



## **MPLS Basic MPLS Configuration Guide, Cisco IOS Release 12.2SX**

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# Multiprotocol Label Switching Overview

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This chapter describes the Multiprotocol Label Switching (MPLS) distribution protocol. MPLS is a high-performance packet forwarding technology that integrates the performance and traffic management capabilities of data link layer (Layer 2) switching with the scalability, flexibility, and performance of network-layer (Layer 3) routing. It enables service providers to meet challenges brought about by explosive growth and provides the opportunity for differentiated services without necessitating the sacrifice of existing infrastructure.

The MPLS architecture is remarkable for its flexibility:

- Data can be transferred over any combination of Layer 2 technologies
- Support is offered for all Layer 3 protocols
- Scaling is possible well beyond anything offered in today's networks.

Specifically, MPLS can efficiently enable the delivery of IP services over an ATM switched network. It supports the creation of different routes between a source and a destination on a purely router-based Internet backbone. Service providers who use MPLS can save money and increase revenue and productivity.



## Note

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Label switching on a router requires that Cisco Express Forwarding be enabled on that router. Refer to the Cisco Express Forwarding feature documentation for configuration information.

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## Finding Feature Information

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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.

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## MPLS Tag Switching Terminology

Beginning with Cisco IOS Release 12.1, the Tag Switching distribution protocol has been replaced with the MPLS distribution protocol. The Tag Switching command-line interface (CLI) commands are supported but will be discontinued in a future release.

The table below lists tag switching terms (found in earlier releases of this document) and the equivalent MPLS terms used in this document.

**Table 1** *Equivalency Table for Tag Switching and MPLS Terms*

Old Tag Switching Terminology	New MPLS Terminology
Tag Switching	Multiprotocol Label Switching (MPLS)
Tag (short for Tag Switching)	MPLS
Tag (item or packet)	Label
TDP (Tag Distribution Protocol)	LDP (Label Distribution Protocol)  Cisco TDP and LDP (MPLS Label Distribution Protocol) are nearly identical in function, but use incompatible message formats and some different procedures. Cisco is changing from TDP to a fully compliant LDP.
Tag Switched	Label Switched
TFIB (Tag Forwarding Information Base)	LFIB (Label Forwarding Information Base)
TSR (Tag Switching Router)	LSR (Label Switching Router)
TSC (Tag Switch Controller)	LSC (Label Switch Controller)
ATM-TSR (ATM Tag Switch Router)	ATM-LSR (ATM Label Switch Router, such as the Cisco BPX 8650 switch)
TVC (Tag VC, Tag Virtual Circuit)	LVC (Label VC, Label Virtual Circuit)
TSP (Tag Switch Path)	LSP (Label Switch Path)
XTag ATM (extended Tag ATM port)	XmplsATM (extended MPLS ATM port)

## MPLS Commands and Saved Configurations

During the transition period from tag switching to MPLS, if a configuration command has both MPLS and tag switching forms, the tag switching version is written to saved configurations. For example, you can configure MPLS hop-by-hop forwarding for a router POS interface by issuing the following commands:

```
Router# configure terminal
Router(config)# interface POS3/0
Router(config-if)# mpls ip
```

In this example, the **mpls ip** command has a tag switching form (**tag-switching ip**). After you enter these commands and save this configuration or display the running configuration by means of the **showrunningconfiguration** command, the configuration commands appear as follows:

```
interface POS3/0
tag-switching ip
```

Saving the tag switching form of commands (that have both tag switching and MPLS forms) allows for backward compatibility. You can use a new router software image to modify and write configurations, and then later use configurations created by the new image with earlier software versions that do not support the MPLS forms of commands.

Using the tag switching forms of the commands allows older software that supports tag switching commands, but not new MPLS commands, to successfully interpret interface configurations.

## MPLS Tag Switching CLI Command Summary

The table below summarizes general-purpose MPLS commands. Except where otherwise noted, these MPLS commands have been derived from existing tag-switching commands to preserve the familiar syntax of existing commands that formed the basis for implementing new MPLS functionality. The tag-switching versions of the command will be discontinued in a future release.

**Table 2** Summary of MPLS Commands Described in this Document

Command	Corresponding Tag Switching Command	Description
<b>debug mpls adjacency</b>	<b>debug tag-switching adjacency</b>	Displays changes to label switching entries in the adjacency database.
<b>debug mpls events</b>	<b>debug tag-switching events</b>	Displays information about significant MPLS events.
<b>debug mpls lfib cef</b>	<b>debug tag-switching tfib cef</b>	Prints detailed information about label rewrites being created, resolved, and deactivated as CEF routes are added, changed, or removed.
<b>debug mpls lfib enc</b>	<b>debug tag-switching tfib enc</b>	Prints detailed information about label encapsulations while label rewrites are created or updated and placed into the label forwarding information base (LFIB).
<b>debug mpls lfib lsp</b>	<b>debug tag-switching tfib tsp</b>	Prints detailed information about label rewrites being created and deleted as TSP tunnels are added or removed.

Command	Corresponding Tag Switching Command	Description
<code>debug mpls lfib state</code>	<code>debug tag-switching tfib state</code>	Traces what happens when label switching is enabled or disabled.
<code>debug mpls lfib struct</code>	<code>debug tag-switching tfib struct</code>	Traces the allocation and freeing of LFIB-related data structures, such as the LFIB itself, label-rewrites, and label-info data.
<code>debug mpls packets</code>	<code>debug tag-switching packets</code>	Displays labeled packets switched by the host router.
<code>interface atm</code>	<code>interface atm</code>	Enters interface configuration mode, specifies ATM as the interface type, and enables the creation of a subinterface on the ATM interface.
<code>mpls atm control-vc</code>	<code>tag-switching atm control-vc</code>	Configures the VPI and VCI to be used for the initial link to the label switching peer device.
<code>mpls atm vpi</code>	<code>tag-switching atm vpi</code>	Configures the range of values to be used in the VPI field for label VCs.
<code>mpls ip (global configuration)</code>	<code>tag-switching ip (global configuration)</code>	Enables MPLS forwarding of IPv4 packets along normally routed paths for the platform.
<code>mpls ip (interface configuration)</code>	<code>tag-switching ip (interface configuration)</code>	Enables MPLS forwarding of IPv4 packets along normally routed paths for a particular interface.
<code>mpls ip default-route</code>	<code>tag-switching ip default-route</code>	Enables the distribution of labels associated with the IP default route.
<code>mpls ip propagate-ttl</code>	<code>tag-switching ip propagate-ttl</code>	Sets the time-to-live (TTL) value when an IP packet is encapsulated in MPLS.
<code>mpls ip ttl-expiration pop</code>	N/A	Forwards packets using the global IP routing table or the original label stack, depending on the number of labels in the packet.
<code>mpls label range</code>	<code>tag-switching tag-range downstream</code>	Configures the range of local labels available for use on packet interfaces.  <b>Note</b> The syntax of this command differs slightly from its tag-switching counterpart.
<code>mpls mtu</code>	<code>tag-switching mtu</code>	Sets the per-interface maximum transmission unit (MTU) for labeled packets.



Command	Corresponding Tag Switching Command	Description
<code>show mpls forwarding-table</code>	<code>show tag-switching forwarding-table</code>	Displays the contents of the label forwarding information base (LFIB).
<code>show mpls interfaces</code>	<code>show tag-switching interfaces</code>	Displays information about one or more interfaces that have been configured for label switching.
<code>show mpls label range</code>	N/A	Displays the range of local labels available for use on packet interfaces.

## Benefits

MPLS provides the following major benefits to service provider networks:

- Scalable support for Virtual Private Networks (VPNs)--MPLS enables VPN services to be supported in service provider networks, thereby greatly accelerating Internet growth.

The use of MPLS for VPNs provides an attractive alternative to the building of VPNs by means of either ATM or Frame Relay permanent virtual circuits (PVCs) or various forms of tunneling to interconnect routers at customer sites.

Unlike the PVC VPN model, the MPLS VPN model is highly scalable and can accommodate increasing numbers of sites and customers. The MPLS VPN model also supports “any-to-any” communication among VPN sites without requiring a full mesh of PVCs or the backhauling (suboptimal routing) of traffic across the service provider network. For each MPLS VPN user, the network of the service provider appears to function as a private IP backbone over which the user can reach other sites within the VPN organization, but not the sites of any other VPN organization.

From a user perspective, the MPLS VPN model enables network routing to be dramatically simplified. For example, rather than needing to manage routing over a topologically complex virtual backbone composed of many PVCs, an MPLS VPN user can generally employ the backbone of the service provider as the default route in communicating with all of the other VPN sites.

- Explicit routing capabilities (also called constraint-based routing or traffic engineering)--Explicit routing employs “constraint-based routing,” in which the path for a traffic flow is the shortest path that meets the resource requirements (constraints) of the traffic flow.

In MPLS traffic engineering, factors such as bandwidth requirements, media requirements, and the priority of one traffic flow versus another can be taken into account. These traffic engineering capabilities enable the administrator of a service provider network to perform the following tasks:

- - Control traffic flow in the network
  - Reduce congestion in the network
  - Make best use of network resources

Thus, the network administrator can specify the amount of traffic expected to flow between various points in the network (thereby establishing a traffic matrix), while relying on the routing system to perform the following tasks:

- - Calculate the best paths for network traffic
  - Set up the explicit paths to carry the traffic

## Label Switching Functions

In conventional Layer 3 forwarding mechanisms, as a packet traverses the network, each router extracts all the information relevant to forwarding the packet from the Layer 3 header. This information is then used as an index for a routing table lookup to determine the next hop for the packet.

In the most common case, the only relevant field in the header is the destination address field, but in some cases, other header fields might also be relevant. As a result, the header analysis must be done independently at each router through which the packet passes. In addition, a complicated table lookup must also be done at each router.

In label switching, the analysis of the Layer 3 header is done only once. The Layer 3 header is then mapped into a fixed length, unstructured value called a *label*.

Many different headers can map to the same label, as long as those headers always result in the same choice of next hop. In effect, a label represents a *forwarding equivalence class* --that is, a set of packets which, however different they may be, are indistinguishable by the forwarding function.

The initial choice of a label need not be based exclusively on the contents of the Layer 3 packet header; for example, forwarding decisions at subsequent hops can also be based on routing policy.

Once a label is assigned, a short label header is added at the front of the Layer 3 packet. This header is carried across the network as part of the packet. At subsequent hops through each MPLS router in the network, labels are swapped and forwarding decisions are made by means of MPLS forwarding table lookup for the label carried in the packet header. Hence, the packet header does not need to be reevaluated during packet transit through the network. Because the label is of fixed length and unstructured, the MPLS forwarding table lookup process is both straightforward and fast.

## Distribution of Label Bindings

Each label switching router (LSR) in the network makes an independent, local decision as to which label value to use to represent a forwarding equivalence class. This association is known as a label binding. Each LSR informs its neighbors of the label bindings it has made. This awareness of label bindings by neighboring routers is facilitated by the following protocols:

- Tag Distribution Protocol (TDP)--Used to support MPLS forwarding along normally routed paths
- Resource Reservation Protocol (RSVP)--Used to support MPLS traffic engineering
- Border Gateway Protocol (BGP)--Used to support MPLS virtual private networks (VPNs)

When a labeled packet is being sent from LSR A to the neighboring LSR B, the label value carried by the IP packet is the label value that LSR B assigned to represent the forwarding equivalence class of the packet. Thus, the label value changes as the IP packet traverses the network.

## MPLS and Routing

A label represents a forwarding equivalence class, but it does not represent a particular path through the network. In general, the path through the network continues to be chosen by the existing Layer 3 routing algorithms such as OSPF, Enhanced IGRP, and BGP. That is, at each hop when a label is looked up, the next hop chosen is determined by the dynamic routing algorithm.

## MPLS Traffic Engineering

MPLS traffic engineering software enables an MPLS backbone to replicate and expand upon the traffic engineering capabilities of Layer 2 ATM and Frame Relay networks. MPLS is an integration of Layer 2 and Layer 3 technologies. By making traditional Layer 2 features available to Layer 3, MPLS enables traffic engineering. Thus, you can offer in a one-tier network what now can be achieved only by overlaying a Layer 3 network on a Layer 2 network.

Traffic engineering is essential for service provider and Internet service provider (ISP) backbones. Such backbones must support a high use of transmission capacity, and the networks must be very resilient so that they can withstand link or node failures.

MPLS traffic engineering provides an integrated approach to traffic engineering. With MPLS, traffic engineering capabilities are integrated into Layer 3, which optimizes the routing of IP traffic, given the constraints imposed by backbone capacity and topology.

- [Why Use MPLS Traffic Engineering, page 7](#)
- [How MPLS Traffic Engineering Works, page 7](#)

## Why Use MPLS Traffic Engineering

WAN connections are an expensive item in an ISP budget. Traffic engineering enables ISPs to route network traffic to offer the best service to their users in terms of throughput and delay. By making the service provider more efficient, traffic engineering reduces the cost of the network.

Currently, some ISPs base their services on an overlay model. In the overlay model, transmission facilities are managed by Layer 2 switching. The routers see only a fully meshed virtual topology, making most destinations appear one hop away. If you use the explicit Layer 2 transit layer, you can precisely control how traffic uses available bandwidth. However, the overlay model has numerous disadvantages. MPLS traffic engineering achieves the traffic engineering benefits of the overlay model without running a separate network, and without needing a nonscalable, full mesh of router interconnects.

## How MPLS Traffic Engineering Works

MPLS traffic engineering automatically establishes and maintains LSPs across the backbone by using RSVP. The path that an LSP uses is determined by the LSP resource requirements and network resources, such as bandwidth.

Available resources are flooded by means of extensions to a link-state-based Interior Gateway Protocol (IGP).

Traffic engineering tunnels are calculated at the LSP head based on a fit between required and available resources (constraint-based routing). The IGP automatically routes the traffic onto these LSPs. Typically, a packet crossing the MPLS traffic engineering backbone travels on a single LSP that connects the ingress point to the egress point.

MPLS traffic engineering is built on the following Cisco IOS mechanisms:

- IP tunnel interfaces--From a Layer 2 standpoint, an MPLS tunnel interface represents the head of an LSP. It is configured with a set of resource requirements, such as bandwidth and media requirements, and priority.

From a Layer 3 standpoint, an LSP tunnel interface is the head-end of a unidirectional virtual link to the tunnel destination.

- MPLS traffic engineering path calculation module--This calculation module operates at the LSP head. The module determines a path to use for an LSP. The path calculation uses a link-state database containing flooded topology and resource information.
- RSVP with traffic engineering extensions--RSVP operates at each LSP hop and is used to signal and maintain LSPs based on the calculated path.
- MPLS traffic engineering link management module--This module operates at each LSP hop, does link call admission on the RSVP signalling messages, and does bookkeeping of topology and resource information to be flooded.
- Link-state IGP (Intermediate System-to-Intermediate System (IS-IS) or OSPF--each with traffic engineering extensions)--These IGPs are used to globally flood topology and resource information from the link management module.
- Enhancements to the SPF calculation used by the link-state IGP (IS-IS or OSPF)--The IGP automatically routes traffic onto the appropriate LSP tunnel based on tunnel destination. Static routes can also be used to direct traffic onto LSP tunnels.
- Label switching forwarding--This forwarding mechanism provides routers with a Layer 2-like ability to direct traffic across multiple hops of the LSP established by RSVP signalling.

One approach to engineering a backbone is to define a mesh of tunnels from every ingress device to every egress device. The MPLS traffic engineering path calculation and signalling modules determine the path taken by the LSPs for these tunnels, subject to resource availability and the dynamic state of the network. The IGP, operating at an ingress device, determines which traffic should go to which egress device, and steers that traffic into the tunnel from ingress to egress.

A flow from an ingress device to an egress device might be so large that it cannot fit over a single link, so it cannot be carried by a single tunnel. In this case, multiple tunnels between a given ingress and egress can be configured, and the flow is load-shared among them.

## MPLS Virtual Private Networks

Using MPLS VPNs in a Cisco IOS network provide the capability to deploy and administer scalable Layer 3 VPN backbone services including applications, data hosting network commerce, and telephony services to business customers. A VPN is a secure IP-based network that shares resources on one or more physical networks. A VPN contains geographically dispersed sites that can communicate securely over a shared backbone.

A one-to-one relationship does not necessarily exist between customer sites and VPNs; a given site can be a member of multiple VPNs. However, a site can associate with only one VPN routing and forwarding instance (VRF). Each VPN is associated with one or more VPN VRFs. A VRF includes routing and forwarding tables and rules that define the VPN membership of customer devices attached to CE routers. A VRF consists of the following:

- IP routing table
- CEF table
- Set of interfaces that use the CEF forwarding table
- Set of rules and routing protocol parameters to control the information in the routing tables

VPN routing information is stored in the IP routing table and the CEF table for each VRF. A separate set of routing and CEF tables is maintained for each VRF. These tables prevent information from being forwarded outside a VPN and also prevent packets that are outside a VPN from being forwarded to a router within the VPN.

## MPLS Quality of Service

The quality of service (QoS) feature for MPLS enables network administrators to provide differentiated types of service across an MPLS network. Differentiated service satisfies a range of requirements by supplying for each packet transmitted the particular kind of service specified for that packet by its QoS. Service can be specified in different ways, for example, using the IP precedence bit settings in IP packets.

In supplying differentiated service, MPLS QoS offers packet classification, congestion avoidance, and congestion management. The table below lists these functions and their descriptions.

**Table 3** QoS Services and Features

Service	QoS Function	Description
Packet classification	Committed access rate (CAR). Packets are classified at the edge of the network before labels are assigned.	Classifies packets according to input or output transmission rates. Allows you to set the MPLS experimental bits or the IP Precedence or DSCP bits (whichever is appropriate).
Congestion avoidance	Weighted Random Early Detection (WRED). Packet classes are differentiated based on drop probability.	Monitors network traffic to prevent congestion by dropping packets based on the IP Precedence or DSCP bits or the MPLS experimental field.
Congestion management	Class-based weighted fair queueing (CBWFQ). Packet classes are differentiated based on bandwidth and bounded delay.	An automated scheduling system that uses a queueing algorithm to ensure bandwidth allocation to different classes of network traffic.



### Note

MPLS QoS lets you duplicate Cisco IOS IP QoS (Layer 3) features as closely as possible in MPLS devices, including label edge routers (LERs), LSRs, and ATM-LSRs. MPLS QoS functions map nearly one-for-one to IP QoS functions on all interface types.

For more information on configuration of the QoS functions (CAR, WRED, and CBWFQ), refer to the *Cisco IOS Quality of Service Solutions Configuration Guide*.

For complete command syntax information for CAR, WRED, and WFQ, refer to the *Cisco IOS Quality of Service Solutions Command Reference*.

- [Specifying the QoS in the IP Precedence Field, page 9](#)

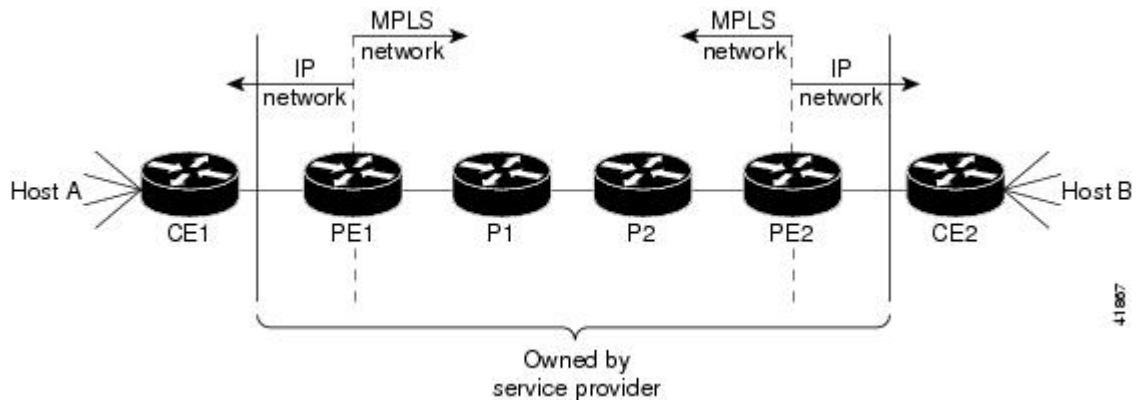
## Specifying the QoS in the IP Precedence Field

When you send IP packets from one site to another, the IP Precedence field (the first three bits of the DSCP field in the header of an IP packet) specifies the QoS. Based on the IP precedence marking, the packet is given the desired treatment such as the latency or the percent of bandwidth allowed for that quality of service. If the service provider network is an MPLS network, then the IP precedence bits are copied into the

MPLS EXP field at the edge of the network. However, the service provider might want to set a QoS for a MPLS packet to a different value determined by the service offering.

This feature allows the service provider to set the MPLS experimental field instead of overwriting the value in the IP precedence field belonging to a customer. The IP header remains available for the customer's use; the QoS of an IP packet is not changed as the packet travels through the MPLS network.

The figure below shows an MPLS network that connects two sites of a IP network belonging to a customer.

**Note**

The network is bidirectional, but for the purpose of this document the packets move left to right.

In the figure above, the symbols have the following meanings displayed in the table below:

**Table 4**      **Device Symbols**

Symbol	Meaning
CE1	Customer equipment 1
PE1	Service provider edge router (ingress LSR)
P1	Service provider router within the core of the network of the service provider
P2	Service provider router within the core of the network of the service provider
PE2	Service provider edge router (egress LSR)
CE2	Customer equipment 2

**Note**

Notice that PE1 and PE2 are at the boundaries between the MPLS network and the IP network.

In the figure above, the following behavior occurs:

- Packets arrive as IP packets at PE1, the provider edge router (also known as the ingress label switching router).
- PE1 sends the packets as MPLS packets.

- Within the service provider network, there is *no IP Precedence field* for the queueing mechanism to look at because the packets are MPLS packets. The packets remain MPLS packets until they arrive at PE2, the provider edge router.
- PE2 removes the label from each packet and forwards the packets as IP packets.

This MPLS QoS enhancement allows service providers to classify packets according to their type, input interface, and other factors by setting (marking) each packet within the MPLS experimental field without changing the IP Precedence or DSCP field. For example, service providers can classify packets with or without considering the rate of the packets that PE1 receives. If the rate is a consideration, the service provider marks in-rate packets differently from out-of-rate packets.

**Note**

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The MPLS experimental bits allow you to specify the QoS for an MPLS packet. The IP Precedence/DSCP bits allow you to specify the QoS for an IP packet.

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## MPLS MTU Command Changes

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This document explains the change in the behavior of the **mplsmtu** command for the following Cisco IOS releases:

- 12.2(27)SBC and later
- 12.2(33)SRA and later
- 12.2(33)SXH and later
- 12.4(11)T and later
- 15.0(1)M1
- 15.1(2)S

You cannot set the Multiprotocol Label Switching (MPLS) maximum transmission unit (MTU) to a value larger than the interface MTU value. This eliminates problems such as dropped packets, data corruption, and high CPU rates from occurring when the MPLS MTU value settings are larger than the interface MTU values. Cisco IOS software allows the MPLS MTU value to be higher than the interface MTU value only for interfaces that have a default interface MTU value of 1580 or less.



### Note

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In Cisco IOS Release 15.0(1)M1, you can configure the interface MTU on PA-1FE and PA-2FE port adapters (PAs). The range of values is from 1500 to 1530. Before this enhancement, the MTU of those interfaces was not configurable, and any attempt to configure the interface MTU displayed the following message: *%Interface{InterfaceName}doesnotsupportusersettablemtu*.

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- [Information About MPLS MTU Command Changes, page 14](#)
- [How to Configure MPLS MTU Values, page 15](#)
- [Configuration Examples for Setting the MPLS MTU Values, page 19](#)
- [Additional References, page 21](#)
- [Feature Information for MPLS MTU Command Changes, page 22](#)

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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.

## Information About MPLS MTU Command Changes

- [MPLS MTU Values During Upgrade](#), page 14
- [Guidelines for Setting MPLS MTU and Interface MTU Values](#), page 14
- [MPLS MTU Values for Ethernet Interfaces](#), page 15

## MPLS MTU Values During Upgrade

If you have configuration files with MPLS MTU values that are larger than the interface MTU values and you upgrade to Cisco IOS Release 12.2(27)SBC, 12.2(33)SRA, 12.4(11)T, 12.2(33)SXH, or later releases, the software does not change the MPLS MTU value. When you reboot the router, the software accepts the values that are set for the MPLS MTU and the interface MTU. The following error message is displayed during system initialization:

```
Setting the mpls mtu to xxxx on interface x/x, which is higher than the interface MTU
xxxx. This could lead to packet forwarding problems including packet drops.
You must set the MPLS MTU values equal to or lower than the interface MTU values.
```



### Caution

If you do not set the MPLS MTU less than or equal to the interface MTU, data corruption, dropped packets, and high CPU conditions can occur.

## Guidelines for Setting MPLS MTU and Interface MTU Values

When configuring the network to use MPLS, set the core-facing interface MTU values greater than the edge-facing interface MTU values using one of the following methods:

- Set the interface MTU values on the core-facing interfaces to a higher value than the interface MTU values on the customer-facing interfaces to accommodate any packet labels, such as MPLS labels, that an interface might encounter. Make sure that the interface MTUs on the remote end interfaces have the same interface MTU values. The interface MTU values on both ends of the link must match.
- Set the interface MTU values on the customer-facing interfaces to a lower value than the interface MTU on the core-facing interfaces to accommodate any packet labels, such as MPLS labels, that an interface might encounter. When you set the interface MTU on the edge interfaces, ensure that the interface MTUs on the remote end interfaces have the same values. The interface MTU values on both ends of the link must match.

Changing the interface MTU can also modify the IP MTU, Connectionless Network Service (CLNS) MTU, and other MTU values because they depend on the value of the interface MTU. The Open Shortest Path First (OSPF) routing protocol requires that the IP MTU values match on both ends of the link. Similarly, the Intermediate System-to-Intermediate System (IS-IS) routing protocol requires that the CLNS MTU values match on both ends of the link. If the values on both ends of the link do not match, IS-IS or OSPF cannot complete initialization.

If the configuration of the adjacent router does not include the `mplsmtu` and `mtu` commands, add these commands to the router.

**Note**

The MPLS MTU setting is displayed only in the show running-config output if the MPLS MTU value is different from the interface MTU value. If the values match, only the interface MTU value is displayed.

If you attempt to set the MPLS MTU value higher than the interface MTU value, the software displays the following error message, which prompts you to set the interface MTU to a higher value before you set the MPLS MTU value:

```
% Please increase interface mtu to xxxx and then set mpls mtu
```

**Note**

In Cisco IOS Release 15.1(2)S, the **mplsmtu** command was modified. This command was made available in L3VPN encapsulation configuration mode. The **maximum** keyword was replaced with the **max** keyword. The **override** keyword and the *bytes* argument were removed from the GRE tunnel interface. To set MPLS MTU to the maximum MTU on L3VPN profiles, use the **mplsmtu** command in L3VPN encapsulation configuration mode.

## MPLS MTU Values for Ethernet Interfaces

If you have an interface with a default interface MTU value of 1580 or less (such as an Ethernet interface), the **mplsmtu** command provides an **override** keyword, which allows you to set the MPLS MTU to a value higher than the interface MTU value. The **override** keyword is not available for interface types that do not have a default interface MTU value of 1580 or less. For configuration details, see the [Setting the MPLS MTU Value on an Ethernet Interface](#), page 17.

Setting the MPLS MTU value higher than the Ethernet interface MTU value can lead to dropped packets, data corruption, or high CPU rates. When you set the MPLS MTU value higher than the Ethernet interface MTU value, the software displays the following message:

```
%MFI-30-MPLS_MTU_SET: Setting the mpls mtu to xxxx on Ethernet x/x, which is higher than the interface MTU xxxx. This could lead to packet forwarding problems including packet drops.
```

```
Most drivers will be able to support baby giants and will gracefully drop packets that are too large. Certain drivers will have packet forwarding problems including data corruption.
```

```
Setting the mpls mtu higher than the interface mtu can lead to packet forwarding problems and may be blocked in a future release.
```

**Note**

The **override** keyword is supported in Cisco IOS Release 12.2(27)SBC, 12.2(33)SRA, 12.4(11)T, 12.2(33)SXH, and later releases, but may not be supported in a future release.

## How to Configure MPLS MTU Values

The following sections explain how to configure MPLS MTU and interface MTU values:

- [Setting the Interface MTU and MPLS MTU Values](#), page 16
- [Setting the MPLS MTU Value on an Ethernet Interface](#), page 17
- [Setting the MPLS MTU Value to the Maximum on L3VPN Profiles](#), page 18

## Setting the Interface MTU and MPLS MTU Values

Use the following steps to set the interface MTU and the MPLS MTU.



### Note

In Cisco IOS Release 15.0(1)M1, you can configure the interface MTU on PA-1FE and PA-2FE port adapters. The range of values is from 1500 to 1530. Before this enhancement, the MTU of those interfaces was not configurable.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type slot / port*
4. **mtu** *bytes*
5. **mpls mtu** *bytes*
6. **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>interface</b> <i>type slot / port</i>  <b>Example:</b> Router(config)# interface Serial 1/0	Enters interface configuration mode to configure the interface.
<b>Step 4</b> <b>mtu</b> <i>bytes</i>  <b>Example:</b> Router(config-if)# mtu 1520	Sets the interface MTU size.

Command or Action	Purpose
<b>Step 5</b> <code>mpls mtu bytes</code>  <b>Example:</b> <pre>Router(config-if)# mpls mtu 1520</pre>	Sets the MPLS MTU to match the interface MTU.
<b>Step 6</b> <code>end</code>  <b>Example:</b> <pre>Router(config-if)# end</pre>	Exits interface configuration mode and returns to privileged EXEC mode.

## Setting the MPLS MTU Value on an Ethernet Interface

Use the following steps to set the MPLS MTU value on an Ethernet interface.

### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `interface type slot / port`
4. `mpls mtu override bytes`
5. `end`

### 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>configure terminal</code>  <b>Example:</b> <pre>Router# configure terminal</pre>	Enters global configuration mode.
<b>Step 3</b> <code>interface type slot / port</code>  <b>Example:</b> <pre>Router(config)# interface ethernet 1/0</pre>	Enters interface configuration mode to configure the Ethernet interface.

Command or Action	Purpose
<b>Step 4</b> <code>mpls mtu override bytes</code>  <b>Example:</b> <pre>Router(config-if)# mpls mtu override 1510</pre>	Sets the MPLS MTU to a value higher than the interface MTU value.  <b>Caution</b> Setting the MPLS MTU to a value higher than the Ethernet interface MTU value can lead to dropped packets, data corruption, or high CPU rates.
<b>Step 5</b> <code>end</code>  <b>Example:</b> <pre>Router(config-if)# end</pre>	Exits interface configuration mode and returns to privileged EXEC mode.

## Setting the MPLS MTU Value to the Maximum on L3VPN Profiles

Use the following steps to set the MPLS MTU value to the maximum on L3VPN profiles.

### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `l3vpn encapsulation ip profile`
4. `mpls mtu max`
5. `end`

### 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>configure terminal</code>  <b>Example:</b> <pre>Router# configure terminal</pre>	Enters global configuration mode.
<b>Step 3</b> <code>l3vpn encapsulation ip profile</code>  <b>Example:</b> <pre>Router(config)# l3vpn encapsulation ip profile1</pre>	Configures an L3VPN encapsulation profile and enters the L3VPN encapsulation configuration mode.

Command or Action	Purpose
<p><b>Step 4</b> <code>mpls mtu max</code></p> <p><b>Example:</b></p> <pre>Router(config-l3vpn-encap-ip)# mpls mtu max</pre>	Sets the MPLS MTU value to the maximum MTU on the L3VPN profile.
<p><b>Step 5</b> <code>end</code></p> <p><b>Example:</b></p> <pre>Router(config-l3vpn-encap-ip)# end</pre>	Exits L3VPN encapsulation configuration mode and returns to privileged EXEC mode.

## Configuration Examples for Setting the MPLS MTU Values

- [Example Setting the Interface MTU and MPLS MTU, page 19](#)
- [Example Setting the MPLS MTU Value on an Ethernet Interface, page 20](#)
- [Example Setting the MPLS MTU Value to the Maximum MTU on L3VPN profiles, page 21](#)

### Example Setting the Interface MTU and MPLS MTU

The following example shows how to set the interface and MPLS MTU values. The serial interface in the following configuration examples is at the default interface MTU value. The MPLS MTU value is not set. The interface settings are as follows:

```
interface Serial 4/0
 ip unnumbered Loopback0
 mpls traffic-eng tunnels
 mpls ip
 serial restart-delay 0
 ip rsvp bandwidth 2000 2000
end
```

The following example attempts to set the MPLS MTU value to 1520. This returns an error because MPLS MTU cannot be set to a value greater than the value of the interface MTU.

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# interface serial 4/0
Router(config-if)# mpls mtu 1520
% Please increase interface mtu to 1520 and then set mpls mtu
```

The following example first sets the interface MTU to 1520 and then sets the MPLS MTU to 1520:

```
Router(config-if)# mtu 1520
Router(config-if)# mpls mtu 1520
```

The following example shows the new interface MTU value. The MPLS MTU value is not displayed because it is equal to the interface value.

```
Router#
```

```

show running-config interface serial 4/0
Building configuration...
interface Serial4/0
  mtu 1520
  ip unnumbered Loopback0
  mpls traffic-eng tunnels
  mpls ip
  serial restart-delay 0
  ip rsvp bandwidth 2000 2000
end

```

The following example sets the MPLS MTU value to 1510:

```
Router(config-if)# mpls mtu 1510
```

The following example shows the new interface MTU value. The MPLS MTU value is displayed because it is different than the interface MTU value.

```

Router#
show running-config interface serial 4/0
Building configuration...
interface Serial4/0
  mtu 1520
  ip unnumbered Loopback0
  mpls mtu 1510
  mpls traffic-eng tunnels
  mpls ip
  serial restart-delay 0
  ip rsvp bandwidth 2000 2000
end

```

## Example Setting the MPLS MTU Value on an Ethernet Interface



### Caution

---

Setting the MPLS MTU to a value higher than the Ethernet interface MTU value can lead to dropped packets, data corruption, or high CPU rates.

---

The following example shows how to set the MPLS MTU values on an Ethernet interface. The Ethernet interface in the following configuration examples is at the default interface MTU value. The MPLS MTU value is not set. The interface settings are as follows:

```

interface Ethernet 2/0
  ip unnumbered Loopback0
  mpls traffic-eng tunnels
  mpls ip
  serial restart-delay 0
  ip rsvp bandwidth 2000 2000
end

```

The following example uses the **override** keyword to set the MPLS MTU to 1520, which is higher than the Ethernet interface's MTU value:

```

Router(config-if)# mpls mtu override 1520
%MFI-30-MPLS_MTU_SET: Setting the mpls mtu to 1520 on Ethernet2/0, which is higher than
the interface MTU 1500. This could lead to packet forwarding problems including packet
drops.

```

The following example shows the new MPLS MTU value:

```

Router#
show running-config interface ethernet 2/0
Building configuration...
interface Ethernet 2/0
  mtu 1500

```



```

ip unnumbered Loopback0
mpls mtu 1520
mpls traffic-eng tunnels
mpls ip
serial restart-delay 0
ip rsvp bandwidth 2000 2000
end

```

## Example Setting the MPLS MTU Value to the Maximum MTU on L3VPN profiles

The following example shows how to set the MPLS MTU value to the maximum MTU on L3VPN profiles:

```

Router# configure terminal
Router(config)# l3vpn encapsulation ip profile1
Router(config-l3vpn-encap-ip)# mpls mtu max

```

## Additional References

### Related Documents

Related Topic	Document Title
Cisco IOS commands	<a href="#">Cisco IOS Master Commands List, All Releases</a>
MPLS commands	

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

### Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

## Feature Information for MPLS MTU Command Changes

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.

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**Table 5** Feature Information for MPLS MTU Command Changes

Feature Name	Releases	Feature Information
MPLS MTU Command Changes	12.2(27)SBC 12.2(28)SB 12.2(33)SRA 12.2(33)SXH 12.4(11)T 15.0(1)M1 15.1(2)S	<p>This document explains the changes to the <b>mplsmtu</b> command. You cannot set the MPLS MTU value larger than the interface MTU value, except for Ethernet interfaces.</p> <p>In 12.2(28)SB, support was added for the Cisco 10000 router.</p> <p>In 12.2(33)SRA, support was added for the Cisco 7600 series router.</p> <p>This feature was integrated into Cisco IOS Release 12.4(11)T.</p> <p>This feature was integrated into Cisco IOS Release 12.2(33)SXH.</p> <p>In 15.0(1)M1, you can configure the interface MTU on PA-1FE and PA-2FE port adapters.</p> <p>In 15.1(2)S, the <b>mplsmtu</b> command was made available in L3VPN encapsulation configuration mode. The <b>maximum</b> keyword was replaced with the <b>max</b> keyword. The <b>override</b> keyword and the <i>bytes</i> argument were removed from the GRE tunnel interface.</p>

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