



Configuring MPLS Label Imposition

This chapter contains information on how to configure multiprotocol label switching (MPLS) label imposition.

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About MPLS Label Imposition

An outgoing label stack having one or more labels can be statically provisioned using the MPLS Label Stack Imposition feature. The outgoing label stack is used in the following two types of statically configured MPLS bindings:

- **Prefix and Label to Label Stack** - Here an IP prefix or an incoming label is mapped to an outgoing stack, similar to static MPLS. An incoming prefix is mapped to out-label-stack for IP-only ingress traffic.
- **Label to Label Stack** - Here only an incoming label is mapped to an outgoing stack without any prefix.

The new MPLS binding types are implemented in the static MPLS component and are available only when the **feature mpls segment-routing** command is enabled.

If configured next-hops of MPLS label imposition are SR recursive next-hops (RNH), then they are resolved to actual next-hops using RIB. The outer label of the out-label stack is imposed automatically from the SR allocated labels.

ECMP is also supported by adding a number of path configurations.



Note The static MPLS process is started when either the **feature mpls segment-routing** command or the **feature mpls static** command is run. Certain standard static MPLS commands will not be available when static MPLS is run using the **feature mpls segment-routing** command, and the commands for MPLS bindings will not be available when the **feature mpls static** command is run.

Guidelines and Limitations for MPLS Label Imposition

The MPLS label imposition has the following guidelines and limitations:

- The MPLS label imposition supports only IPv4.
- The maximum number of labels in an out-label stack is three for Nexus 3000-XL switches.
- The MPLS label imposition is supported on Nexus 3000-XL running in Nexus 9000 mode.
- Multicast is not supported for the MPLS label imposition.
- For the MPLS label imposition, upto 128 Label Switched Paths (LSPs) can be configured and each LSP can have a maximum of 32 next-hops.
- In the multi-label stack configuration, changing an outgoing path is not allowed, instead delete it.
- Sub-interfaces are not supported for multi-label imposition.
- Contention between MPLS label imposition and Segment Routing or any other routing protocol including static routes is not supported.
- The maximum number of labels in an out-label stack is three for Nexus 3000-XL switches. If more than three labels are tried to impose, then the trailing label is truncated automatically and a syslog error message appears signaling to correct the configurations.

Configuring MPLS Label Imposition

Enabling MPLS Label Imposition

You must install and enable the MPLS feature set and then enable the MPLS segment routing feature before you can configure MPLS label imposition.

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: <pre>switch# configure terminal switch(config)#</pre>	Enters global configuration mode.
Step 2	[no] install feature-set mpls Example: <pre>switch(config)# install feature-set mpls</pre>	Installs the MPLS feature set. The no form of this command uninstalls the MPLS feature set.
Step 3	[no] feature-set mpls Example: <pre>switch(config)# feature-set mpls</pre>	Enables the MPLS feature set. The no form of this command disables the MPLS feature set.

	Command or Action	Purpose
Step 4	<p>[no] feature mpls segment-routing</p> <p>Example:</p> <pre>switch(config)# feature mpls segment-routing</pre>	Enables the MPLS segment routing feature. The no form of this command disables the MPLS segment routing feature.
Step 5	<p>(Optional) show feature-set</p> <p>Example:</p> <pre>switch(config)# show feature-set Feature Set Name ID State ----- mpls 4 enabled</pre>	Displays the status of the MPLS feature set.
Step 6	<p>(Optional) show feature grep segment-routing</p> <p>Example:</p> <pre>switch(config)# show feature grep segment-routing segment-routing 1 enabled</pre>	Displays the status of MPLS segment routing.

Reserving Labels for MPLS Label Imposition

You can reserve the labels that are to be statically assigned. Dynamic label allocation is not supported.

Before you begin

Ensure that the MPLS segment routing feature is enabled.

Procedure

	Command or Action	Purpose
Step 1	<p>configure terminal</p> <p>Example:</p> <pre>switch# configure terminal switch(config)#</pre>	Enters global configuration mode.
Step 2	<p>[no] mpls label range min-value max-value [static min-static-value max-static-value]</p> <p>Example:</p> <pre>switch(config)# mpls label range 17 99 static 100 10000</pre>	Reserves a range of labels for static label assignment. The range for the minimum and maximum values is from 16 to 471804.
Step 3	<p>(Optional) show mpls label range</p> <p>Example:</p> <pre>switch(config)# show mpls label range</pre>	Displays the label range that is configured for static MPLS.

	Command or Action	Purpose
Step 4	(Optional) copy running-config startup-config Example: switch(config)# copy running-config startup-config	Copies the running configuration to the startup configuration.

Configuring MPLS Label Imposition

You can configure MPLS label imposition on the device.



Note The feature **mpls segment-routing** command cannot be enabled when the following commands are in use: **feature nv overlay**, **nv overlay evpn**, **feature vpc**, and **feature vn-segment-vlan-based**.

Before you begin

Ensure that the MPLS segment routing feature is enabled.

Set a static label range as follows: **mpls label range 16 16 static 17 50000**.

Procedure

	Command or Action	Purpose
Step 1	configure terminal Example: switch# configure terminal switch(config)#	Enters global configuration mode.
Step 2	interface type slot/port Example: switch(config)# interface ethernet 2/2 switch(config-if)#	Enters the interface configuration mode for the specified interface.
Step 3	[no] mpls ip forwarding Example: switch(config-if)# mpls ip forwarding	Enables MPLS on the specified interface. The no form of this command disables MPLS on the specified interface.
Step 4	mpls static configuration Example: switch(config-if)# mpls static configuration switch(config-mpls-static)#	Enters MPLS static global configuration mode.
Step 5	address-family ipv4 unicast Example:	Enters global address family configuration mode for the specified IPv4 address family.

	Command or Action	Purpose
	<pre>switch(config-mpls-static)# address-family ipv4 unicast switch(config-mpls-static-af)#</pre>	
Step 6	<p>lsp name</p> <p>Example:</p> <pre>switch(config-mpls-static-af)# lsp lsp1 switch(config-mpls-static-lsp)#</pre>	Specifies a name for LSP.
Step 7	<p>in-label value allocate policy prefix</p> <p>Example:</p> <pre>switch(config-mpls-static-lsp)# in-label 8100 allocate policy 15.15.1.0/24 switch(config-mpls-static-lsp-inlabel)#</pre>	Configures an in-label value and a prefix value (optional).
Step 8	<p>forward</p> <p>Example:</p> <pre>switch(config-mpls-static-lsp-inlabel)# forward switch(config-mpls-static-lsp-inlabel-forw)#</pre>	Enters the forward mode.
Step 9	<p>path number next-hop ip-address out-label-stack label-id label-id</p> <p>Example:</p> <pre>switch(config-mpls-static-lsp-inlabel-forw)# path 1 next-hop 13.13.13.13 out-label-stack 16 3000</pre>	Specifies the path. The maximum number of supported paths is 32.
Step 10	<p>(Optional) copy running-config startup-config</p> <p>Example:</p> <pre>switch(config-mpls-static-lsp-inlabel-forw)# copy running-config startup-config</pre>	Copies the running configuration to the startup configuration.

Verifying the MPLS Label Imposition Configuration

To display the MPLS label imposition configuration, perform one of the following tasks:

Command	Purpose
show feature grep segment-routing	Displays the status of MPLS label imposition.
show feature-set	Displays the status of the MPLS feature set.
show forwarding ecmp recursive	Displays VOBJ and the label stack.

Command	Purpose
show forwarding mpls ecmp [<i>module slot</i> <i>platform</i>]	Displays the MPLS forwarding statistics for equal-cost multipath (ECMP).
show forwarding mpls label <i>label</i>	Displays MPLS label forwarding statistics for a particular label.
show mpls label range	Displays the label range that is configured for MPLS label imposition.
show mpls static binding { <i>all</i> <i>ipv4</i> }	Displays the configured static prefix or label bindings.
show mpls switching [<i>detail</i>]	Displays MPLS label switching information.
show running-config mpls static	Displays the running static MPLS configuration.

This example shows sample output for the **show forwarding ecmp recursive** command:

```

slot 1
=====
Virtual Object 16 :
  LFIB-ECMP-idx1:0x514ca(333002), LFIB-ECMP-idx2:0x0(0) ADJ-idx 0
  Hw vobj-index (0): unit-0:200022 unit-1:0 unit-2:0, cmn-index: 99004
  Hw NVE vobj-index (0): unit-0:0 unit-1:0 unit-2:0, cmn-index: 99004
  Hw vobj-index (1): unit-0:0 unit-1:0 unit-2:0, cmn-index: 0
  Hw NVE vobj-index (1): unit-0:0 unit-1:0 unit-2:0, cmn-index: 0
  Num prefixes : 0
Partial Install: No
Active paths:
  Recursive NH 12.12.3.2/32 ,Label stack : 3132 16, table 0x1
  Recursive NH 12.12.4.2/32 ,Label stack : 3132 16, table 0x1
  Recursive NH 12.12.1.2/32 ,Label stack : 3132 16, table 0x1
  Recursive NH 12.12.2.2/32 ,Label stack : 3132 16, table 0x1
CNHs:
  12.12.1.2, port-channell121
  Hw adj: unit-0:100006 unit-1:0 unit-2:0, cmn-index: 6, LIF:4155
  Hw NVE adj: unit-0:0 unit-1:0 unit-2:0, cmn-index: 6, LIF:4155
  12.12.2.2, Ethernet1/51
  Hw adj: unit-0:100009 unit-1:0 unit-2:0, cmn-index: 7, LIF:4150
  Hw NVE adj: unit-0:0 unit-1:0 unit-2:0, cmn-index: 7, LIF:4150
  12.12.3.2, Vlan122
  Hw adj: unit-0:100012 unit-1:0 unit-2:0, cmn-index: 8, LIF:122
  Hw NVE adj: unit-0:0 unit-1:0 unit-2:0, cmn-index: 8, LIF:122
  12.12.4.2, Vlan123
  Hw adj: unit-0:100017 unit-1:0 unit-2:0, cmn-index: 9, LIF:123
  Hw NVE adj: unit-0:0 unit-1:0 unit-2:0, cmn-index: 9, LIF:123
Hw instance new : (0x182bc, 99004) ls count new 4
FEC:
  FEC-ECMP-idx1:0x514cb(333003), FEC-ECMP-idx2:0x0(0) ADJ-idx 0
  Hw instance new: (0x182bd, 99005) ls count new 4
  label list count: (1)
  VOBJ Refcount : 1
Virtual Object 12 :
  LFIB-ECMP-idx1:0x514c8(333000), LFIB-ECMP-idx2:0x0(0) ADJ-idx 0
  Hw vobj-index (0): unit-0:200016 unit-1:0 unit-2:0, cmn-index: 99002
  Hw NVE vobj-index (0): unit-0:0 unit-1:0 unit-2:0, cmn-index: 99002
  Hw vobj-index (1): unit-0:0 unit-1:0 unit-2:0, cmn-index: 0
  Hw NVE vobj-index (1): unit-0:0 unit-1:0 unit-2:0, cmn-index: 0
  Num prefixes : 1
Partial Install: No
Active paths:

```


(P)=Protected, (F)=FRR active, (*)=more labels in stack.

Local Next-Hop	Out-Label	FEC		Out-Interface
8200	3132	Label 8200		
12.12.3.2			*	
8200	3132	Label 8200		
12.12.4.2			*	
8200	3132	Label 8200		
12.12.1.2			*	
8200	3132	Label 8200		
12.12.2.2			*	

Local Next-Hop	Out-Label	FEC		Out-Interface
8100	3131	Pol 25.25.0.0/16		
12.12.1.2			*	
8100	3131	Pol 25.25.0.0/16		
12.12.2.2			*	
8100	3131	Pol 25.25.0.0/16		
12.12.3.2			*	
8100	3131	Pol 25.25.0.0/16		
12.12.4.2			*	

This example shows sample output for the **show running-config mpls static** command:

```
mpls static configuration
  address-family ipv4 unicast
    lsp LI_TEST2
      in-label 8100 allocate policy 25.25.0.0 255.255.0.0
      forward
        path 1 next-hop 12.12.1.2 out-label-stack 3131 17
        path 2 next-hop 12.12.2.2 out-label-stack 3131 17
        path 3 next-hop 12.12.3.2 out-label-stack 3131 17
        path 4 next-hop 12.12.4.2 out-label-stack 3131 17
```

This example shows sample output for the **show running-config mpls static all** command.

```
switch# show running-config mpls static all

!Command: show running-config mpls static all
!Time: Mon Aug 21 14:59:46 2017

version 7.0(3)I7(1)
logging level mpls static 5
mpls static configuration
  address-family ipv4 unicast
    lsp 9_label_stack_LPM
      in-label 72000 allocate policy 71.200.11.0 255.255.255.0
      forward
        path 1 next-hop 27.1.32.4 out-label-stack 21901 29701 27401 24501 25801
    lsp 9_label_stack_LPM_01
      in-label 72001 allocate policy 72.201.1.1 255.255.255.255
    lsp DRV-01
      in-label 71011 allocate policy 71.111.21.0 255.255.255.0
      forward
        path 1 next-hop 27.1.31.4 out-label-stack implicit-null
    lsp DRV-02
      in-label 71012 allocate policy 71.111.22.0 255.255.255.0
      forward
        path 1 next-hop 8.8.8.8 out-label-stack 28901
    lsp DRV-03
```



```

SWAP
  " |0x1 |25.25.0.0/16 |12.12.2.2 |Eth1/51 |17
SWAP
  " |0x1 |25.25.0.0/16 |12.12.3.2 |Vlan122 |17
SWAP
  " |0x1 |25.25.0.0/16 |12.12.4.2 |Vlan123 |17
SWAP
  " |0x1 |25.25.0.0/16 |12.12.4.2 |Vlan123 |17
SWAP
  " |0x1 |25.25.0.0/16 |12.12.4.2 |Vlan123 |17

Input Pkts : 126906012      Input Bytes : 64975876096
SWAP Output Pkts: 126959183  SWAP Output Bytes: 65764550340
TUNNEL Output Pkts: 126959053  TUNNEL Output Bytes: 66272319384

```

This example shows sample output for the **show mpls forwarding statistics** command:

```

MPLS software forwarding stats summary:
Packets/Bytes sent      : 0/0
Packets/Bytes received  : 0/0
Packets/Bytes forwarded : 0/0
Packets/Bytes originated: 0/0
Packets/Bytes consumed  : 0/0
Packets/Bytes input dropped : 0/0
Packets/Bytes output dropped : 0/0

```

Clearing MPLS Label Imposition Statistics

To clear the MPLS label imposition statistics, perform these tasks:

Command	Purpose
clear forwarding [ipv4] adjacency mpls stats	Clears the MPLS IPv4 adjacency statistics.
clear forwarding mpls drop-stats	Clears the MPLS forwarding packet drop statistics.
clear forwarding mpls stats	Clears the ingress MPLS forwarding statistics.
clear mpls forwarding statistics	Clears the MPLS forwarding statistics.
clear mpls switching label statistics [interface type slot/port]	Clears the MPLS switching label statistics.

Configuration Examples for MPLS Label Imposition

This example shows how to configure MPLS label imposition by allocating a prefix and an incoming-label to out-label-stack binding:

```

switch(config-if)# mpls static configuration
switch(config-mpls-static)# address-family ipv4 unicast
switch(config-mpls-static-af)# lsp LI_TEST1
switch(config-mpls-static-lsp)# in-label 8100 allocate policy 25.25.0.0/16
switch(config-mpls-static-lsp-inlabel)# forward

```

```
switch(config-mpls-static-lsp-inlabel-forw)# path 1 next-hop 12.12.1.2 out-label-stack 3131
17
switch(config-mpls-static-lsp-inlabel-forw)# path 2 next-hop 12.12.2.2 out-label-stack 3131
17
switch(config-mpls-static-lsp-inlabel-forw)# path 3 next-hop 12.12.3.2 out-label-stack 3131
17
switch(config-mpls-static-lsp-inlabel-forw)# path 4 next-hop 12.12.4.2 out-label-stack 3131
17
```

To remove a next-hop, you can use

```
no path 1
```

To remove the named lsp, you can use

```
no lsp LI_TEST1
```

This example shows how to configure MPLS label imposition by allocating an incoming-label to out-label-stack binding (no prefix):

```
switch(config-if)# mpls static configuration
switch(config-mpls-static)# address-family ipv4 unicast
switch(config-mpls-static-af)# lsp LI_TEST1
switch(config-mpls-static-lsp)# in-label 8200 allocate
switch(config-mpls-static-lsp-inlabel)# forward
switch(config-mpls-static-lsp-inlabel-forw)# path 1 next-hop 12.12.3.2 out-label-stack 3132
16
switch(config-mpls-static-lsp-inlabel-forw)# path 2 next-hop 12.12.4.2 out-label-stack 3132
16
switch(config-mpls-static-lsp-inlabel-forw)# path 3 next-hop 12.12.1.2 out-label-stack 3132
16
switch(config-mpls-static-lsp-inlabel-forw)# path 4 next-hop 12.12.2.2 out-label-stack 3132
16
```

