Using Multilink PPP over Frame Relay

Last Updated: December 7, 2011

Multilink PPP is a method used to reduce latency and jitter for real-time traffic. This module contains conceptual information and configuration tasks for using Multilink PPP over Frame Relay.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for Using Multilink PPP over Frame Relay

Knowledge

- Be familiar with the concepts in the "Reducing Latency and Jitter for Real-Time Traffic Using Multilink PPP" module.

Enable Queuing Mechanism

- Multilink uses first-in first out (FIFO) queuing for queuing and interleaving packets. Other queuing mechanisms such as low latency queuing (LLQ), weighted fair queuing (WFQ), and class-based weighted fair queuing (CBWFQ) can be used. If you want to use one of these alternative mechanisms, enable it before configuring Multilink.

Enable FRTS

- Frame Relay Traffic Shaping (FRTS) must be enabled on the Frame Relay interface.

Restrictions for Using Multilink PPP over Frame Relay

Number of Links per Multilink Bundle

Only one link per multilink bundle is supported.

VoIP Support

Only Voice over IP (VoIP) is supported; Voice over Frame Relay (VoFR) is not supported.

QoS Configuration

Only one PVC is supported per virtual template.

To handle congestion, a shape policy in an MLP over Frame Relay should be configured via a map class and attached to the PVC.

Information About Using Multilink PPP over Frame Relay

Frame Relay Traffic Shaping and Multilink PPP over Frame Relay

Before using Multilink PPP over Frame Relay, FRTS must be enabled.

Note On the Cisco 7200 and lower series of routers, the **frame-relay traffic-shaping** command is used to enable FRTS. On the Cisco 7500 and higher series of routers, the Modular Quality of Service (QoS) Command-Line Interface (CLI) (MQC) is used to enable FRTS. For more information about MQC, see the "MQC and Multilink PPP over Frame Relay" section.

FRTS is a Cisco traffic shaping mechanism. A traffic shaping mechanism allows you to regulate (that is, "shape") the packet flow on a network. When you shape traffic, you control the speed of traffic leaving an interface. This way, you can match the flow of the traffic to the speed of the interface and avoid bottlenecks on the network.

Cisco has long provided support for forward explicit congestion notification (FECN) for DECnet and OSI, and backward explicit congestion notification (BECN) for Systems Network Architecture (SNA) traffic using Logical Link Control, type 2 (LLC2) encapsulation via RFC 1490 and discard eligible (DE) bit support. FRTS builds upon this existing Frame Relay support with additional capabilities that improve the scalability and performance of a Frame Relay network, increasing the density of virtual circuits (VCs) and improving response time.

FRTS can eliminate bottlenecks in Frame Relay networks that have high-speed connections at the central site and low-speed connections at branch sites. You can configure rate enforcement--a peak rate configured to limit outbound traffic--to limit the rate at which data is sent on the VC at the central site.

MQC and Multilink PPP over Frame Relay

Before using Multilink PPP over Frame Relay, a policy map must be created. (See the "Prerequisites" section.) Policy maps are created using the Modular Quality of Service (QoS) Command-Line Interface (CLI) (MQC).

Virtual Template Interfaces

A virtual template interface is logical interface configured with generic configuration information for a specific purpose or configuration common to specific users, plus router-dependent information. The template takes the form of a list of Cisco IOS interface commands that are applied to virtual access interfaces, as needed.

Multilink Group Interfaces

A multilink group interface is a collection of interfaces bundled together in the multilink PPP configuration. With a multilink group interface, you can bundle interfaces into logical multilink groups.

How to Configure Multilink PPP over Frame Relay

While the first two procedures are listed as optional, you must choose one or the other according to the Cisco router that you are using in your network.

- Configuring Multilink PPP over Frame Relay on a Virtual Template Interface, page 3
- Configuring Multilink PPP over Frame Relay on a Multilink Group Interface, page 6
- Associating the Virtual Template Interface with a Frame Relay PVC, page 9
- Verifying the Multilink PPP over Frame Relay Configuration, page 11

Configuring Multilink PPP over Frame Relay on a Virtual Template Interface

These steps apply if you are using the Cisco 7500 series router or the Cisco 7600 series router only. If you are using another series of Cisco router, do not complete these steps. Instead, advance to Configuring Multilink PPP over Frame Relay on a Multilink Group Interface, page 6.

Before proceeding with this task, you must create a policy map. The policy map contains the configuration parameters used to apply a specific QoS features such as distributed LLQ (dLLQ) to the network traffic. To create a policy map and configure the appropriate QoS feature, use the MQC. See the MQC and Multilink PPP over Frame Relay, page 3.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface virtual-template** *number*
4. **bandwidth** *kbps*
5. **ip address** *ip-address mask* [**secondary**]
6. **service-policy output** *policy-map-name*
7. **service-policy input** *policy-map-name*
8. **ppp multilink**
9. **ppp multilink fragment delay** *milliseconds* [*microseconds*]
10. **ppp multilink interleave**
11. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface virtual-template** *number* **Example:** `Router(config)# interface virtual-template 1`	Creates a virtual template and enters interface configuration mode. • Enter the virtual template number.
Step 4	**bandwidth** *kbps* **Example:** `Router(config-if)# bandwidth 32`	Sets the bandwidth value for an interface. • Enter the bandwidth value in kilobits per second. **Note** The bandwidth value for the interface should match the traffic speed of the PVC; for instance, if the VBR peak cell rate is 128 kbps, the *kbps* option in the **bandwidth** command should be entered as 128. Similarly, if the PVC is being shaped to 64 kbps, the *kbps* option should be entered as 64.

	Command or Action	Purpose
Step 5	**ip address** *ip-address mask* [**secondary**] **Example:** `Router(config-if)# ip address 10.10.100.1 255.255.255.0`	Sets a primary IP address for an interface. This command can also set the optional secondary IP address for an interface. • Enter the primary IP address (and, optionally, the secondary IP address).
Step 6	**service-policy output** *policy-map-name* **Example:** `Router(config-if)# service-policy output policy1`	Attaches the previously created QoS traffic policy (policy map). See the Configuring Multilink PPP over Frame Relay on a Virtual Template Interface, page 3. The policy map evaluates and applies QoS features for traffic *leaving* the interface. • Enter the policy map name.
Step 7	**service-policy input** *policy-map-name* **Example:** `Router(config-if)# service-policy input policy1`	Attaches the previously created QoS traffic policy (policy map). See the Configuring Multilink PPP over Frame Relay on a Virtual Template Interface, page 3. The policy map evaluates and applies QoS features for traffic *entering* the interface. • Enter the policy map name.
Step 8	**ppp multilink** **Example:** `Router(config-if)# ppp multilink`	Enables MLP on the interface.
Step 9	**ppp multilink fragment delay** *milliseconds* [*microseconds*] **Example:** `Router(config-if)# ppp multilink fragment delay 20`	Specifies a maximum size in units of time for packet fragments on a Multilink PPP (MLP) bundle. • Enter the maximum amount of time, in milliseconds. **Note** The fragment size can be configured using the following formula: fragment size = bandwidth x fragment-delay / 8
Step 10	**ppp multilink interleave** **Example:** `Router(config-if)# ppp multilink interleave`	Enables interleaving of packets among the fragments of larger packets on a multilink bundle.
Step 11	**end** **Example:** `Router(config-if)# end`	(Optional) Exits interface configuration mode.

Configuring Multilink PPP over Frame Relay on a Multilink Group Interface

If you are using the Cisco 7500 series router or the Cisco 7600 series router, do not complete these steps. Instead, complete the steps in Configuring Multilink PPP over Frame Relay on a Virtual Template Interface, page 3.

Before proceeding with this task, you must create a policy map. The policy map contains the configuration parameters used to apply a specific QoS features such as distributed LLQ (dLLQ) to the network traffic. To create a policy map and configure the appropriate QoS feature, use the MQC. See the MQC and Multilink PPP over Frame Relay, page 3.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface multilink** *multilink-bundle-number*
4. **ip address** *ip-address mask* [**secondary**]
5. **service-policy output** *policy-map-name*
6. **service-policy input** *policy-map-name*
7. **ppp multilink fragment delay** *milliseconds* [*microseconds*]
8. **ppp multilink interleave**
9. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface multilink** *multilink-bundle-number* **Example:** `Router(config)# interface multilink 1`	Creates a multilink bundle and enters interface configuration mode. • Enter the multilink bundle number.

	Command or Action	Purpose
Step 4	**ip address** *ip-address mask* [**secondary**] **Example:** `Router(config-if)# ip address 10.10.100.1 255.255.255.0`	Sets a primary IP address for an interface. This command can also set the optional secondary IP address for an interface. • Enter the primary IP address (and, optionally, the secondary IP address).
Step 5	**service-policy output** *policy-map-name* **Example:** `Router(config-if)# service-policy output policy1`	Attaches the previously created QoS traffic policy (policy map). See the Configuring Multilink PPP over Frame Relay on a Multilink Group Interface, page 6. The policy map evaluates and applies QoS features for traffic *leaving* the interface. • Enter the policy map name.
Step 6	**service-policy input** *policy-map-name* **Example:** `Router(config-if)# service-policy input policy1`	Attaches the previously created QoS traffic policy (policy map). See the Configuring Multilink PPP over Frame Relay on a Multilink Group Interface, page 6. The policy map evaluates and applies QoS features for traffic *entering* the interface. • Enter the policy map name.
Step 7	**ppp multilink fragment delay** *milliseconds* [*microseconds*] **Example:** `Router(config-if)# ppp multilink fragment delay 20`	Specifies a maximum size in units of time for packet fragments on a multilink bundle. • Enter the maximum amount of time, in milliseconds, required to transmit a fragment.
Step 8	**ppp multilink interleave** **Example:** `Router(config-if)# ppp multilink interleave`	Enables interleaving of packets among the fragments of larger packets on a multilink bundle.
Step 9	**end** **Example:** `Router(config-if)# end`	(Optional) Exits interface configuration mode.

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- Associating the Virtual Template Interface with the Multilink Group, page 8

What to Do Next

After configuring Multilink PPP over Frame Relay on a multilink group interface, the next step is to associate the virtual template interface with the multilink group by completing the steps in the following section.

If you are using a Cisco 7500 series router or a Cisco 7600 series router, advance to Associating the Virtual Template Interface with a Frame Relay PVC, page 9 to continue.

Associating the Virtual Template Interface with the Multilink Group

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface virtual-template** *number*
4. **no ip address**
5. **ppp multilink group** *group-number*
6. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface virtual-template** *number* **Example:** `Router# interface virtual-template 1`	Creates a virtual template interface that can be configured and applied dynamically in creating virtual access interfaces, and enters interface configuration mode. • Enter the number used to identify the virtual template interface.
Step 4	**no ip address** **Example:** `Router(config-if)# no ip address`	Removes an IP address or disables IP processing.

	Command or Action	Purpose
Step 5	**ppp multilink group** *group-number* **Example:** `Router(config-if)# ppp multilink group 1`	Restricts a physical link to joining only a designated multilink group interface. • Enter the multilink group number.
Step 6	**end** **Example:** `Router(config-if)# end`	(Optional) Exits interface configuration mode.

Associating the Virtual Template Interface with a Frame Relay PVC

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number* [**name-tag**]
4. **frame-relay traffic-shaping**
5. **frame-relay interface-dlci** *dlci* [**ietf** | **cisco**] [**voice-cir** *cir*] [**ppp** *virtual-template-name*]
6. **class** *name*
7. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 3	**interface** *type number* [**name-tag**] **Example:** `Router(config)# interface serial1/0/0/1:0`	Configures an interface type and enters interface configuration mode. • Enter the interface type and number.
Step 4	**frame-relay traffic-shaping** **Example:** `Router(config-if)# frame-relay traffic-shaping`	Enables both traffic shaping and per-virtual-circuit queueing for all permanent virtual circuits (PVCs) and switched virtual circuits (SVCs) on a Frame Relay interface. **Note** Use this command on Cisco 7200 and lower series routers *only* . Do not use this command on Cisco 7500 or higher series routers. For Cisco 7500 and higher series routers, use the MQC instead of this command.
Step 5	**frame-relay interface-dlci** *dlci* [**ietf** | **cisco**] [**voice-cir** *cir*] [**ppp** *virtual-template-name*] **Example:** `Router(config-if)# frame-relay interface-dlci 100 ppp virtual-template1`	Assigns a data-link connection identifier (DLCI) to a specified Frame Relay subinterface on the router or access server, assigns a specific PVC to a DLCI, or applies a virtual template configuration for a PPP session. Enters Frame Relay DLCI configuration mode. • Enter the DLCI number and any optional keywords and arguments, as appropriate.
Step 6	**class** *name* **Example:** `Router(config-fr-dlci)# class frdlci`	Associates a map class with a specified DLCI. • Enter the name of the map class to associate with the specified DLCI. **Note** Use this command on Cisco 7200 and lower series routers *only* . For Cisco 7500 and higher series routers, this command is not needed.
Step 7	**end** **Example:** `Router(config-fr-dlci)# end`	(Optional) Exits Frame Relay DLCI configuration mode.

Verifying the Multilink PPP over Frame Relay Configuration

SUMMARY STEPS

1. **enable**
2. **show frame-relay pvc** [**interface** *interface*] [**dlci**] [**64-bit**]
3. **show interfaces** [*type number*] [*first*] [*last*] [**accounting**]
4. **show ppp multilink** [**active** | **inactive** | **interface** *bundle-interface* | [**username** *name*] [**endpoint** *endpoint*]]
5. **show policy-map interface** *interface-name* [**vc** [*vpi/*] *vci*] [**dlci** *dlci*] [**input** | **output**]
6. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show frame-relay pvc** [**interface** *interface*] [**dlci**] [**64-bit**] **Example:** `Router# show frame-relay pvc`	(Optional) Displays statistics about permanent virtual circuits (PVCs) for Frame Relay interfaces.
Step 3	**show interfaces** [*type number*] [*first*] [*last*] [**accounting**] **Example:** `Router# show interfaces`	(Optional) Displays statistics for all interfaces configured on the router or access server.
Step 4	**show ppp multilink** [**active** | **inactive** | **interface** *bundle-interface* | [**username** *name*] [**endpoint** *endpoint*]] **Example:** `Router# show ppp multilink`	(Optional) Displays bundle information for multilink bundles.
Step 5	**show policy-map interface** *interface-name* [**vc** [*vpi/*] *vci*] [**dlci** *dlci*] [**input** | **output**] **Example:** `Router# show policy-map interface serial0/0`	(Optional) Displays the packet statistics of all classes that are configured for all service policies either on the specified interface or subinterface or on a specific PVC on the interface.

	Command or Action	Purpose
Step 6	**exit** **Example:** `Router# exit`	(Optional) Exits privileged EXEC mode.

Configuration Examples for Multilink PPP over Frame Relay

Example Configuring Multilink PPP over Frame Relay on a Virtual Template Interface

The following is an example of configuring Multilink PPP over Frame Relay on a virtual template interface:

```
Router> enable
Router# configure terminal
Router(config)# interface virtual-template 1
Router(config-if)# bandwidth 32
Router(config-if)# ip address 10.10.100.1 255.255.255.0
Router(config-if)# service-policy output policy1
Router(config-if)# service-policy input policy1
Router(config-if)# ppp multilink
Router(config-if)# ppp multilink fragment delay 20
Router(config-if)# ppp multilink interleave
Router(config-if)# end
```

Example Configuring Multilink PPP over Frame Relay on a Multilink Group Interface

The following is an example of configuring Multilink PPP over Frame Relay on a multilink group interface:

```
Router> enable
Router# configure terminal
Router(config)# interface multilink 1
Router(config-if)# ip address 10.10.100.1 255.255.255.0

Router(config-if)# service-policy output policy1
Router(config-if)# service-policy input policy1
Router(config-if)# ppp multilink fragment delay 20
Router(config-if)# ppp multilink interleave
Router(config-if)# end
```

Example Associating the Virtual Template Interface with the Multilink Group

The following is an example of associating the virtual template interface with the multilink group:

```
Router> enable
Router# configure terminal
Router(config)# interface virtual-template 1
Router(config-if)# no ip address
Router(config-if)# ppp multilink group 1
Router(config-if)# end
```

Example Associating the Virtual Template Interface with a Frame Relay PVC

The following is an example of associating the virtual template interface with a Frame Relay PVC:

```
Router> enable

Router# configure terminal

Router(config)# interface serial1/0/0/1:0

Router(config-if)# frame-relay interface-dlci 100 ppp virtual-template1

Router(config-fr-dlci)# class frdlci

Router(config-fr-dlci)# end
```

Example Verifying the Multilink PPP over Frame Relay Configuration

You can verify the Multilink with PPP over Frame Relay configuration by using one or more of the following **show** commands:

- **show frame relay pvc**
- **show interfaces**
- **show ppp multilink**
- **show policy-map interface**

The following section provides sample output of the **show ppp multilink** command only. For sample output of the other commands, see the appropriate Cisco IOS Release 12.3T command reference publication.

show ppp multilink Command Output Example

The following is an example of the **show ppp multilink** command output. In this example, one Multilink bundle called 7206-2 is on the system. This bundle has two member links: one active link and one inactive link.

```
Router# show ppp multilink

Multilink1, bundle name is 7206-2
  Endpoint discriminator is 7206-2
  Bundle up for 00:00:15, 1/255 load
  Receive buffer limit 12000 bytes, frag timeout 3428 ms
    0/0 fragments/bytes in reassembly list
    1 lost fragments, 1 reordered
    0/0 discarded fragments/bytes, 0 lost received
    0x3 received sequence, 0x3 sent sequence
  Member links:1 active, 1 inactive (max not set, min not set)
    Vi2, since 00:00:15, 105 weight, 93 frag size
    Vt1 (inactive)
```

Where to Go Next

To use Multilink PPP over ATM links, see the "Using Multilink PPP over ATM Links" module.

To use Multilink PPP over dialer interface links, see the "Using Multilink PPP over Dialer Interface Links" module.

To use Multilink PPP over serial interface links, see the "Using Multilink PPP over Serial Interface Links" module.

Additional References

The following sections provide references related to using Multilink PPP over Frame Relay.

Related Documents

Related Topic	Document Title
QoS commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples	*Cisco IOS Quality of Service Solutions Command Reference*
LLQ, WFQ, CBWFQ, PQ, CQ, FIFO and other queueing mechanisms	"Configuring Weighted Fair Queueing" module
MQC	"Applying QoS Features Using the MQC" module
FRTS	"MQC-Based Frame Relay Traffic Shaping" module
Multilink PPP configurations	"Configuring Media-Independent PPP and Multilink PPP" module
Virtual template interfaces	"Configuring Virtual Template Interfaces" module
Multilink PPP overview module	"Reducing Latency and Jitter for Real-Time Traffic Using Multilink PPP" module
Multilink PPP over ATM links (including ATM interfaces and ATM PVCs)	"Using Multilink PPP over ATM Links" module
Multilink PPP over dialer interface links	"Using Multilink PPP over Dialer Interface Links" module
Multilink PPP over serial interface links	"Using Multilink PPP over Serial Interface Links" module

Standards

Standard	Title
No new or modified standards are supported, and support for existing standards has not been modified.	--

MIBs

MIB	MIBs Link
No new or modified MIBs are supported, and support for existing MIBs has not been modified.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	Title
RFC 1990	*The PPP Multilink Protocol (MP)*
RFC 2686	*Multiclass Extension to Multilink PPP (MCML)*

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for Using Multilink PPP over Frame Relay

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 1 Feature Information for Using Multilink PPP over Frame Relay

Feature Name	Software Releases	Feature Configuration Information
Distributed Link Fragmentation and Interleaving for Frame Relay and ATM Interfaces on Cisco 7500 Series Routers	12.2(4)T	The Distributed Link Fragmentation and Interleaving (dLFI) for Frame Relay and ATM Interfaces on Cisco 7500 Series Routers feature extends link fragmentation and interleaving functionality to VIP-enabled Cisco 7500 series routers. This feature was extensively rewritten from the perspective of using Multilink PPP for link fragmentation and interleaving over Frame Relay.
Distributed Link Fragmentation and Interleaving Over Leased Lines	12.2(8)T	The Distributed Link Fragmentation and Interleaving over Leased Lines feature extends distributed link fragmentation and interleaving functionality to leased lines. This feature was extensively rewritten from the perspective of using Multilink PPP for link fragmentation and interleaving over Frame Relay.