



# ATM Multilink PPP Support on Multiple VCs

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**Last Updated: May 22, 2012**

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.

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## 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](http://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`



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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, page 2](#)
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### 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, page 2](#)
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### 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
<b>Step 1</b> <b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b> <b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b> <b>class-map</b> <i>class-map-name</i> [ <b>match-all</b>   <b>match-any</b> ]  <b>Example:</b> 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.
<b>Step 4</b> <b>match ip precedence</b> <i>ip-precedence-value</i> [ <i>ip-precedence-value ip-precedence-value ip-precedence-value</i> ]  <b>Example:</b> Router(config-cmap)# match ip precedence 3 2 4	Identifies IP precedence values as match criteria.

Command or Action	Purpose
<b>Step 5</b> <code>exit</code>  <b>Example:</b> <pre>Router(config-cmap)# exit</pre>	Exits class-map configuration mode.
<b>Step 6</b> <code>policy-map <i>policy-name</i></code>  <b>Example:</b> <pre>Router(config)# policy-map policy1</pre>	Specifies the name of the policy map to be created and enters policy-map configuration mode.
<b>Step 7</b> <code>class-map <i>class-map-name</i> [match-all  match-any]</code>  <b>Example:</b> <pre>Router(config-ppp)# class class2</pre>	Classifies traffic based on the class map specified and enters policy-map class configuration mode.
<b>Step 8</b> <code>bandwidth {<i>bandwidth-kbps</i>   percent <i>percent</i>}</code>  <b>Example:</b> <pre>Router (config-pmap-c)# bandwidth 45</pre>	Specifies a minimum bandwidth guarantee to a traffic class in periods of congestion. <ul style="list-style-type: none"> <li>• A minimum bandwidth guarantee can be specified in kbps or by a percentage of the overall available bandwidth.</li> </ul>
<b>Step 9</b> <code>end</code>  <b>Example:</b> <pre>Router(config-ppp)# end</pre>	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**

	<b>Command or Action</b>	<b>Purpose</b>
<b>Step 1</b>	<p><b>enable</b></p> <p><b>Example:</b></p> <pre>Router&gt; enable</pre>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<p><b>configure terminal</b></p> <p><b>Example:</b></p> <pre>Router# configure terminal</pre>	<p>Enters global configuration mode.</p>
<b>Step 3</b>	<p><b>interface</b> <i>type number</i></p> <p><b>Example:</b></p> <pre>Router(config)# interface multilink 34</pre>	<p>Configures an interface type and enters interface configuration mode.</p>
<b>Step 4</b>	<p><b>ip address</b> <i>ip-address mask</i> [<b>secondary</b>]</p> <p><b>Example:</b></p> <pre>Router(config-if)# ip address 209.165.201.1 255.255.255.0</pre>	<p>Sets a primary or secondary IP address for an interface.</p>

Command or Action	Purpose
<p><b>Step 5</b> <code>load-interval <i>seconds</i></code></p> <p><b>Example:</b></p> <pre>Router(config-if)# load-interval 60</pre>	<p>Changes the length of time for which data is used to compute load statistics.</p>
<p><b>Step 6</b> <code>no cdp enable</code></p> <p><b>Example:</b></p> <pre>Router(config-if)# no cdp enable</pre>	<p>Disables Cisco Discovery Protocol (CDP) on an interface.</p>
<p><b>Step 7</b> <code>service-policy output <i>policy-name</i></code></p> <p><b>Example:</b></p> <pre>Router(config-if)# service-policy output policy1</pre>	<p>Attaches the specified policy map to the output interface.</p>
<p><b>Step 8</b> <code>ppp multilink</code></p> <p><b>Example:</b></p> <pre>Router(config-if)# ppp multilink</pre>	<p>Enables MLP on an interface.</p>
<p><b>Step 9</b> <code>ppp multilink fragment disable</code></p> <p><b>Example:</b></p> <pre>Router(config-if)# ppp multilink fragment disable</pre>	<p>Disables packet fragmentation.</p>
<p><b>Step 10</b> <code>ppp multilink group <i>group-number</i></code></p> <p><b>Example:</b></p> <pre>Router(config-if)# ppp multilink group 54</pre>	<p>Restricts a physical link to joining only a designated multilink-group interface.</p>
<p><b>Step 11</b> <code>end</code></p> <p><b>Example:</b></p> <pre>Router(config-if)# end</pre>	<p>Exits interface configuration mode.</p>

## 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	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
Step 3	<b>interface</b> <i>type number</i>  <b>Example:</b> Router(config)# interface multilink 34	Configures an interface type and enters interface configuration mode.
Step 4	<b>no ip address</b>  <b>Example:</b> Router(config-if)# no ip address	Removes existing IP addresses or disables IP processing.
Step 5	<b>load-interval</b> <i>seconds</i>  <b>Example:</b> Router(config-if)# load-interval 30	Changes the length of time for which data is used to compute load statistics.

Command or Action	Purpose
<b>Step 6</b> <code>ppp multilink</code>  <b>Example:</b> <pre>Router(config-if)# ppp multilink</pre>	Enables MLP on the interface.
<b>Step 7</b> <code>ppp multilink group group-number</code>  <b>Example:</b> <pre>Router(config-if)# ppp multilink-group 44</pre>	Restricts a physical link to joining only a designated multilink-group interface.
<b>Step 8</b> <code>end</code>  <b>Example:</b> <pre>Router(config-if)# end</pre>	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
<b>Step 1</b>	<p><b>enable</b></p> <p><b>Example:</b></p> <pre>Router&gt; enable</pre>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<p><b>configure terminal</b></p> <p><b>Example:</b></p> <pre>Router# configure terminal</pre>	<p>Enters global configuration mode.</p>
<b>Step 3</b>	<p>Do one of the following:</p> <ul style="list-style-type: none"> <li><b>interface atm slot /0</b></li> <li>.</li> <li>.</li> <li><b>interface atm slot / port</b></li> </ul> <p><b>Example:</b></p> <pre>Router(config)# interface atm 2/0</pre> <p><b>Example:</b></p> <p>or</p> <p><b>Example:</b></p> <pre>Router(config)# interface atm 2/1</pre>	<p>Specifies the ATM interface type and enters interface configuration mode.</p>
<b>Step 4</b>	<p><b>no ip address</b></p> <p><b>Example:</b></p> <pre>Router(config-if)# no ip address</pre>	<p>Removes an IP address or disables IP processing.</p>
<b>Step 5</b>	<p><b>load interval seconds</b></p> <p><b>Example:</b></p> <pre>Router(config-if)# load interval 30</pre>	<p>Changes the length of time for which data is used to compute load statistics.</p>

	Command or Action	Purpose
<b>Step 6</b>	<b>atm ilmi-keepalive</b> [ <i>seconds</i> [ <i>retry</i> [ <i>seconds</i> ]]]  <b>Example:</b> Router(config-if)# atm ilmi-keepalive	Enables Interim Local Management Interface (ILMI) keepalives.
<b>Step 7</b>	<b>pvc</b> [ <i>name</i> ] <i>vpi/vci</i>  <b>Example:</b> Router(config-if)# pvc pvc1 0/56	Creates an ATM PVC. Enters interface-ATM-VC configuration mode.
<b>Step 8</b>	<b>vbr-nrt</b> <i>output-pcr output-scr</i> [ <i>output-mbs</i> ]  <b>Example:</b> Router(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.
<b>Step 9</b>	<b>tx-ring-limit</b> <i>ring-limit</i>  <b>Example:</b> Router(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. <ul style="list-style-type: none"> <li>Use this command to tune the transmission ring to assign most of the packets to the Layer 3 queues.</li> </ul>
<b>Step 10</b>	<b>protocol ppp virtual-template</b> <i>number</i>  <b>Example:</b> Router(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.
<b>Step 11</b>	<b>end</b>  <b>Example:</b> Router(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*] [*dldi*] [**64-bit**] | **summary** [**all**]]
4. **show interfaces**
5. **show policy-map**
6. **show ppp multilink**
7. **show queueing**

**DETAILED STEPS**

Command or Action	Purpose
<p><b>Step 1</b> <b>enable</b></p> <p><b>Example:</b></p> <pre>Router&gt; enable</pre>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<p><b>Step 2</b> <b>show atm pvc</b></p> <p><b>Example:</b></p> <pre>Router# show atm pvc</pre>	<p>Displays all ATM PVCs and traffic information.</p>
<p><b>Step 3</b> <b>show frame-relay pvc</b> [[<i>interface interface</i>] [<i>dldi</i>] [<b>64-bit</b>]   <b>summary</b> [<b>all</b>]]</p> <p><b>Example:</b></p> <pre>Router# show frame-relay pvc 16</pre>	<p>Displays statistics about PVCs for Frame Relay interfaces.</p>
<p><b>Step 4</b> <b>show interfaces</b></p> <p><b>Example:</b></p> <pre>Router# show interfaces</pre>	<p>Displays interleaving statistics.</p> <ul style="list-style-type: none"> <li>• Interleaving data is displayed only if interleaving occurs.</li> </ul>
<p><b>Step 5</b> <b>show policy-map</b></p> <p><b>Example:</b></p> <pre>Router# show policy-map</pre>	<p>Displays the configuration of all classes for a specified service policy map or all classes for all existing policy maps.</p>

Command or Action	Purpose
<b>Step 6</b> <code>show ppp multilink</code>  <b>Example:</b> <pre>Router# show ppp multilink</pre>	Displays bundle information for the MLP bundles and their PPP links in the router.
<b>Step 7</b> <code>show queueing</code>  <b>Example:</b> <pre>Router# show queueing</pre>	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
<b>Step 1</b> <code>enable</code>  <b>Example:</b> <pre>Router&gt; enable</pre>	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b> <code>debug atm errors</code>  <b>Example:</b> <pre>Router# debug atm errors</pre>	Displays ATM errors.

Command or Action	Purpose
<b>Step 3</b> <b>debug atm events</b>  <b>Example:</b> Router# debug atm events	Displays ATM events.
<b>Step 4</b> <b>debug ppp error</b>  <b>Example:</b> Router# debug ppp error	Displays information on traffic and exchanges in an internetwork implementing the PPP.
<b>Step 5</b> <b>debug ppp multilink events</b>  <b>Example:</b> Router# debug ppp multilink events	Displays information about events affecting multilink groups.
<b>Step 6</b> <b>debug voice rtp</b>  <b>Example:</b> Router# debug voice RTP	Displays information about the interleaving of voice and data packets. <ul style="list-style-type: none"> <li>The debug voice RTP command has memory overhead and should not be used when memory is scarce or when traffic is very high.</li> </ul>

## Configuration Examples for ATM Multilink PPP Support

- [Defining the Service Policy Using MQC Example, page 13](#)
- [Defining a Multilink MLP Bundle Interface Example, page 14](#)
- [Defining Virtual Templates for Member Links Example, page 14](#)
- [Defining PVCs and Bundling Member Links Example, page 14](#)

### Defining the Service Policy Using MQC Example

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

```

Router> enable
Router# configure terminal
Router(config)# class-map match-all DATA
Router(config-cmap)# match ip precedence 0
Router(config-cmap)# class-map match-all VOICE
Router(config-cmap)# match access-group 100
Router(config-cmap)# policy-map CISCO
Router(config-pmap)# class VOICE
Router(config-pmap-c)# priority percent 70
Router(config-pmap-c)# class DATA
Router(config-pmap-c)# bandwidth percent 5
Router(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 multilink interface:

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

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

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

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

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

## Additional References

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	<i>Cisco IOS Quality of Service Solutions Configuration Guide</i>
QoS commands: complete command syntax, defaults, command mode, command history, usage guidelines, and examples	<i>Cisco IOS Quality of Service Solutions Command Reference</i>
WAN configuration tasks	<i>Cisco IOS Wide-Area Networking Configuration Guide</i>
WAN commands: complete command syntax, defaults, command mode, command history, usage guidelines, and examples	<i>Cisco IOS Wide-Area Networking Command Reference</i>
Cisco IOS commands	<a href="#">Cisco IOS Master Commands List, All Releases</a>

### Standards

Standard	Title
None	--

### 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: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>

### RFCs

RFC	Title
RFC 1990	<i>The PPP Multilink Protocol (MP)</i>

**Technical Assistance**

Description	Link
<p>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</p> <p>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.</p> <p>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</p>	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

## 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](http://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	<p>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.</p>

## Glossary

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

**MLP** --multilink PPP.



**QoS** --quality of service.

**VC** --virtual circuit.

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