



Implementing MPLS Static Labeling

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MPLS Static Labeling

The MPLS static feature enables you to statically assign local labels to an IPv4 prefix. Also, Label Switched Paths (LSPs) can be provisioned for these static labels by specifying the next-hop information that is required to forward the packets containing static label.

If there is any discrepancy between labels assigned statically and dynamically, the router issues a warning message in the console log. By means of this warning message, the discrepancy can be identified and resolved.

The advantages of static labels over dynamic labels are:

- Improve security because the risk of receiving unwanted labels from peers (running a compromised MPLS dynamic labeling protocol) is reduced.
- Gives users full control over defined LSPs.
- Utilize system resources optimally because dynamic labeling is not processed.
- Static labeling on IPv6 packets is supported.

Restrictions

- The router does not prevent label discrepancy at the time of configuring static labels. Any generated discrepancy needs to be subsequently cleared.
- Equal-cost multi-path routing (ECMP) is not supported.
- Interfaces must be explicitly configured to handle traffic with static MPLS labels.
- When paths of different technologies are resolved over ECMP, it results in *heterogeneous* ECMP, leading to severe network traffic issues. Don't use ECMP for any combination of the following technologies:
 - LDP.
 - BGP-LU, including services over BGP-LU loopback peering or recursive services at Level-3.
 - VPNv4.
 - 6PE and 6VPE.

- EVPN.
- Recursive static routing.

Define Label Range and Enable MPLS Encapsulation

By default, MPLS encapsulation is disabled on all interfaces. MPLS encapsulation has to be explicitly enabled on all ingress and egress MPLS interfaces through which the static MPLS labeled traffic travels.

Also, the dynamic label range needs to be defined. Any label that falls outside this dynamic range is available for manually allocating as static labels. The router does not verify statically-configured labels against the specified label range. Therefore, to prevent label discrepancy, ensure that you do not configure static MPLS labels that fall within the dynamic label range.



Note For Cisco IOS XR software release 7.5.2 onwards, MPLS static supports 200G Ethernet.

Configuration Example

You have to accomplish the following to complete the MPLS static labeling configuration. Values are provided as an example.

1. Define a dynamic label range, which in this task is set between 17000 and 18000.
2. Enable MPLS encapsulation on the required interface.
3. Setup a static MPLS LSP for a specific ingress label 24035.
4. Specify the forwarding information so that for packets that are received with the label, 24035, the MPLS protocol swaps labels and applies the label, 24036. After applying the new label, it forwards the packets to the next hop, 10.2.2.2, through the specified interface.

```
RP/0/RP0/CPU0:router(config)#mpls label range table 0 17000 18000
RP/0/RP0/CPU0:router(config)#commit

RP/0/RP0/CPU0:router(config)#mpls static

RP/0/RP0/CPU0:router(config-mpls-static)#interface tenGigE 0/0/0/5
RP/0/RP0/CPU0:router(config-mpls-static)#address-family ipv4 unicast
RP/0/RP0/CPU0:router(config-mpls-static-af)#local-label 24035 allocate

RP/0/RP0/CPU0:router(config-mpls-static-af-lbl)#forward
RP/0/RP0/CPU0:router(config-mpls-static-af-lbl-fwd)#path 1 nexthop tenGigE 0/0/0/1 10.2.2.2
out-label 24036

RP/0/RP0/CPU0:router(config-mpls-static-af-lbl-fwd)# commit
```

Verification

Verify the interfaces on which MPLS is enabled

```
RP/0/RP0/CPU0:router# show mpls interfaces
Mon May 12 06:21:30.937 DST
```

Interface	LDP	Tunnel	Static	Enabled
TenGigE0/0/0/5	No	No	Yes	Yes

Verify that the status is "Created" for the specified label value.

```
RP/0/RP0/CPU0:router#show mpls static local-label all
Tue Apr 22 18:21:55.764 UTC
```

Label	VRF	Type	Prefix	RW Configured	Status
24035	default	X-Connect	NA	Yes	Created

Check the dynamic range and ensure that the specified local-label value is outside this range.

```
RP/0/RP0/CPU0:router#show mpls label range
Mon Apr 28 19:56:00.596 IST
Range for dynamic labels: Min/Max: 17000/18000
```

Verify that the MPLS static configuration has taken effect, and the label forwarding is taking place.

```
RP/0/RP0/CPU0:router#show mpls lsd forwarding
Wed Nov 25 21:40:57.918 UTC
In Label, (ID), Path_Info: <Type>
24035, (Static), 1 Paths
  1/1: IPv4, 'default':4U, BE1.2, nh=10.20.3.1, lbl=35001, flags=0x0, ext_flags=0x0
```

Associated Commands

- mpls static
- mpls label range
- show mpls interfaces

Identify and Clear Label Discrepancy

During configuring or de-configuring static labels or a label range, a label discrepancy can get generated when:

- A static label is configured for an IP prefix that already has a binding with a dynamic label.
- A static label is configured for an IP prefix, when the same label value is dynamically allocated to another IP prefix.

Verification

Identify label discrepancy by using these show commands.

```
Router#show mpls static local-label discrepancy
```

Label	VRF	Type	Prefix	RW Configured	Status
24000	default	X-Connect	NA	Yes	Discrepancy

```
Router#show mpls static local-label all
```

Label	VRF	Type	Prefix	RW Configured	Status
24000	default	X-Connect	N/A	Yes	Discrepancy

```
24035    default          X-Connect    N/A                Yes        Created
```

```
RP/0/RP0/CPU0:router#show log
```

```
Thu Apr 24 14:18:57.655 UTC
```

```
Syslog logging: enabled (0 messages dropped, 0 flushes, 0 overruns)
```

```
  Console logging: level warnings, 199 messages logged
```

```
  Monitor logging: level debugging, 0 messages logged
```

```
  Trap logging: level informational, 0 messages logged
```

```
  Buffer logging: level debugging, 2 messages logged
```

```
Log Buffer (307200 bytes):
```

```
RP/0/RSP0/CPU0:Apr 24 14:18:53.743 : mpls_static[1043]:
```

```
%ROUTING-MPLS_STATIC-7-ERR_STATIC_LABEL_DISCREPANCY :
```

```
The system detected 1 label discrepancies (static label could not be allocated due to conflict with other applications).
```

```
Please use 'clear mpls static local-label discrepancy' to fix this issue.
```

```
RP/0/RSP0/CPU0:Apr 24 14:18:53.937 : config[65762]: %MGBL-CONFIG-6-DB_COMMIT : Configuration committed by user 'cisco'.
```

```
Use 'show configuration commit changes 1000000020' to view the changes.
```

Rectification

Label discrepancy is cleared by allocating a new label to those IP prefixes that are allocated dynamic label. The static label configuration takes precedence while clearing discrepancy. Clearing label discrepancy may result in traffic loss for the dynamic label which got cleared.

```
Router# clear mpls static local-label discrepancy all
```

Verify that the discrepancy is cleared.

```
Router# show mpls static local-label all
```

```
Wed Nov 25 21:45:50.368 UTC
```

Label	VRF	Type	Prefix	RW Configured	Status
24000	default	X-Connect	N/A	Yes	Created
24035	default	X-Connect	N/A	Yes	Created

Associated Commands

- show mpls static local-label discrepancy
- clear mpls static local-label discrepancy all