

Support for Static MPLS Labels on Cisco RSP3 Module

Table 1: Feature History

Feature Name	Release Information	Description
Increased MPLS label scale support	Cisco IOS XE Cupertino 17.7.1	Starting with Cisco IOS XE Cupertino 17.7.1 release, the MPLS label range is increased from 32,768 to 40,960 to configure the dynamic label range.
Support for Static MPLS Labels on Cisco RSP3 Module	Cisco IOS XE Bengaluru 17.5.1	This feature allows you to provision an Any Transport over Multiprotocol (AToM) label switching static pseudowire without the use of a directed control connection. In environments that do not or cannot use directed control protocols, this feature provides a means for provisioning the pseudowire parameters statically at the Cisco IOS Command-Line Interface (CLI). This feature is supported on Cisco RSP3 module. This feature is supported on NCS 4206/4216 routers.

Before Cisco IOS XE Bengaluru Release 17.5.1, pseudowires were dynamically provisioned using Label Distribution Protocol (LDP), or another directed control protocol such as Resource Reservation Protocol over traffic-engineered tunnels (RSVP-TE), to exchange the various parameters required for these connections.

Starting with Cisco IOS XE Bengaluru Release 17.5.1, you can provision an Any Transport over Multiprotocol (AToM) label switching static pseudowire without the use of a directed control connection. In environments that do not or cannot use directed control protocols, a means for provisioning the pseudowire parameters statically at the Cisco IOS CLI is provided by the AToM Static Pseudowire feature.

The MPLS static feature enables you to statically assign local labels to an IPv4 prefix per VRF. 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.

Static labels are more advantageous than dynamic labels because static labels:

- Improve security because the risk of receiving unwanted labels from peers (running a compromised MPLS dynamic labeling protocol) is reduced.
- Provide you with the full control over defined LSPs.
- Utilize system resources optimally because dynamic labeling is not processed.

Static Label Pseudowire Provisioning for CEM also overcomes the restriction of limited 1400 (1-dimensional) targeted LDP sessions scale.

The feature allows you to manually configure the following parameters:

- Local Pseudowire Label
- Remote Pseudowire Label

This feature is supported on the following CEM IMs:

- 1-port OC-48 1/ STM-16 or 4-port OC-12/OC-3 / STM-1/STM-4 + 12-Port T1/E1 + 4-Port T3/E3 CEM Interface Module
- 1-port OC-192 Interface module or 8-port Low Rate Interface Module (ASR 900 Combo 8-port SFP GE and 1-port 10GE IM with CEM, 10G)
- 48-port T3/E3 CEM Interface Module
- 48-port T1/E1 CEM Interface Module
- NCS 4200 1-Port 10 Gigabit MR + 8-Port 20 Gigabit LR CEM, iMSG Interface Module

MPLS Label Range

The MPLS label range configuration helps you to configure the dynamic label range. 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.

Starting with Cisco IOS XE Bengaluru Release 17.5.1, the overall range for MPLS label is from 16 through 32768. Both the static and dynamic labels must be allocated within this range. For example, if you configure the dynamic label range from 16 through 32700, you can only configure the static label range from 32701 through 32767.

The number of lookup labels or local labels that are supported in Cisco RSP3 module as of Cisco IOS XE Bengaluru Release 17.5.1 is 32k. To increase the scale value, CEM pseudowires both dynamic service labels and statics service labels must be increased. MPLS label range must be increased more than 39k to maintain a consistent configuration across the pDCS (dynamic service labels) and pADM (static service labels).

To support 13k CEM PW protection, 13440 is required for dynamic + 13440 for static + 10k global block + 2k SRLB/SRMS = 38880 total labels needed.

To support this requirement, the mpls label range is extended from 32k to 40k starting with Cisco IOS XE Cupertino Release 17.7.1.

Note Whenever the **mpls label range** command is used to modify the dynamic and static labels range, we recommend that you reload the router.

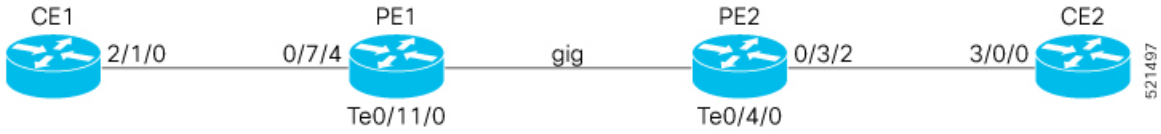
There is no increase in the overall knowledge base processor (KBP) scale that is allocated for the IPv4 Prefix and MPLS ingress labels due to this scale increase. The overall scale remains to be 163k. If 40k MPLS ingress labels are in use, then only 123k IPv4 prefixes can be used.

Note The scale increase is supported only for ingress labels with KBP. No change in scale of EoMPLS and VPLS pseudowires. Also, this change is not specific to any template, but it is applicable on all the templates.

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Configuring Static MPLS Labels on Cisco RSP3 Module

This section shows the configuration of static MPLS labels on Cisco RSP3 module for CEM. In the figure below, the serial interfaces are configured on Customer Edge (CE) routers (CE1 and CE2). The Xconnect is configured on the Provider Edge (PE) routers (PE1 and PE2). Unlike the process where the LDP protocol assigns the MPLS labels, you can manually configure the static labels on PE1 and PE2 routers. The CEM groups are configured on PE1 and PE2 routers. The traffic originating from the CE1 router is sent to the PE2 router, where the packets are converted and are finally sent to the CE2 router.



The following configuration examples are for SONET VT-15 CEP mode.

Core Configuration:

This section shows the core configuration including the loopback, MPLS label range, OSPF, and SR configurations. You need to perform these configurations only once at the beginning.

- **For PE1**:

```
interface Loopback0
no ip address
ip address 10.1.1.1 255.0.0.0
end
l2 router-id 10.1.1.1
end
mpls label range 28032 32767 static 16 15998
mpls ldp label
allocate global prefix-list DENYALL
multilink bundle-name authenticated
end
segment-routing mpls
global-block 16000 28031
local-block 15999 15999
connected-prefix-sid-map
```

```
address-family ipv4
10.1.1.1/32 absolute 16001 range 1
exit-address-family
end
no router ospf 100
end
router ospf 100
router-id 10.1.1.1
segment-routing area 0 mpls
fast-reroute per-prefix enable prefix-priority high
fast-reroute per-prefix ti-lfa
fast-reroute keep-all-paths
network 10.1.1.1 255.0.0.0 area 0
network 192.168.1.0 255.255.0.0 area 0
end
interface Port-channel1
ip address 192.168.1.1 255.255.0.0
ip ospf network point-to-point
ip ospf mtu-ignore
end
interface Te0/11/0
no ip address
cdp enable
channel-group 1 mode active
end
network-clock input-source 1 interface Te0/11/0
network-clock synchronization automatic
network-clock synchronization mode qL-enabled
network-clock wait-to-restore 0 global
esmc process
end
```

- **For PE2**:

```
interface Loopback0
no ip address
ip address 10.2.2.2 255.0.0.0
end
l2 router-id 10.2.2.2
end
mpls label range 28032 32767 static 16 15998
mpls ldp label
allocate global prefix-list DENYALL
multilink bundle-name authenticated
end
segment-routing mpls
global-block 16000 28031
local-block 15999 15999
connected-prefix-sid-map
address-family ipv4
10.2.2.2/32 absolute 16002 range 1
exit-address-family
end
no router ospf 100
end
router ospf 100
router-id 10.2.2.2
segment-routing area 0 mpls
fast-reroute per-prefix enable prefix-priority high
fast-reroute per-prefix ti-lfa
fast-reroute keep-all-paths
network 10.2.2.2 255.0.0.0 area 0
network 192.168.1.0 255.255.0.0 area 0
end
interface Port-channel1
```

```
ip address 192.168.1.2 255.255.0.0
ip ospf network point-to-point
ip ospf mtu-ignore
end
interface Te0/4/0
no ip address
cdp enable
channel-group 1 mode active
end
network-clock synchronization automatic
network-clock synchronization mode qL-enabled
esmc process
end
```

Controller Configuration:

This section shows the controller configuration of the routers.

- **For CE 1**:

```
controller sonet 2/1/0
framing sonet
end
controller sonet 2/1/0
no shut
end
controller sonet 2/1/0
sts-1 1
mode vt-15
vtg 1 t1 1 channel-group 0 timeslots 1-24
end
interface Serial2/1/0.1/1/1:0
ip address 172.16.0.1 255.240.0.0
end
```

- **For PE1**:

```
controller mediatype 0/7/4
mode sonet
controller sonet 0/7/4
rate OC12
end
controller sonet 0/7/4
sts-1 1
mode vt-15
vtg 1 vt 1 cem-group 0 cep
end
```

- **For PE2**:

```
controller mediatype 0/3/2
mode sonet
controller sonet 0/3/2
rate OC12
end
controller sonet 0/3/2
sts-1 1
mode vt-15
vtg 1 vt 1 cem-group 0 cep
end
```

- **For CE 2**:

```
controller sonet 3/0/0
framing sonet
```

```
end
controller sonet 3/0/0
no shut
end
controller sonet 3/0/0
sts-1 1
mode vt-15
vtg 1 t1 1 channel-group 0 timeslots 1-24
end
interface Serial3/0/0.1/1/1:0
ip address 172.16.0.2 255.240.0.0
end
```

Xconnect Configuration:

This section shows the Xconnect configuration of PE1 and PE2 routers.

- **For PE1**:

```
interface cem 0/7/4
cem 0
xconnect 10.2.2.2 1 encapsulation mpls manual
mpls label 16 16
end
interface cem 0/7/4
cem 1
xconnect 10.2.2.2 2 encapsulation mpls manual
mpls label 17 17
end
```

- **For PE2**:

```
interface cem 0/3/2
cem 0
xconnect 10.1.1.1 1 encapsulation mpls manual
mpls label 16 16
end
interface cem 0/3/2
cem 1
xconnect 10.1.1.1 2 encapsulation mpls manual
mpls label 17 17
end
```

Verification of Static Label Pseudowire Provisioning for CEM Configuration

With Xconnect Configuration:

- Use the **show run | i mpls label** command to verify the MPLS label configuration:

```
Router# show  run  | i mpls label
mpls label range 16 32700 static 32701 32767

interface CEM0/4/2
no ip address
cem 0
  xconnect 10.3.3.3 1 encapsulation mpls manual
   mpls label 32702 32702
```

- Use the **show mpls l2 vc** *vc-id* **detail** command to display detailed information related to the virtual connection (VC) with the signaling protocol manual configuration:

```
Router# show mpls l2 vc 1 detail

Local interface: CE0/4/2 up, line protocol up, SATOP T1 0 up
  Destination address:10.3.3.3, VC ID:1 , VC status: up
    Output interface: Po1, imposed label stack {16005 32702}
    Preferred path: not configured
    Default path: active
    Next hop: 10.10.1.6
  Create time: 00:00:54, last status change time: 00:00:54
    Last label FSM state change time: 00:00:54
  Signaling protocol: Manual
    Status TLV support (local/remote)   : enabled/N/A
      LDP route watch                   : enabled
      Label/status state machine        : established, LruRru
      Last local dataplane   status rcvd: No fault
      Last BFD dataplane     status rcvd: Not sent
      Last BFD peer monitor  status rcvd: No fault
      Last local AC  circuit status rcvd: No fault
      Last local AC  circuit status sent: No fault
      Last local PW i/f circ status rcvd: No fault
      Last local LDP TLV     status sent: No status
      Last remote LDP TLV    status rcvd: Not sent
      Last remote LDP ADJ    status rcvd: No fault
    MPLS VC labels: local 32702, remote 32702 -
    Group ID: local 498, remote 498
    MTU: local 0, remote 0
  Sequencing: receive disabled, send disabled
  Control Word: On (configured: autosense)
  SSO Descriptor: 209.165.201.5/40004010, local label: 32702
  Dataplane:
    SSM segment/switch IDs: 12313/16408 (used), PWID: 2
  VC statistics:
    transit packet totals: receive 0, send 0
    transit byte totals:   receive 0, send 0
    transit packet drops:  receive 0, seq error 0, send 0
```

With L2VPN Xconnect Configuration:

- Use the **show run | sec pseudowire99** and **show run | sec l2vpn** commands to verify the MPLS label configuration with L2VPN Xconnect :

```
Router#show run | sec pseudowire99
interface pseudowire99
 encapsulation mpls
 signaling protocol none
 neighbor 10.1.1.1 1
 label 27001 27001

Router#show run | sec l2vpn
l2vpn xconnect context cem_static
 member CEM0/3/0 0
 member pseudowire99
```

- Use the **show mpls l2 vc** *vc-id* **detail** command to display detailed information related to the virtual connection (VC) with the signaling protocol manual configuration:

```
Router# show mpls l2 vc 1 detail

Local interface: CE0/3/0 up, line protocol up, SATOP T1 0 up
  Destination address: 10.1.1.1, VC ID: 1, VC status: down
    Last error: MPLS dataplane reported a fault to the nexthop
```

```
  Output interface: none, imposed label stack {}
  Preferred path: not configured
  Default path: no route
  No adjacency
Create time: 00:04:40, last status change time: 00:04:40
  Last label FSM state change time: 00:04:40
Signaling protocol: Manual
  Status TLV support (local/remote)   : enabled/N/A
    LDP route watch                   : enabled
    Label/status state machine        : activating, LruRruD
    Last local dataplane   status rcvd: DOWN(pw-tx-fault)
    Last BFD dataplane     status rcvd: Not sent
    Last BFD peer monitor  status rcvd: No fault
    Last local AC  circuit status rcvd: No fault
    Last local AC  circuit status sent: DOWN(pw-rx-fault)
    Last local PW i/f circ status rcvd: No fault
    Last local LDP TLV     status sent: No status
    Last remote LDP TLV    status rcvd: Not sent
    Last remote LDP ADJ    status rcvd: No fault
  MPLS VC labels: local 27001, remote 27001
  Group ID: local 94, remote 94
  MTU: local 0, remote 0
Sequencing: receive disabled, send disabled
Control Word: On (configured: autosense)
SSO Descriptor: 10.1.1.1/1, local label: 27001
Dataplane:
  SSM segment/switch IDs: 0/20492 (used), PWID: 5
VC statistics:
  transit packet totals: receive 0, send 0
  transit byte totals:   receive 0, send 0
  transit packet drops:  receive 0, seq error 0, send 0
```