PPP/MLP MRRU Negotiation Configuration

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The PPP/MLP MRRU Negotiation Configuration feature allows a device to send and receive frames over Multilink PPP (MLP) bundles that are larger than the default Maximum Receive Reconstructed Unit (MRRU) limit of 1524 bytes.

Finding Feature Information in This Module

Your Cisco IOS software release may not support all of the features documented in this module. For the latest feature information and caveats, see the release notes for your Cisco IOS software release. 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 PPP/MLP MRRU Negotiation Configuration" section on page 1048.

Finding Support Information for Platforms and Cisco IOS and Catalyst OS Software Images

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

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Prerequisites for PPP/MLP MRRU Negotiation Configuration

Before performing the tasks to configure the PPP/MLP MRRU Negotiation Configuration feature, you need to understand how to configure PPP and MLP. It will also be useful to be familiar with concepts presented in RFC 1990. See the "Related Documents" and "RFCs" sections for pointers to this information.

Restrictions for PPP/MLP MRRU Negotiation Configuration

This feature and its new interface configuration command are valid only on interfaces that support MLP.

Note Be careful when configuring MLP MRRU negotiation in a virtual private dialup network (VPDN) environment with an L2TP network server (LNS) that is not running Cisco IOS Release 12.3(7)T. The software performs strict matching on the MRRU values in earlier versions of the Cisco IOS software.

Information About PPP/MLP MRRU Negotiation Configuration

To configure PPP/MLP MRRU Negotiation Configuration, you need to understand the following concepts:

- MRRU Negotiation on MLP, page 1036
- Advertisement of a Specific MRRU Value, page 1037
- Peer MRRU Negotiation, page 1037

MRRU Negotiation on MLP

Before Cisco IOS Release 12.3(7)T, configuring the MRRU option negotiated on a multilink bundle with the MLP was not possible. Cisco IOS software always advertised an MRRU default value of 1524 bytes, which meant that the maximum transmission unit (MTU) of the peer's bundle interface was restricted to a value of 1524 bytes or fewer if the data transfer was to be successful. Users who wanted to benefit from MLP features had to accept limits on the MTU byte size setting.

The PPP/MLP MRRU Negotiation Configuration feature allows configuration control over MRRU negotiation. A new interface configuration command introduced with this feature, **ppp multilink mrru,** allows configuring the specific MRRU value that the device will advertise, and optionally establishing a lower boundary on the MRRU value of the peer.

MLP is a method for spreading traffic across multiple physical WAN links while providing packet fragmentation and reassembly, proper sequencing, multi-vendor interoperability, and load balancing on inbound and outbound traffic. MLP was developed to use the multiple bearer channels in ISDN, but is equally applicable to any situation in which multiple PPP links connect two systems, including asynchronous links.

When MLP is used, several physical interfaces can constitute one logical connection to the peer. To represent the logical connection, software provides a logical interface, often called the *bundle* interface. This interface will have the IP address, for instance, and the MTU setting of the interface that IP uses when it is deciding whether to fragment an IP datagram that needs to be forwarded. The physical interfaces simply forward individual MLP fragments or frames that are given to them by the bundle interface.

The result of having to decide whether to fragment a packet is that, whereas with simple PPP the interface MTU must not exceed the peer's MRRU, with MLP the MTU size of the bundle interface must not exceed the MRRU setting of the peer.

The MRRU settings on both sides need not be equal, but the "must not exceed" rule just specified must be followed; otherwise a system might send several fragments that, when reconstructed as a frame, will be too large for the peer's receive buffer.

Advertisement of a Specific MRRU Value

Where a PPP link is destined to join an existing MLP bundle, the MRRU value advertised on that link will be the MRRU of the existing bundle, in configurations where the software can determine which bundle the link is destined to join at the time the Link Control Protocol (LCP) is negotiated.

In Cisco IOS Release 12.0(28)S, this is the case for multilink groups only.

In Cisco IOS Release 12.3(7)T and later releases, this is the case for both multilink groups and dialer profiles that have already been bound to the physical interface at the time LCP is negotiated.

In all other cases, the MRRU value advertised on a link is by an order of preference, as follows:

- The value configured on the link interface with the **ppp multilink mrru** interface command, or the value inherited from the configuration of the **ppp multilink mrru** command on the parent interface. If both values are present, the link interface value has precedence.

- The value of the bundle interface MTU, if the bundle interface is known at the time LCP is negotiated. In Cisco IOS Release 12.0(28)S, this is the case for multilink groups only.

- The default MRRU value of 1524 bytes.

Peer MRRU Negotiation

By default, any peer MRRU value that is set higher thatn the lower boundary of what is considered to be acceptable will be acknowledged.

In addition, the **ppp multilink mrru** interface command will allow specifying a minimum required peer MRRU value. If a lower value has been configured on a link interface or is inherited from a parent interface, software will send a negative acknowledgment along with the required minimum MRRU value to any peer with MRRU values that are below the established threshold.

When the bundle interface comes up, its MTU will be reduced if it exceeds the peer's MRRU for the duration of the existence of the bundle.

When a link joins a bundle, it must have the same values configured for the local and remote MRRU as the bundle does. If not, the link will be dropped and an error message will be displayed.

How to Configure PPP/MLP MRRU Negotiation Configuration

The following sections describe how to configure the PPP/MLP MRRU Negotiation Configuration feature.

Configuring PPP/MLP MRRU Negotiation Configuration on Virtual Templates

In this task, you configure MRRU negotiation on the serial interface. The bundle interface will be a virtual access interface cloned from the virtual template.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **multilink virtual-template** *number*
4. **interface virtual-template** *number*
5. **ip address** *ip-address mask*
6. **mtu** *bytes*
7. **exit**
8. **interface serial** *slot*/*port*
9. **ppp multilink**
10. **ppp multilink mrru** [**local** | **remote**] *mrru-value*
11. **mtu** *bytes*
12. **exit**

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.

	Command or Action	**Purpose**
Step 3	**multilink virtual-template** *number* **Example:** Device(config)# multilink virtual-template 1	Specifies a virtual template from which the specified MLP bundle interface can clone its interface parameters.
Step 4	**interface virtual-template** *number* **Example:** Device(config)# interface virtual-template 1	Creates a virtual template interface that can be configured and applied dynamically in creating virtual access interfaces, and enters interface configuration mode.
Step 5	**ip address** *ip-address mask* **Example:** Device(config-if)# ip address 10.13.1.1 255.255.255.0	Sets the IP address for the interface.
Step 6	**mtu** *bytes* **Example:** Device(config-if)# mtu 1600	(Optional) Adjusts the maximum packet size or MTU size. • Once you configure the MRRU on the bundle interface, you enable the DeviceDevice to receive large reconstructed MLP frames. You may want to configure the bundle MTU so the Device can transmit large MLP frames, although it is not strictly necessary. • The maximum recommended value for the bundle MTU is the value of the peer's MRRU. The default MTU for serial interfaces is 1500. The software will automatically reduce the bundle interface MTU if necessary, to avoid violating the peer's MRRU.
Step 7	**exit** **Example:** Device(config-if)# exit	Exits interface configuration mode and returns to global configuration mode.
Step 8	**interface serial** *slot*/*port* **Example:** Device(config)# interface serial 0/0	Selects a serial interface to configure and starts interface configuration mode.
Step 9	**ppp multilink** **Example:** Device(config-if)# ppp multilink	Enables MLP on an interface.

	Command or Action	Purpose
Step 10	`ppp multilink mrru [local	remote] mrru-value`  **Example:** `Device(config-if)# ppp multilink mrru local 1600`	Configures the MRRU value negotiated on a multilink bundle when MLP is used. • **local**—(Optional) Configures the local MRRU value. The default values for the local MRRU are the value of the multilink group interface MTU for multilink group members, and 1524 bytes for all other interfaces. • **remote**—(Optional) Configures the minimum value that the software will accept from the peer when it advertises its MRRU. By default, the software accepts any peer MRRU value of 128 or higher. You can specify a higher minimum acceptable MRRU value in a range from 128 to 16384 bytes.

Step 11	`mtu bytes`
	
	Example:
	`Device(config-if)# mtu 1600`
		(Optional) Adjusts the maximum packet size or MTU size.
		
		• The default MTU for serial interfaces is 1500.
		
		• When the bundle interface MTU is tuned to a higher number, then depending upon the fragmentation configuration, the link interface may be given larger frames to transmit.
		
		• You must ensure that fragmentation is performed such that fragments are sized less than the link interface MTU (refer to command pages for the **ppp multilink fragmentation** and **ppp multilink fragment-delay** commands for more information about packet fragments), or configure the MTUs of the link interfaces such that they can transmit the larger frames.

Step 12	`exit`
	
	Example:
	`Device(config-if)# exit`
		Exits interface configuration mode and returns to global configuration mode.
		
		• Return to Step 8 and configure additional interfaces, if necessary.

Troubleshooting Tips

Use the **debug ppp negotiation** command to verify and troubleshoot MRRU negotiation on virtual templates. Use the **show interface** command to verify MRRU negotiation on the interfaces.

Configuring PPP/MLP MRRU Negotiation Configuration on Multilink Groups

In this task, you configure MRRU negotiation on the multilink interface. The bundle interface is static, that is, always available.

SUMMARY STEPS

1. **enable**

2. **configure terminal**

3. **interface multilink** *number*

4. **ip address** *ip-address mask*

5. **ppp multilink mrru** [**local** | **remote**] *mrru-value*

6. **mtu** *bytes*

7. **exit**

8. **interface serial** *slot*/*port*

9. **ppp multilink**

10. **ppp multilink group** *group-number*

11. **mtu** *bytes*

12. **exit**

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	`interface multilink` *number* **Example:** `Device(config)# interface multilink 10`	Creates a virtual template interface that can be configured and applied dynamically in creating virtual access interfaces, and enters interface configuration mode.

Step 4	`ip address` *ip-address mask*
	
	Example:
	`Device(config-if)# ip address 10.13.1.1`
	`255.255.255.0`
		Sets the IP address for the interface.

Step 5	`ppp multilink mrru` [`local` | `remote`] *mrru-value*
	
	Example:
	`Device(config-if)# ppp multilink mrru local`
	`1600`
		Configures the MRRU value negotiated on a multilink bundle when MLP is used.
		
		• **local**—(Optional) Configures the local MRRU value. The default values for the local MRRU are the value of the multilink group interface MTU for multilink group members, and 1524 bytes for all other interfaces.
		
		• **remote**—(Optional) Configures the minimum value that the software will accept from the peer when it advertises its MRRU. By default, the software accepts any peer MRRU value of 128 or higher. You can specify a higher minimum acceptable MRRU value in a range from 128 to 16384 bytes.

	Command or Action	Purpose
Step 6	**mtu** *bytes* **Example:** Device(config-if)# mtu 1600	(Optional) Adjusts the maximum packet size or MTU size. • Once you configure the MRRU on the bundle interface, you enable the Device to receive large reconstructed MLP frames. You may want to configure the bundle MTU so the Device can transmit large MLP frames, although it is not strictly necessary. • The maximum recommended value for the bundle MTU is the value of the peer's MRRU. The default MTU for serial interfaces is 1500. The software will automatically reduce the bundle interface MTU if necessary, to avoid violating the peer's MRRU.
Step 7	**exit** **Example:** Device(config-if)# exit	Exits interface configuration mode and returns to global configuration mode.
Step 8	**interface serial** *slot*/*port* **Example:** Device(config)# interface serial 0/0	Selects a serial interface to configure and enters interface configuration mode.
Step 9	**ppp multilink** **Example:** Device(config-if)# ppp multilink	Enables MLP on the interface.
Step 10	**ppp multilink group** *group-number* **Example:** Device(config-if)# ppp multilink group 1	Restricts a physical link to joining only a designated multilink-group interface.
Step 11	**mtu** *bytes* **Example:** Device(config-if)# mtu 1600	(Optional) Adjusts the maximum packet size or MTU size. • The default MTU for serial interfaces is 1500. • When the bundle interface MTU is tuned to a higher number, then depending upon the fragmentation configuration, the link interface may be given larger frames to transmit. • You must ensure that fragmentation is performed such that fragments are sized less than the link interface MTU (refer to command pages for the **ppp multilink fragmentation** and **ppp multilink fragment-delay** commands for more information about packet fragments), or configure the MTUs of the link interfaces such that they can transmit the larger frames.
Step 12	**exit** **Example:** Device(config-if)# exit	Exits interface configuration mode and returns to global configuration mode.

Troubleshooting Tips

Use the **debug ppp negotiation** command to verify and troubleshoot MRRU negotiation on multilink groups. Use the **show interface** command to verify MRRU negotiation on the interfaces.

Configuring PPP/MLP MRRU Negotiation Configuration on Dialer Interfaces

In this task, you configure MRRU negotiation on the dialer interface. The bundle interface will be a virtual access interface cloned from the dialer interface.

SUMMARY STEPS

1. **enable**

2. **configure terminal**

3. **interface dialer** *number*

4. **ip address** *ip-address mask*

5. **encapsulation ppp**

6. **dialer** *configuration-commands*

7. **ppp multilink**

8. **ppp multilink mrru** [**local** | **remote**] *mrru-value*

9. **mtu** *bytes*

10. **exit**

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	`interface dialer` *number* **Example:** `Device(config)# interface dialer 1`	Defines a dialer rotary group and enters interface configuration mode.
Step 4	`ip address` *ip-address mask* **Example:** `Device(config-if)# ip address 10.13.1.1 255.255.255.0`	Sets the IP address for the interface.

	Command or Action	Purpose
Step 5	**encapsulation ppp** **Example:** Device(config-if)# encapsulation ppp	Sets the PPP encapsulation method.
Step 6	**dialer** *configuration-commands* **Example:** Device(config-if)# dialer string 5550101	Configures dialer interface characteristics. • The dialer commands you use depend upon your network configuration. Choose from dialer interface configuration commands such as **dialer remote-name**, **dialer idle-timeout**, **dialer string**, and **dialer pool**. See the "Configuration Examples for PPP/MLP MRRU Negotiation Configuration" and "Related Documents" sections for dialer interface configuration examples.
Step 7	**ppp multilink** **Example:** Device(config-if)# ppp multilink	Enables MLP on the interface.
Step 8	**ppp multilink mrru** [**local**	**remote**] *mrru-value* **Example:** Device(config-if)# ppp multilink mrru local 1600	Configures the MRRU value negotiated on a multilink bundle when MLP is used. • **local**—(Optional) Configures the local MRRU value. The default values for the local MRRU are the value of the multilink group interface MTU for multilink group members, and 1524 bytes for all other interfaces. • **remote**—(Optional) Configures the minimum value that the software will accept from the peer when it advertises its MRRU. By default, the software accepts any peer MRRU value of 128 or higher. You can specify a higher minimum acceptable MRRU value in a range from 128 to 16384 bytes.
Step 9	**mtu** *bytes* **Example:** Device(config-if)# mtu 1600	(Optional) Adjusts the maximum packet size or MTU size. • The default MTU for serial interfaces is 1500.
Step 10	**exit** **Example:** Device(config-if)# exit	Exits interface configuration mode and returns to global configuration mode.

Troubleshooting Tips

Use the **debug ppp negotiation** command to verify and troubleshoot MRRU negotiation on multilink groups. Use the **show interface** command to verify MRRU negotiation on dialer interfaces.

Configuration Examples for PPP/MLP MRRU Negotiation Configuration

This section contains the following examples:

PPP/MLP MRRU Negotiation Configuration on Virtual Templates: Example

The following example shows how to configure MRRU negotiation on a virtual template with synchronous serial interfaces. The example also applies to asynchronous serial interfaces.

```
multilink virtual-template 1
!
interface virtual-template 1
 ip address 10.13.1.1 255.255.255.0
 mtu 1600
!
interface serial 0/0
 ppp multilink
 ppp multilink mrru local 1600
 mtu 1600
!
interface serial 0/1
 ppp multilink
 ppp multilink mrru local 1600
 mtu 1600
```

PPP/MLP MRRU Negotiation Configuration on Multilink Groups: Example

The following example shows how to configure MRRU negotiation on multilink groups:

```
interface multilink 10
 ip address 10.13.1.1 255.255.255.0
 ppp multilink mrru local 1600
 mtu 1600
!
interface serial 0/0
 ppp multilink
 multilink-group 10
 mtu 1600
!
interface serial 0/1
 ppp multilink
 multilink-group 10
 mtu 1600
```

PPP/MLP MRRU Negotiation Configuration on Dialer Interfaces: Example

The following example shows how to configure MRRU negotiation on dialer interfaces:

```
interface dialer 1
 ip address 10.13.1.1 255.255.255.0
 encapsulation ppp
 dialer remote-name 2610-2
 dialer idle-timeout 30 inbound
 dialer string 5550101
 dialer pool 1
 dialer-group 1
 no cdp enable
 ppp multilink
 ppp multilink mrru local 1600
 mtu 1600
```

Additional References

The following sections provide references related to the PPP/MLP MRRU Negotiation Configuration feature.

Related Documents

Related Topic	Document Title
Configuring media-independent PPP and Multilink PPP	*"Part 9: PPP Configuration"* in the *Cisco IOS Dial Technologies Configuration Guide*
PPP and MLP commands	*Cisco IOS Dial Technologies Command Reference*

Standards

Standards	Title
None	—

MIBs

MIBs	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

RFCs	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/techsupport

Command Reference

The following commands are introduced or modified in the feature or features documented in this module. For information about these commands, see the *Cisco IOS Dial Technologies Command Reference* at http://www.cisco.com/en/US/docs/ios/dial/command/reference/dia_book.html. For information about all Cisco IOS commands, go to the Command Lookup Tool at http://tools.cisco.com/Support/CLILookup or to the *Cisco IOS Master Commands List*.

- **ppp multilink mrru**

Feature Information for PPP/MLP MRRU Negotiation Configuration

Table 1 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.

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which Cisco IOS and Catalyst OS software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Note Table 1 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 1   Feature Information for PPP/MLP MRRU Negotiation Configuration

Feature Name	Releases	Feature Information
PPP/MLP MRRU Negotiation Configuration	12.3(7)T 12.0(28)S 12.2(27)SB 12.2(25)S1 12.2(28)SB 12.2(33)SRC	The PPP/MLP MRRU Negotiation Configuration feature allows a device to send and receive frames over MLP bundles that are larger than the default MRRU limit of 1524 bytes.
	Cisco IOS Release XE 3.14S	In Cisco IOS Release XE 3.14S, support was added for the Cisco 4000 series Integrated Services Routers.