Multiclass Multilink PPP

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This document describes the multiclass multilink PPP feature on the Cisco 10000 series router. This feature provides the ability to fragment packets of various priorities into multiple classes, allowing high-priority packets to be sent between fragments of lower priorities.

Finding Feature Information in This Module

Your Cisco IOS software release may not support all of the features documented in this module. To reach links to specific feature documentation in this module and to see a list of the releases in which each feature is supported, use the "Feature Information for Multiclass Multilink PPP" section on page 20.

Finding Support Information for Platforms and Cisco IOS Software Images

Use Cisco Feature Navigator to find information about platform support and Cisco IOS software image support. Access Cisco Feature Navigator at http://www.cisco.com/go/fn. You must have an account on Cisco.com. If you do not have an account or have forgotten your username or password, click **Cancel** at the login dialog box and follow the instructions that appear.

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Prerequisites for Multiclass Multilink PPP

- The multilink interface must be configured with PPP encapsulation enabled.
- Link Fragmentation and Interleaving (LFI) must be configured on the bundle. Refer to the "Configuring Multiclass Multilink PPP LFI on a Bundle" section on page 3.

Restrictions for Multiclass Multilink PPP

- This feature is only supported on serial interfaces with PPP encapsulation in a multilink PPP (MLPPP) bundle.
- Multiclass multilink PPP is not supported on ATM virtual circuits (VCs) in a Multilink PPP over ATM (MLPoA) bundle, Link Fragmentation and Interleaving over ATM (LFIoA) bundle, or Multilink PPP over Frame Relay (MLPoFR) encapsulated serial interfaces.
- The Prefix Elision and Short Sequence Numbers options in RFC 2686 are not supported.

Information About the Multiclass Multilink PPP Feature

Multiclass multilink PPP provides the ability to fragment packets of various priorities into multiple classes, allowing high-priority packets to be sent between fragments of lower priorities. In multiclass multilink PPP, outgoing packets can be divided into four different multilink classes. Each class has its own governing sequence number, and the receiving network peer (bundle) sorts and processes each class independently. Sequence numbers are embedded in the multilink header and used internally to reassemble packets.

Multiclass multilink PPP must be successfully negotiated with the peer system. If multiclass multilink PPP cannot be negotiated with the peer system, the router uses standard interleaving, Priority queue traffic is always PPP encapsulated when interleaving with non-priority traffic.

Scalability

The Cisco 10000 series router supports a maximum of 1996 multilink classes and 1250 multilink bundles, with up to four classes in each bundle. Table 1 lists the number of bundles that are supported system-wide based on the number of multilink classes in a bundle.

Table 1 Maximum Multiclass Multilink PPP Bundles

Number of Multiclass Multilink PPP Classes Per Bundle	Maximum Number of Multiclass Multilink PPP Bundles
1	1250
2	998
3	665
4	499

How to Configure Multiclass Multilink PPP

This section includes the following multiclass multilink PPP procedures:

Multiclass Multilink PPP Configuration Guidelines

- The **ppp multilink multiclass** command must be configured on each link that is a member of the bundle, or on the multilink interface itself when multilink groups are used. Failure to configure this command may result in the peer refusing to allow mismatched links to join the bundle. The first link to join the bundle determines whether multiclass multilink PPP is in effect for the bundle. Each subsequent link must negotiate the same multiclass multilink PPP parameters to join the bundle.
- A maximum of four multilink classes is allowed in each multiclass multilink PPP bundle.
- The number of transmit classes negotiated with the peer must be greater than the highest encapsulation sequence class number configured in the outbound service policy. The service policy is rejected if the number of transmit classes is too small.
- The fragment size is computed at the interface multilink level when the first link is added to the bundle, and it applies to all links and classes.
- The configuration for each link in a bundle must be identical.
- A bundle configuration must be applied prior to the start of the PPP Link Control Protocol (LCP). You can apply this configuration on a multilink interface and then add all links to a multilink group.
- The default sequence number for class-default is 0 and it is not configurable.

Configuring Multiclass Multilink PPP LFI on a Bundle

Use the following procedure to configure multiclass multilink PPP LFI on a bundle.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface multilink** *multilink-bundle-number*
4. **ip address** *ip_address mask*
5. **ppp multilink**
6. **ppp multilink interleave**
7. **ppp multilink fragment delay** *milliseconds* [*microseconds*]
8. **ppp timeout multilink lost-fragment** *seconds* [*milliseconds*]
9. **ppp multilink multiclass local** {**request** [**initial** *init-value*] [**maximum** *max-value*] | **allow** [**maximum** *max-value*] | **forbid**}

10. **ppp multilink multiclass remote** {**apply** [**minimum** *min-value*] | **reject** | **ignore**}
11. **no cdp enable**
12. **exit**

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. • *multilink-bundle-number*—Number of the multilink bundle (a nonzero number).
Step 4	**ip address** *ip_address mask* **Example:** `Router(config-if)# ip address 10.0.0.161 255.255.255.240`	Assigns an IP address and subnet mask to the bundle.
Step 5	**ppp multilink** **Example:** `Router(config-if)# ppp multilink`	Enables multilink PPP on an interface.
Step 6	**ppp multilink interleave** **Example:** `Router(config-if)# ppp multilink interleave`	Enables interleaving of packets among the fragments of larger packets on a multiclass multilink PPP bundle.
Step 7	**ppp multilink fragment delay** *milliseconds* [*microseconds*] **Example:** `Router(config-if)# ppp multilink fragment delay 0 500`	(Optional) Specifies a maximum time for the transmission of a packet fragment on a multiclass multilink PPP bundle. • *milliseconds*—Valid range is from 0 to 1000 milliseconds. The default is 30 milliseconds. • *microseconds*—Valid range is from 0 to 999 microseconds. The default is 0 milliseconds.

	Command or Action	Purpose
Step 8	**ppp timeout multilink lost-fragment** *seconds* [*milliseconds*] **Example:** `Router(config-if)# ppp timeout multilink lost-fragment 0 100`	(Optional) Sets a timer that determines how long multilink PPP waits for an expected fragment to arrive before declaring it lost. The default value is calculated on the bundle's current reassembly buffer limit. • *seconds*—Wait period in the range from 1 to 255 seconds. • *milliseconds*—Wait period in the range from 1 to 999 milliseconds. **Note** If the delay is in *milliseconds*, set the *seconds* argument to **0** and enter a value for the *milliseconds* argument.
Step 9	**ppp multilink multiclass local** {**request** [**initial** *init-value*] [**maximum** *max-value*] | **allow** [**maximum** *max-value*] | **forbid**} **Example:** `Router(config-if)# ppp multilink multiclass local request maximum 4`	Configures the multilink header format option when negotiating class of service with a peer. • **request**—Signals the Link Control Protocol (LCP) to request the multilink header format option when the interface is negotiating with the peer. • **initial** *init-value*—(Optional) The initial number of multilink classes the multilink is initially prepared to accept in the receive path. The range is 1 to 4. • **maximum** *max-value*—(Optional) The maximum number of classes that can be requested and the multilink supports in the receive path. The range is 1 to 4. • **allow**—Causes the LCP to initially omit the multilink header format option when negotiating with the peer but requests the option in subsequent requests if the peer includes it in a Configure-Nak message. • **forbid**—Causes the LCP to omit the multilink header format option when negotiating with the peer.

	Command or Action	Purpose
Step 10	**ppp multilink multiclass remote** {**apply** [**minimum** *min-value*] | **reject** | **ignore**} **Example:** `Router(config-if)# ppp multilink multiclass remote apply minimum 4`	Configures the multilink header format option when a peer requests class of service. • **apply**—Causes the multilink: – To negotiate the multilink header format option if the peer requests it and attempts to induce the peer to request the option by including it in a Configure-Nak message if it does not. – To use multiple multilink classes on transmitted packets (potentially including multilink headers on interleaved packets) if the option is negotiated. • **minimum** *min-value*—The minimum number of classes that the peer is expected to request and the multilink needs in the transmit path. The range is 2 to 4. • **reject**—Causes the multilink to reject the multilink header format option if the peer requests it. • **ignore**—Causes the multilink to acknowledge the multilink header format option if the peer requests it and multiple classes are not used. This is the default setting when a multiclass is not configured.
Step 11	**no cdp enable** **Example:** `Router(config-if)# no cdp enable`	Disables Cisco Discovery Protocol (CDP) on an interface.
Step 12	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode.

Examples

```
Router> enable
Router# configure terminal
Router(config)# interface multilink 1
Router(config-if)# ip address 10.0.0.161 255.255.255.240
Router(config-if)# ppp multilink
Router(config-if)# ppp multilink interleave
Router(config-if)# ppp multilink fragment delay 0 500
Router(config-if)# ppp timeout multilink lost-fragment 0 100
Router(config-if)# ppp multilink multiclass local request maximum 4
Router(config-if)# ppp multilink multiclass remote apply minimum 4
Router(config-if)# no cdp enable
Router(config-if)# exit
```

Configuring Multiclass Multilink PPP on a Member Link

Use the following procedure to configure multiclass multilink PPP on a configured and operational member link.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *interface*
4. **ppp multilink**
5. **ppp multilink multiclass**
6. **no cdp enable**
7. **exit**

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** *interface* **Example:** `Router(config)# interface serial0/0/0`	Specifies the multilink serial interface and enters interface configuration mode.
Step 4	**ppp multilink** **Example:** `Router(config-if)# ppp multilink`	Enables multilink PPP on an interface.
Step 5	**ppp multilink multiclass** **Example:** `Router(config-if)# ppp multilink multiclass`	Enables multiclass multilink PPP on an interface.
Step 6	**no cdp enable** **Example:** `Router(config-if)# no cdp enable`	Disables Cisco Discovery Protocol (CDP) on the interface.
Step 7	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode.

Examples

```
Router> enable
```

```
Router# configure terminal
Router(config)# interface serial0/0/0
Router(config-if)# ppp multilink
Router(config-if)# ppp multilink multiclass
Router(config-if)# no cdp enable
Router(config-if)# exit
```

Verifying Multiclass Multilink PPP

To verify that the multiclass multilink PPP feature is configured correctly, enter the **show ppp multilink** command in privileged EXEC mode. The following output includes class-specific information for the PPP Multilink bundles:

```
Router# show ppp multilink
Multilink1, bundle name is cork
Bundle up for 01:59:35, 1/255 load, 2 receive classes, 2 transmit classes
!
Receive Class 0:
51 lost fragments, 432 reordered, 0 unassigned
0 discarded, 0 lost received
0xC36E received sequence
!
Receive Class 1:
0 lost fragments, 0 reordered, 0 unassigned
0 discarded, 0 lost received
0x0 received sequence
!
Transmit Class 0:
0xC170 sent sequence
!
Transmit Class 1:
0x0 sent sequence
!
Member links: 2 active, 0 inactive (max not set, min not set)
Serial0, since 01:59:35  160 weight, 154 bytes
Serial1, since 01:59:35  160 weight, 32 bytes
```

Configuration Examples for Multiclass Multilink PPP

This section provides the following configuration examples:

Configuring Multiclass Multilink Classes on Bundles: Example

The following example shows how to configure a multilink bundle for up to four receive classes and at least four transmit classes:

```
Router(config)# interface multilink 9
Router(config-if)# ip address 10.0.0.161 255.255.255.240
Router(config-if)# ppp multilink
```

```
Router(config-if)# ppp multilink interleave
Router(config-if)# ppp multilink fragment delay 20
Router(config-if)# ppp multilink multiclass local request maximum 4
Router(config-if)# ppp multilink multiclass remote apply minimum 4
Router(config-if)# no cdp enable
```

Configuring Multiclass Multilink Peer Options: Examples

The following example shows how to configure a multilink bundle to not use multiple classes but allows the peer to request the option and transmit up to four classes when needed:

```
Router(config)# interface multilink 9
Router(config-if)# ip address 10.0.0.161 255.255.255.240
Router(config-if)# ppp multilink
Router(config-if)# ppp multilink interleave
Router(config-if)# ppp multilink fragment delay 20
Router(config-if)# ppp multilink multiclass local allow maximum 4
Router(config-if)# ppp multilink multiclass remote ignore
Router(config-if)# no cdp enable
```

The following example shows how to configure a multilink bundle to not use multiple classes, but allows the peer to request the option and inform the peer that the option is supported, allowing for up to four receive classes:

```
Router(config)# interface multilink 9
Router(config-if)# ip address 10.0.0.161 255.255.255.240
Router(config-if)# ppp multilink
Router(config-if)# ppp multilink interleave
Router(config-if)# ppp multilink fragment delay 20
Router(config-if)# ppp multilink multiclass local request initial 1 maximum 4
Router(config-if)# ppp multilink multiclass remote ignore
Router(config-if)# no cdp enable
```

Configuring the Fragment Timeout: Example

The following example sets a 5-second wait period for receiving expected fragments before declaring the fragments lost:

```
Router(config)# interface multilink 9
Router(config-if)# ip address 10.0.0.161 255.255.255.240
Router(config-if)# ppp multilink
Router(config-if)# ppp multilink interleave
Router(config-if)# ppp multilink fragment delay 20
Router(config-if)# ppp timeout multilink lost-fragment 5
```

The following example sets a 100-millisecond wait period for receiving expected fragments before declaring the fragments lost:

```
Router(config)# interface multilink 9
Router(config-if)# ip address 10.0.0.161 255.255.255.240
Router(config-if)# ppp multilink
Router(config-if)# ppp multilink interleave
Router(config-if)# ppp multilink fragment delay 20
Router(config-if)# ppp timeout multilink lost-fragment 0 100
```

Disabling MultiClass Multilink PPP: Example

The following example shows how to completely disable multiclass multilink PPP, rejecting the option and declining to allow the peer to transmit multiple classes:

```
Router(config)# interface multilink 9
Router(config-if)# ip address 10.0.0.161 255.255.255.240
Router(config-if)# ppp multilink
Router(config-if)# ppp multilink interleave
Router(config-if)# ppp multilink fragment delay 20
Router(config-if)# ppp multilink multiclass local forbid
Router(config-if)# ppp multilink multiclass remote reject
Router(config-if)# no cdp enable
```

Additional References

The following sections provide references related to the multiclass multilink PPP feature.

Related Documents

Related Topic	Document Title
Provisioning Qos	*Cisco 10000 Series Router Quality of Service Configuration Guide*
Configuring Multilink PPP Connections	*Cisco 10000 Series Router Broadband Aggregation, Leased-Line, and MPLS Configuration Guide*
Configuring Cisco 10000 series router line cards	*Cisco 10000 Series Router Line Card Configuration Guide*

Standards

Standard	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	—

MIBs

MIB	MIBs Link
No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature.	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 2686	The Multi-Class Extension to Multi-Link PPP

Technical Assistance

Description	Link
The Cisco Technical Support & Documentation website contains thousands of pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/techsupport

Command Reference

This section documents new commands only.

New Commands

- **encap-sequence**
- **ppp multilink multiclass**
- **ppp timeout multilink lost-fragment**

encap-sequence

To assign an encapsulation sequence number to a priority class in a multiclass multilink PPP bundle, use the **encap-sequence** command in policy-map class configuration mode. To reset the default value, use the **no** form of this command.

encap-sequence [*sequence-id* | **none**]

no encap-sequence *sequence-id*

Syntax Description

sequence-id	Assigns a unique encapsulation sequence number to priority class in a multiclass multilink PPP bundle. Valid range is from 0 to 3.
none	Specifies that a certain priority class is classified as or is assigned the highest priority, and packets are not encapsulated with a sequence number for multiclass multilink PPP.

Command Default

Sequence numbers are not assigned to priority classes.

Command Modes

Policy-map class configuration

Command History

Release	Modification
12.2(31)SB2	This command was introduced and implemented on the Cisco 10000 series router for the PRE2.

Usage Guidelines

The **encap-sequence** command allows you to assign sequence numbers to priority classes in a policy map for multiclass multilink PPP encapsulation. This command is only supported on the PRE2.

A class with a multiclass multilink PPP sequence number must have an associated queue action such as bandwidth and shape. The sequence number assigned to each priority class must be unique.

The default sequence number for class-default is 0 and it is not configurable.

If you do not assign a sequence number to a priority class, the priority queue packets use PPP encapsulation. Interleaving is allowed for priority traffic regardless of the encapsulated sequence number configuration.

Examples

The following example shows that class voice has the highest priority and that packets are not encapsulated with a sequence number for multiclass multilink PPP.

```
Router(config)# policy-map prec1
Router(config-pmap)# class voice
Router(config-pmap-c)# priority
Router(config-pmap-c)# police 128
Router(config-pmap-c)# encap-sequence none
Router(config-pmap-c)# exit
Router(config-pmap)# class video
```

```
Router(config-pmap-c)# bandwidth 1000
Router(config-pmap-c)# police 1000
Router(config-pmap-c)# encap-sequence 1
Router(config-pmap-c)# exit
Router(config-pmap)# class game
Router(config-pmap-c)# bandwidth 1000
Router(config-pmap-c)# encap-sequence 2
Router(config-pmap-c)# exit
Router(config-pmap)# class class-default
```

Related Commands

Command	Description
show ppp multilink	Displays information for multilink PPP bundles.

ppp multilink multiclass

To enable multiclass multilink PPP on an interface, use the **ppp multilink multiclass** command in interface configuration mode. To disable multiclass multilink PPP, use the **no** form of this command.

ppp multilink multiclass [**local** {**request** [**initial** *init-value*] [**maximum** *max-value*] | **allow** [**maximum** *max-value*] | **forbid**} | [**remote** {**apply** [**minimum** *min-value*] | **reject** | **ignore**}]

no ppp multilink multiclass [**local** {**request** [**initial** *init-value*] [**maximum** *max-value*] | **allow** [**maximum** *max-value*] | **forbid**} | [**remote** {**apply** [**minimum** *min-value*] | **reject** | **ignore**}]

Syntax Description

local	Configures the multiclass multilink PPP multilink header format option when negotiating class of service with a peer.
request	Signals the Link Control Protocol (LCP) to request the multilink header format option when the interface is negotiating with the peer.
initial *init-value*	(Optional) The initial number of multilink classes to request, that is, the number of classes the multilink is initially prepared to accept in the receive path. The range is 1 to 4.
maximum *max-value*	(Optional) The maximum number of classes that can be requested, that is, the maximum number of classes the multilink supports in the receive path. The range is 1 to 4.
allow	Causes the LCP to initially omit the multilink header format option when negotiating with the peer, but to request the option in subsequent requests if the peer includes it in a Configure-Nak message.
forbid	Causes the LCP to omit the multilink header format option when negotiating with the peer.
remote	Configure the multiclass multilink PPP multilink header format option when a peer requests class of service.
apply	Causes the multilink: • To negotiate the multilink header format option if the peer requests it and attempts to induce the peer to request the option by including it in a configure-nak message if it does not. • To use multiple multilink classes on transmitted packets (potentially including multilink headers on interleaved packets) if the option is negotiated.
minimum *min-value*	Indicates the minimum number of classes that the peer is expected to request. This value indicates the number of classes the multilink will need in the transmit path. The range is 1 to 4.
reject	Causes the multilink to reject the option if the peer requests it.
ignore	Causes the multilink to acknowledge the multilink header format option if the peer requests it, but multiple classes will not be used. This is the default setting when a multiclass is not configured.

Command Default

Initially omits the multilink header format option when negotiating with the peer, but requests the option in a maximum of 4 subsequent requests when the peer includes it in a Configure-Nak message. Acknowledges the multilink header format option if the peer requests it, but multiple classes will not be used.

Command Modes

Interface configuration

Command History

Release	Modification
12.2(31)SB2	This command was introduced and implemented on the Cisco 10000 series router for the PRE2.

Usage Guidelines

This command applies only to interfaces that use PPP encapsulation. Multiclass multilink PPP and PPP reliable links do not work together.

The **ppp multilink multiclass** command can be configured on each member link joining the bundle. For multilink groups, you can configure the command on the bundle itself (the member links inherit the configuration from the group interface).

When this command is configured (and assuming that the peer also supports and is configured for multiclass interleaving), interleaved packets are assigned sequence numbers so that they are kept in order at the receiving end. Without this command, interleaved packets are sent without multilink headers and are subject to reordering when sent over parallel links.

Pairing the **local** and **remote** keywords configures the multilink header format option when negotiating with a peer. These keywords extend the multiclass multilink PPP transmit logic to allow up to 4 transmit and receive classes, and up to 4 classes that can be negotiated with the peer. The **local** and **remote** keywords use PPP link fragmentation and interleaving (LFI) to apply multilink headers to interleaved packets. This keeps the packets in sequence when transmitted over multiple parallel links within a multilink bundle.

When the **ppp multilink multiclass** command is configured without the **local** and **remote** keywords, the configuration is equivalent to the following combination:

```
ppp multilink multiclass local request initial 2 maximum 4
ppp multilink multiclass remote apply minimum 2
```

This configuration requests two classes and the peer is sent a Configure-Nak message with a value of 2 if the option request fails.

Examples

The following example shows the configuration for a multilink bundle with up to four receive classes and at least four transmit classes:

```
interface multilink 9
 ip address 10.0.0.161 255.255.255.240
 ppp multilink
 ppp multilink interleave
 ppp multilink fragment delay 20
 ppp multilink multiclass local request maximum 4
 ppp multilink multiclass remote apply minimum 4
 no cdp enable
```

The following example shows the configuration for a multilink bundle that does not use multiple classes but allows the peer to request the option and transmit up to four classes when needed:

```
interface multilink 9
 ip address 10.0.0.161 255.255.255.240
 ppp multilink
 ppp multilink interleave
 ppp multilink fragment delay 20
 ppp multilink multiclass local allow maximum 4
 ppp multilink multiclass remote ignore
 no cdp enable
```

The following example shows the configuration for a multilink bundle that does not use multiple classes, but allows the peer to request the option and inform the peer that the option is supported, allowing for up to four receive classes:

```
interface multilink 9
 ip address 10.0.0.161 255.255.255.240
 ppp multilink
 ppp multilink interleave
 ppp multilink fragment delay 20
 ppp multilink multiclass local request initial 1 maximum 4
 ppp multilink multiclass remote ignore
 no cdp enable
```

The following example shows the configuration for multilink PPP interleaving and a maximum real-time traffic delay of 20 milliseconds on a multilink interface. Multiclass multilink PPP is then configured on a serial 0/0/1 member link and the member link is restricted to joining only the designated multilink group interface.

```
interface multilink 1
 ip address 10.2.3.4 255.255.255.0
 ppp multilink
 ppp multilink interleave
 ppp multilink fragment delay 20
!
interface serial0/0/1
 encapsulation ppp
 ppp authentication chap
 ppp multilink
 ppp multilink multiclass
 ppp multilink group 1
```

The following example shows how to completely disable multiclass multilink PPP, rejecting the header and declining to allow the peer to transmit multiple classes:

```
interface multilink 9
 ip address 10.0.0.161 255.255.255.240
 ppp multilink
 ppp multilink interleave
 ppp multilink fragment delay 20
 ppp multilink multiclass local forbid
 ppp multilink multiclass remote reject
 no cdp enable
```

Related Commands

Command	Description
encapsulation ppp	Enables PPP encapsulation.
ppp authentication	Enables CHAP or PAP or both and specifies the order in which CHAP and PAP authentication is selected on the interface.

Command	Description
ppp multilink	Enables MLP on an interface.
ppp multilink fragment-delay	Specifies a maximum size in units of time for packet fragments on a multilink PPP bundle.
ppp timeout multilink lost-fragment	Sets a timer that determines how long multilink PPP waits for an expected fragment to arrive before declaring it lost.
ppp multilink interleave	Enables interleaving of packets among the fragments of larger packets on a multilink PPP bundle.
show ppp multilink	Displays information for multilink PPP bundles.

ppp timeout multilink lost-fragment

To set a timer that determines how long multilink PPP waits for an expected fragment to arrive before declaring it lost, use the **ppp timeout multilink lost-fragment** command in interface configuration mode. To reset the default value, use the **no** form of this command.

ppp timeout multilink lost-fragment *seconds* [*milliseconds*]

no ppp timeout multilink lost-fragment

Syntax Description

seconds	Specifies the wait period, in seconds. The range is from 1 to 255 seconds. **Note** If the desired delay should be in milliseconds, set the *seconds* argument to **0** and enter a value for the *milliseconds* argument.
milliseconds	(Optional) Specifies the wait period, in milliseconds. The range is from 1 to 999 milliseconds.

Command Default

The default value is not fixed, but is calculated based on the bundle's current reassembly buffer limit.

Command Modes

Interface configuration

Command History

Release	Modification
11.3	This command was introduced.
12.2(31)SB2	The command was enhanced to include the *milliseconds* argument on the Cisco 10000 series router.

Examples

The following example sets a 5-second wait period for receiving expected fragments before declaring the fragments lost:

```
ppp timeout multilink lost-fragment 5
```

The following example sets a 300-millisecond wait period for receiving expected fragments before declaring the fragments lost:

```
ppp timeout multilink lost-fragment 0 300
```

Related Commands

Command	Description
encapsulation ppp	Enables PPP encapsulation.
ppp authentication	Enables CHAP or PAP or both and specifies the order in which CHAP and PAP authentication is selected on the interface.
ppp multilink	Enables MLP on an interface.
ppp multilink fragment delay	Specifies a maximum size in units of time for packet fragments on a multilink PPP bundle.

Command	Description
ppp multilink interleave	Enables interleaving of packets among the fragments of larger packets on a multilink PPP bundle.
ppp multilink multiclass	Enables multiclass multilink PPP on an interface.
ppp multilink multiclass local	Configure the multiclass multilink PPP multilink header format option when negotiating class of service with a peer.
ppp multilink multiclass remote	Causes multilink to negotiate the multilink header format option if the peer requests it, and to use multiple multilink classes on transmitted packets (potentially including multilink headers on interleaved packets) if the option is negotiated.
show ppp multilink	Displays information for multilink PPP bundles.

Feature Information for Multiclass Multilink PPP

Table 2 lists the release history for this feature.

Not all commands may be available in your Cisco IOS software release. For release information about a specific command, see the command reference documentation.

Cisco IOS software images are specific to a Cisco IOS software release, a feature set, and a platform. Use Cisco Feature Navigator to find information about platform support and Cisco IOS software image support. Access Cisco Feature Navigator at http://www.cisco.com/go/fn. You must have an account on Cisco.com. If you do not have an account or have forgotten your username or password, click **Cancel** at the login dialog box and follow the instructions that appear.

Note Table 2 lists only the Cisco IOS software release that introduced support for a given feature in a given Cisco IOS software release train. Unless noted otherwise, subsequent releases of that Cisco IOS software release train also support that feature.

Table 2 Feature Information for Multiclass Multilink PPP

Feature Name	Releases	Feature Information
Multiclass Multilink PPP	12.2(31)SB2	This feature was introduced and implemented on the Cisco 10000 series router for the PRE2.