Configuring Hierarchical VPLS with MPLS Access

Configuring Virtual Private LAN Service (VPLS) requires a full mesh of tunnel label switched paths (LSPs) between all the provider edge (PE) devices that participate in the VPLS. With full-mesh configuration, signaling overhead and packet replication requirements for each provisioned virtual circuit (VC) on a PE device are high. Configuring Hierarchical VPLS with Multiprotocol Label Switching (MPLS) Access reduces signaling overhead and packet replication between devices.

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Prerequisites for Configuring Hierarchical VPLS with MPLS Access

Configure the PE to customer edge (CE) interface with a list of allowed VLANs.

Restrictions for Configuring Hierarchical VPLS with MPLS Access

- This feature is not supported on the Cisco Catalyst 9500 Series Switches.
- This feature is not supported if VPLS Autodiscovery is configured on pseudowires (PWs) that are attached to user provider edge (U-PE) devices. (When you create the VPLS, you can manually create the virtual forwarding interface (VFI)).
- This feature is not supported if Q-in-Q access is configured between a U-PE device and a N-PE device.
- Internet Group Management Protocol (IGMP) snooping is not supported.

- Cisco Discovery Protocol (CDP) is not supported.
- Multiprotocol Label Switching (MPLS) over generic routing encapsulation (GRE) and VPLS over GRE are not supported.

Information About Configuring Hierarchical VPLS with MPLS Access

The following section provides information about configuring hierarchical VPLS with MPLS access.

About Hierarchical VPLS with MPLS Access

A standard VPLS configuration comprises CE devices and PE devices. Using the Hierarchical VPLS with MPLS Access feature, each PE device is replaced with a U-PE and an N-PE device. U-PE devices communicate with the CE devices and N-PE devices on the access side, and N-PE devices communicate with other N-PE devices on the provider core.

Figure 1: Hierarchical VPLS with MPLS Access Configuration shows a hierarchical VPLS with MPLS access configuration. Each CE device is connected to a U-PE device through an attachment circuit. A U-PE device is connected to an N-PE device through a single pseudowire (PW) for each VPLS instance.

The following configuration types are supported between a U-PE device and an N-PE device:

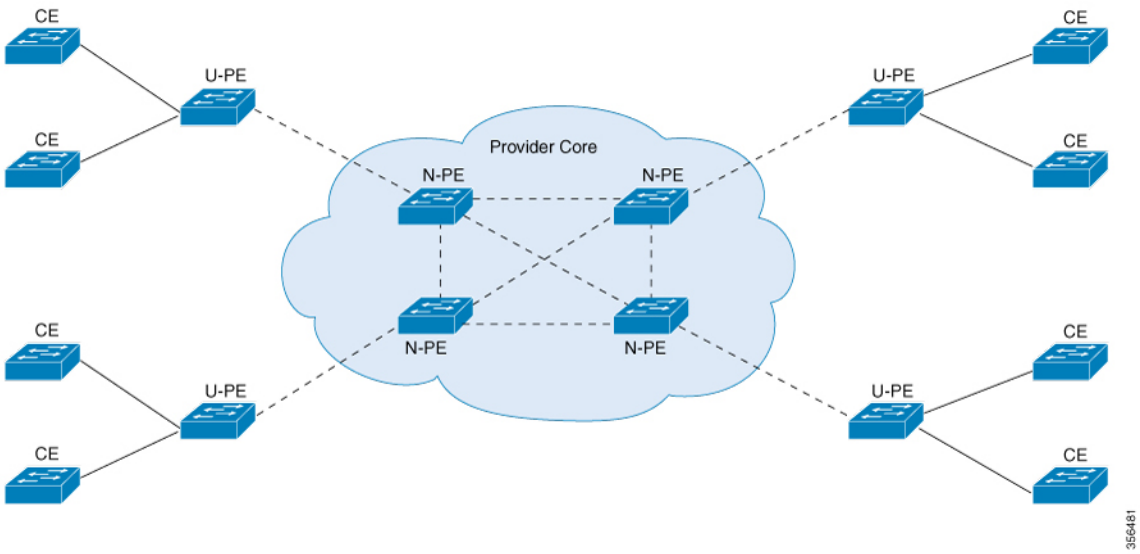
- Ethernet Q-in-Q

Note Ethernet Q-in-Q configurations are not supported in Cisco IOS XE Amsterdam 17.2.x.

- EoMPLS

N-PE devices are connected to each other through a mesh of PWs. Packets from a U-PE device to an N-PE device can be forwarded to other U- PE devices that are connected to the same N-PE device and to other N-PE devices, if any, because split horizon is disabled. Packets in the provider core are not forwarded back to the provider core because split horizon is enabled.

Figure 1: Hierarchical VPLS with MPLS Access Configuration



Features that Support Hierarchical VPLS with MPLS Access Configuration

The following is a list of features that support the Hierarchical VPLS with MPLS Access Configuration:

- VPLS integrated routing and bridging (IRB)
- VPLS MAC address withdrawal
- PW redundancy
- VPLS flow-aware transport PW

How to Configure Hierarchical VPLS with MPLS Access

The following sections provide information on how to configure the Hierarchical VPLS with MPLS Access feature.

Configuring VPLS (Protocol-CLI Method) on an N-PE Device

To configure VPLS (Protocol-CLI method) on an N-PE device, perform this procedure,

Note Repeat this procedure on each N-PE device.

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	**l2vpn vfi context** *name* **Example:** `Device(config)# l2vpn vfi context vpn100`	Establishes a Layer 2 VPN VFI between two or more separate networks, and enters L2VFI configuration mode.
Step 4	**vpn id** *vpn id* **Example:** `Device(config-vfi)# vpn id 100`	Sets a VPN ID on the VPLS instance. • Use the same VPN ID for the N-PE devices that belong to the same VPN. • Make sure that the VPN ID is unique for each VPN in the service provider network. The range is from 1 to 4294967295.
Step 5	**member** *ip-address* **encapsulation mpls** **Example:** `Device(config-vfi)# member 4.4.4.4 encapsulation mpls`	Specifies the device that forms a point-to-point L2VPN VFI connection. • *ip-address*: IP address of the VFI neighbor (the N-PE device). • **encapsulation mpls**: Specifies **mpls** as the data encapsulation method.
Step 6	**exit** **Example:** `Device(config-vlan-config)# exit`	Returns to global configuration mode.
Step 7	**vlan configuration** *vlan-id* **Example:** `Device(config)# vlan configuration 100`	Applies the configuration on the VLAN, and enters VLAN configuration mode.
Step 8	**member vfi** *vfi-name* **Example:** `Device(config-vlan-config)# member vfi vpn100`	Binds a VFI instance to a VLAN or an interface.

	Command or Action	Purpose
Step 9	**member** *ip-address* **encapsulation mpls** **Example:** `Device(config-vlan-config)# member 19.19.19.19 encapsulation mpls`	Specifies the device that forms a point-to-point L2VPN VFI connection. • *ip-address*: IP address of the VFI neighbor (the U-PE device). • **encapsulation mpls**: Specifies **mpls** as the data encapsulation method.
Step 10	**end** **Example:** `Device(config-vlan-config)# end`	Exits privileged EXEC mode.

Configuring EoMPLS VLAN (Xconnect Method) on an U-PE Device

To configure EoMPLS VLAN (Xconnect method) on an U-PE device, perform this procedure,

Note Perform this task on each U-PE device

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	**interface** *interface-id.subinterface* **Example:** `Device(config)# interface TenGigabitEthernet1/6/21.100`	Defines the subinterface to be configured, and enters subinterface configuration mode.
Step 4	**encapsulation dot1q** *vlan-id* **Example:** `Device(config-subif)# encapsulation dot1q 100`	Enables IEEE 802.1Q encapsulation of traffic on the subinterface.

	Command or Action	Purpose
Step 5	**xconnect** *peer-ip-addr vc-id* **encapsulation mpls** **Example:** `Device(config-if)# xconnect 3.3.3.3 150 encapsulation mpls`	Binds the attachment circuit to a PW VC. The syntax for this command is the same as for all the other Layer 2 transports.
Step 6	**exit** **Example:** `Device(config-if)# exit`	Returns to global configuration mode.

Configuration Examples for Hierarchical VPLS with MPLS Access

The following example shows how to configure loopback interface for N-PE1:

```
Device> enable
Device# configure terminal
Device(config)# interface loopback 0
Device(config-if)# ip address 3.3.3.3 255.255.255.255
Device(config-if)# ip ospf 1 area 0
Device(config-if)# end
```

The following example shows how to enable MPLS on N-PE1:

```
Device> enable
Device# configure terminal
Device(config)# interface For 1/0/20
Device(config-if)# ip address 17.0.0.2 255.255.255.0
Device(config-if)# mpls ip
Device(config-if)# ip ospf 1 area 0
Device(config-if)# end
```

The following example shows how to enable VFI on N-PE1:

```
Device> enable
Device# configure terminal
Device(config)# l2vpn vfi context vpn100
Device(config-vfi)# vpn id 100
Device(config-vfi)# member 4.4.4.4 encapsulation mpls
```

The following example shows how to specify a point-to-point Layer 2 VPN (L2VPN) VFI connection on N-PE1:

```
Device> enable
Device# configure terminal
Device(config)# vlan configuration 100
Device(config-vlan-config)# member vfi vpn100
Device(config-vlan-config)# mmember 19.19.19.19 encapsulation mpls
```

The following example shows how to configure loopback interface for N-PE2:

```
Device> enable
Device# configure terminal
Device(config)# interface loopback 0
```

```
Device(config-if)# ip address 4.4.4.4 255.255.255.255
Device(config-if)# ip ospf 1 area 0
Device(config-if)# end
```

The following example shows how to enable MPLS on N-PE2:

```
Device> enable
Device# configure terminal
Device(config)# interface For 1/0/5
Device(config-if)# ip address 13.0.0.2 255.255.255.0
Device(config-if)# mpls ip
Device(config-if)# ip ospf 1 area 0
Device(config-if)# end
```

The following example shows how to enable VFI on the N-PE2:

```
Device> enable
Device# configure terminal
Device(config)# l2vpn vfi context vpn100
Device(config-vfi)# vpn id 100
Device(config-vfi)# member 3.3.3.3 encapsulation mpls
```

The following example shows how to specify a point-to-point L2VPN VFI connection on N-PE2:

```
Device> enable
Device# configure terminal
Device(config)# vlan configuration 100
Device(config-vlan-config)# member vfi vpn100
```

The following example shows how to configure loopback interface for U-PE1:

```
Device> enable
Device# configure terminal
Device(config)# interface loopback 0
Device(config-if)# ip address 19.19.19.19 255.255.255.255
Device(config-if)# ip ospf 1 area 0
Device(config-if)# end
```

The following example shows how to enable MPLS on U-PE1:

```
Device> enable
Device# configure terminal
Device(config)# interface Forty2/1
Device(config-if)# ip address 17.0.0.1 255.255.255.0
Device(config-if)# mpls ip
Device(config-if)# ip ospf 1 area 0
Device(config-if)# end
```

The following example shows how to enable EoMPLS on U-PE1:

```
Device> enable
Device# configure terminal
Device(config)# interface TenGig6/21.100
Device(config-if)# encapsulation dot1q 100
Device(config-if)# xconnect 3.3.3.3 100 encapsulation mpls
```

Additional References for Configuring Hierarchical VPLS with MPLS Access

Related Documents

Related Topic	Document Title
Configuring EoMPLS in VLAN mode (Protocol-CLI method)	Configuring Ethernet-over-MPLS and Pseudowire Redundancy
Configuring VPLS and VPLS flow-aware transport	Configuring Virtual Private LAN Service (VPLS) and VPLS BGP-Based Autodiscovery

Feature History for Configuring Hierarchical VPLS with MPLS Access

This table provides release and related information for the features explained in this module.

These features are available in all the releases subsequent to the one they were introduced in, unless noted otherwise.

Release	Feature	Feature Information
Cisco IOS XE Amsterdam 17.2.1	Hierarchical VPLS with MPLS Access	Configuring VPLS requires a full mesh of tunnel LSPs between all the PE devices that participate in the VPLS. With full-mesh configuration, signaling overhead and packet replication requirements for each provisioned VC on a PE device are high. Configuring Hierarchical VPLS with MPLS Access reduces signaling overhead and packet replication between devices.s

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