ATM Multilink PPP Support on Multiple VCs

The ATM Multilink PPP Support on Multiple VCs feature facilitates traffic load balancing on high-speed virtual circuits (VCs) using multilink PPP (MLP) over Frame Relay and ATM. It also facilitates traffic load balancing by using MLP to combine packet datagrams on high-speed VCs as a means of transporting both the voice and data traffic more efficiently.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and 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 module.

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.

Restrictions for ATM Multilink PPP Support

The ATM Multilink PPP Support on Multiple VCs feature does not support the following commands and functionality. The configuration accepts these commands, but the commands have no effect:

- **ppp interleave**

- **ppp multilink fragment-delay**

The ATM Multilink PPP Support on Multiple VCs feature does not support the link fragmentation and interleaving (LFI) functionality.

Information About ATM Multilink PPP Support

ATM Multilink PPP Support Overview

Load balancing operates at Layer 2 or Layer 3 (the network layer) of the Open System Interconnection (OSI) reference model. Layer 3 load balancing is independent of any link-layer technologies. The ATM Multilink Point-to-Point Protocol (PPP) Support on Multiple VCs feature implements load balancing at Layer 2 and depends on having MLP enabled at the link layer.

The ATM MLP functionality keeps track of packet sequencing, and this functionality buffers any packets that arrive early. With this ability, ATM MLP preserves packet order across the entire bundle.

In addition to MLP, low latency queueing (LLQ) and class-based weighted fair queueing (CBWFQ) are used to prioritize and differentiate the voice and data packets. LLQ and CBWFQ help to ensure that the voice and data traffic receive the proper quality of service (QoS) treatment (such as the correct priority queue assignment) when the voice and data traffic are transmitted.

For more information about LLQ and CBWFQ, see the *Cisco IOS Quality of Service Solutions Configuration Guide.*

Benefits of ATM Multilink PPP Support

Facilitates More Efficient Traffic Load Balancing

The ATM Multilink PPP Support on Multiple VCs feature supports the transport of real-time (voice) and other (data) traffic on Frame Relay and ATM VCs.

How to Configure ATM Multilink PPP Support

Defining the Service Policy Using the MQC

Perform this task to define the service policy using the MQC. The MQC allows you to create class maps and define service policies. Service policies are used to create classes and set match criteria for classifying traffic.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map** *class-map-name* [**match-all**| **match-any**]
4. **match ip precedence** *ip-precedence-value* [*ip-precedence-value ip-precedence-value ip-precedence-value*]
5. **exit**
6. **policy-map** *policy-name*
7. **class-map** *class-map-name* [**match-all**| **match-any**
8. **bandwidth** {*bandwidth-kbps* | **percent** *percent*}
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	**class-map** *class-map-name* [**match-all**| **match-any**] **Example:** `Router(config)# class-map class1`	Specifies the name of the class map to be created and enters class-map configuration mode. If match-all or match-any value is not specified, traffic must match all the match criteria to be classified as part of the class map.
Step 4	**match ip precedence** *ip-precedence-value* [*ip-precedence-value ip-precedence-value ip-precedence-value*] **Example:** `Router(config-cmap)# match ip precedence 3 2 4`	Identifies IP precedence values as match criteria.
Step 5	**exit** **Example:** `Router(config-cmap)# exit`	Exits class-map configuration mode.

	Command or Action	Purpose
Step 6	**policy-map** *policy-name* **Example:** `Router(config)# policy-map policy1`	Specifies the name of the policy map to be created and enters policy-map configuration mode.
Step 7	**class-map** *class-map-name* [**match-all**| **match-any** **Example:** `Router(config-pmp)# class class2`	Classifies traffic based on the class map specified and enters policy-map class configuration mode.
Step 8	**bandwidth** {*bandwidth-kbps* | **percent** *percent*} **Example:** `Router (config-pmap-c)# bandwidth 45`	Specifies a minimum bandwidth guarantee to a traffic class in periods of congestion. • A minimum bandwidth guarantee can be specified in kbps or by a percentage of the overall available bandwidth.
Step 9	**end** **Example:** `Router(config-pmp)# end`	Exits class-map configuration mode.

Defining a Multilink MLP Bundle Interface

Perform this task to define a multilink MLP bundle interface. The purpose of a multilink bundle interface is to combine more than one permanent virtual circuit (PVC). All configurations for PPP over ATM links are placed into virtual templates, and the bundle parameters are placed into the multilink bundle.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **ip address** *ip-address mask* [**secondary**]
5. **load-interval** *seconds*
6. **no cdp enable**
7. **service-policy output** *policy-name*
8. **ppp multilink**
9. **ppp multilink fragment disable**
10. **ppp multilink group** *group-number*
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** *type number* **Example:** `Router(config)# interface multilink 34`	Configures an interface type and enters interface configuration mode.
Step 4	**ip address** *ip-address mask* [**secondary**] **Example:** `Router(config-if)# ip address 209.165.201.1 255.255.255.0`	Sets a primary or secondary IP address for an interface.
Step 5	**load-interval** *seconds* **Example:** `Router(config-if)# load-interval 60`	Changes the length of time for which data is used to compute load statistics.
Step 6	**no cdp enable** **Example:** `Router(config-if)# no cdp enable`	Disables Cisco Discovery Protocol (CDP) on an interface.
Step 7	**service-policy output** *policy-name* **Example:** `Router(config-if)# service-policy output policy1`	Attaches the specified policy map to the output interface.
Step 8	**ppp multilink** **Example:** `Router(config-if)# ppp multilink`	Enables MLP on an interface.

	Command or Action	Purpose
Step 9	**ppp multilink fragment disable** **Example:** `Router(config-if)# ppp multilink fragment disable`	Disables packet fragmentation.
Step 10	**ppp multilink group** *group-number* **Example:** `Router(config-if)# ppp multilink group 54`	Restricts a physical link to joining only a designated multilink-group interface.
Step 11	**end** **Example:** `Router(config-if)# end`	Exits interface configuration mode.

Defining the Virtual Templates for Member Links

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **no ip address**
5. **load-interval** *seconds*
6. **ppp multilink**
7. **ppp multilink group** *group-number*
8. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Device(config)# interface multilink 34`	Configures an interface type and enters interface configuration mode.
Step 4	**no ip address** **Example:** `Device(config-if)# no ip address`	Removes existing IP addresses or disables IP processing.
Step 5	**load-interval** *seconds* **Example:** `Device(config-if)# load-interval 30`	Changes the length of time for which data is used to compute load statistics.
Step 6	**ppp multilink** **Example:** `Device(config-if)# ppp multilink`	Enables MLP on the interface.
Step 7	**ppp multilink group** *group-number* **Example:** `Device(config-if)# ppp multilink-group 44`	Restricts a physical link to joining only a designated multilink-group interface.

Step 8	**end**
	
	Example:
	`Device(config-if)#`
	`end`
		Exits interface configuration mode.

Defining the PVCs and Bundling Member Links

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. Do one of the following:
   - **interface atm** *slot* **/0**
   -
   -
   - **interface atm** *slot* **/** *port*
4. **no ip address**
5. **load interval** *seconds*
6. **atm ilmi-keepalive** [*seconds* [*retry*[*seconds*]]]
7. **pvc** [*name*] *vpi*/*vci*
8. **vbr-nrt** *output-pcr output-scr* [*output-mbs*]
9. **tx-ring-limit** *ring-limit*
10. **protocol ppp virtual-template** *number*
11. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	Do one of the following: • **interface atm** *slot* **/0** • • • **interface atm** *slot* **/** *port*	Specifies the ATM interface type and enters interface configuration mode.

	Command or Action	Purpose

	Example:
	`Device(config)# interface atm 2/0`
	Example:
	`or`
	Example:
	`Device(config)# interface atm 2/1`	

Step 4	**no ip address** **Example:** `Device(config-if)# no ip address`	Removes an IP address or disables IP processing.
Step 5	**load interval** *seconds* **Example:** `Device(config-if)# load interval 30`	Changes the length of time for which data is used to compute load statistics.
Step 6	**atm ilmi-keepalive** [*seconds* [*retry*[*seconds*]]] **Example:** `Device(config-if)# atm ilmi-keepalive`	Enables Interim Local Management Interface (ILMI) keepalives.
Step 7	**pvc** [*name*] *vpi*/*vci* **Example:** `Device(config-if)# pvc pvc1 0/56`	Creates an ATM PVC. Enters interface-ATM-VC configuration mode.
Step 8	**vbr-nrt** *output-pcr output-scr* [*output-mbs*] **Example:** `Device(config-if-atm-vc)# vbr-nrt 45 4 45`	Configures the variable bit rate (VBR)-non real time (NRT) QoS and specifies output peak cell rate, output sustainable cell rate, and output maximum burst cell size.
Step 9	**tx-ring-limit** *ring-limit* **Example:** `Device(config-if-atm-vc)# tx-ring-limit 3`	Limits the number of particles or packets that can be used on a transmission ring on an interface. • Use this command to tune the transmission ring to assign most of the packets to the Layer 3 queues.

	Command or Action	Purpose
Step 10	**protocol ppp virtual-template** *number* **Example:** `Device(config-if-atm-vc)# protocol ppp virtual-template 34`	Specifies that PPP is established over the ATM PVC using the configuration from the specified virtual template and enters interface configuration mode.
Step 11	**end** **Example:** `Device(config-if)# end`	Exits interface configuration mode.

Verifying ATM Multilink PPP Support

Perform this task to display information about ATM Multilink PPP Support on Multiple VCs:

SUMMARY STEPS

1. **enable**
2. **show atm pvc**
3. **show frame-relay pvc** [[**interface** *interface*] [*dlci*] [**64-bit**] | **summary** [**all**]]
4. **show interfaces**
5. **show policy-map**
6. **show ppp multilink**
7. **show queueing**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show atm pvc** **Example:** `Device# show atm pvc`	Displays all ATM PVCs and traffic information.

	Command or Action	Purpose
Step 3	**show frame-relay pvc** [[**interface** *interface*] [*dlci*] [**64-bit**] | **summary** [**all**]] **Example:** `Device# show frame-relay pvc 16`	Displays statistics about PVCs for Frame Relay interfaces.
Step 4	**show interfaces** **Example:** `Device# show interfaces`	Displays interleaving statistics. • Interleaving data is displayed only if interleaving occurs.
Step 5	**show policy-map** **Example:** `Device# show policy-map`	Displays the configuration of all classes for a specified service policy map or all classes for all existing policy maps.
Step 6	**show ppp multilink** **Example:** `Device# show ppp multilink`	Displays bundle information for the MLP bundles and their PPP links in the Device.
Step 7	**show queueing** **Example:** `Device# show queueing`	Lists all or selected configured queueing strategies.

Monitoring ATM Multilink PPP Support

SUMMARY STEPS

1. **enable**
2. **debug atm errors**
3. **debug atm events**
4. **debug ppp error**
5. **debug ppp multilink events**
6. **debug voice rtp**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**debug atm errors** **Example:** `Device# debug atm errors`	Displays ATM errors.
Step 3	**debug atm events** **Example:** `Device# debug atm events`	Displays ATM events.
Step 4	**debug ppp error** **Example:** `Device# debug ppp error`	Displays information on traffic and exchanges in an internetwork implementing the PPP.
Step 5	**debug ppp multilink events** **Example:** `Device# debug ppp multilink events`	Displays information about events affecting multilink groups.
Step 6	**debug voice rtp** **Example:** `Device# debug voice RTP`	Displays information about the interleaving of voice and data packets. • The debug voice RTP command has memory overhead and should not be used when memory is scarce or when traffic is very high.

Configuration Examples for ATM Multilink PPP Support

Defining the Service Policy Using MQC Example

The following example shows how to configure a service policy using the MQC:

```
Device> enable
```

```
Device# configure terminal
Device(config)# class-map match-all DATA
Device(config-cmap)# match ip precedence 0
Device(config-cmap)# class-map match-all VOICE
Device(config-cmap)# match access-group 100
Device(config-cmap)# policy-map CISCO
Device(config-pmap)# class VOICE
Device(config-pmap-c)# priority percent 70
Device(config-pmap-c)# class DATA
Device(config-pmap-c)# bandwidth percent 5
Device(config-pmap-c)# access-list 100 permit udp any any precedence critical
```

Defining a Multilink MLP Bundle Interface Example

The following example shows how to define a multilink bundle for the mulitilink interface:

```
Device> enable
Device# configure terminal
Device(config)# interface Multilink1
Device(config-if)# ip address 10.2.1.1 255.0.0.0
Device(config-if)# load-interval 30
Device(config-if)# no cdp enable
Device(config-if)# service-policy output CISCO
Device(config-if)# ppp multilink fragment disable
Device(config-if)# ppp multilink group 1
```

Defining Virtual Templates for Member Links Example

The following example shows how to define virtual templates for member links:

```
Device> enable
Device# configure terminal
Device(config)# interface Virtual-Template1
Device(config-if)# no ip address
Device(config-if)# load-interval 30
Device(config-if)# ppp multilink
Device(config-if)# ppp multilink group 1
Device(config-if)# interface Virtual-Template2
Device(config-if)# no ip address
Device(config-if)# load-interval 30
Device(config-if)# ppp multilink
Device(config-if)# ppp multilink group 1
```

Defining PVCs and Bundling Member Links Example

The following example shows how to define and configure PVCs as bundle members:

```
Device> enable
Device# configure terminal
Device(config)# interface atm 6/0
Device(config-if)# no ip address
Device(config-if)# load-interval 30
Device(config-if)# atm ilmi-keepalive
Device(config-if)# pvc 0/34

Device(config-if-atm-vc)# vbr-nrt 1536 1536
Device(config-if-atm-vc)# tx-ring-limit 5
Device(config-if-atm-vc)# protocol ppp Virtual-Template1
Device(config-if-atm-vc)# pvc 0/35
```

```
Device(config-if-atm-vc)# vbr-nrt 800 800
Device(config-if-atm-vc)# tx-ring-limit 3
Device(config-if-atm-vc)# protocol ppp Virtual-Template2
Device(config-if-atm-vc)# pvc 0/36
Device(config-if-atm-vc)# vbr-nrt 800 400 94
Device(config-if-atm-vc)# tx-ring-limit 5
Device(config-if-atm-vc)# protocol ppp Virtual-Template1
Device(config-if-atm-vc)# pvc 0/37
Device(config-if-atm-vc)# vbr-nrt 800 800
Device(config-if-atm-vc)# tx-ring-limit 3
Device(config-if-atm-vc)# protocol ppp Virtual-Template2
Device(config-if-atm-vc)# end
```

Additional References for ATM Multilink PPP Support on Multiple VCs

The following sections provide references related to the ATM Multilink PPP Support on Multiple VCs feature.

Related Documents

Related Topic	Document Title
QoS configuration tasks	*Cisco IOS Quality of Service Solutions Configuration Guide*
QoS commands: complete command syntax, defaults, command mode, command history, usage guidelines, and examples	*Cisco IOS Quality of Service Solutions Command Reference*
WAN configuration tasks	*Cisco IOS Wide-Area Networking Configuration Guide*
WAN commands: complete command syntax, defaults, command mode, command history, usage guidelines, and examples	*Cisco IOS Wide-Area Networking Command Reference*
Cisco IOS commands	Cisco IOS Master Commands List, All Releases

MIBs

MIB	MIBs Link
None	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)*

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for ATM Multilink PPP Support

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 ATM Multilink PPP Support on Multiple VCs

Feature Name	Releases	Feature Information
ATM Multilink PPP Support on Multiple VCs	12.2(28)SB 12.2(13)T 12.2(33)SRE Cisco IOS Release XE 3.14S	The ATM Multilink PPP Support on Multiple VCs feature facilitates traffic load balancing on high-speed virtual circuits, using MLP over Frame Relay and ATM. It facilitates traffic load balancing by using MLP to combine packet datagrams on high-speed VCs, as a means for transporting both the voice and data traffic more efficiently. In Cisco IOS Release XE 3.14S, support for the ATM Multilink PPP Support on Multiple VCs feature was added on the 4451-X Integrated Services Router.

Glossary

LFI --link fragmentation and interleaving. Method of fragmenting large packets and then queueing the fragments between small packets.

MLP --multilink PPP.

QoS --quality of service.

VC --virtual circuit.