EVPN Virtual Private Wire Service (VPWS)

The EVPN-VPWS is a BGP control plane solution for point-to-point services. It implements the signaling and encapsulation techniques for establishing an EVPN instance between a pair of PEs. It has the ability to forward traffic from one network to another without MAC lookup. The use of EVPN for VPWS eliminates the need for signaling single-segment and multi-segment PWs for point-to-point Ethernet services. The EVPN-VPWS technology works on IP and MPLS core; IP core to support BGP and MPLS core for switching packets between the endpoints.

EVPN-VPWS support both single-homing and multi-homing.

Supported Modes for EVPN-VPWS

EVPN-VPWS supports the following modes:

- Single-homed - Enables you to connect a customer edge (CE) device to one provider edge (PE) device.
- Multi-homed - Enables you to connect a customer edge (CE) device to more than one provider edge (PE) device. Multihoming ensures redundant connectivity. The redundant PE device ensures that there is no traffic disruption when there is a network failure. Following are the types of multihoming:
  - Single-Active - In single-active mode only a single PE among a group of PEs attached to the particular Ethernet-Segment is allowed to forward traffic to and from that Ethernet Segment.
  - All-Active - In all-active mode all the PEs attached to the particular Ethernet-Segment is allowed to forward traffic to and from that Ethernet Segment.

Benefits of EVPN-VPWS

The following are the benefits of EVPN-VPWS:

- Scalability is achieved without signaling pseudowires.
- Ease of provisioning

- Pseudowires (PWs) are not used.
- Leverages BGP best path selection (optimal forwarding).

Prerequisites for EVPN-VPWS

- Ensure BGP is configured for EVPN SAFI.
- BGP session between PEs with 'address-family l2vpn evpn' to exchange EVPN routes.

Restrictions for EVPN-VPWS

- The VPN ID is unique per router.
- When specifying a list of route targets, they must be unique per PE (per BGP address-family).
- On versions earlier than IOS XR release 6.7.1, MTU is not signaled and the MTU mismatch is ignored with no interoperability issues.
- On versions starting from IOS XR release 6.7.1, L3 MTU is advertised by default and the MTU mismatch is enforced by default.
- On versions earlier than IOS XR release 7.0.x, MTU is not signaled and the MTU mismatch is ignored with no interoperability issues.

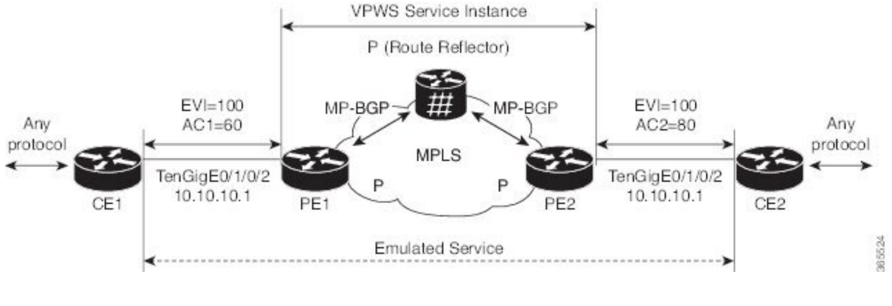
  On versions later than IOS XR release 7.0.x, L3 MTU is advertised by default and the MTU mismatch is enforced by default. But this results in interoperability issues with IOS XR release 7.3.2, if transmit-l2-mtu is configured since L3 and L2 MTUs do not match. You can configure **transmit-mtu-zero** and **ignore-mtu-mismatch** commands to avoid this situation.

  On versions later than IOS XR release 7.3.2, MTU of 0 is advertised by default, and the MTU mismatch is ignored by default. L2 MTU can be advertised using the **transmit-l2-mtu** command, and MTU mismatch can be enforced with **enforce-mtu-mismatch** command.

EVPN-VPWS Single Homed

The EVPN-VPWS single homed solution requires per EVI Ethernet Auto Discovery route. EVPN defines a new BGP Network Layer Reachability Information (NLRI) used to carry all EVPN routes. BGP Capabilities Advertisement used to ensure that two speakers support EVPN NLRI (AFI 25, SAFI 70) as per RFC 4760.

The architecture for EVPN VPWS is that the PEs run Multi-Protocol BGP in control-plane. The following image describes the EVPN-VPWS configuration:



- The VPWS service on PE1 requires the following three elements to be specified at configuration time:
    - The VPN ID (EVI)
    - The local AC identifier (AC1) that identifies the local end of the emulated service.
    - The remote AC identifier (AC2) that identifies the remote end of the emulated service.

  PE1 allocates a MPLS label per local AC for reachability.
- The VPWS service on PE2 is set in the same manner as PE1. The three same elements are required and the service configuration must be symmetric.

  PE2 allocates a MPLS label per local AC for reachability.
- PE1 advertise a single EVPN per EVI Ethernet AD route for each local endpoint (AC) to remote PEs with the associated MPLS label.

  PE2 performs the same task.
- On reception of EVPN per EVI EAD route from PE2, PE1 adds the entry to its local L2 RIB. PE1 knows the path list to reach AC2, for example, next hop is PE2 IP address and MPLS label for AC2.

  PE2 performs the same task.

Configure EVPN-VPWS Single Homed

This section describes how you can configure single-homed EVPN-VPWS feature.

```
/* Configure PE1 */

Router# configure
Router(config)# router bgp 100
Router(config-bgp)# address-family l2vpn evpn
Router(config-bgp-af)# exit
Router(config-bgp)# neighbor 10.10.10.1
Router(config-bgp-nbr))# address-family l2vpn evpn
Router(config-bgp-nbr-af)# commit
Router(config-bgp-nbr-af)# exit
Router(config-bgp-nbr)# exit
Router(config-bgp)# exit
Router(config)# l2vpn
Router(config-l2vpn)# xconnect group evpn-vpws
Router(config-l2vpn-xc)# p2p evpn1
Router(config-l2vpn-xc-p2p)# interface TenGigE0/1/0/2
Router(config-l2vpn-xc-p2p)# neighbor evpn evi 100 target 12 source 10

Router(config-l2vpn-xc-p2p-pw)# commit
Router(config-l2vpn-xc-p2p)# exit
```

```
/* Configure PE2 */

Router# configure
Router(config)# router bgp 100
Router(config-bgp)# address-family l2vpn evpn
Router(config-bgp-af)# exit
Router(config-bgp)# neighbor 10.10.10.1
Router(config-bgp-nbr))# address-family l2vpn evpn
Router(config-bgp-nbr-af)# commit
Router(config-bgp-nbr-af)# exit
Router(config-bgp-nbr)# exit
Router(config-bgp)# exit
Router(config)# l2vpn
Router(config-l2vpn)# xconnect group evpn-vpws
Router(config-l2vpn-xc)# p2p evpn1
Router(config-l2vpn-xc-p2p)# interface TenGigE0/1/0/2
Router(config-l2vpn-xc-p2p)# neighbor evpn evi 100 target 10 source 12

Router(config-l2vpn-xc-p2p-pw)# commit
Router(config-l2vpn-xc-p2p)# exit
```

Running Configuration

```
/* On PE1 */

configure
router bgp 100
 address-family l2vpn evpn
 neighbor 10.10.10.1
  address-family l2vpn evpn
!

configure
l2vpn
 xconnect group evpn-vpws
  p2p evpn1
   interface TenGigE0/1/0/2
   neighbor evpn evi 100 target 12 source 10
!
```

```
/* On PE2 */

configure
router bgp 100
 address-family l2vpn evpn
 neighbor 10.10.10.1
  address-family l2vpn evpn
!

configure
l2vpn
 xconnect group evpn-vpws
  p2p evpn1
   interface TenGigE0/1/0/2
   neighbor evpn evi 100 target 10 source 12
!
```

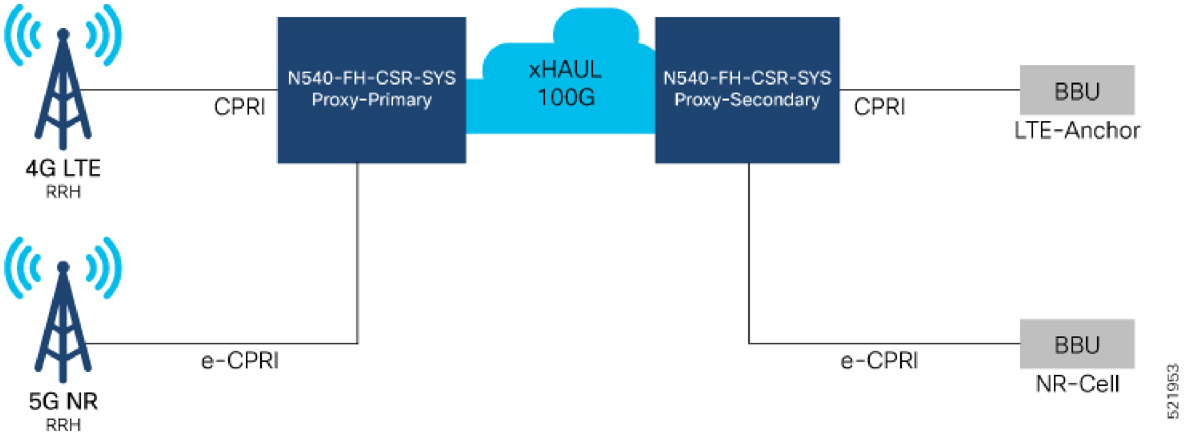
Configure EVPN-VPWS on RoE Interface

This section describes how you can configure EVPN-VPWS on RoE interface feature.

Table 1: Feature History Table

Feature Name	Release Information	Feature Description
EVPN-VPWS support to RoE interface	Release 7.3.2	This feature extends support in carrying the Radio over Ethernet (RoE) packets from Cell Site Router (CSR) to the aggregation router.

Figure 1: EVPN-VPWS to RoE Interface



Global Configurations for BGP

```
router bgp 108
bgp router-id 10.255.255.5
address-family l2vpn evpn
!
neighbor 10.255.255.4
remote-as 108
update-source Loopback0
address-family l2vpn evpn
```

Global Configurations for EVPN

```
evpn
evi 108
!
evpn
evi 109
!
```

Common Public Radio Interface (CPRI)

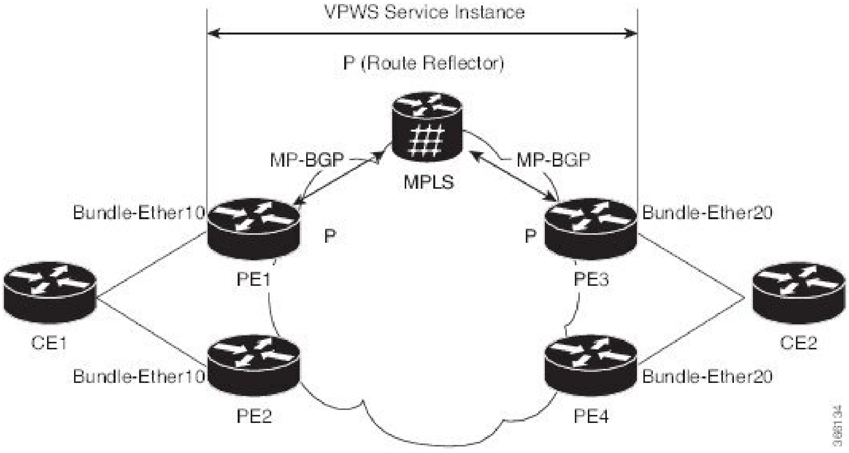
```
interface CPRIoE0/0/0/6
mtu 9600
l2transport

l2vpn

xconnect group evpn-vpws108
p2p evpn108
interface CPRIoE0/0/0/6
neighbor evpn evi 108 service 108
!
```

EVPN-VPWS Multi-Homed

The EVPN VPWS feature supports all-active multihoming capability that enables you to connect a customer edge device to two or more provider edge (PE) devices to provide load balancing and redundant connectivity. The load balancing is done using equal-cost multipath (ECMP).

When a CE device is multi-homed to two or more PEs and when all PEs can forward traffic to and from the multi-homed device for the VLAN, then such multihoming is referred to as all-active multihoming.

Figure 2: EVPN VPWS Multi-Homed



Consider the topology in which CE1 is multi-homed to PE1 and PE2; CE2 is multi-homed to PE3 and PE4. PE1 and PE2 will advertise an EAD per EVI route per AC to remote PEs which is PE3 and PE4, with the associated MPLS label. The ES-EAD route is advertised per ES (main interface), and it will not have a label. Similarly, PE3 and PE4 advertise an EAD per EVI route per AC to remote PEs, which is PE1 and PE2, with the associated MPLS label.

Consider a traffic flow from CE1 to CE2. Traffic is sent to either PE1 or PE2. The selection of path is dependent on the CE implementation for forwarding over a LAG. Traffic is encapsulated at each PE and forwarded to the remote PEs (PE 3 and PE4) through MPLS core. Selection of the destination PE is established by flow-based load balancing. PE3 and PE4 send the traffic to CE2. The selection of path from PE3 or PE4 to CE2 is established by flow-based load balancing.

If there is a failure and when the link from CE1 to PE1 goes down, the PE1 withdraws the ES-EAD route; sends a signal to the remote PEs to switch all the VPWS service instances associated with this multi-homed ES to backup PE, which is PE2.

Configure EVPN-VPWS All-Active Multi-Homed

This section describes how to configure all-active multi-homed EVPN-VPWS feature.

```
/* Configure PE1 */
Router# configure
Router(config)# l2vpn
Router(config-l2vpn)#  xconnect group evpn_vpws
Router(config-l2vpn-xc)#  p2p e1_5-6
Router(config-l2vpn-xc-p2p)#  interface Bundle-Ether10.2
Router(config-l2vpn-xc-p2p)#  neighbor evpn evi 1 target 5 source 6

Router(config-l2vpn-xc-p2p-pw)# exit
Router(config-l2vpn-xc)# exit
Router(config-l2vpn)# exit
Router(config)# evpn
Router(config-evpn)# interface Bundle-Ether10
Router(config-evpn-ac)#  ethernet-segment
Router(config-evpn-ac-es)# identifier type 0 00.01.00.ac.ce.55.00.0a.00
Router(config-evpn-ac-es)# commit


/* Configure PE2 */
Router# configure
Router(config)# l2vpn
Router(config-l2vpn)#  xconnect group evpn_vpws
Router(config-l2vpn-xc)#  p2p e1_5-6
Router(config-l2vpn-xc-p2p)#  interface Bundle-Ether10.2
Router(config-l2vpn-xc-p2p)#  neighbor evpn evi 1 target 5 source 6

Router(config-l2vpn-xc-p2p-pw)# exit
Router(config-l2vpn-xc)# exit
Router(config-l2vpn)# exit
Router(config)# evpn
Router(config-evpn)# interface Bundle-Ether10
Router(config-evpn-ac)#  ethernet-segment
Router(config-evpn-ac-es)# identifier type 0 00.01.00.ac.ce.55.00.0a.00
Router(config-evpn-ac-es)# commit


/* Configure PE3 */
Router# configure
Router(config)# l2vpn
Router(config-l2vpn)#  xconnect group evpn_vpws
Router(config-l2vpn-xc)#  p2p e1_5-6
Router(config-l2vpn-xc-p2p)#  interface Bundle-Ether20.1
Router(config-l2vpn-xc-p2p)#  neighbor evpn evi 1 target 6 source 5

Router(config-l2vpn-xc-p2p-pw)# exit
Router(config-l2vpn-xc)# exit
Router(config-l2vpn)# exit
Router(config)# evpn
Router(config-evpn)# interface Bundle-Ether20
Router(config-evpn-ac)#  ethernet-segment
Router(config-evpn-ac-es)# identifier type 0 00.01.00.ac.ce.55.00.14.00
Router(config-evpn-ac-es)# commit


/* Configure PE4 */
Router# configure
Router(config)# l2vpn
Router(config-l2vpn)#  xconnect group evpn_vpws
Router(config-l2vpn-xc)#  p2p e1_5-6
Router(config-l2vpn-xc-p2p)#  interface Bundle-Ether20.1
Router(config-l2vpn-xc-p2p)#  neighbor evpn evi 1 target 6 source 5
Router(config-l2vpn-xc-p2p)# exit
Router(config-l2vpn-xc)# exit
Router(config-l2vpn)# exit
Router(config)# evpn
Router(config-evpn)# interface Bundle-Ether20
Router(config-evpn-ac)#  ethernet-segment
Router(config-evpn-ac-es)# identifier type 0 00.01.00.ac.ce.55.00.14.00
Router(config-evpn-ac-es)# commit
```

Running Configuration

```
/* On PE1 */
!
configure
l2vpn xconnect group evpn_vpws
 p2p e1_5-6
```

```
  interface Bundle-Ether10.2
  neighbor evpn evi 1 target 5 source 6
!
evpn
interface Bundle-Ether10
  ethernet-segment
   identifier type 0 00.01.00.ac.ce.55.00.0a.00

!


/* On PE2 */
!
configure
l2vpn xconnect group evpn_vpws
 p2p e1_5-6
  interface Bundle-Ether10.2
  neighbor evpn evi 1 target 5 source 6
!
evpn
interface Bundle-Ether10
  ethernet-segment
   identifier type 0 00.01.00.ac.ce.55.00.0a.00

!

/* On PE3 */
!
configure
l2vpn xconnect group evpn_vpws
 p2p e1_5-6
  interface Bundle-Ether20.1
  neighbor evpn evi 1 target 6 source 5
!
evpn
interface Bundle-Ether20
  ethernet-segment
      identifier type 0 00.01.00.ac.ce.55.00.14.00

!

/* On PE4 */
!
configure
l2vpn xconnect group evpn_vpws
 p2p e1_5-6
  interface Bundle-Ether20.1
  neighbor evpn evi 1 target 6 source 5
!
evpn
interface Bundle-Ether20
  ethernet-segment
      identifier type 0 00.01.00.ac.ce.55.00.14.00

!
```

Flow Label Support for EVPN VPWS

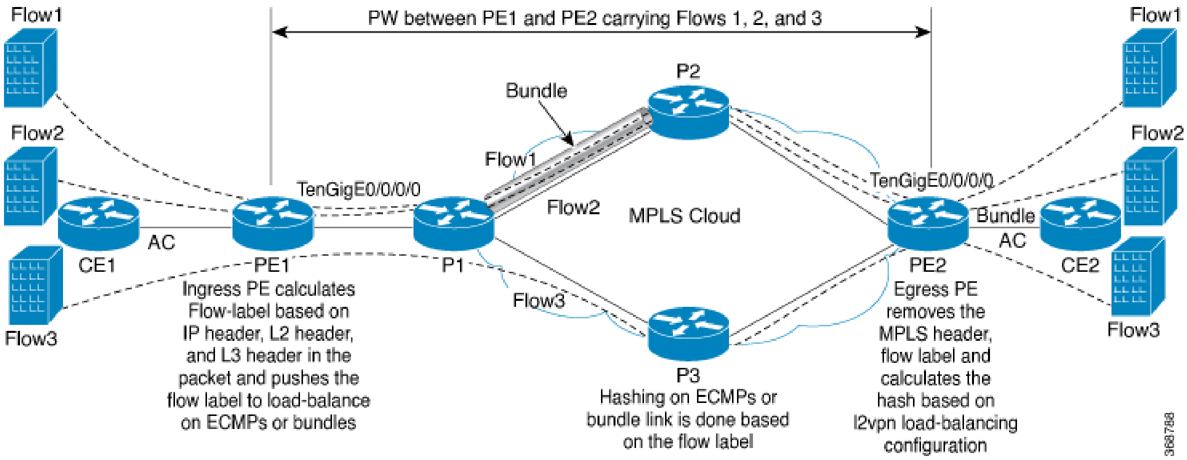
The Flow Label support for EVPN VPWS feature enables provider (P) routers to use the flow-based load balancing to forward traffic between the provider edge (PE) devices. This feature uses Flow-Aware Transport

(FAT) of pseudowires (PW) over an MPLS packet switched network for load-balancing traffic across BGP-based signaled pseudowires for Ethernet VPN (EVPN) Virtual Private Wire Service (VPWS).

FAT PWs provide the capability to identify individual flows within a PW and provide routers the ability to use these flows to load-balance the traffic. FAT PWs are used to load balance the traffic in the core when equal cost multipaths (ECMP) are used. A flow label is created based on indivisible packet flows entering an imposition PE. This flow label is inserted as the lower most label in the packet. P routers use the flow label for load balancing to provide better traffic distribution across ECMP paths or link-bundled paths in the core. A flow is identified either by the source and destination IP address of the traffic, or the source and destination MAC address of the traffic.

The following figure shows a FAT PW with two flows distributing over ECMPs and bundle links.

Figure 3: FAT PW with Two Flows Distributing over ECMPs and Bundle


Flow1
PW between PE1 and PE2 carrying Flows 1, 2, and 3
Flow1
P2
Bundle
Flow2
Flow1
Flow2
TenGigE0/0/0/0
TenGigE0/0/0/0
Flow2
MPLS Cloud
Bundle
AC
AC
CE1
PE1
P1
PE2
CE2
Flow3
Flow3
Flow3
Ingress PE calculates Flow-label based on IP header, L2 header, and L3 header in the packet and pushes the flow label to load-balance on ECMPs or bundles
P3
Hashing on ECMPs or bundle link is done based on the flow label
Egress PE removes the MPLS header, flow label and calculates the hash based on l2vpn load-balancing configuration
368788

An extra label is added to the stack, called the flow label, which is generated for each unique incoming flow on the PE. A flow label is a unique identifier that distinguishes a flow within the PW, and is derived from source and destination MAC addresses, and source and destination IP addresses. The flow label contains the end of label stack (EOS) bit set. The flow label is inserted after the VC label and before the control word (if any). The ingress PE calculates and forwards the flow label. The FAT PW configuration enables the flow label. The egress PE discards the flow label such that no decisions are made.

Core routers perform load balancing using the flow-label in the FAT PW with other information like MAC address and IP address. The flow-label adds greater entropy to improve traffic load balancing. Therefore, it is possible to distribute flows over ECMPs and link bundles.

In this topology, the imposition router, PE1, adds a flow label in the traffic. The disposition router, PE2, allows mixed types of traffic of which some have flow label, others do not. The P router uses flow label to load balance the traffic between the PEs. PE2 ignores the flow label in traffic, and uses one EVPN label for all unicast traffic.

Restrictions

To configure flow label for EVPN VPWS, the following restrictions are applicable:

- This feature is not supported for EVPN Point-to-Multipoint (P2MP) of VPLS and Ethernet LAN (E-LAN) service.
- This feature is supported only for EVPN VPWS single homing. AC bundle interfaces must be configured with ESI-0 only.

- This feature is not supported for EVPN flexible cross-connect service.
- This feature is not supported for EVPN VPWS multihoming.

Configure Flow Label for EVPN VPWS

Configuration Example

Perform this task to configure flow label for EVPN VPWS on both PE1 and PE2.

```
Router# configure
Router(config)# l2vpn
Router(config-l2vpn)# xconnect group evpn-vpws
Router(config-l2vpn-xc)# p2p evpn1
Router(config-l2vpn-xc-p2p)# interface TenGigE0/0/0/0
Router(config-l2vpn-xc-p2p)# neighbor evpn evi 1 target 2 source 1
Router(config-l2vpn-xc-p2p)# exit
!
Router# configure
Router(config)# evpn
Router(config-evpn)# evi 1
Router(config-evpn-instance)# control-word-disable
Router(config-evpn-instance)# load-balancing
Router(config-evpn-instance-lb)# flow-label static
Router(config-evpn-instance-lb)# commit
```

Running Configuration

This section shows the running configuration of flow label for EVPN VPWS.

```
l2vpn
 xconnect group evpn-vpws
  p2p evpn1
   interface TenGigE0/0/0/0
   neighbor evpn evi 1 target 2 source 1
   !
  !
evpn
 evi 1
  control-word-disable
  load-balancing
   flow-label static
  !
!
```

Verification

Verify EVPN VPWS flow label configuration.

```
Router# show l2vpn xconnect detail
Group evpn-vpws, XC evpn1, state is up; Interworking none
  AC: TenGigE0/0/0/0, state is up
    Type Ethernet
    MTU 1500; XC ID 0x1; interworking none
    Statistics:
      packets: received 21757444, sent 0
      bytes: received 18226521128, sent 0
```

```
EVPN: neighbor 100.100.100.2, PW ID: evi 1, ac-id 2, state is up ( established )
  XC ID 0xc0000001
  Encapsulation MPLS
 Encap type Ethernet, control word disabled
  Sequencing not set
  LSP : Up
  Flow Label flags configured (Tx=1,Rx=1) statically

    EVPN         Local                          Remote
    ------------ ------------------------------ -----------------------------
    Label        64002                          64002
    MTU          1500                           1500
    Control word disabled                       disabled
    AC ID        1                              2
    EVPN type    Ethernet                       Ethernet

    ------------ ------------------------------ -----------------------------
  Create time: 30/10/2018 03:04:16 (00:00:40 ago)
  Last time status changed: 30/10/2018 03:04:16 (00:00:40 ago)
  Statistics:
    packets: received 0, sent 21757444
    bytes: received 0, sent 18226521128
```

Related Topics

- Flow Label Support for EVPN VPWS, on page 8

Associated Commands

- show evpn evi

Decoupled mode for L2VPN and EVPN VPWS services

Decoupled mode is a configuration for Layer 2 Virtual Private Networks (L2VPN) and Ethernet VPN Virtual Private Wire Services (EVPN VPWS) that

- enhances network reliability and resilience,
- enables the pseudowire (PW) to operate independently of the Attachment Circuit (AC), ensuring uninterrupted PW traffic even when the AC fails, and
- uses a cross-connect (XC), a virtual connection linking the AC and PW segments, to manage state transitions effectively.

Table 2: Feature History Table

Feature Name	Release Information	Feature Description

Decoupled mode for L2VPN and EVPN VPWS services	Release 25.3.1	Decoupled mode improves fault tolerance by allowing the Provider Edge (PE) router to maintain the pseudowire (PW) in an active state independently of the Attachment Circuit (AC) status. Unlike the traditional coupled mode, which requires both AC and PW to be active for traffic flow, decoupled mode ensures uninterrupted PW traffic even during AC failures. The feature introduces these changes: **CLI**: • **decoupled-mode** **YANG Data Model**: • `Cisco-IOS-XR-l2vpn-cfg.yang` • `Cisco-IOS-XR-l2vpn-oper.yang` (see GitHub, YANG Data Models Navigator)

Decoupled mode states

In decoupled mode, the XC manages traffic flow using independent AC and PW statuses, enhancing service resilience by maintaining PW traffic even if the AC fails.

The XC operates in these states:

- **Bound state:** When both the AC and PW segments are active, the XC is in a bound state, enabling seamless traffic flow between the AC and PW segments.
- **Bound down state:** When the AC segment fails, the XC transitions to a bound down state. In this state, the PW remains active, and traffic continues to flow across the PW between PE routers.
- **Unbound state:** When the PW segment fails, or when both AC and PW segments fail, the XC transitions to an unbound state. In this state, the XC brings the AC connection down, stops all traffic flow between AC and PW segments, and drops any pending data on the AC.

From Release 25.3.1, you can configure the decoupled mode in addition to the existing coupled mode. Decoupled mode ensures PW traffic continues even if the AC fails, improving service resilience.

Benefits of decoupled mode for L2VPN and EVPN VPWS services

Decoupling the state of static Layer 2 (L2) PW from the Provider-Edge to Customer-Edge (PE-CE) physical link state improves network reliability and traffic management. The key benefits include:

- **Enhanced network reliability**: It decouples static L2 pseudowire states from the physical link status, ensuring continuity even during link disruptions.
- **Improved fault recovery**: It can be used along with Connectivity Fault Management (CFM) for faster and more stable fault resolution.
- **Prevents network deadlocks**: It prevents network deadlocks by disabling data transmission on the remote end during local faults, avoiding a full connection shutdown.

- **Flexible deployment**: It operates on both bundle and physical interfaces, ensuring adaptability to various network setups.

Limitations of decoupled mode for L2VPN and EVPN VPWS services

The router does not support decoupled mode for these configurations:

- PWHE Attachment Circuit (AC) segment
- Monitor session AC segment
- Multi-segment Pseudowire (PW)
- Local switching between AC
- BGP Auto-Discovery for PW, and
- Multi-homing EVPN circuits.

How decoupled mode for L2VPN and EVPN VPWS services works

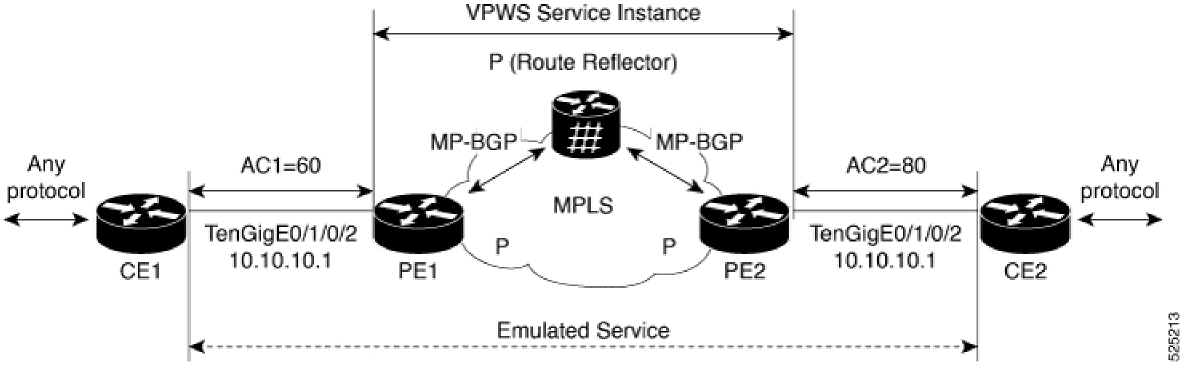
The key components involved in this process are:

- Customer edge devices: Connect customer networks to the provider network, CE1 and CE2.
- Provider edge routers: Interface between the provider network and customer devices, PE1 and PE2.
- Route reflector: Enables the exchange of routing information between interconnected provider edge routers PE1 and PE2.

Decoupled mode enhances network resilience by allowing Provider Edge (PE) routers to manage PW and AC connections independently. This ensures uninterrupted PW traffic and dynamic fault handling between Customer Edge (CE) devices and PE routers.

Workflow

Figure 4: VPWS Traffic flow



These scenarios illustrate how packet transmission occurs in decoupled mode.

Scenario 1: Both AC and PW are active - Bound state

When both the AC and PW are active, the XC remains in a bound state, enabling seamless traffic flow between the AC and PW. The PE routers perform these steps to manage packet transmission:

1. CE1 sends packets to PE1 through the active AC.
2. PE1 forwards packets to PE2 over the active PW.
3. PE2 forwards packets to CE2 through its active AC.
4. Traffic flows normally between CE1 and CE2.

Scenario 2: AC experiences a failure - Bound down state

When the AC experiences a failure, the XC transitions to a bound down state, keeping the PW operational and allowing traffic to continue flowing across the PW between PE routers. The PE routers perform these steps to manage packet transmission:

1. PE1 detects the AC failure but does not deactivate the PW
2. The XC transitions to bound down, keeping the PW operational.
3. PE1 continues forwarding traffic over the PW to PE2.
4. PE2 delivers packets to CE2 through its active AC.
5. Despite the AC failure at PE1, traffic continues across the PW.

Scenario 3: PW experiences a failure - Unbound state

When the PW experiences a failure, the XC transitions to an unbound state, bringing the AC down and stopping all traffic flow. The PE routers perform these steps to manage packet transmission:

1. PE1 detects the PW failure.
2. The XC transitions to unbound, bringing the AC down.
3. Both PE1 and PE2 stop forwarding traffic.
4. Pending traffic on the AC is dropped, and the traffic flow stops completely.

Configure decoupled mode for L2VPN and EVPN VPWS services

Perform these steps on PE routers to configure decoupled mode for L2VPN and EVPN VPWS services.

Procedure

Step 1 Enable L2VPN services and configure a point-to-point (p2p) pseudowire service that extends a Layer 2 network across a Layer 3 IP and MPLS network.

Example:

```
Router# configuration
Router(config)# l2vpn
Router(config-l2vpn)# xconnect group g1
Router(config-l2vpn-xc)# p2p xc1
```

Step 2 Enable decoupled mode within p2p services, which keeps the PW active even if the AC experiences a failure.

Example:

```
Router(config-l2vpn-xc-p2p)# decoupled-mode
```

Step 3 Enable interface and configure PW, ipv4 , EVPN or MPLS services for establishing the required L2VPN service over a network.

Example:

```
Router(config-l2vpn-xc-p2p)# interface TenGigE0/1/0/2
Router(config-l2vpn-xc-p2p)# neighbor evpn evi 1 service-id 10011
Router(config-l2vpn-xc-p2p)# commit
```

Step 4 Run **show l2vpn** command to verify the XC, AC, and PW states.

a) **Example:**

```
Router# show l2vpn xconnect group g1 xc-name p1 detail
Group g1, XC p1, state is up; Interworking none
Decoupled mode: Enabled
  AC: GigabitEthernet0/0/0/2.1, state is up
    Type VLAN; Num Ranges: 1
    Rewrite Tags: []
    VLAN ranges: [1, 1]
    MTU 1504; XC ID 0x1; interworking none
    Statistics:
      packets: received 0, sent 0
      bytes: received 0, sent 0
      drops: illegal VLAN 0, illegal length 0
  PW: neighbor 1.1.1.1, PW ID 1, state is up ( established )
    PW class not set, XC ID 0xfff80013
    Encapsulation MPLS, protocol LDP
    Source address 2.2.2.2
    PW type Ethernet, control word disabled, interworking none
    PW backup disable delay 0 sec
    Sequencing not set
    Ignore MTU mismatch: Disabled
    Transmit MTU zero: Disabled
    LSP : Up
    Nexthop type: IPV4 1.1.1.1
```

In this example, both the AC and PW are in the bound state, and the XC is in the up state.

b) **Example:**

```
Router# show l2vpn xconnect group g1 xc-name p1 detail

Group g1, XC p1, state is down; Interworking none
Decoupled mode: Enabled
  AC: GigabitEthernet0/0/0/2.1, state is down (Admin)
    Type VLAN; Num Ranges: 1
    Rewrite Tags: []
    VLAN ranges: [1, 1]
    MTU 1504; XC ID 0x1; interworking none
    Statistics:
      packets: received 0, sent 0
      bytes: received 0, sent 0
      drops: illegal VLAN 0, illegal length 0
  PW: neighbor 1.1.1.1, PW ID 1, state is up ( established )
    PW class not set, XC ID 0xfff80013
    Encapsulation MPLS, protocol LDP
    Source address 2.2.2.2
    PW type Ethernet, control word disabled, interworking none
    PW backup disable delay 0 sec
    Sequencing not set
    Ignore MTU mismatch: Disabled
    Transmit MTU zero: Disabled
    LSP : Up
    Nexthop type: IPV4 1.1.1.1
```

In this example, due to a local AC fault, the AC is in the down state and the PW is in the up state.

Step 5 Run the **show l2vpn forwarding xconnect <xc-id> detail location <location>** command to verify the xconnect and PW binding state.

a) **Example:**

```
Router# show l2vpn forwarding xconnect 0x1 detail location 0/0/CPU0

Local interface: GigabitEthernet0/0/0/2.1, Xconnect id: 0x1, Status: down
  Segment 1
    AC, GigabitEthernet0/0/0/2.1, status: Bound
    Statistics:
      packets: received 0, sent 0
      bytes: received 0, sent 0
  Segment 2
    MPLS, Destination address: 1.1.1.1, pw-id: 1, status: Bound
    Pseudowire label: 24014
    Control word disabled
    Statistics:
      packets: received 0, sent 0
      bytes: received 0, sent 0
    PD System Data:  0x00000000, 0x00000000, 0x00000000, 0x01000000, 0x22000000,
                    0x00000000, 0x00000000
```

In this example, the XC is in the down state, both AC and PW are in a bound state, and the segment can still carry traffic across the PW despite the AC failure.

b) **Example:**

```
Router# show l2vpn forwarding xconnect 0x1 detail location 0/0/CPU0

Local interface: GigabitEthernet0/0/0/2.1, Xconnect id: 0x1, Status: up
  Segment 1
    AC, GigabitEthernet0/0/0/2.1, status: Bound
    Statistics:
      packets: received 0, sent 0
      bytes: received 0, sent 0
  Segment 2
    MPLS, Destination address: 1.1.1.1, pw-id: 1, status: Bound
    Pseudowire label: 24014
    Control word disabled
```

In this example, the XC is in the up state and both AC and PW are in bound state.