	detail extensive none

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

Field Name	Field Description	Level of Output
DCE Statistics	<p>Statistics about information transferred from the DCE to the DTE.</p> <ul style="list-style-type: none"> • Enquiries received—Number of enquiries received by the DCE from the DTE. • Full enquiries received—Number of full enquiries received by the DCE from the DTE. • Enquiry responses sent—Number of enquiry responses sent from the DCE to the DTE. • Full enquiry responses sent—Number of full enquiry responses sent from the DCE to the DTE. 	detail extensive none
Common Statistics	<p>Statistics about messages sent between the DTE and the DCE.</p> <ul style="list-style-type: none"> • Unknown messages received—Number of received packets that do not fall into any other category. • Asynchronous updates received—Number of link status peer changes received. • Out-of-sequence packets received—Number of packets for which the sequence of the packets received is different from the expected sequence. • Keepalive responses timed out—Number of keepalive responses that time out when no Local Management Interface (LMI) packet was reported for n392dte or n393dce intervals. (See <i>LMI settings</i>.) 	
Traffic statistics	<p>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 Packet Forwarding Engine (PFE). Input traffic refers to the fragments received by the ingress PFE, which get assembled into Layer 3 input packets. Output packets refer to the IP packets transmitted out of the ingress PFE to the LSQ, which get segmented into output fragments.</p>	detail extensive
DLCInn	<p>Data-link connection identifier (DLCI) number of the logical interface. The following information is displayed.</p> <ul style="list-style-type: none"> • Flags—Values are: <ul style="list-style-type: none"> • Active—Set when the link is active and the DTE and DCE are exchanging information. • Down—Set when the link is active, but no information is received from the DTE. • DCE unconfigured—Set when the corresponding DLCI in the DCE is not configured. • Configured—Set when the corresponding DLCCI is configured. • DCE-Configured—Displayed when the command is issued from the DTE. 	
DLCI Statistics	<p>(Frame Relay) Data-link connection identifier (DLCI) statistics.</p> <ul style="list-style-type: none"> • Active DLCI—Number of active DLCIs. • Inactive DLCI—Number of inactive DLCIs. 	
Input rate	(Redundant LSQ) Rate of bits and packets received on the interface.	None specified
Output rate	(Redundant LSQ) Rate of bits and packets transmitted on the interface.	None specified

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

Field Name	Field Description	Level of Output
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	<p>Information about framing exceptions. Includes events recorded under Exception Events for each logical interface.</p> <ul style="list-style-type: none"> • 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. 	extensive
Buffering exceptions	<p>Information about buffering exceptions. Includes events recorded under Exception Events for each logical interface:</p> <ul style="list-style-type: none"> • Packet data buffer overflow—Packet buffer memory is 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 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 IQ capacity. Check the logical interface exception event counters to determine which bundle is responsible. 	extensive

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

Field Name	Field Description	Level of Output
Assembly exceptions	<p>(Multilink Frame Relay end-to-end only) Information about assembly exceptions. Includes events recorded under Exception Events for each logical interface.</p> <p>An assembly exception does not necessarily indicate an operational problem with the physical link services IQ interface itself. If multilink-encapsulated traffic is dropped or reordered after a sequence number has been assigned, the interface records one or more exception events. The physical interface can drop multilink-encapsulated fragments itself as a result. Any multilink packets or fragments dropped by the 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.</p> <ul style="list-style-type: none"> • 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 IQ 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 IQ 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 within a single link. This event indicates that an individual link within a bundle reordered traffic, making the link services IQ 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—Received a 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. Check the logical interface exception event counters to determine which bundle is responsible. 	extensive
Hardware errors (sticky)	<p>(Multilink Frame Relay end-to-end only) Information about hardware errors:</p> <ul style="list-style-type: none"> • 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
Egress queues	Total number of egress queues supported on the specified interface.	detail extensive none

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

Field Name	Field Description	Level of Output
Queue counters	Queue number and its associated user-configured forwarding class name. <ul style="list-style-type: none"> Queued packets—Number of queued packets. Transmitted packets—Number of transmitted packets. Dropped packets—Number of packets dropped by the ASIC's RED mechanism. 	detail extensive none
Logical Interface		
Logical interface	Name of the logical interface.	All levels
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 <i>Common Output Fields Description</i> .	All levels
Encapsulation	Encapsulation being used: PPP or Multilink PPP.	All levels
Bandwidth	Speed at which the interface is running.	All levels
Bundle options	(Multilink Frame Relay end-to-end interfaces only) <ul style="list-style-type: none"> MRRU—Configured size of the maximum received reconstructed unit (MRRU): 1500 through 4500 bytes. The default is 1504 bytes. Drop timer period—Drop timeout value to provide a recovery mechanism if individual links in link services bundle drop one or more packets: 0 through 2000 milliseconds. Values under 5 ms are not recommended. The default setting is 0, which disables the timer. Sequence number format—Short sequence number header format (MLPPP only). Fragmentation threshold—Configured fragmentation threshold: 64 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. Multilink classes—Number of multilink classes negotiated. Link layer overhead—Percentage of bundle bandwidth to be set aside for link-layer overhead. 	detail extensive none

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

Field Name	Field Description	Level of Output
Bundle status (MLPPP) or Multilink class status (Multiclass MLPPP)	Information about bundle status: <ul style="list-style-type: none"> • 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—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. • Missing sequence number—A gap was 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—Received a 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 is 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 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 IQ capacity. 	detail extensive none

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

Field Name	Field Description	Level of Output
Statistics	<p>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. Each field has columns that indicate the number of frames received and transmitted, frames per second (fps), the number of bytes received and transmitted, and bits per second (bps).</p> <ul style="list-style-type: none"> • Bundle—Information for each active bundle link. <ul style="list-style-type: none"> • Fragments: Input and Output—Total number and rate of fragments received and transmitted. • Packets: Input and Output—Total number and rate of packets received and transmitted. • Multilink class—(Multiclass MLPPP only) Information about multiclass links used in the multilink operation. • Link—Information about links used in the multilink operation. <ul style="list-style-type: none"> • Link name—Interface name of the link services IQ channel and state information (physical link up or down). • Input and Output—Total number and rate of fragments and packets received and transmitted. 	detail extensive
NCP state	<p>(PPP) Network Control Protocol state.</p> <ul style="list-style-type: none"> • Conf-ack-received—Acknowledgement was received. • Conf-ack-sent—Acknowledgement was sent. • Conf-req-sent—Request was sent. • Down—NCP negotiation is incomplete (not yet completed or has failed). • Not-configured—NCP is not configured on the interface. • Opened—NCP negotiation is successful. 	detail extensive none
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
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 <i>Common Output Fields Description</i> .	detail extensive none
Addresses, Flags	Information about the addresses configured on the logical interface. Possible values are described in the “Addresses Flags” section under <i>Common Output Fields Description</i> .	detail extensive none
Destination	IP address of the remote side of the connection.	detail extensive none

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

Field Name	Field Description	Level of Output
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
MLPPP Bundle Interface		
Logical interface	Name of the logical interface.	All levels
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 <i>Common Output Fields Description</i> .	All levels
SNMP-Traps	SNMP trap notifications are enabled.	All levels
Encapsulation	Encapsulation being used: PPP, Multilink PPP, or Multilink-FR.	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
Bandwidth	Speed at which the interface is running.	All levels
Bundle links information	Information about the bundled links. <ul style="list-style-type: none"> • Active bundle links—Number of active links. • Removed bundle links—Information about links used in the multilink operation. • Disabled bundle links—Number of disabled links. 	detail extensive none

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

Field Name	Field Description	Level of Output
Bundle options	<p>(Multilink Frame Relay end-to-end interfaces only)</p> <ul style="list-style-type: none"> • MRRU—Configured size of the maximum received reconstructed unit (MRRU): 1500 through 4500 bytes. The default is 1504 bytes. • Drop timer period—Drop timeout value to provide a recovery mechanism if individual links in link services bundle drop one or more packets: 0 through 2000 milliseconds. Values under 5 ms are not recommended. The default setting is 0, which disables the timer. • Inner PPP Protocol field compression—Inner PPP protocol compression is enabled or disabled. • Sequence number format—Short sequence number header format (MLPPP only). • Fragmentation threshold—Configured fragmentation threshold: 64 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. • Multilink classes—Number of multilink classes negotiated. • Link layer overhead—Percentage of bundle bandwidth to be set aside for link-layer overhead. 	detail extensive none

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

Field Name	Field Description	Level of Output
Bundle status (MLPPP)	<p>Information about bundle status:</p> <ul style="list-style-type: none"> • 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. • MRRU exceeded—Number of reassembled packets exceeding the MRRU. This counter is not implemented in this release. • 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. • Missing sequence number—A gap was detected in the sequence numbers of fragments on a bundle. • 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. • Out-of-range sequence number—A 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. • Packet data buffer overflow—Packet buffer memory is 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 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 IQ capacity. 	detail extensive none

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

Field Name	Field Description	Level of Output
Statistics	<p>Information about frames, bytes, and bits per second received and sent by the router. All references to traffic direction (input or output) are defined with respect to the router. Each field has columns that indicate the number of frames received and transmitted, frames per second (fps), the number of bytes received and transmitted, and bits per second (bps).</p> <p>The bundle, multilink, and network statistics are reported by the Packet Forwarding Engine (PFE). The Multi Link Detail statistics like fragments, non-fragments and LFI are reported by the PIC.</p> <p>However, the PFE reports an extra overhead of 2 bytes in the output when compared with the Multilink Detail Statistics. This is due to the service-cookie in the PFE which does the link demux for the ML header.</p> <p>The difference in the bytes received and transmitted from Network and Multilink interfaces and Multilink statistics for each member link is divided between the ML and the PPP headers. For example the header counter for a long sequence configuration would be as follows.</p> <ul style="list-style-type: none"> • Input side - Total overhead = 6 bytes. <ul style="list-style-type: none"> • ML: 4 bytes of ML header = 1 byte of Flag + 3 bytes of long sequence number. • PPP: 2 bytes of protocol field. • Output side - Total overhead = 11 bytes. <ul style="list-style-type: none"> • ML: 4 bytes of ML Header = 1 byte of Flag + 3 bytes of Long sequence number. • PPP: 5 bytes = 4 bytes of header + 1 byte of Idle flag. • 2 bytes of Service Cookie. • Bundle—Information for each active bundle link. <ul style="list-style-type: none"> • Multilink: Input and Output—Total number and rate of multilink frames, bytes, and bits per second received and transmitted. It is a module connecting LSQ PIC and its member link. Multilink Input displays L2 fragments received from the member link to the LSQ PIC. Multilink Output displays the L2 fragments transmitted from LSQ PIC to the member links. • Network: Input and Output—Total number of network frames, bytes, and bits per second received and transmitted. It refers to the packets transmitted from an ingress interface to the PFE and then to the LSQ PIC. Network Input displays the L3 packets received from the LSQ PIC to the PFE. Network Output displays the L3 packets transmitted from PFE to LSQ PIC. • Link—Information about links used in the multilink operation. <ul style="list-style-type: none"> • Link name—The interface name of the link services IQ channel and state information (physical link <i>up</i> or <i>down</i>) and up time. • Input and Output—Total number and rate of frames, bytes, and bits per second received and transmitted. 	extensive

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

Field Name	Field Description	Level of Output
Multilink detail statistics	<p>Frames, bytes, and bits per second received and sent by the bundle. All references to traffic direction (input or output) are defined with respect to the router. Each field has columns that indicate the number of frames received and transmitted, frames per second (fps), the number of bytes received and transmitted, and bits per second (bps).</p> <p>The difference in the bytes received and transmitted from the bundle is divided between the ML and the PPP headers. For example the header counter for a long sequence configuration would be as follows:</p> <ul style="list-style-type: none"> • Input side - Total overhead = 6 bytes. <ul style="list-style-type: none"> • ML: 4 bytes of ML header = 1 byte of Flag + 3 bytes of long sequence number. • PPP: 2 bytes of protocol field. • Output side - Total overhead = 9 bytes. <ul style="list-style-type: none"> • ML: 4 bytes of ML Header = 1 byte of Flag + 3 bytes of Long sequence number. • PPP: 5 bytes = 4 bytes of header + 1 byte of Idle flag. • Bundle—Information for the bundle link. <ul style="list-style-type: none"> • Fragments: Input and Output—Total number and rate of multilink fragments received and transmitted. • Non-fragments: Input and Output—Total number and rate of nonfragmented multilink frames received and transmitted. • LFI: Input and Output—Total number and rate of link fragmented and interleaved frames and bytes. 	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 <i>Adjusted</i> .	detail extensive none
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
Addresses, Flags	Information about the addresses configured on the logical interface. Possible values are described in the “Addresses Flags” section under <i>Common Output Fields Description</i> .	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 (MLPPP on Link Services IQ)

```

user@host> show interfaces lsq-0/2/0 extensive
Physical interface: lsq-0/2/0, Enabled, Physical link is Up
  Interface index: 140, SNMP ifIndex: 25, Generation: 23
  Link-level type: LinkService, MTU: 1504
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps
  Last flapped   : 2005-06-02 08:54:36 PDT (00:05:45 ago)
  Statistics last cleared: Never
  Traffic statistics:
    Input bytes   :          8872424          229080 bps
    Output bytes  :          9856960          234448 bps
    Input packets :          38202           117 pps
    Output packets:          39453           117 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
  Queue counters:

```

	Queued packets	Transmitted packets	Dropped packets
0 be	0	0	0
1 ef	0	0	0
2 af	0	0	0
3 nc	0	0	0

```

  Logical interface lsq-0/2/0.0 (Index 66) (SNMP ifIndex 26) (Generation 5)
  Flags: Point-To-Point SNMP-Traps Encapsulation: Multilink-PPP
  Bandwidth: 256kbps
  Bundle options:
    MRRU          1504
    Drop timer period 2000
    Sequence number format long (24 bits)
    Fragmentation threshold 0
    Links needed to sustain bundle 1
    Multilink classes 0
    Link layer overhead 4.0 %
  Bundle status:
    Remote MRRU          1500
    Received sequence number 0x0
    Transmit sequence number 0x0
    Packet drops          0 (0 bytes)

```



```

Fragment drops          9 (1401 bytes)
MRRU exceeded           0
Fragment timeout        0
Missing sequence number 0
Out-of-order sequence number 4
Out-of-range sequence number 0
Packet data buffer overflow 0
Fragment data buffer overflow 0
Statistics              Frames    fps      Bytes      bps
Bundle:
Multilink:
  Input :               79827      239      9593009     232288
  Output:              77533      234      9811743     238056
Network:
  Input :               38202      117      8872424     229080
  Output:              39453      117      9856960     234448
Link:
ds-1/0/2:1:1.0 <-- up
  Input :               1114         87      180183      113608
  Output:              1577        118      199215      119064
ds-1/0/2:1:2.0 <-- down
  Input :               1941        152      187948      118680
  Output:              1574        116      199494      118992
Protocol inet, MTU: 1500 [Adjusted]
Flags: User-MTU, MTU-Protocol-Adjusted
Addresses, Flags: Is-Preferred Is-Primary
Destination: 10.74.11/24, Local: 10.74.11.10
Protocol iso, MTU: 1500 [Adjusted]
Flags: User-MTU, MTU-Protocol-Adjusted
Protocol mpls, MTU: 1488 [Adjusted], Maximum labels: 3
Flags: User-MTU, MTU-Protocol-Adjusted

```

show interfaces extensive (Multiclass MLPPP on Link Services IQ)

```

user@host> show interfaces extensive lsq-0/2/0
Physical interface: lsq-0/2/0, Enabled, Physical link is Up
Interface index: 140, SNMP ifIndex: 25, Generation: 23
Link-level type: LinkService, MTU: 1504
Device flags   : Present Running
Interface flags: Point-To-Point SNMP-Traps
Last flapped   : 2005-06-02 08:54:36 PDT (00:02:25 ago)
Statistics last cleared: Never
Traffic statistics:
Input bytes :           3474024           223704 bps
Output bytes :          4193992           233888 bps
Input packets:           15809             116 pps
Output packets:          16788             117 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
Queue counters:      Queued packets  Transmitted packets      Dropped packets

  0 be                  0                0                0
  1 ef                  0                0                0
  2 af                  0                0                0
  3 nc                  0                0                0

Logical interface lsq-0/2/0.0 (Index 66) (SNMP ifIndex 26) (Generation 5)
Flags: Point-To-Point SNMP-Traps Encapsulation: Multilink-PPP
Bandwidth: 256kbps
Bundle options:
  MRRU                      1504
  Drop timer period         2000
  Sequence number format    long (24 bits)
  Fragmentation threshold   0
  Links needed to sustain bundle 1
  Multilink classes         2
  Link layer overhead       4.0 %
Multilink class 0 status:
  Received sequence number   0x4c38
  Transmit sequence number   0x4890
  Packet drops               0 (0 bytes)
  Fragment drops             2551 (397084 bytes)
  MRRU exceeded              0
  Fragment timeout           52
  Missing sequence number    0
  Out-of-order sequence number 953
  Out-of-range sequence number 0
  Packet data buffer overflow 0
  Fragment data buffer overflow 0
Multilink class 1 status:
  Received sequence number   0xffffffff
  Transmit sequence number   0x3710
  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
Statistics      Frames      fps      Bytes      bps
Bundle:
Fragments:
  Input :      33719      239      4041763      231632
  Output:      32371      234      4096545      237488
Packets:
  Input :      15809      116      3474024      223704
  Output:      16788      117      4193992      233888
Multilink class 0:
Fragments:
  Input :      19331      0        0        0
  Output:      0        0        0        0
Packets:

```

```

      Input :          2064          0          0          0
      Output:          1864          0          0          0
Multilink class 1:
  Fragments:
    Input :           0          0          0          0
    Output:         14096          0          0          0
  Packets:
    Input :         14096          0          0          0
    Output:           0          0          0          0
Link:
ds-1/0/2:1:1.0, Enabled, Physical link is Up
  Input :          20972          151          2030595          118080
  Output:          16184          116          2048468          118488
ds-1/0/2:1:2.0, Enabled, Physical link is Up
  Input :          12747           88          2011168          113552
  Output:          16187          118          2048077          119000
Protocol inet, MTU: 1500 [Adjusted], Generation: 14, Route table: 0
Flags: User-MTU, MTU-Protocol-Adjusted
Addresses, Flags: Is-Preferred Is-Primary
  Destination: 10.0.1.0/30, Local: 10.0.1.2, Broadcast: Unspecified,
  Generation: 18

```

show interfaces extensive (MLPPP on Link Services IQ Bundle)

```

user@host> show interfaces lsq-7/1/0.0 extensive
Logical interface lsq-7/1/0.0 (Index 88) (SNMP ifIndex 114) (Generation 188)
Flags: Point-To-Point SNMP-Traps 0x4000 Encapsulation: Multilink-FR
Last flapped: Never
Bandwidth: 256kbps
Bundle links information:
  Active bundle links      2
  Removed bundle links     0
  Disabled bundle links    0
Bundle options:
  MRRU                      1504
  Drop timer period         1500
  Inner PPP Protocol field compression enabled
  Sequence number format    short (12 bits)
  Fragmentation threshold   0
  Links needed to sustain bundle 1
  Multilink classes         0
  Link layer overhead       4.0 %
Bundle status:
  Received sequence number   0xb74
  Transmit sequence number   0xb74
  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
Statistics      Frames      fps      Bytes      bps
Bundle:
Multilink:
  Input :       315381        0    42757818        0
  Output:       315381        0    43388580        0
Network:
  Input :       315381        0    40952064        0

```

```

        Output:          315381          0      40952064          0
Link:
  ds-6/0/0:1:1.0
    Up time: Up since boot
    Input :             63794          0      25146728          0
    Output:             63778          0      25273164          0
  ds-6/0/0:1:2.0
    Up time: Up since boot
    Input :             251587          0      17611090          0
    Output:             251603          0      18115416          0
Multilink detail statistics:
Bundle:
  Fragments:
    Input :              0          0          0          0
    Output:              0          0          0          0
  Non-Fragments:
    Input :             293748          0      19387368          0
    Output:             293748          0      20562360          0
  LFI:
    Input :             21633          0      22152192          0
    Output:             21633          0      22325256          0
Protocol inet, MTU: 1500, Generation: 204, Route table: 0
Addresses, Flags: Is-Preferred Is-Primary
Destination: 10.0.1.0/30, Local: 10.0.1.2, Broadcast:
Unspecified, Generation: 214

```

show interfaces extensive (MFR on Link Services IQ Bundle)

```

user@host> show interfaces lsq-1/0/0:0 extensive
Physical interface: lsq-1/0/0:0, Enabled, Physical link is Up
Interface index: 179, SNMP ifIndex: 746, Generation: 182
Link-level type: Multilink-FR-UNI-NNI, MTU: 1508
Device flags   : Present Running
Interface flags: Point-To-Point SNMP-Traps Internal: 0x4000
Last flapped   : 2010-11-15 01:11:00 PST (00:31:58 ago)
Statistics last cleared: Never
Hold-times     : Up 0 ms, Down 0 ms
Multilink Frame Relay UNI NNI bundle options:
  Device type           DCE
  MRRU                  1508
  Bandwidth             1536kbps
  Fragmentation threshold 0
  Red differential delay limit 120
  Yellow differential delay limit 72
  Red differential delay action Remove link
  Reassembly drop timer  65535
  Links needed to sustain bundle 1
  Link layer overhead    4.0 %
  LIP Hello timer        10
    Acknowledgement timer 4
    Acknowledgement retries 2
  Bundle class           A
  LMI type               Consortium
    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
  Consortium LMI settings: n392dce 3, n393dce 4, t392dce 15 seconds
LMI statistics:

```

```

Input : 188 (last seen 00:00:01 ago)
Output: 189 (last sent 00:00:01 ago)
DTE statistics:
  Enquiries sent           : 0
  Full enquiries sent      : 0
  Enquiry responses received : 0
  Full enquiry responses received : 0
DCE statistics:
  Enquiries received       : 157
  Full enquiries received  : 31
  Enquiry responses sent   : 158
  Full enquiry responses sent : 31
Common statistics:
  Unknown messages received : 0
  Asynchronous updates received : 0
  Out-of-sequence packets received : 0
  Keepalive responses timedout : 0
Traffic statistics:
  Input bytes : 0 0 bps
  Output bytes : 0 0 bps
  Input packets: 0 0 pps
  Output packets: 0 0 pps
IPv6 transit 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

Multilink:
  Input : 0 0 0 0
  Output: 0 0 0 0
Network:
  Input : 0 0 0 0
  Output: 0 0 0 0
Multilink Frame Relay UNI NNI bundle links information:
  Active bundle links 1
  Removed bundle links 0
  Disabled bundle links 0
Multilink Frame Relay UNI NNI active bundle links statistics:
      Frames      fps      Bytes      bps

t1-7/0/0:1:3.0
Up time: 00:31:24
  Input : 0 0 0 0
  Output: 0 0 0 0
  Current differential delay 0.0 ms
  Recent high differential delay 0.0 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 0 189 0 0
Xmt: 2 1 0 189 0 0 0

```

Logical interface lsq-1/0/0:2.0 (Index 77) (SNMP ifIndex 751) (Generation 142)

```

Flags: Point-To-Point SNMP-Traps Encapsulation: Multilink-FR-UNI-NNI
Last flapped: 2010-11-15 01:11:40 PST (00:31:18 ago)
Bundle status:
  Received sequence number      0xffff
  Transmit sequence number      0x0
  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
Statistics      Frames      fps      Bytes      bps
Bundle:
Multilink:
  Input :          0          0          0          0
  Output:          0          0          0          0
Network:
  Input :          0          0          0          0
  Output:          0          0          0          0
Link:
  t1-7/0/0:1:3.0
  Up time: 00:31:24
  Input :          0          0          0          0
  Output:          0          0          0          0
Multilink detail statistics:
Bundle:
Fragments:
  Input :          0          0          0          0
  Output:          0          0          0          0
Non-fragments:
  Input :          0          0          0          0
  Output:          0          0          0          0
Protocol inet, MTU: 1500, Generation: 153, Route table: 0
Flags: Sendbcst-pkt-to-re
Addresses, Flags: Is-Preferred Is-Primary
Destination: 10.0.1.8/30, Local: 10.0.1.9, Broadcast: Unspecified,
Generation: 154
DLCI 12
Flags: Active
Total down time: 00:00:32 sec, Last down: 00:31:50 ago
Traffic statistics:
  Input bytes :          0
  Output bytes :          0
  Input packets:         0
  Output packets:        0
DLCI statistics:
  Active DLCI :1  Inactive DLCI :0

```

show interfaces extensive (Multiclass MLPPP on Link Services IQ)

```

user@host> show interfaces extensive lsq-0/2/0
Physical interface: lsq-0/2/0, Enabled, Physical link is Up
Interface index: 140, SNMP ifIndex: 25, Generation: 23
Link-level type: LinkService, MTU: 1504
Device flags : Present Running
Interface flags: Point-To-Point SNMP-Traps
Last flapped : 2005-06-02 08:54:36 PDT (00:02:25 ago)
Statistics last cleared: Never

```

```

Traffic statistics:
Input bytes :          3474024          223704 bps
Output bytes :          4193992          233888 bps
Input packets:           15809           116 pps
Output packets:          16788           117 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
Queue counters:      Queued packets  Transmitted packets  Dropped packets

  0 be                0                0                0
  1 ef                0                0                0
  2 af                0                0                0
  3 nc                0                0                0

Logical interface lsq-0/2/0.0 (Index 66) (SNMP ifIndex 26) (Generation 5)
Flags: Point-To-Point SNMP-Traps Encapsulation: Multilink-PPP
Bandwidth: 256kbps
Bundle options:
  MRRU              1504
  Drop timer period 2000
  Sequence number format long (24 bits)
  Fragmentation threshold 0
  Links needed to sustain bundle 1
  Multilink classes 2
  Link layer overhead 4.0 %
Multilink class 0 status:
  Received sequence number 0x4c38
  Transmit sequence number 0x4890
  Packet drops 0 (0 bytes)
  Fragment drops 2551 (397084 bytes)
  MRRU exceeded 0
  Fragment timeout 52
  Missing sequence number 0
  Out-of-order sequence number 953
  Out-of-range sequence number 0
  Packet data buffer overflow 0
  Fragment data buffer overflow 0
Multilink class 1 status:
  Received sequence number 0xffffffff
  Transmit sequence number 0x3710
  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
Statistics      Frames      fps      Bytes      bps
Bundle:
Fragments:
  Input :      33719      239      4041763      231632
  Output:      32371      234      4096545      237488
Packets:
  Input :      15809      116      3474024      223704
  Output:      16788      117      4193992      233888
Multilink class 0:
Fragments:
  Input :      19331      0      0      0
  Output:      0      0      0      0
Packets:
  Input :      2064      0      0      0
  Output:      1864      0      0      0
Multilink class 1:
Fragments:
  Input :      0      0      0      0
  Output:      14096      0      0      0
Packets:
  Input :      14096      0      0      0
  Output:      0      0      0      0
Link:
ds-1/0/2:1:1.0, Enabled, Physical link is Up
  Input :      20972      151      2030595      118080
  Output:      16184      116      2048468      118488
ds-1/0/2:1:2.0, Enabled, Physical link is Up
  Input :      12747      88      2011168      113552
  Output:      16187      118      2048077      119000
Protocol inet, MTU: 1500 [Adjusted], Generation: 14, Route table: 0
Flags: User-MTU, MTU-Protocol-Adjusted
Addresses, Flags: Is-Preferred Is-Primary
Destination: 10.0.1.0/30, Local: 10.0.1.2, Broadcast: Unspecified,
Generation: 18

```


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 199](#)

Output Fields [Table 10 on page 193](#) lists the output fields for the **show interfaces** (Multilink Services) command. Output fields are listed in the approximate order in which they appear.

Table 10: 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 <i>Common Output Fields Description</i> .	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

Table 10: Multilink 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
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 <i>Common Output Fields Description</i> .	All levels
Interface flags	Information about the interface. Possible values are described in the “Interface Flags” section under <i>Common Output Fields Description</i> .	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: <ul style="list-style-type: none"> • 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

Table 10: Multilink Services show interfaces Output Fields (*continued*)

Field Name	Field Description	Level of Output
Buffering exceptions	<p>Information about buffering exceptions. Includes events recorded under Exception Events for each logical interface:</p> <ul style="list-style-type: none"> • 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
Assembly exceptions	<p>Information about assembly exceptions. Includes events recorded under Exception Events for each logical interface.</p> <p>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.</p> <ul style="list-style-type: none"> • 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

Table 10: Multilink Services show interfaces Output Fields (*continued*)

Field Name	Field Description	Level of Output
Hardware errors	Information about hardware errors: <ul style="list-style-type: none"> • 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
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 <i>Common Output Fields Description</i> .	detail extensive none
Bundle options	Information about configured bundle options: <ul style="list-style-type: none"> • 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 10: Multilink Services show interfaces Output Fields (*continued*)

Field Name	Field Description	Level of Output
Bundle status (MLPPP) or Multilink class status (MC-MLPPP)	<p>Information about bundle status:</p> <ul style="list-style-type: none"> • 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 10: Multilink Services show interfaces Output Fields (*continued*)

Field Name	Field Description	Level of Output
Bundle errors	Information about bundle errors: <ul style="list-style-type: none"> • 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. <ul style="list-style-type: none"> • 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 <i>Common Output Fields Description</i> .	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 <i>Common Output Fields Description</i> .	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: 198.51.100.2, Local: 198.51.100.1, Broadcast: Unspecified,
Generation: 1090
Protocol iso, MTU: 1500 [Adjusted], Flags: Is-Primary,
Generation: 753 Route table: 0

```