



# MPLS LDP-VRF-Aware Static Labels

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This document explains how to configure the MPLS LDP--VRF-Aware Static Labels feature and Multiprotocol Label Switching (MPLS) static labels. Virtual Private Network routing and forwarding (VRF)-aware static labels can be used at the edge of an MPLS Virtual Private Network (VPN), whereas MPLS static labels can be used only in the MPLS VPN provider core.

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## Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

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

## Information About

To configure and use VRF-aware static labels, you should understand the following concepts:

- [Overview of MPLS Static Labels and MPLS LDP--VRF-Aware Static Labels, page 2](#)
- [Labels Reserved for Static Assignment, page 2](#)



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**Americas Headquarters:**  
Cisco Systems, Inc., 170 West Tasman Drive, San Jose, CA 95134-1706 USA

## Overview of MPLS Static Labels and MPLS LDP--VRF-Aware Static Labels

Label switch routers (LSRs) dynamically learn the labels they should use to label-switch packets by means of the following label distribution protocols:

- Label Distribution Protocol (LDP), the Internet Engineering Task Force (IETF) standard used to bind labels to network addresses
- Resource Reservation Protocol (RSVP) used to distribute labels for traffic engineering (TE)
- Border Gateway Protocol (BGP) used to distribute labels for MPLS VPNs

The LSR installs the dynamically learned label into its Label Forwarding Information Base (LFIB).

You can configure static labels for the following purposes:

- To bind labels to IPv4 prefixes to support MPLS hop-by-hop forwarding through neighbor routers that do not implement LDP label distribution. MPLS static labels allow you to configure entries in the MPLS forwarding table and assign label values to forwarding equivalence classes (FECs) learned by LDP. You can manually configure an LSP without running an LDP between the endpoints.
- To create static cross connects to support MPLS label switched path (LSP) midpoints when neighbor routers do not implement the LDP or RSVP label distribution, but do implement an MPLS forwarding path.
- To statically bind a VRF-aware label on a provider edge (PE) router to a customer network prefix (VPN IPv4 prefix). VRF-aware static labels can be used with nonglobal VRF tables, so the labels can be used at the VPN edge. For example, with the Carrier Supporting Carrier (CSC) feature, the backbone carrier can assign specific labels to FECs it advertises to the edge routers of customer carriers. Then, backbone carrier can monitor backbone traffic coming from particular customer carriers for billing or other purposes. Depending on how you configure VRF-aware static labels, they are advertised one of the following ways:
  - By LDP between PE and customer edge (CE) routers within a VRF instance
  - In VPNv4 BGP in the service provider's backbone

## Labels Reserved for Static Assignment

Before you can manually assign labels, you must reserve a range of labels to be used for the manual assignment. Reserving the labels ensures that the labels are not dynamically assigned. If you are running Cisco IOS Release 12.0S or an older release, you may need to reload the router for the range of labels you reserve to take effect.

## How to Configure MPLS LDP--VRF-Aware Static Labels

- [Reserving Labels to Use for MPLS Static Labels and MPLS LDP--VRF-Aware Static Labels, page 3](#)
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- [Configuring MPLS Static Cross Connects, page 5](#)
- [Configuring MPLS LDP--VRF-Aware Static Labels at the Edge of the VPN, page 6](#)

## Reserving Labels to Use for MPLS Static Labels and MPLS LDP--VRF-Aware Static Labels

The following procedure explains how to reserve the labels that are to be statically assigned so that the labels are not dynamically assigned.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls label range** minimum-value maximum-value [**static** minimum-static-value maximum-static-value]
4. **end**
5. **show mpls label range**

### DETAILED STEPS

Command or Action	Purpose
<p><b>Step 1</b> <b>enable</b></p> <p><b>Example:</b></p> <pre>Router&gt; enable</pre>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<p><b>Step 2</b> <b>configure terminal</b></p> <p><b>Example:</b></p> <pre>Router# configure terminal</pre>	<p>Enters global configuration mode.</p>
<p><b>Step 3</b> <b>mpls label range</b> minimum-value maximum-value [<b>static</b> minimum-static-value maximum-static-value]</p> <p><b>Example:</b></p> <pre>Router(config)# mpls label range 200 100000 static 16 199</pre>	<p>Reserves a range of labels for static labels assignment. The default is that no labels are reserved for static assignment.</p> <p><b>Note</b> You might need to reload the router for the range of labels you reserve to take effect.</p>
<p><b>Step 4</b> <b>end</b></p> <p><b>Example:</b></p> <pre>Router(config)# end</pre>	<p>Exits global configuration mode.</p>

Command or Action	Purpose
<b>Step 5</b> <code>show mpls label range</code>  <b>Example:</b>  <pre>Router# show mpls label range</pre>	Displays information about the range of values for local labels, including those available for static assignment.

## Configuring MPLS Static Labels in the MPLS VPN Provider Core

MPLS static labels allow you to configure entries in the MPLS forwarding table and assign label values to FECs learned by LDP. You can manually configure an LSP without running a label distribution protocol between the endpoints. In MPLS VPN networks, static labels can be used only in the MPLS VPN provider core.

- Globally enable MPLS on each LSR.
- Enable Cisco Express Forwarding on each LSR.

### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `mpls static binding ipv4 prefix mask {label | input label | output nexthop {explicit-null | implicit-null | label}}`
4. `end`
5. `show mpls static binding ipv4`
6. `show mpls forwarding-table`

### 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 and returns to privileged EXEC mode.

Command or Action	Purpose
<p><b>Step 3</b> <code>mpls static binding ipv4 prefix mask {label   input label   output nexthop {explicit-null   implicit-null   label}}</code></p> <p><b>Example:</b></p> <pre>Router(config)# mpls static binding ipv4 10.2.2.0 255.255.255.255 input 17</pre>	<p>Specifies static binding of labels to IPv4 prefixes. Specified bindings are installed automatically in the MPLS forwarding table as routing demands.</p>
<p><b>Step 4</b> <code>end</code></p> <p><b>Example:</b></p> <pre>Router(config)# end</pre>	<p>Exits global configuration mode and enters privileged EXEC mode.</p>
<p><b>Step 5</b> <code>show mpls static binding ipv4</code></p> <p><b>Example:</b></p> <pre>Router# show mpls static binding ipv4</pre>	<p>Displays the configured static labels.</p>
<p><b>Step 6</b> <code>show mpls forwarding-table</code></p> <p><b>Example:</b></p> <pre>Router# show mpls forwarding-table</pre>	<p>Displays the static labels used for MPLS forwarding.</p>

## Configuring MPLS Static Cross Connects

You can configure MPLS static cross connects to support MPLS LSP midpoints when neighbor routers do not implement either the LDP or RSVP label distribution, but do implement an MPLS forwarding path.

- Globally enable MPLS on each LSR.
- Enable Cisco Express Forwarding on each LSR.



**Note**

- MPLS static cross connect functionality is supported in Cisco IOS Releases 12.0(23)S and 12.3(14)T and later releases. It is not supported in Cisco IOS Release 12.4(20)T.
- MPLS static cross-connect labels remain in the LFIB even if the router to which the entry points goes down.
- MPLS static cross-connect mappings remain in effect even with topology changes.

>

**SUMMARY STEPS**

1. **enable**
2. **configure terminal**
3. `mpls static crossconnect inlabel out-interface nexthop {outlabel| explicit-null| implicit-null}`
4. **end**
5. `show mpls static crossconnect`

**DETAILED STEPS**

Command or Action	Purpose
<b>Step 1</b> <b>enable</b>  <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> <b>configure terminal</b>  <b>Example:</b> <pre>Router# configure terminal</pre>	Enters global configuration mode.
<b>Step 3</b> <code>mpls static crossconnect inlabel out-interface nexthop {outlabel  <b>explicit-null</b>  <b>implicit-null</b>}</code>  <b>Example:</b> <pre>Router(config)# mpls static crossconnect 45 pos5/0 45 explicit-null</pre>	Specifies static cross connects. <b>Note</b> The <i>nexthop</i> argument is required for multiaccess interfaces.
<b>Step 4</b> <b>end</b>  <b>Example:</b> <pre>Router(config)# end</pre>	Exits global configuration mode and returns to privileged EXEC mode.
<b>Step 5</b> <code>show mpls static crossconnect</code>  <b>Example:</b> <pre>Router# show mpls static crossconnect</pre>	Displays the configured static cross connects.

**Configuring MPLS LDP--VRF-Aware Static Labels at the Edge of the VPN**

You can statically bind a VRF-aware label on a PE router to a customer network prefix (VPN IPv4 prefix). VRF-aware static labels can be used with nonglobal VRF tables, so the labels can be used at the VPN edge.

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- [Troubleshooting Tips, page 8](#)

## Restrictions

- Globally enable MPLS on each LSR.
- Enable Cisco Express Forwarding on each LSR.
- Ensure the MPLS VPN is configured. See [MPLS VPN Carrier Supporting Carrier Using LDP and IGP](#) for information about configuring the VPN and VRFs.
- Ensure that the provider network has MPLS LDP installed and running. See [MPLS VPN Carrier Supporting Carrier Using LDP and IGP](#) for information about configuring LDP.



**Note**

The MPLS LDP-VRF-Aware Static Labels feature is supported only with MPLS VPN Carrier Supporting Carrier networks that use MPLS LDP.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **mpls static binding ipv4 vrf *vpn-name prefix mask* {input *label*} label }**
4. **end**
5. **show mpls static binding ipv4 vrf *vpn-name***

### DETAILED STEPS

Command or Action	Purpose
<p><b>Step 1</b> <b>enable</b></p> <p><b>Example:</b></p> <pre>Router&gt; enable</pre>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<p><b>Step 2</b> <b>configure terminal</b></p> <p><b>Example:</b></p> <pre>Router# configure terminal</pre>	<p>Enters global configuration mode.</p>
<p><b>Step 3</b> <b>mpls static binding ipv4 vrf <i>vpn-name prefix mask</i> {input <i>label</i>} label }</b></p> <p><b>Example:</b></p> <pre>Router(config)# mpls static binding ipv4 vrf vpn100 10.2.0.0 255.255.0.0 input 17</pre>	<p>Binds a prefix to a local label.</p> <p>Specified bindings are installed automatically in the MPLS forwarding table as routing demands.</p> <p><b>Note</b> You must configure the MPLS VPN and VRFs before creating VRF-aware static labels.</p>

Command or Action	Purpose
<b>Step 4</b> <code>end</code>  <b>Example:</b>  <pre>Router(config)# end</pre>	Exits global configuration mode and enters privileged EXEC mode.
<b>Step 5</b> <code>show mpls static binding ipv4 vrf vpn-name</code>  <b>Example:</b>  <pre>Router(config)# show mpls static binding ipv4 vrf vpn100</pre>	Displays the configured MPLS static bindings.

## Troubleshooting Tips

To display information related to static binding events, use the **debug mpls static binding vrf** command.

# Configuration Examples for MPLS LDP--VRF-Aware Static Labels

- [Reserving Labels to Use for MPLS Static Labels and MPLS LDP--VRF-Aware Static Labels Example, page 8](#)
- [Configuring MPLS Static Labels in the MPLS VPN Provider Core Example, page 9](#)
- [Configuring MPLS Static Cross Connects Example, page 9](#)
- [Configuring MPLS LDP--VRF-Aware Static Labels at the VPN Edge Example, page 9](#)

## Reserving Labels to Use for MPLS Static Labels and MPLS LDP--VRF-Aware Static Labels Example

In the following example, the `mpls label range` command reserves a generic range of labels from 200 to 100000 and configures a static label range of 16 to 199:

```
Router(config)# mpls label range 200 100000 static 16 199
% Label range changes take effect at the next reload.
```

In this example, the output from the `show mpls label range` command indicates that the new label ranges do not take effect until a reload occurs:

```
Router# show mpls label range

Downstream label pool: Min/Max label: 16/100000
 [Configured range for next reload: Min/Max label: 200/100000]
Range for static labels: Min/Max/Number: 16/199
```



In the following output, the **show mpls label range** command, executed after a reload, indicates that the new label ranges are in effect:

```
Router# show mpls label range

Downstream label pool: Min/Max label: 200/100000
Range for static labels: Min/Max/Number: 16/199
```

## Configuring MPLS Static Labels in the MPLS VPN Provider Core Example

The following example configures input and output labels for several prefixes:

```
Router(config)# mpls static binding ipv4 10.0.0.0 255.0.0.0 55
Router(config)# mpls static binding ipv4 10.0.0.0 255.0.0.0 output 10.0.0.66 167
Router(config)# mpls static binding ipv4 10.66.0.0 255.255.0.0 input 17

Router(config)# mpls static binding ipv4 10.66.0.0 255.255.0.0 output 10.13.0.8 explicit-
null
```

The **show mpls static binding ipv4** command displays the configured static labels:

```
Router# show mpls static binding ipv4

10.0.0.0/8: Incoming label: 55
  Outgoing labels:
    10.0.0.66 167
10.66.0.0/24: Incoming label: 17
  Outgoing labels:
    10.13.0.8 explicit-null
```

## Configuring MPLS Static Cross Connects Example

In the following example, the **mpls static crossconnect** command configures a cross connect from incoming label 45 to outgoing label 46 on the POS interface 5/0:

```
Router(config)# mpls static crossconnect 45 pos5/0 46
```

The **show mpls static crossconnect** command displays information about cross connects that have been configured:

```
Router# show mpls static crossconnect
Local  Outgoing  Outgoing  Next Hop
label  label      interface
45     46         pos5/0    point2point (in LFIB)
```

## Configuring MPLS LDP--VRF-Aware Static Labels at the VPN Edge Example

In the following example, the **mpls static binding ipv4 vrf** commands configure static label bindings. They also configure input (local) labels for various prefixes.

```
Router(config)# mpls static binding ipv4 vrf vpn100 10.0.0.0 10.0.0.0 55
Router(config)# mpls static binding ipv4 vrf vpn100 10.66.0.0 255.255.0.0 input 17
```

In the following output, the **show mpls static binding ipv4 vrf** command displays the configured VRF-aware static bindings:

```
Router# show mpls static binding ipv4 vrf
vpn100
```

```

10.0.0.0/8: (vrf: vpn100) Incoming label: 55
           Outgoing labels: None
10.66.0.0/16: (vrf: vpn100) Incoming label: 17
            Outgoing labels: None

```

## Additional References

The following sections provide references related to the MPLS LDP--VRF-Aware Static Labels feature.

### Related Documents

Related Topic	Document Title
MPLS VPN CSC with LDP and IGP	MPLS VPN Carrier Supporting Carrier Using LDP and IGP

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

### RFCs

RFC	Title
	No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.

### Technical Assistance

Description	Link
<p>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</p> <p>To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds.</p> <p>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</p>	<a href="http://www.cisco.com/techsupport">http://www.cisco.com/techsupport</a>

## 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 Multiprotocol Label Switching Command Reference* at [http://www.cisco.com/en/US/docs/ios/mpls/command/reference/mp\\_book.html](http://www.cisco.com/en/US/docs/ios/mpls/command/reference/mp_book.html) . For information about all Cisco IOS commands, use the Command Lookup Tool at <http://tools.cisco.com/Support/CLILookup> or the *Cisco IOS Master Command List, All Releases* , at [http://www.cisco.com/en/US/docs/ios/mcl/allreleasemcl/all\\_book.html](http://www.cisco.com/en/US/docs/ios/mcl/allreleasemcl/all_book.html) .

- **debug mpls static binding**
- **mpls label range**
- **mpls static binding ipv4**
- **mpls static binding ipv4 vrf**
- **show mpls label range**
- **show mpls static binding ipv4**
- **show mpls static binding ipv4 vrf**

## Feature Information for MPLS LDP--VRF-Aware Static Labels

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 1**      **Feature Information for MPLS LDP--VRF-Aware Static Labels**

Feature Name	Releases	Feature Information
MPLS LDP-VRF-Aware Static Labels	12.0(23)S 12.0(26)S 12.3(14)T 12.2(33)SRA 12.2(33)SXH 12.2(33)SB	<p>The MPLS LDP-VRF-Aware Static Labels feature explains how to configure the MPLS LDP--VRF-Aware Static Labels feature and MPLS static labels. VVRF-aware static labels can be used at the edge of an MPLS VPN, whereas MPLS static labels can be used only in the MPLS VPN provider core.</p> <p>In 12.0(23)S, MPLS static labels were introduced, but they supported only global routing tables.</p> <p>In 12.0(26)S, the MPLS LDP--VRF-Aware Static Labels feature was introduced, allowing MPLS static labels to be used for VRF traffic at the VPN edge.</p> <p>In 12.3(14)T, this feature was integrated.</p> <p>In 12.2(33)SRA, this feature was integrated.</p> <p>In 12.2(33)SXH, this feature was integrated.</p> <p>In 12.2(33)SB, support was added for the Cisco 10000 series router.</p>

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