

MPLS LDP VRF-Aware Static Labels

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.

- Information About MPLS LDP VRF-Aware Static Labels, on page 1
- How to Configure MPLS LDP VRF-Aware Static Labels, on page 2
- Configuration Examples for MPLS LDP VRF-Aware Static Labels, on page 7
- Additional References, on page 9
- Feature Information for MPLS LDP VRF-Aware Static Labels, on page 9

Information About MPLS LDP VRF-Aware Static Labels

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 Multiprotocol Label Switching (MPLS) virtual private networks (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 devices 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 devices do not implement the LDP or RSVP label distribution, but do implement an MPLS forwarding path.

- To statically bind a virtual routing and forwarding (VRF)-aware label on a provider edge (PE) device 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 devices 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) devices 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.

How to Configure MPLS LDP VRF-Aware Static Labels

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

To reserve the labels that are to be statically assigned so that the labels are not dynamically assigned, perform the following task.

SUMMARY STEPS

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

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:**	Enters global configuration mode.

	Command or Action	Purpose
	`Device# configure terminal`	
Step 3	**mpls label range** *minimum-value maximum-value* [**static** *minimum-static-value maximum-static-value*] **Example:** `Device(config)# mpls label range 200 100000 static 16 199`	Reserves a range of labels for static labels assignment. The default is that no labels are reserved for static assignment. **Note** You might need to reload the device for the range of labels you reserve to take effect.
Step 4	**exit** **Example:** `Device(config)# exit`	Returns to privileged EXEC mode.
Step 5	**show mpls label range** **Example:** `Device# show mpls label range`	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

To configure MPLS static labels in the MPLS virtual private network (VPN) provider core, perform the following task.

MPLS static labels allow you to configure entries in the MPLS forwarding table and assign label values to forwarding equivalence classes (FECs) learned by the Label Distribution Protocol (LDP). You can manually configure a label switched path (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.

Note When static MPLS labels are used, LDP must be enabled on the interfaces, even though there is no need to establish an LDP session between devices.

Before you begin

- Globally enable Multiprotocol Label Switching (MPLS) on each label switch router (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. **exit**

5. **show mpls static binding ipv4**
6. **show mpls forwarding-table**

DETAILED STEPS

Procedure

	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	**mpls static binding ipv4** *prefix mask* {*label* | **input** *label* | **output** *nexthop* {**explicit-null** | **implicit-null** | *label*}} **Example:** `Device(config)# mpls static binding ipv4 10.2.2.0 255.255.255.255 input 17`	Specifies static binding of labels to IPv4 prefixes. • Specified bindings are installed automatically in the MPLS forwarding table as routing demands.
Step 4	**exit** **Example:** `Device(config)# exit`	Returns to privileged EXEC mode.
Step 5	**show mpls static binding ipv4** **Example:** `Device# show mpls static binding ipv4`	Displays the configured static labels.
Step 6	**show mpls forwarding-table** **Example:** `Device# show mpls forwarding-table`	Displays the static labels used for MPLS forwarding.

Configuring MPLS Static Cross Connects

You can configure MPLS static cross connects to support MPLS LSP midpoints when neighbor devices do not implement either the Label Distribution Protocol (LDP) or Resource Reservation Protocol (RSVP) label distribution, but do implement an MPLS forwarding path.

Before you begin

- Globally enable Multiprotocol Label Switching (MPLS) on each label switch router (LSR).
- Enable Cisco Express Forwarding on each LSR.



Note
- MPLS static cross-connect labels remain in the Label Forwarding Information Base (LFIB) even if the device 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

Procedure

	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	**mpls static crossconnect** *inlabel out-interface nexthop* {*outlabel*	**explicit-null**	**implicit-null**} **Example:** `Device(config)# mpls static crossconnect 45 pos5/0 45 explicit-null`	Specifies static cross connects. **Note** The *nexthop* argument is required for multiaccess interfaces.
Step 4	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

	Command or Action	Purpose
Step 5	**show mpls static crossconnect** **Example:** `Device# show mpls static crossconnect`	Displays the configured static cross connects.

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

You can statically bind a virtual routing and forwarding (VRF)-aware label on a provider edge (PE) device 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.

Before you begin

- Globally enable Multiprotocol Label Switching (MPLS) on each label switch router (LSR).
- Enable Cisco Express Forwarding on each LSR.
- Ensure the MPLS virtual private network (VPN) is configured.
- Ensure that the provider network has the MPLS Label Distribution Protocol (LDP) installed and running.

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. **exit**
5. **show mpls static binding ipv4 vrf** *vpn-name*

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:**	Enters global configuration mode.

	Command or Action	Purpose
	`Device# configure terminal`	
Step 3	**mpls static binding ipv4 vrf** *vpn-name prefix mask* {**input** *label* | *label*} **Example:** `Device(config)# mpls static binding ipv4 vrf vpn100 10.2.0.0 255.255.0.0 input 17`	Binds a prefix to a local label. • Specified bindings are installed automatically in the MPLS forwarding table as routing demands. **Note** You must configure the MPLS VPN and VRFs before creating VRF-aware static labels.
Step 4	**exit** **Example:** `Device(config)# exit`	Returns to privileged EXEC mode.
Step 5	**show mpls static binding ipv4 vrf** *vpn-name* **Example:** `Device(config)# show mpls static binding ipv4 vrf vpn100`	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

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

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:

```
Device(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:

```
Device# 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:

```
Device# show mpls label range

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

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

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

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

```
Device# 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
```

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

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

```
Device(config)# mpls static binding ipv4 vrf vpn100 10.0.0.0 10.0.0.0 55
Device(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:

```
Device# 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

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
MPLS commands	Cisco IOS Multiprotocol Label Switching Command Reference
MPLS VPN CSC with LDP and IGP	"MPLS VPN Carrier Supporting Carrier Using LDP and IGP" module in the *MPLS Layer 3 VPNs Inter-AS and CSC Configuration Guide*

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.	http://www.cisco.com/cisco/web/support/index.html

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.

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. An account on Cisco.com is not required.