H-VPLS N-PE Redundancy for MPLS Access

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). Having redundant N-PE devices provides improved stability and reliability against link and node failures.

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Prerequisites for H-VPLS N-PE Redundancy for MPLS Access

- Before configuring this feature, configure your hierarchical virtual private LAN service (H-VPLS) network and make sure it is operating correctly.
- Make sure that the PE-to-customer edge (CE) interface is configured with a list of allowed VLANs.
- To provide faster convergence, you can enable the MPLS Traffic Engineering—Fast Reroute feature in the Multiprotocol Label Switching (MPLS) core.
- Enable the L2VPN Pseudowire Redundancy feature on the user provider edge (U-PE) devices for MPLS access.

Restrictions for H-VPLS N-PE Redundancy for MPLS Access

- This feature cannot be used with the VPLS Autodiscovery feature on pseudowires that attach to user provider edge (U-PE) devices. When you create the virtual private LAN service (VPLS), you can 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.

Information About H-VPLS N-PE Redundancy for MPLS Access

How H-VPLS N-PE Redundancy for MPLS Access

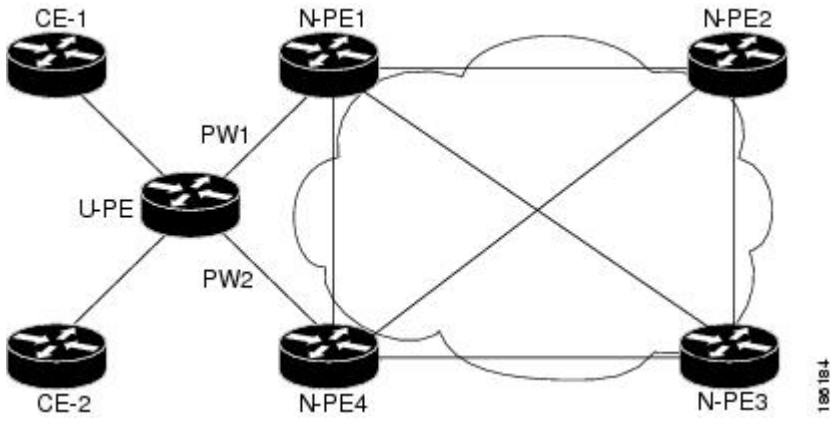
In a network configured with the H-VPLS N-PE Redundancy feature, the user provider edge (U-PE) device is connected to two network provider edge (N-PE) devices. This feature provides a level of redundancy that can tolerate both link and device faults. If a failure occurs in the network that disables one N-PE device from transmitting data, the other N-PE device takes over.

H-VPLS N-PE Redundancy with MPLS Access Based on Pseudowire Redundancy

For the H-VPLS Redundancy with MPLS Access feature based on pseudowire redundancy, the Multiprotocol Label Switching (MPLS) network has pseudowires to the virtual private LAN service (VPLS) core network provider edge (N-PE) devices.

As shown in the figure below, one pseudowire transports data between the user provider edge (U-PE) device and its peer N-PE devices. When a failure occurs along the path of the U-PE device, the backup pseudowire and the redundant N-PE device become active and start transporting data.

Figure 1: H-VPLS N-PE Redundancy for MPLS Access Based on Pseudowire Redundancy



How to Configure H-VPLS N-PE Redundancy for MPLS Access

Configuring the VPLS Pseudowire Between the N-PE Devices

Configuring network provider edge (N-PE) redundancy in a hierarchical Virtual Private LAN service (H-VPLS) network requires that you define the VPLS pseudowire for transporting bridge protocol data unit (BPDU) packets (described here) and that you connect that pseudowire to the native VLAN (described in the next task). This configuration provides a redundancy that provides improved reliability against link and node failures.

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	**l2 vfi** *name* **manual** **Example:** `Device(config)# l2 vfi vfitest1 manual`	Creates a Layer 2 virtual forwarding interface (VFI) and enters Layer 2 VFI manual configuration mode.
Step 4	**vpn id** *id-number* **Example:** `Device(config-vfi)# vpn id 10`	Specifies the VPN ID.
Step 5	**bridge-domain** *bridge-id*	Configures the router to derive bridge domains from the encapsulation VLAN list.
Step 6	**forward permit l2protocol all** **Example:** `Device(config-vfi)# forward permit l2protocol all`	Creates a pseudowire that is to be used to transport BPDU packets between the two N-PE devices.
Step 7	**neighbor** *remote-router-id vc-id* {**encapsulation** *encapsulation-type* | **pw-class** *pw-name*} [**no-split-horizon**] **Example:**	Specifies the peer IP address of the redundant N-PE device and the type of tunnel signaling and encapsulation mechanism.

	Command or Action	Purpose
	`Device(config-vfi)# neighbor 10.2.2.2 3 encapsulation mpls`	
Step 8	**end** **Example:** `Device(config-vfi)# end`	Exits Layer 2 VFI manual configuration mode and returns to privileged EXEC mode.

Example

You can also configure the VPLS pseudowire between the N-PE devices using this alternate method.

```
RoutDeviceer> enable
Device# configure terminal
Device(config)# l2vpn vfi context vfi110
Device(config-vfi)# vpn id 10
Device(config-vfi)# exit
Device(config)# bridge-domain 100
Device(config-bdomain)# member vfi vfi110
Device(config-vfi)# member 172.16.10.2 4 encapsulation mpls
Device(config-vfi)# end
```

Configuring the SVI for the Native VLAN

Perform this task to configure the switched virtual interface (SVI) for the native VLAN and verify that it is correctly configured.

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 vlan** *vlan-id* **Example:** `Device(config)# interface vlan 23`	Creates a dynamic SVI. • To make the SVI active when you create a VLAN, you must configure the VLAN with at least one physical interface that is in the “up” state. Use the **show vfi** command to display the status of the SVI. The state field will display “up” when the SVI is active.

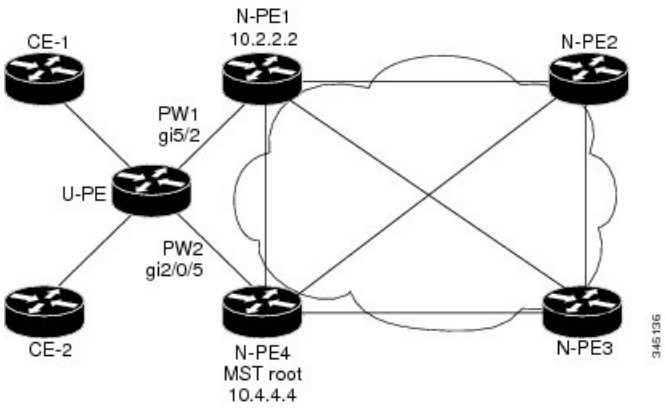
	Command or Action	Purpose
Step 4	**xconnect vfi** *vfi-name* **Example:** `Device(config)# xconnect vfi vfitest1`	Specifies the Layer 2 virtual forwarding interface (VFI) that you are binding to the VLAN port.
Step 5	**end** **Example:** `Device(config-vfi)# end`	Ends the current configuration session and returns to privileged EXEC mode.
Step 6	**show vfi** *vfi-name* **Example:** `Device# show vfi VPLS-2`	(Optional) Displays information about the pseudowire between the two network provider edge (N-PE) devices so that you can verify that the H-VPLS N-PE Redundancy feature is correctly configured.
Step 7	**end** **Example:** `Device# end`	Exits privileged EXEC mode and returns to user EXEC mode.

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

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

The figure below shows a configuration that is set up for the H-VPLS N-PE Redundancy with MPLS Access feature.

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



The table below shows the configuration of two network provider edge (N-PE) devices.

Table 1: Example: H-VPLS N-PE Redundancy for MPLS Access

N-PE1	N-PE4
l2 vfi l2trunk manual vpn id 10 bridge-domain 10 forward permit l2protocol all neighbor 10.4.4.4 encapsulation mpls ! interface Vlan1 no ip address xconnect vfi l2trunk ! spanning-tree mode mst spanning-tree extend system-id ! spanning-tree mst configuration revision 10 instance 1 vlan 20 ! interface GigabitEthernet5/2 switchport switchport trunk encapsulation dot1q switchport trunk allowed vlan 20 switchport mode trunk interface GigabitEthernet 0/5/2 service instance 5 ethernet encapsulation dot1q 10 bridge-domain 10	l2 vfi l2trunk manual vpn id 10 bridge-domain 10 forward permit l2protocol all neighbor 10.2.2.2 encapsulation mpls ! interface Vlan1 no ip address xconnect vfi l2trunk ! spanning-tree mode mst spanning-tree extend system-id ! spanning-tree mst configuration revision 10 instance 1 vlan 20 ! spanning-tree mst 1 priority 0 ! interface GigabitEthernet2/0/5 switchport switchport trunk allowed vlan 20 switchport mode trunk mls qos trust dscp interface GigabitEthernet 0/5/2 service instance 5 ethernet encapsulation dot1q 10 bridge-domain 10

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
MPLS commands	Cisco IOS Multiprotocol Label Switching Command Reference
L2VPN pseudowire redundancy	“L2VPN Pseudowire Redundancy” feature module in the *MPLS Layer 2 VPNs Configuration Guide*.
H-VPLS	“ Configuring VPLS ” in the “Configuring Multiprotocol Label Switching on the Optical Services Modules” chapter in the *Optical Services Modules Installation and Configuration Notes*, 12.2SR document.
MPLS traffic engineering	“MPLS Traffic Engineering Fast Reroute Link and Node Protection” feature module in the *MPLS Traffic Engineering: Path, Link, and Node Protection Configuration Guide* (part of the Multiprotocol Label Switching Configuration Guide Library)

Standards

Standard	Title
http://www.ietf.org/rfc/rfc4447.txt	*Pseudowire Setup and Maintenance Using the Label Distribution Protocol (LDP)*
http://www3.ietf.org/proceedings/06mar/IDs/draft-ietf-l2vpn-vpls-ldp-08.txt	*Virtual Private LAN Services over MPLS*
http://www.ietf.org/internet-drafts/draft-ietf-pwe3-segmented-pw-02.txt	*Segmented Pseudo Wire*
draft-ietf-pwe3-vccv-10.txt	*Pseudo Wire Virtual Circuit Connectivity Verification (VCCV)*
draft-ietf-pwe3-oam-msg-map-03.txt	*Pseudo Wire (PW) OAM Message Mapping*

MIBs

MIB	MIBs Link
Pseudowire Emulation Edge-to-Edge MIBs for Ethernet, Frame Relay, and ATM Services	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for H-VPLS N-PE Redundancy for MPLS Access

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

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

Table 2: Feature Information for H-VPLS N-PE Redundancy for MPLS Access

Feature Name	Releases	Feature Information
H-VPLS N-PE Redundancy for MPLS Access	Cisco IOS XE Release 3.13.0S	This feature was introduced on the Cisco ASR 920 Routers (ASR-920-12CZ-A, ASR-920-12CZ-D, ASR-920-4SZ-A, ASR-920-4SZ-D).

Glossary

CE device—customer edge device. A device that belongs to a customer network, which connects to a PE device to utilize MPLS VPN network services.

LAN—local-area network. High-speed, low-error data network covering a relatively small geographic area. LANs connect workstations, peripherals, terminals, and other devices in a single building or other geographically limited areas.

MPLS—Multiprotocol Label Switching. A packet-forwarding technology, used in the network core, that applies data link layer labels to tell switching nodes how to forward data, resulting in faster and more scalable forwarding than network layer routing normally can do.

MSTP—Multiple Spanning Tree Protocol. MSTP enables multiple VLANs to be mapped to the same spanning-tree instance, reducing the number of spanning-tree instances needed to support a large number of VLANs.

N-PE—network provider edge device. This device acts as a gateway between the MPLS core and edge domains.

PE device—provider edge device. The PE device is the entry point into the service provider network. The PE device is typically deployed on the edge of the network and is administered by the service provider.

pseudowire—A pseudowire is a virtual connection that, in the context of VPLS, connects two SVIs. It is a mechanism that carries the elements of an emulated service from one PE device to one or more PE devices over a packet switched network (PSN). A pseudowire is bidirectional and consists of a pair of unidirectional MPLS virtual circuits (VCs). A pseudowire can be used to connect a point-to-point circuit.

QinQ—An IEEE 802.1Q VLAN tunnel. A mechanism for constructing multipoint Layer 2 VPN using Ethernet switches.

redundancy—The duplication of devices, services, or connections so that, in the event of a failure, they can perform the work of those that failed.

router—A network layer device that uses one or more metrics to determine the optimal path along which network traffic should be forwarded. Routers forward packets from one network to another based on network layer information.

spanning tree—Loop-free subset of a network topology.

U-PE—user provider edge device. This device connects CE devices to the service.

VFI—virtual forwarding instance. A VFI is a collection of data structures used by the data plane, software-based or hardware-based, to forward packets to one or more VCs.

VLAN—Virtual LAN. Group of devices on one or more LANs that are configured (using management software) so that they can communicate as if they were attached to the same wire, when in fact they are located on a number of different LAN segments.

VPLS—Virtual Private LAN Service. VPLS describes an architecture that delivers Layer 2 service that emulates an Ethernet LAN across a wide-area network (WAN) and inherits the scaling characteristics of a LAN.

VPLS redundancy—Also called N-PE redundancy. Allows U-PEs to be dual-honed (to their N-PEs) in a loop-free topology with MPLS or QinQ as the access or aggregation domain.

VPN—Virtual Private Network. Allows IP traffic to travel securely over public TCP/IP networks and the Internet by encapsulating and encrypting all IP packets. VPN uses a tunnel to encrypt all information at the IP level.