

H-VPLS N-PE Redundancy for MPLS Access

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H-VPLS

The H-VPLS N-PE Redundancy for MPLS Access feature enables two network provider edge (N-PE) devices to provide failover services to a user provider edge (U-PE) device in a hierarchical virtual private LAN service (H-VPLS). Redundant N-PE devices increase stability and reliability by protecting against link and node failures. If a failure occurs in the network that disables one N-PE device from transmitting data, the other N-PE device takes over.

Prerequisites for H-VPLS

- Configure your H-VPLS network.
- Enable the MPLS Traffic Engineering-Fast Reroute feature in the MPLS core to improve convergence.
- Enable the L2VPN Pseudowire Redundancy feature on the U-PE devices for MPLS access.

Restrictions for H-VPLS

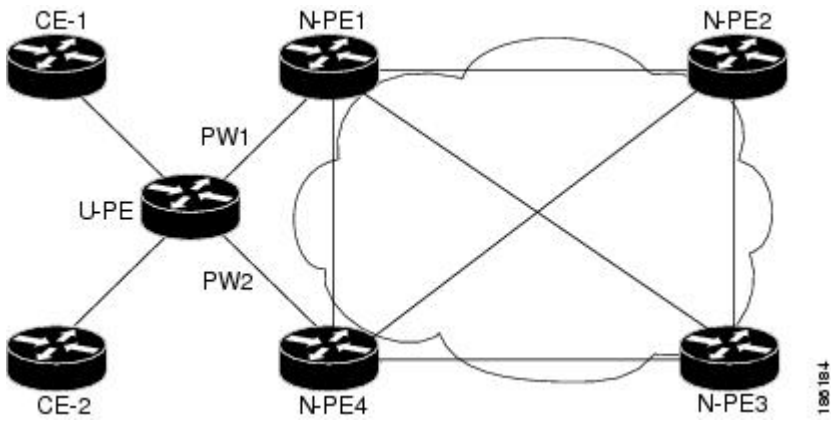
- You cannot use this feature with the VPLS Autodiscovery feature on pseudowires that connect to U-PE devices. When you create the virtual private LAN service (VPLS), manually create the virtual forwarding interface (VFI).
- You cannot configure more than one pseudowire to carry the bridge protocol data unit (BPDU) information between the network provider edge (N-PE) devices.
- You cannot configure a local loopback address as a neighbor when you configure the H-VPLS N-PE Redundancy feature on N-PE devices.
- Only two N-PE devices can be connected to each U-PE device.

H-VPLS N-PE redundancy with MPLS access based on pseudowire redundancy

For H-VPLS Redundancy with MPLS Access, the MPLS network uses redundant pseudowires. These pseudowires connect the MPLS network to N-PE devices in the VPLS core.

As shown in the figure, a primary pseudowire carries data between the U-PE and N-PE devices. If the U-PE path fails, a backup pseudowire and redundant N-PE device activate to continue data transport.

Figure 1: H-VPLS N-PE redundancy for MPLS access based on pseudowire Redundancy



Configuration of H-VPLS N-PE Redundancy for MPLS Access

Specify the devices in the layer 2 VPN VFI

Before you begin

Ensure that the device is in configuration mode.

Procedure

Step 1 Use the **l2vpn vfi context** *name* command to establish a L2VPN VFI between two or more separate networks, and enter L2VFI configuration mode.

Example:

```
Device(config)# l2vpn vfi context VPLS-10
```

Step 2 Use the **vpn id** *vpn id* command to set a VPN ID on the VPLS instance.

Example:

```
Device(config-vfi)# vpn id 10
```

- Use the same VPN ID for the PE devices that belong to the same VPN.
- Make sure the VPN ID is unique for each VPN in the service provider network. The range is from 1 to 4294967295.

Step 3 Use the **member** *ip address* **encapsulation mpls** command to specify the device that forms a point-to-point L2VPN VFI connection.

Example:

```
Device(config-vfi)# member 102.102.102.102 encapsulation mpls
```

- ip-address : IP address of the VFI neighbor (the N-PE device).
- encapsulation mpls: specifies MPLS as the data encapsulation method.

Step 4 Use the **exit** command to return to global configuration mode.

Example:

```
Device(config-vfi)# exit
```

Step 5 Use the **bridge domain** *bridge domain* command to configure components on a bridge domain, and enter bridge-domain configuration mode.

Example:

```
Device(config)# bridge domain 10
```

Step 6 Use the **member vfi** *vfi-name* command to configure the VFI member in the bridge-domain.

Example:

```
Device(config-bdomain)# member vfi VPLS-10
```

Step 7 Use the **member** *ip-address vc-id* **encapsulation mpls** command to specify the device that forms a point-to-point L2VPN VFI connection.

Example:

```
Device(config-vfi)# member 105.105.105.105 10  encapsulation mpls
```

- *ip-address*: IP address of the VFI neighbor (U-PE device).
- *vc-id*: Virtual circuit identifier.
- **encapsulation mpls**: Specifies MPLSas the data encapsulation method.

Specify the N-PE devices that form the layer 2 VPN cross connection with the U-PE

Before you begin

Ensure that the device is in configuration mode.

Procedure

Step 1 Use the **interface** *type number* command to specify the interface to configure, and enter interface configuration mode.

Example:

```
Device(config)# interface GigabitEthernet0/0/0
```

Step 2 Use the **service instance** *id* **ethernet** command to configure an ethernet service instance on the interface, and enter ethernet service configuration mode.

Example:

```
Device(config-if)# service instance 10 ethernet
```

Step 3 Use the **encapsulation untagged** command define the criteria to map tagged or untagged frame ingress on the interface to the appropriate service instance.

Example:

```
Device(config-if-srv)# encapsulation untagged
```

Step 4 Use the **exit** command to return to interface configuration mode.

Example:

```
Device(config-if-srv)# exit
```

Step 5 Use the **exit** command again to return to global configuration mode.

Example:

```
Device(config-if)# exit
```

Step 6 Use the **l2vpn xconnect context** *context-name* to create a L2VPN cross connect context, and enter xconnect configuration mode.

Example:

```
Device(config)# l2vpn xconnect context XC-10
```

Step 7 Use the **member gigabitethernet** *interface-number* [**service-instance** *id*] command to specify devices that form a L2VPN cross connect.

Example:

```
Device(config-xconnect)# member GigabitEthernet0/0/0 service-instance 10
```

service-instance *id*: (Optional) Specifies the service instance identifier.

Step 8 Use the **member** *ip-address vc-id* **encapsulation mpls** [**group** *group-name* [**priority** *number*] command to specify devices that form a L2VPN cross connect.

Example:

```
Device(config-xconnect)# member 101.101.101.101 10 encapsulation mpls group pwred priority 9

Device(config-xconnect)# member 102.102.102.102 10 encapsulation mpls group pwred priority 10
```

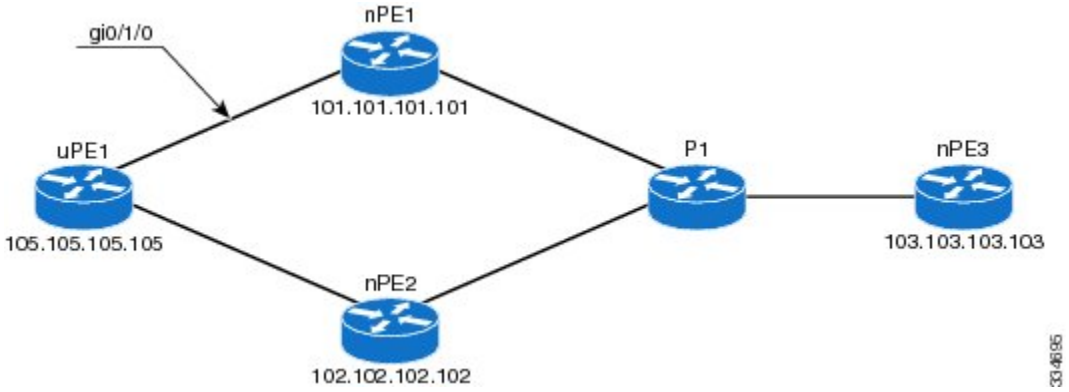
- *ip-address*—IP address of the peer N-PE device.
- *vc-id*—Virtual circuit identifier.
- **encapsulation mpls**—Specifies Multiprotocol Label Switching (MPLS) as the data encapsulation method.
- **group** *group-name*—Specifies the cross-connect member redundancy group name.
- **priority** *number*—Specifies the cross-connect member priority. The range is from 0 to 16. The highest priority is 0. Lowest priority is 16.

Configuration Example for H-VPLS N-PE Redundancy for MPLS Access

Example of configuring H-VPLS N-PE redundancy for MPLS access

The figure displays a configuration for H-VPLS N-PE redundancy with MPLS access. There is no option to configure multihoming on access VPLS, so the **xconnect** command with priority is used on uPE1.

Figure 2: H-VPLS N-PE Redundancy with MPLS Access Topology



nPE1 Configuration

```
l2vpn vfi context VPLS-10
 vpn id 10
 member 102.102.102.102 encapsulation mpls
 member 103.103.103.103 encapsulation mpls
!
bridge-domain 10
 member vfi VPLS-10
 member 105.105.105.105 10 encapsulation mpls
```

nPE2 Configuration

```
l2vpn vfi context VPLS-10
 vpn id 10
 member 101.101.101.101 encapsulation mpls
 member 103.103.103.103 encapsulation mpls
!
bridge-domain 10
 member vfi VPLS-10
 member 105.105.105.105 10 encapsulation mpls
```

nPE3 Configuration

```
l2vpn vfi context VPLS-10
 vpn id 10
 member 101.101.101.101 encapsulation mpls
 member 102.102.102.102 encapsulation mpls
!
bridge-domain 10
 member vfi VPLS-10
```

uPE1 Configuration

```
interface GigabitEthernet0/1/0
```

```
 service instance 10 ethernet
 encapsulation dot1q 10
!
l2vpn xconnect context XC-10
 member GigabitEthernet0/1/0 service-instance 10
 member 101.101.101.101 10 encapsulation mpls group pwred priority 9
 member 102.102.102.102 10 encapsulation mpls group pwred priority 10
```

Verification

Use the show commands to verify that H-VPLS N-PE redundancy for MPLS access is configured successfully.

Sample Output on uPE1

```
Device# show xconnect peer 101.101.101.101 vcid 10

Legend:    XC ST=Xconnect State  S1=Segment1 State  S2=Segment2 State
  UP=Up       DN=Down            AD=Admin Down      IA=Inactive
  SB=Standby  HS=Hot Standby     RV=Recovering      NH=No Hardware

XC ST  Segment 1                         S1 Segment 2                          S2
------+---------------------------------+--+---------------------------------+--
UP pri   ac Gi0/1/0:10(Eth VLAN)         UP mpls 101.101.101.101:10            UP

Device# show xconnect peer 102.102.102.102 vcid 10

Legend:    XC ST=Xconnect State  S1=Segment1 State  S2=Segment2 State
  UP=Up       DN=Down            AD=Admin Down      IA=Inactive
  SB=Standby  HS=Hot Standby     RV=Recovering      NH=No Hardware

XC ST  Segment 1                         S1 Segment 2                          S2
------+---------------------------------+--+---------------------------------+--
IA pri   ac Gi0/1/0:10(Eth VLAN)         UP mpls 102.102.102.102:10            SB
Device#
```

Pseudowire types for H-VPLS

This section describes how the router determines Pseudowire (PW) types automatically based on the interface configuration and how to manually override these types to ensure compatibility with far-end devices.

Understanding Pseudowire types

The router supports two primary Pseudowire types for H-VPLS:

- Type 4 (VLAN): Used for Ethernet VLAN interworking.
- Type 5 (Ethernet): Used for raw Ethernet interworking.

Automatic PW type selection

The router automatically selects the PW type based on the type of interface where the `xconnect` is configured.

Table 1: Automatic PW type selection

Interface Type	Configuration Method	Default PW Type
Layer 3 Interfaces (Onboard Gig, SP, SPMI, or 4S8I modules)	`xconnect` attached directly to the interface or sub-interface.	Type 5 (Ethernet)

Interface Type	Configuration Method	Default PW Type
Layer 2 Interfaces (Onboard FastEthernet (Fa) or 4A2T modules)	`xconnect` attached to a Switched Virtual Interface (SVI).	Type 4 (VLAN)

Limitations

These are the limitations for selecting Pseudowire types:

- Compatibility Check: Before configuring H-VPLS, verify the PW type used by the far-end device. If the router and the remote peer use mismatched types (one using Type 4 and the other Type 5), the connection will fail.
- SVI Limitation: Configuring an `xconnect` on an SVI automatically forces the router into Type 4 mode.
- FastEthernet Support: Onboard FastEthernet (Fa) interfaces are Layer 2 only and require an SVI for H-VPLS configuration.
- Always use an SVI for FastEthernet interfaces.

Overriding Pseudowire types

If the far-end device requires a specific PW type that does not match the router default, you can manually override the setting using an Layer 2 Virtual Private Network (L2VPN) cross-connect profile.

Here is an example of forcing Type 5 on an SVI:

```
Router(config-pw-class)# encapsulation mpls
Router(config-pw-class)# interworking ethernet
Router(config-pw-class)# exit
Router(config)# interface vlan 100
Router(config-if)# xconnect 10.1.1.1 123 pw-class PW_TYPE_5_PROFILE
Router(config-if)# end
```

To verify the current PW type use the **show l2vpn atom vc** [*vcid*/*interface-id*]**detail** command.

Note You can look for the local interface type or PW type fields in the output to confirm if it is Type 4 or Type 5.