Configuring Ethernet-over-MPLS (EoMPLS)

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Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and 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 module.

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

Configuring EoMPLS

Information About EoMPLS

EoMPLS is one of the AToM transport types. EoMPLS works by encapsulating Ethernet PDUs in MPLS packets and forwarding them across the MPLS network. Each PDU is transported as a single packet.

Only the following mode is supported:

• Port mode—Allows all traffic on a port to share a single VC across an MPLS network. Port mode uses VC type 5.

For scale information related to this feature, see Cisco Catalyst 9400 Series Switch Data Sheet.

Prerequisites for EoMPLS

Before you configure EoMPLS, ensure that the network is configured as follows:

• Configure IP routing in the core so that the PE routers can reach each other through IP.
• Configure MPLS in the core so that a label switched path (LSP) exists between the PE routers.
• Configure **no switchport**, **no keepalive** and **no ip address** before configuring xconnect on the attachment circuit.

• For load-balancing, **port-channel load-balance** command is mandatory to be configured.

## Restrictions for EoMPLS

• VLAN mode is not supported. Ethernet Flow Point is not supported.

• QoS : Customer DSCP Re-marking is not supported with VPWS and EoMPLS.

• VCCV Ping with explicit null is not supported.

• L2 VPN Interworking is not supported.

• L2 Protocol Tunneling CLI is not supported.

• Untagged, tagged and 802.1Q in 802.1Q are supported as incoming traffic.

### Note

Flow Load balance for 802.1Q in 802.1Q over EoMPLS is not supported.

• Flow Aware Transport Pseudowire Redundancy (FAT PW) is supported only in Protocol-CLI mode. Supported load balancing parameters are Source IP, Source MAC address, Destination IP and Destination MAC address.

• Enabling or disabling Control word is supported.

• MPLS QoS is supported in Pipe and Uniform Mode. Default mode is Pipe Mode.

• Both – the legacy xconnect and Protocol-CLI (interface pseudowire configuration) modes are supported.

• Xconnect and MACSec cannot be configured on the same interface.

• MACSec should be configured on CE devices and Xconnect should be configured on PE devices.

• A MACSec session should be between CE devices.

By default, EoMPLS PW tunnels all protocols like CDP, STP. EoMPLS PW cannot perform selective protocol tunneling as part of L2 Protocol Tunneling CLI.

## Configuring Port-Mode EoMPLS

Port-Mode EoMPLS can be configured in two modes :

• Xconnect Mode

• Protocol CLI Method

### Xconnect Mode

To configure port-mode EoMPLS in xconnect mode, perform the following task :
SUMMARY STEPS

1. enable
2. configure terminal
3. interface interface-id
4. no switchport
5. no ip address
6. no keepalive
7. xconnect peer-device-id vc-id encapsulation mpls
8. end

DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td></td>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td>configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td>interface interface-id</td>
<td>Defines the interface to be configured as a trunk, and enters interface configuration mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device(config)# interface TenGigabitEthernet1/0/36</td>
<td></td>
</tr>
<tr>
<td>Step 4</td>
<td>no switchport</td>
<td>For physical ports only, enters Layer 3 mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device(config-if)# no switchport</td>
<td></td>
</tr>
<tr>
<td>Step 5</td>
<td>no ip address</td>
<td>Ensures that there is no IP address assigned to the physical port.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device(config-if)# no ip address</td>
<td></td>
</tr>
<tr>
<td>Step 6</td>
<td>no keepalive</td>
<td>Ensures that the device does not send keepalive messages.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
</tbody>
</table>
Protocol CLI Method

To configure port-mode EoMPLS in protocol-CLI mode, perform the following task:

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `port-channel load-balance dst-ip`
4. `interface interface-id`
5. `no switchport`
6. `no ip address`
7. `no keepalive`
8. `exit`
9. `interface pseudowire number`
10. `encapsulation mpls`
11. `neighbor peer-device-id vc-id`
12. `load-balance flow ip dst-ip`
13. `load-balance flow-label both`
14. `l2vpn xconnect context context-name`
15. `member interface-id`
16. `member pseudowire number`
17. `end`

**DETAILED STEPS**

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<td>Step 1</td>
<td><code>enable</code> Enables privileged EXEC mode.</td>
</tr>
</tbody>
</table>

**Purpose**

Example:

```
Device(config)# no keepalive
```

**Step 7**

`xconnect peer-device-id vc-id encapsulation mpls`

Example:

```
Device(config-if)# xconnect 1.1.1.1 962 encapsulation mpls
```

Binds the attachment circuit to a pseudowire VC. The syntax for this command is the same as for all other Layer 2 transports.

**Step 8**

`end`

Example:

```
Device(config)# end
```

Returns to privileged EXEC mode.
<table>
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<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td></td>
</tr>
<tr>
<td>port-channel load-balance dst-ip</td>
<td>Sets the load-distribution method to the destination IP address.</td>
</tr>
<tr>
<td>Example:</td>
<td>• dst-ip — Destination IP address</td>
</tr>
<tr>
<td>Device(config)# port-channel load-balance 192.168.2.25</td>
<td></td>
</tr>
<tr>
<td>Step 4</td>
<td></td>
</tr>
<tr>
<td>interface interface-id</td>
<td>Defines the interface to be configured as a trunk, and enters interface configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config)# interface TenGigabitEthernet1/0/21</td>
<td></td>
</tr>
<tr>
<td>Step 5</td>
<td></td>
</tr>
<tr>
<td>no switchport</td>
<td>For physical ports only, enters Layer 3 mode..</td>
</tr>
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<td>Example:</td>
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</tr>
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<td>Device(config-if)# no ip address</td>
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<td>Step 7</td>
<td></td>
</tr>
<tr>
<td>no keepalive</td>
<td>Ensures that the device does not send keepalive messages.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config-if)# no keepalive</td>
<td></td>
</tr>
<tr>
<td>Step 8</td>
<td></td>
</tr>
<tr>
<td>exit</td>
<td>Exits interface configuration mode.</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Device(config-if)# exit</td>
<td>Establishes an interface pseudowire with a value that you specify and enters pseudowire configuration mode.</td>
</tr>
<tr>
<td><strong>Step 9</strong> interface pseudowire number</td>
<td>Specifies the number of the pseudowire to be configured.</td>
</tr>
</tbody>
</table>
| **Example:**
  Device(config-if)# interface pseudowire 17 | |
| **Step 10** encapsulation mpls | Specifies the tunneling encapsulation. |
| **Example:**
  Device(config-if)# encapsulation mpls | |
| **Step 11** neighbor peer-device-id vc-id | Specifies the peer IP address and virtual circuit (VC) ID value of a Layer 2 VPN (L2VPN) pseudowire. |
| **Example:**
  Device(config-if)# neighbor 4.4.4.4 17 | |
| **Step 12** load-balance flow ip dst-ip | Enables edge load balancing of traffic across multiple core facing interfaces using equal cost multipaths (ECMP). |
| **Example:**
  Device(config-if)# load-balance flow ip 192.168.2.25 | • dst-ip — Destination IP address |
| **Step 13** load-balance flow-label both | Enables core load balancing based on flow-labels. |
| **Example:**
  Device(config-if)# load-balance flow-label both | |
| **Step 14** l2vpn xconnect context context-name | Creates a Layer 2 VPN (L2VPN) cross connect context and enters xconnect context configuration mode. |
| **Example:**
  Device(config)# l2vpn xconnect context vpws17 | |
<p>| <strong>Step 15</strong> member interface-id | Specifies interface that forms a Layer 2 VPN (L2VPN) cross connect. |
| <strong>Example:</strong> | |</p>
<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device(config-if)# member TenGigabitEthernet1/0/21</td>
<td>Specifies pseudowire interface that forms a Layer 2 VPN (L2VPN) cross connect.</td>
</tr>
</tbody>
</table>

**Step 16**

member pseudowire *number*

**Example:**

Device(config-if)# member pseudowire 17

**Step 17**

end

**Example:**

Device(config)# end

---

**Configuration Examples for EoMPLS**

*Figure 1: EoMPLS Topology*
### PE Configuration

```plaintext
mpls ip
mpls label protocol ldp
mpls ldp graceful-restart
mpls ldp router-id loopback 1 force
interface Loopback1
  ip address 1.1.1.1 255.255.255.255
  ip ospf 100 area 0
  router ospf 100
  router-id 1.1.1.1
  nsf
  system mtu 9198
  port-channel load-balance dst-ip
! interface GigabitEthernet2/0/39
  no switchport
  no ip address
  no keepalive
! interface pseudowire101
  encapsulation mpls
  neighbor 4.4.4.4 101
  load-balance flow ip dst-ip
  load-balance flow-label both
  l2vpn xconnect context pw101
  member pseudowire101
  member GigabitEthernet2/0/39
! interface TenGigabitEthernet3/0/10
  switchport trunk allowed vlan 142
  switchport mode trunk
  channel-group 42 mode active
! interface Port-channel42
  switchport trunk allowed vlan 142
  switchport mode trunk
! interface Vlan142
  ip address 142.1.1.1 255.255.255.0
  ip ospf 100 area 0
mpls ip
mpls label protocol ldp

The following is a sample output of `show mpls l2 vc vc-id detail` command:

Local interface: Gi1/0/1 up, line protocol up, Ethernet up
  Destination address: 1.1.1.1, VC ID: 101, VC status: up
Output interface: Vl182, imposed label stack {17 16}
Preferred path: not configured
Default path: active
Next hop: 182.1.1.1
Load Balance: ECMP
flow classification: ip dst-ip
Create time: 06:22:11, last status change time: 05:58:42
```

### CE Configuration

```plaintext
interface GigabitEthernet1/0/33
  switchport trunk allowed vlan 912
  switchport mode trunk spanning-tree portfast trunk
! interface Vlan912
  ip address 10.91.2.3 255.255.255.0
!```
Last label FSM state change time: 05:58:42  Signaling protocol:
LDP, peer 1.1.1.1:0 up
Targeted Hello: 4.4.4.4(LDP Id) -> 1.1.1.1, LDP is UP
Graceful restart: not configured and not enabled
Non stop routing: not configured and not enabled
Status TLV support (local/remote) : enabled/supported
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 fault
Last remote LDP TLV status rcvd: No fault
Last remote LDP ADJ status rcvd: No fault
MPLS VC labels: local 512, remote 16
Group ID: local n/a, remote 0
MTU: local 9198, remote 9198
Remote interface description:    Sequencing: receive disabled, send disabled

Control Word: On (configured: autosense)
SSO Descriptor: 1.1.1.1/101, local label: 512
Dataplane:
SSM segment/switch IDs: 4096/4096 (used), PWID: 1
VC statistics: transit packet totals: receive 172116845, send 172105364
transit byte totals: receive 176837217071, send 172103349728
transit packet drops: receive 0, seq error 0, send 0

The following is a sample output of `show l2vpn atom vc vc-id detail` command:

pseudowire101 is up, VC status is up PW type: Ethernet
Create time: 06:30:41, last status change time: 06:07:12
Last label FSM state change time: 06:07:12
Destination address: 1.1.1.1 VC ID: 101
Output interface: Vl182, imposed label stack {17 16}
Preferred path: not configured
Default path: active  Next hop: 182.1.1.1
Load Balance: ECMP  Flow classification: ip dst-ip
Member of xconnect service pw101
Associated member G11/0/1 is up, status is up
Interworking type is Like2Like  Service id: 0xe5000001
Signaling protocol: LDP, peer 1.1.1.1:0 up
Targeted Hello: 4.4.4.4(LDP Id) -> 1.1.1.1, LDP is UP
Graceful restart: not configured and not enabled
Non stop routing: not configured and not enabled
PWid FEC (128), VC ID: 101  Status TLV support (local/remote)
: enabled/supported
LDP route watch : enabled
Label/status state machine : established, LruRru
Local dataplane status received : No fault
BFD dataplane status received : Not sent
BFD peer monitor status received : No fault
Status received from access circuit : No fault
Status sent to access circuit : No fault
Status received from pseudowire i/f : No fault
Status sent to network peer : No fault
Status received from network peer : No fault
Adjacency status of remote peer : No fault
Sequencing: receive disabled, send disabled

Parameter | Local | Remote
-----------|-------|-------
Label      | 512   | 16    
Group ID   | n/a   | 0     
Interface  |       |       
MTU        | 9198  | 9198  
Control word on (configured: autosense) | on | Ethernet
PW type    | Ethernet | Ethernet
VCCV CV type | 0x02  | 0x02  
LSPV [2]   |       |       
LSPV [2]   |       |       
VCCV CC type | 0x06  | 0x06  
Status TLV enabled | supported
Flow Label T=1, R=1 | T=1, R=1
SSO Descriptor: 1.1.1.1/101, local label: 512

Dataplane:
SSM segment/switch IDs: 4096/4096 (used), PWID: 1
Rx Counters 176196691 input transit packets, 181028952597 bytes
0 drops, 0 seq err
Tx Counters 176184928 output transit packets, 176182865992 bytes
0 drops

The following is a sample output of `show mpls forwarding-table` command:

<table>
<thead>
<tr>
<th>Local</th>
<th>Outgoing Prefix</th>
<th>Bytes Label</th>
<th>Outgoing</th>
<th>Next Hop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Label</td>
<td>Label or Tunnel Id</td>
<td>Switched</td>
<td>interface</td>
<td></td>
</tr>
<tr>
<td>57</td>
<td>1.1.1.1/32</td>
<td>0</td>
<td>Po45</td>
<td>145.1.1.1</td>
</tr>
<tr>
<td>No Label</td>
<td>1.1.1.1/32</td>
<td>0</td>
<td>Tel/0/2</td>
<td>147.1.1.1</td>
</tr>
<tr>
<td>No Label</td>
<td>1.1.1.1/32</td>
<td>0</td>
<td>Tel/0/11</td>
<td>149.1.1.1</td>
</tr>
<tr>
<td>No Label</td>
<td>1.1.1.1/32</td>
<td>0</td>
<td>Tel/0/40</td>
<td>155.1.1.1</td>
</tr>
</tbody>
</table>