Multilink PPP Minimum Links Mandatory

Multilink PPP allows multiple PPP links to be established in parallel to the same destination. Multilink PPP is often used with dialup lines or ISDN connections to easily increase the amount of bandwidth between points.

With the introduction of the Multilink PPP Minimum Links Mandatory feature, you can configure the minimum number of links in a Multilink PPP (MLP) bundle required to keep that bundle active by entering the **ppp multilink links minimum** *links* **mandatory** command. When you configure this command, all Network Control Protocols (NCPs) for an MLP bundle are disabled until the MLP bundle has the required minimum number of links. When a new link is added to the MLP bundle that brings the number of links up to the required minimum number of links, the NCPs are activated for the MLP bundle. When a link is removed from an MLP bundle, and the number of links falls below the required minimum number of links for that MLP bundle, the NCPs are disabled for that MLP bundle.

This document describes the Multilink PPP Minimum Links Mandatory feature for Cisco IOS Releases 12.2(13)T, 12.2(14)S, and 12.2(15)B.

Feature History for the Multilink PPP Minimum Links Mandatory Feature

Release	Modification
12.1(11b)E	This feature was introduced.
12.2(13)T	This feature was integrated into Cisco IOS Release 12.2(13)T.
12.2(14)S	This feature was integrated into Cisco IOS Release 12.2(14)S.
12.2(15)B	This feature was integrated into Cisco IOS Release 12.2(15)B and support was added for the Cisco 7401ASR and the Cisco 6400 series.
12.2(27)SBA	This feature was integrated into Cisco IOS Release 12.2(27)SBA.

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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Contents

Information About Multilink PPP Minimum Links Mandatory

You must understand the following concepts to configure this feature:

PPP Encapsulation

PPP, described in RFC 1661, encapsulates network layer protocol information over point-to-point links. You can configure PPP on the following types of physical interfaces:

- Asynchronous serial
- High-Speed Serial Interface (HSSI)
- ISDN
- Synchronous serial

When PPP encapsulation is enabled on physical interfaces, PPP can also be in effect on calls placed by the dialer interfaces that use the physical interfaces.

PPP supports option 3, authentication using Challenge Handshake Authentication Protocol (CHAP) or Password Authentication Protocol (PAP); option 4, Link Quality Monitoring (LQM); and option 5, Magic Number configuration options. Cisco IOS software always sends option 5 and negotiates for options 3 and 4 if so configured. All other options are rejected.

Magic Number support is available on all serial interfaces. PPP always attempts to negotiate for Magic Numbers, which are used to detect looped-back lines. Depending on how the **down-when-looped** command is configured, the router might shut down a link if it detects a loop.

Cisco IOS software provides the CHAP and PAP on serial interfaces running PPP encapsulation. For detailed information about authentication, refer to the *Cisco IOS Security Configuration Guide*.

Multilink PPP

The Multilink PPP feature provides load balancing functionality over multiple WAN links, while providing multivendor interoperability, packet fragmentation and proper sequencing, and load calculation on both inbound and outbound traffic. The Cisco implementation of MLP supports the fragmentation and packet sequencing specifications in RFC 1990. Additionally, you can change the default endpoint discriminator value that is supplied as part of user authentication. Refer to RFC 1990 for more information about the endpoint discriminator.

MLP allows packets to be fragmented and the fragments to be sent at the same time over multiple point-to-point links to the same remote address. The multiple links come up in response to a defined dialer load threshold. The load can be calculated on inbound traffic, outbound traffic, or on either, as needed for the traffic between the specific sites. MLP provides bandwidth on demand and reduces transmission latency across WAN links.

MLP is designed to work over synchronous and asynchronous serial and BRI and PRI types of single or multiple interfaces that have been configured to support both dial-on-demand rotary groups and PPP encapsulation.

How to Configure Multilink PPP Minimum Links Mandatory

This section contains the following procedures:

Configuring PPP

Perform this task to configure PPP.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type slot/port*
4. **encapsulation ppp**
5. **ppp authentication** {**chap** | **chap pap** | **pap chap** | **pap**} [**if-needed**] [*list-name* | **default**] [**callin**]
6. **exit**
7. **username** *name* **password** *secret*

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 slot*/*port* **Example:** `Router(config)# interface serial 1/0`	Configures an interface and enters interface configuration mode. • *type*—Type of interface to be configured. • *slot*—Number of the slot being configured. • *port*—Number of the port being configured. **Note** Refer to the appropriate hardware manual for slot and port information.
Step 4	**encapsulation ppp** **Example:** `Router(config-if)# encapsulation ppp`	Enables PPP encapsulation.
Step 5	**ppp authentication** {**chap** | **chap pap** | **pap chap** | **pap**} [**if-needed**] [*list-name* | **default**] [**callin**] **Example:** `Router(config-if)# ppp authentication chap`	(Optional) Defines the authentication methods supported and the order in which they are used. • **chap**—Enables CHAP on a serial interface. • **chap pap**—Enables CHAP and PAP on a serial interface and configures CHAP to be used first. • **pap chap**—Enables CHAP and PAP on a serial interface and configures PAP to be used first. • **pap**—Enables PAP on a serial interface. • **if-needed**—(Optional) Used with TACACS and extended TACACS. Does not perform CHAP or PAP authentication if the user has already provided authentication. This option is available only on asynchronous interfaces. • *list-name*—(Optional) Used with authentication, authorization, and accounting (AAA). Specifies the name of a list of methods of authentication to use. If no list name is specified, the system uses the default. The list is created with the **aaa authentication ppp** command. • **default**—(Optional) The name of the method list is created with the **aaa authentication ppp** command. • **callin**—(Optional) Specifies authentication on incoming (received) calls only.

	Command or Action	Purpose
Step 6	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode.
Step 7	**username** *name* **password** *secret* **Example:** `Router(config)# username username1 password password1`	(Optional) Specifies the password to be used in CHAP or PAP caller identification. • *name*—Assigns a host name, server name, user ID, or command name. The *name* argument can be only a single word and not more than one word. Blank spaces and quotation marks are not allowed. • *secret*—Specifies the secret for the local router or the remote device. The secret is encrypted when it is stored on the local router. The secret can consist of any string of up to 11 ASCII characters. There is no limit to the number of username and password combinations that can be specified, allowing any number of remote devices to be authenticated.

Configuring Multilink PPP

Perform this task to configure MLP.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface multilink** *group-number*
4. **ip address** *address*
5. **encapsulation ppp**
6. **ppp multilink**
7. **ppp multilink links maximum** *links*
8. **ppp multilink links minimum** *links*
9. **bridge-group** *bridge-group-number*
10. **no shutdown**

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** *group-number* **Example:** `Router(config)# interface multilink 3`	Creates a multilink bundle and enters interface configuration mode. • *group-number*—Specifies the number of the multilink bundle. Valid range is from 0 to 214748364.
Step 4	**ip address** *address* **Example:** `Router(config-if)# ip address 172.16.0.0`	Assigns an IP address to the interface.
Step 5	**encapsulation ppp** **Example:** `Router(config-if)# encapsulation ppp`	Enables PPP encapsulation.
Step 6	**ppp multilink** **Example:** `Router(config-if)# ppp multilink`	Enables MLP.
Step 7	**ppp multilink max-links** *links* **Example:** `Router(config-if)# ppp multilink max-links 100`	(Optional) Limits the maximum number of links that MLP can dial for dynamic allocation. • *links*—Maximum number of links, in the range from 0 to 255.
Step 8	**ppp multilink links minimum** *links* **Example:** `Router(config-if)# ppp multilink links minimum 5`	(Optional) Specifies the preferred minimum number of links in an MLP bundle. • *links*—Minimum number of links, in the range from 0 to 255.

	Command or Action	Purpose
Step 9	**bridge-group** *bridge-group-number* **Example:** `Router(config-if)# bridge-group 2`	(Optional) Specifies the bridge group to which this interface belongs. • *bridge-group-number*—Number of the bridge group to which the interface belongs. Valid values are from 1 to 255. **Note** Use this command only if bridging is enabled for this interface.
Step 10	**no shutdown** **Example:** `Router(config-if)# no shutdown`	Enables the interface.

Configuring Multilink PPP Minimum Links Mandatory

Perform this task to configure the minimum number of links in an MLP bundle required to keep that bundle active.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface multilink** *group-number*
4. **ppp multilink**
5. **ppp multilink links minimum** *links* **mandatory**

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** *group-number* **Example:** `Router(config)# interface multilink 3`	Creates a multilink bundle and enters interface configuration mode. • *group-number*—Specifies the number of the multilink bundle. Valid range is from 0 to 214748364.

	Command or Action	Purpose
Step 4	**ppp multilink** **Example:** `Router(config-if)# ppp multilink`	Enables MLP.
Step 5	**ppp multilink links minimum** *links* **mandatory** **Example:** `Router(config-if)# ppp multilink links minimum 5 mandatory`	Specifies the required minimum number of links in an MLP bundle. • If the minimum number of links in the MLP bundle falls below the number specified by the *links* argument, the MLP bundle is disabled. • *links*—Minimum number of links, in the range from 0 to 255.

Verifying the Multilink PPP Minimum Links Mandatory Configuration

Perform this task to verify configuration of the Multilink PPP Minimum Links Mandatory feature.

SUMMARY STEPS

1. **enable**
2. **show running-config** [**interface** *type number*] [**linenum**]
3. **show interfaces multilink** *group-number*
4. **show ppp multilink**
5. **show interfaces multilink** *group-number* **stat**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show running-config** [**interface** *type number*] [**linenum**] **Example:** `Router# show running-config`	Displays the contents of the currently running configuration file or the configuration for a specific interface, or map class information.
Step 3	**show interfaces multilink** *group-number* **Example:** `Router# show interfaces multilink 3`	(Optional) Displays statistics for the specified multilink bundle.

	Command or Action	Purpose
Step 4	**show ppp multilink** **Example:** `Router# show ppp multilink`	(Optional) Displays information about all existing multilink bundles and their member links.
Step 5	**show interfaces multilink** *group-number* **stat** **Example:** `Router# show interfaces multilink 3 stat`	(Optional) Displays traffic statistics for a multilink bundle.

Examples

The following is sample output from the **show running-config** command that shows that the Multilink PPP Minimum Links Mandatory feature is configured on interface bri0:

```
Router# show running-config
.
.
.
interface multilink1
 ip address 10.0.0.0 255.255.255.0
   encapsulation ppp
   ppp authentication chap
   ppp multilink
   ppp multilink max-links 100
   ppp multilink links minimum 10 mandatory

  interface BRI2/1
   no ip address
   encapsulation ppp
   dialer pool-member 2
   no fair-queue
   no cdp enable
   ppp authentication chap
   ppp multilink

 interface bri 0
  description connected to abc 81012345678902
  ip address 172.16.0.10 255.255.255.0
  encapsulation ppp
  dialer idle-timeout 30
  dialer map ip 172.16.0.0 name cisco 81012345678901
  dialer-group 1
  ppp authentication pap
  ppp multilink
  ppp multilink links minimum 2 mandatory ! Indicates that the Multilink PPP Minimum Links
                                            Mandatory feature is enabled.
```

Configuration Examples for Multilink PPP Minimum Links Mandatory

This section provides the following configuration examples:

Configuring PPP: Example

The following example shows how to configure PPP on a serial interface with CHAP authentication:

```
interface serial 1/0
 encapsulation ppp
 ppp authentication chap
 exit
username abc password password1
```

Configuring Multilink PPP: Example

The following example shows how to configure MLP. In this example, the MLP bundle is configured with CHAP authentication. The minimum number of links for this MLP bundle is 5 and the maximum number of links is 100.

```
interface multilink 3
 ip address 172.16.0.0
 encapsulation ppp
 ppp multilink
 ppp multilink max-links 100
 ppp multilink links minimum 5
 bridge-group 2
 no shutdown
```

Configuring Multilink PPP Minimum Links Mandatory: Example

The following example shows how to configure an MLP bundle to be required to have at least five active sessions:

```
ppp multilink
ppp multilink links minimum 5 mandatory
```

Additional References

The following sections provide references related to the Multilink PPP Minimum Links Mandatory feature.

Related Documents

Related Topic	Document Title
Dial technologies configuration	*Cisco IOS Dial Technologies Configuration Guide*
Dial technologies commands	*Cisco IOS Dial Technologies Command Reference,* Release 12.2 T
PPP and multilink PPP configuration	• *Configuring Media-Independent PPP and Multilink PPP* • *Configuring PPP and Multilink PPP* • *Criteria for Naming Multilink PPP Bundles* • *Multichassis Multilink PPP (MMP)* • *Router-to-Router Async Multilink PPP* • *Troubleshooting Async Multilink PPP Operations*

Standards

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

MIBs

MIBs	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

RFCs	Title
RFC 1990	*The PPP Multilink Protocol (MP)*

Technical Assistance

Description	Link
Technical Assistance Center (TAC) home page, containing 30,000 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/public/support/tac/home.shtml

Command Reference

This section documents the following modified commands. All other commands used with this feature are documented in the Cisco IOS Release 12.2 T command reference publications.

- **multilink min-links**
- **ppp multilink links minimum**

multilink min-links

The **multilink min-links** command is replaced by the **ppp multilink links minimum** command. See the **ppp multilink links minimum** command for more information.

ppp multilink links minimum

To specify the preferred minimum number of links in a Multilink PPP (MLP) bundle, use the **ppp multilink links minimum** command in interface configuration mode. To reset the default value, use the **no** form of this command.

ppp multilink links minimum *links* [**mandatory**]

no ppp multilink links minimum

Syntax Description

links	Minimum number of links. Valid values range from 0 to 255. The default is 0.
mandatory	(Optional) Specifies that the minimum number of links configured with the *links* argument is required to establish and maintain the Network Control Protocol (NCP) for the bundle.

Defaults

0 links

Command Modes

Interface configuration

Command History

Release	Modification
11.3	This command was introduced as **multilink min-links**.
12.1(11b)E	The **mandatory** keyword was added to the **multilink min-links** command.
12.2	The **multilink min-links** command was replaced by the **ppp multilink links minimum** command. The **multilink min-links** command was also accepted by the command-line interpreter in Cisco IOS Release 12.2.
12.2(13)T	Support was added for the **mandatory** keyword, and the range of valid values for the *links* argument was changed from 0 to 255 to 0 to 64.
12.2(14)S	This command, as modified in Cisco IOS Release 12.2(13)T, was integrated into Cisco IOS Release 12.2(14)S.
12.2(15)B	This command, as modified in Cisco IOS Release 12.2(13)T, was integrated into Cisco IOS Release 12.2(15)B. Support was added for the Cisco 7401ASR and the Cisco 6400 series.
12.3(8)T	The range of valid values for the *links* argument was changed from 0 to 64 to 0 to 255.
12.2(27)SB.	This command was integrated into Cisco IOS Release 12.2(27)SB.

Usage Guidelines

This command affects only dial-on-demand dynamic bandwidth environments.

The value configured for the *links* argument specifies the minimum number of links that MLP will try to keep in a bundle. If a bundle contains fewer links than the number specified by the *links* argument, and there is a means to establish additional channels (for example, available dialer channels), then MLP

attempts to increase the number of links up to the specified limit. MLP attempts to dial up additional links to obtain the number specified by the *links* argument, even if the load does not exceed the load threshold.

If the **mandatory** keyword is configured, the minimum number of links specified by the *links* argument must be in the bundle. Whenever a link is added to or removed from the bundle, the number of links is checked against the specified minimum number. If the number of links in the bundle falls below the specified minimum, all NCPs will be disabled for the bundle. NCPs will be established if the number of links meets the specified minimum.

If the **dialer max-call** command is configured, MLP will not exceed its value even if the **ppp multilink links maximum** command is configured for a higher value. This restriction does not affect the number of links that you can configure; rather it affects what happens at run time.

Examples

The following example sets the minimum number of links to 12:

```
ppp multilink links minimum 12
```

The following example sets the minimum number of links to 4 and specifies that the bundle must have at least four links to establish and maintain NCPs:

```
ppp multilink links minimum 4 mandatory
```

Related Commands

Command	Description
dialer max-call	Specifies the maximum number of calls to a remote destination that can be up at any one time for a dialer profile.
ppp multilink links maximum	Limits the maximum number of links that MLP can dial for dynamic allocation.