ASR 9000 - Comprensión y configuración de VPLS LSM

Contenido

Introducción

Este documento describe la multidifusión conmutada por etiquetas (LSM) del servicio de LAN privada virtual (VPLS) para el router de servicios de agregación (ASR) serie 9000 que ejecuta el software Cisco IOS® XR.

Prerequisites

Requirements

No hay requisitos específicos para este documento.

Componentes Utilizados

Este documento no tiene restricciones específicas en cuanto a versiones de software y de hardware.

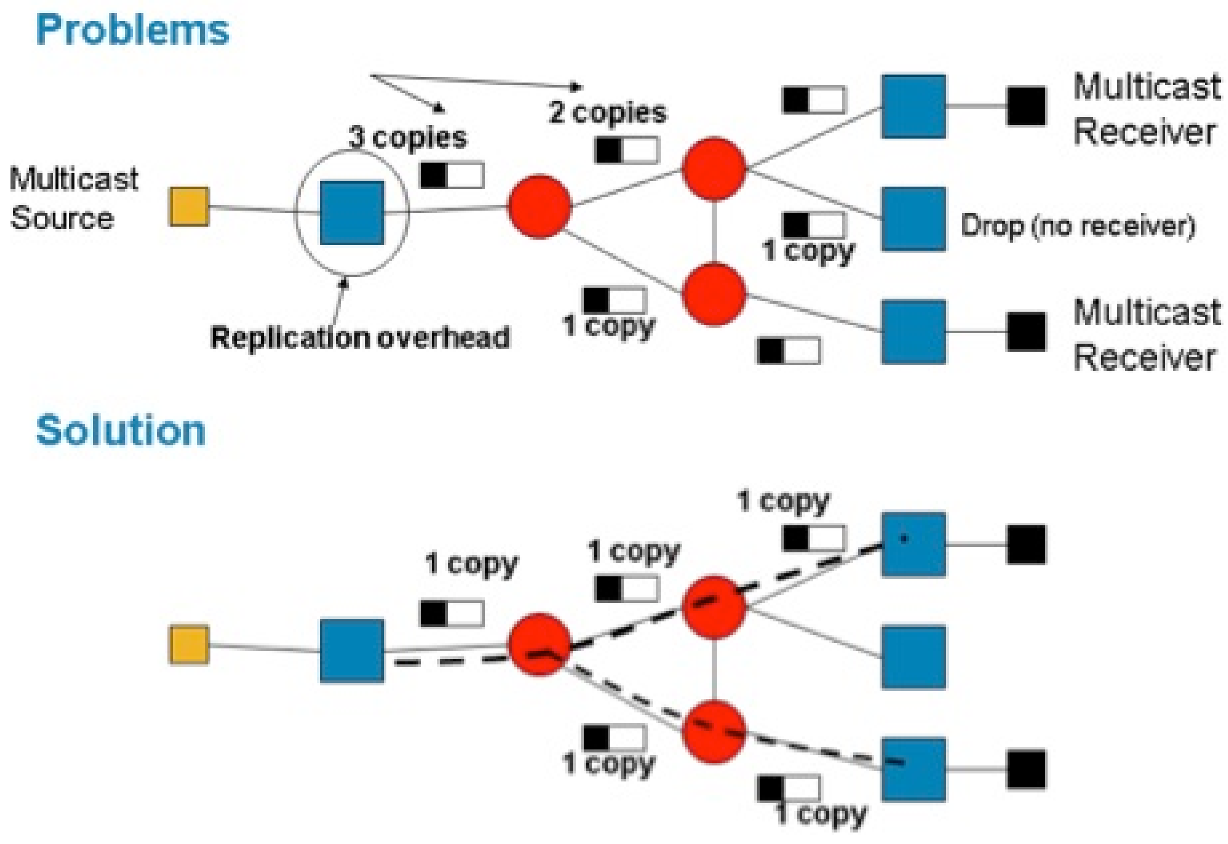
La información que contiene este documento se creó a partir de los dispositivos en un ambiente de laboratorio específico. Todos los dispositivos que se utilizan en este documento se pusieron en funcionamiento con una configuración verificada (predeterminada). If your network is live, make sure that you understand the potential impact of any command.

Descripción General de VPLS Label Switched Multicast (LSM)

VPLS emula servicios LAN a través de un núcleo de Multiprotocol Label Switching (MPLS). Se configura una malla completa de pseudowires (PW) punto a punto (P2P) entre todos los routers Provider Edge (PE) que participan en un dominio VPLS para proporcionar emulación VPLS. El tráfico de difusión, multidifusión y unidifusión desconocida se inunda en un dominio VPLS a todos los PE. La replicación de entrada se utiliza para enviar ese tráfico inundado sobre cada P2P PWs a todos los routers PE remotos que forman parte del mismo dominio VPLS.

Inconvenientes de la replicación de entrada

- La replicación de entrada es ineficiente en cuanto al ancho de banda, ya que el mismo paquete podría enviarse varias veces a través del mismo enlace para cada PW P2P.
- La replicación de entrada puede resultar en un ancho de banda de link desperdiciado significativo cuando hay tráfico VPLS de broadcast y multicast pesado.
- La replicación de entrada también requiere muchos recursos, ya que el router PE de entrada soporta toda la carga de la replicación.



Funciones de VPLS LSM

VPLS es una tecnología L2VPN de proveedor de servicios ampliamente implementada que también se utiliza para el transporte multidifusión. Aunque la tecnología L2 permite que se utilice la indagación para optimizar la replicación del tráfico multicast en los pseudowires L2, el núcleo permanece independiente del tráfico multicast. Como resultado, varias copias del mismo flujo atraviesan las redes de núcleo. Para mitigar esta ineficiencia, vincule LSM con VPLS para introducir árboles de multidifusión LSM sobre el núcleo. En Cisco IOS-XR Software Release 5.1.0, Cisco ASR 9000 Series implementa VPLS LSM con árboles inclusivos de ingeniería de tráfico punto a multipunto (P2MP-TE). Los terminales VPLS se detectan automáticamente y los árboles P2MP-TE se configuran con el uso de la ingeniería de tráfico de protocolo de reserva de recursos (RSVP-TE) sin intervención operativa.

- VPLS LSM supera los inconvenientes de la replicación de ingreso.
- La solución VPLS LSM emplea LSP P2MP en el núcleo MPLS para transportar tráfico de difusión, multidifusión y unidifusión desconocida para un dominio VPLS.
- Los P2MP LSPs permiten la replicación en la red MPLS en el nodo óptimo y minimizan la cantidad de replicación de paquetes en la red.
- La solución VPLS LSM sólo envía tráfico VPLS inundado a través de LSP P2MP.
- El tráfico VPLS unidifusión se sigue enviando a través de PW P2P. El tráfico enviado a través de los PW de acceso continúa enviándose con la replicación de entrada.
- Los P2MP PW son unidireccionales en contraposición a los P2P PW, que son bidireccionales.

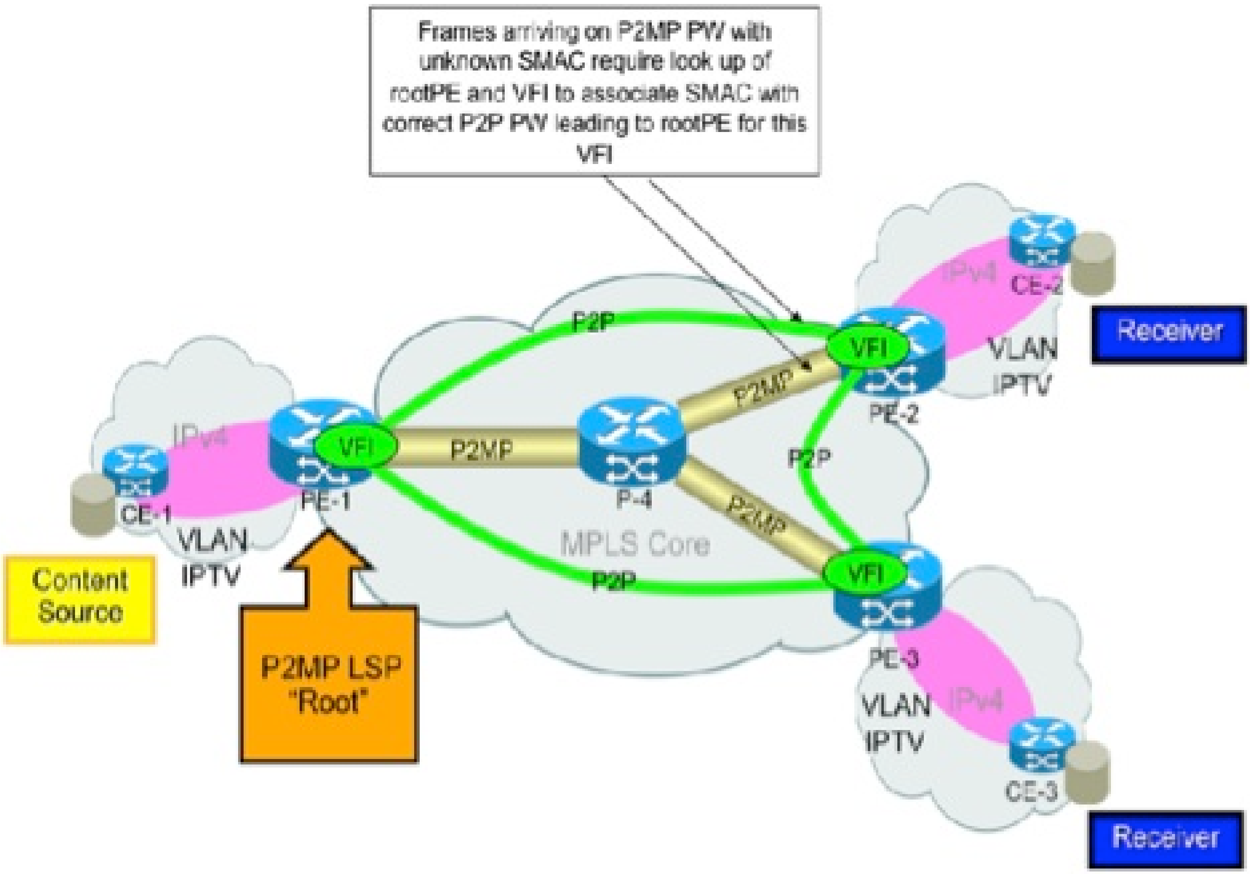
- La solución VPLS LSM implica la creación de un P2MP PW por dominio VPLS para emular un servicio VPLS P2MP para PWs de núcleo en el dominio VPLS.
- VPLS LSM es compatible con Cisco IOS XR Release 5.1.0 y versiones posteriores.

Restricciones de VPLS LSM

- La funcionalidad VPLS LSM de Cisco IOS-XR versión 5.1.0 admite solo árboles P2MP-TE de ingeniería de tráfico MPLS configurados con RSVP-TE.
- Un P2MP PW se puede señalizar con el protocolo BGP solamente en Cisco IOS-XR Release 5.1.0. En esta primera fase, los PE remotos que participan en el dominio VPLS se descubren automáticamente con BGP Auto-Discovery (BGP-AD).
- La señalización LDP estática no se soporta en Cisco IOS XR Release 5.1.0.

Aprendizaje del control de acceso a los medios (MAC)

El aprendizaje de MAC en el PE de hoja para una trama que llega a P2MP PW se realiza como si la trama se recibiera en el PW P2P que conduce al PE raíz para ese PW P2MP. En esta imagen, el aprendizaje de MAC en PE-2 para las tramas que llegan a P2MP PW LSP con raíz en PE-1 se realiza como si la trama llegara al P2P PW entre PE-1 y PE-2. El plano de control L2VPN es responsable de programar la información de disposición VPLS con información P2P PW para el aprendizaje MAC en la disposición P2MP LSP.



Compatibilidad con detección de protocolo de administración de grupos de Internet (IGMPSN)

El snooping del protocolo de administración de grupos de Internet (IGMP) (IGMPSN) es compatible tanto en la cabecera como en la cola del árbol P2MP P en un dominio de puente que participa en VPLS LSM. Esto permite que el tráfico multidifusión IGMPSN a través de un PW de instancia de reenvío virtual (VFI) se beneficie de la optimización de recursos proporcionada por los LSP P2MP. Si IGMPSN está habilitado en un dominio de bridge con uno o más PW VFI que participan en VPLS LSM, todo el tráfico multicast de capa dos (L2) se envía a través del P2MP P-tree Head asociado con el dominio de bridge. Las rutas multicast L2 se utilizan para reenviar el tráfico a los receptores locales, los puntos de flujo Ethernet (EFP), los PW de acceso y los PW VFI que no participan en VPLS LSM.

Cuando IGMPSN está habilitado en un dominio de bridge que es una cola LSP P2MP, la disposición optimizada del tráfico multicast L2 recibido en el LSP P2MP se realiza para los receptores locales (es decir, los puertos puente (BP) del circuito de conexión (AC) y los BP de acceso PW).

> **Nota**: La detección de protocolo de distribución de etiquetas multidifusión (MLDP) no se admite en Cisco IOS XR Release 5.1.0.

Escala admitida

Cisco IOS XR Release 5.1.0 admite un máximo de **1000** túneles P2MP o **1000** PW P2MP por router de cabecera/cola.

Configuración de VPLS LSM

Configuración del Túnel Automático P2MP

```
mpls traffic-eng
 interface GigabitEthernet0/1/1/0
 !
 interface GigabitEthernet0/1/1/1
 !
 auto-tunnel p2mp
 tunnel-id min 100 max 200
```

Configuración de MPLS TE Fast Reroute (FRR)

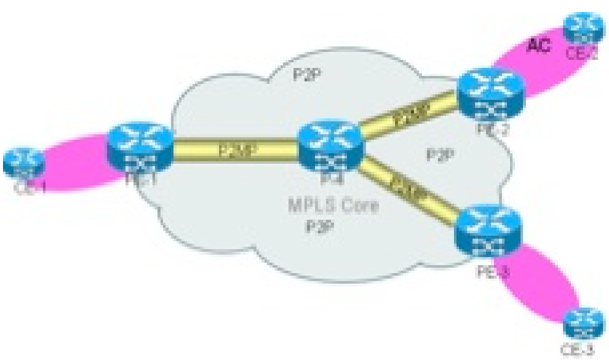
```
mpls traffic-eng
 interface GigabitEthernet0/1/1/0
 auto-tunnel backup
  nhop-only
 !
```

```
 !
 interface GigabitEthernet0/1/1/1
 auto-tunnel backup
  nhop-only
 !
 !
 auto-tunnel p2mp
 tunnel-id min 100 max 200
 !
 auto-tunnel backup
 tunnel-id min 1000 max 1500
 !
 attribute-set p2mp-te set1
 bandwidth 10000
 fast-reroute
 record-route
 !
```

Configuración de L2VPN

```
l2vpn
 bridge group bg1
 bridge-domain bg1_bd1
  interface GigabitEthernet0/1/1/10.1
  !
  vfi bg1_bd1_vfi
   vpn-id 1
   autodiscovery bgp
    rd auto
    route-target 209.165.201.1:1
    signaling-protocol bgp
     ve-id 100
    !
   !
   multicast p2mp
    signaling-protocol bgp
    !
    transport rsvp-te
     attribute-set p2mp-te set1
    !
```

Topología y configuración de ejemplo



Los túneles P2MP son túneles detectados automáticamente. Los túneles P2MP estáticos **no** son compatibles.

No se utilizan configuraciones de túnel estáticas. La configuración automática del túnel P2MP debe estar habilitada en todos los routers PE y también en un router P si actúa como nodo de brote. Un nodo de brote es un router de punto medio y final al mismo tiempo.

Aquí se muestra una topología de ejemplo con configuración. En esta topología, los P2MP PW se crean entre los tres PE y un router P que actúa como un nodo de brote. Los tres routers PE actúan como Head (para el tráfico de entrada) y Tail (para el tráfico de salida).

Configuración PE1

```
RP/0/RSP0/CPU0:PE1#show run
hostname PE1
!
ipv4 unnumbered mpls traffic-eng Loopback0
!
interface Loopback0
 ipv4 address 209.165.200.225 255.255.255.255
!
interface GigabitEthernet0/1/1/0
 description connected P router
 ipv4 address 209.165.201.1 255.255.255.224
!
interface GigabitEthernet0/1/1/1
 description connected to P router
 ipv4 address 209.165.201.151 255.255.255.224
 transceiver permit pid all
!
interface GigabitEthernet0/1/1/10
 transceiver permit pid all
!
interface GigabitEthernet0/1/1/10.1 l2transport
 encapsulation dot1q 1
!
router ospf 100
 router-id 209.165.200.225
 area 0
 mpls traffic-eng
 interface Loopback0
  !
 interface GigabitEthernet0/1/1/0
  !
 interface GigabitEthernet0/1/1/1
  !
  !
 mpls traffic-eng router-id 209.165.200.225
!
router bgp 100
 nsr
 bgp router-id 209.165.200.225
 bgp graceful-restart
 address-family l2vpn vpls-vpws
  !
 neighbor 209.165.200.226
 remote-as 100
 update-source Loopback0
 address-family l2vpn vpls-vpws
  !
  !
 neighbor 209.165.200.227
 remote-as 100
```

```
 update-source Loopback0
 address-family l2vpn vpls-vpws
 !
 !
 neighbor 209.165.200.228
 remote-as 100
 update-source Loopback0
 address-family l2vpn vpls-vpws
 !
 !
!
l2vpn
 bridge group bg1
 bridge-domain bg1_bd1
  interface GigabitEthernet0/1/1/10.1
  !
  vfi bg1_bd1_vfi
   vpn-id 1
   autodiscovery bgp
    rd auto
    route-target 209.165.201.1:1
    signaling-protocol bgp
     ve-id 100
    !
   !
   multicast p2mp
    signaling-protocol bgp
    !
    transport rsvp-te
     attribute-set p2mp-te set1
    !
   !
  !
 !
 !
!
rsvp
 interface GigabitEthernet0/1/1/0
 bandwidth 100000
 !
 interface GigabitEthernet0/1/1/1
 bandwidth 100000
 !
!
mpls traffic-eng
 interface GigabitEthernet0/1/1/0
 auto-tunnel backup
  nhop-only
 !
 !
 interface GigabitEthernet0/1/1/1
 auto-tunnel backup
  nhop-only
 !
 !
 auto-tunnel p2mp
 tunnel-id min 100 max 200
 !
 auto-tunnel backup
 tunnel-id min 1000 max 1500
 !
 attribute-set p2mp-te set1
 bandwidth 10000
 fast-reroute
```

```
 record-route
 !
!
mpls ldp
 nsr
 graceful-restart
 router-id 209.165.200.225
 interface GigabitEthernet0/1/1/0
 !
 interface GigabitEthernet0/1/1/1
 !
!
end

RP/0/RSP0/CPU0:PE1#
```

Configuración de IP

```
RP/0/RSP0/CPU0:P#show run
hostname P
ipv4 unnumbered mpls traffic-eng Loopback0
interface Loopback0
 ipv4 address 209.165.200.226 255.255.255.255
!
interface GigabitEthernet0/1/1/0
 description connected to PE1 router
 ipv4 address 209.165.201.2 255.255.255.224
 transceiver permit pid all
!
interface GigabitEthernet0/1/1/1
 description connected to PE1 router
 ipv4 address 209.165.201.152 255.255.255.224
 transceiver permit pid all
!
interface GigabitEthernet0/1/1/3
 description connected to PE2 router
 ipv4 address 209.165.201.61 255.255.255.224
!
interface GigabitEthernet0/1/1/4
 transceiver permit pid all
!
interface GigabitEthernet0/1/1/4.1 l2transport
 encapsulation dot1q 1
!
interface GigabitEthernet0/1/1/8
 description connected to PE3 router
 ipv4 address 209.165.201.101 255.255.255.224
!
router ospf 100
 nsr
 nsf cisco
 area 0
 mpls traffic-eng
 interface Loopback0
 !
 interface GigabitEthernet0/1/1/0
 !
 interface GigabitEthernet0/1/1/1
 !
 interface GigabitEthernet0/1/1/3
 !
```

```
 interface GigabitEthernet0/1/1/8
 !
 !
 mpls traffic-eng router-id 209.165.200.226
!
router bgp 100
 nsr
 bgp router-id 209.165.200.226
 bgp graceful-restart
 address-family l2vpn vpls-vpws
 !
 neighbor 209.165.200.225
 remote-as 100
 update-source Loopback0
 address-family l2vpn vpls-vpws
 !
 !
 neighbor 209.165.200.227
 remote-as 100
 update-source Loopback0
 address-family l2vpn vpls-vpws
 !
 !
 neighbor 209.165.200.228
 remote-as 100
 update-source Loopback0
 address-family l2vpn vpls-vpws
 !
 !
!
l2vpn
 bridge group bg1
 bridge-domain bg1_bd1
  interface GigabitEthernet0/1/1/4.1
  !
  vfi bg1_bd1_vfi
   vpn-id 1
   autodiscovery bgp
    rd auto
    route-target 209.165.201.1:1
    signaling-protocol bgp
     ve-id 200
    !
   !
   multicast p2mp
    signaling-protocol bgp
    !
    transport rsvp-te
     attribute-set p2mp-te set1
    !
   !
  !
 !
 !
!
rsvp
 interface GigabitEthernet0/1/1/0
 bandwidth 100000
 !
 interface GigabitEthernet0/1/1/1
 bandwidth 100000
 !
 interface GigabitEthernet0/1/1/3
 bandwidth 100000
```

```
 !
 interface GigabitEthernet0/1/1/8
 bandwidth 100000
 !
!
mpls traffic-eng
 interface GigabitEthernet0/1/1/0
 auto-tunnel backup
  nhop-only
 !
 !
 interface GigabitEthernet0/1/1/1
 auto-tunnel backup
  nhop-only
 !
 !
 interface GigabitEthernet0/1/1/3
 !
 interface GigabitEthernet0/1/1/8
 !
 auto-tunnel p2mp
 tunnel-id min 100 max 200
 !
 auto-tunnel backup
 tunnel-id min 1000 max 1500
 !
 attribute-set p2mp-te set1
 bandwidth 10000
 fast-reroute
 record-route
 !
!
mpls ldp
 nsr
 graceful-restart
 router-id 209.165.200.226
 interface GigabitEthernet0/1/1/0
 !
 interface GigabitEthernet0/1/1/1
 !
 interface GigabitEthernet0/1/1/3
 !
 interface GigabitEthernet0/1/1/8
 !
!
end

RP/0/RSP0/CPU0:P#
```

Configuración PE2

```
RP/0/RSP0/CPU0:PE2#show run
hostname PE2
ipv4 unnumbered mpls traffic-eng Loopback0
interface Loopback0
 ipv4 address 209.165.200.227 255.255.255.255
!
interface GigabitEthernet0/3/0/2.1 l2transport
 encapsulation dot1q 1
!
interface GigabitEthernet0/3/0/3
```

```
 description connected to P router
 ipv4 address 209.165.201.62 255.255.255.224
 transceiver permit pid all
!
router ospf 100
 nsr
 router-id 209.165.200.227
 nsf cisco
 area 0
 mpls traffic-eng
 interface Loopback0
 !
 interface GigabitEthernet0/3/0/3
 !
 !
 mpls traffic-eng router-id 209.165.200.227
!
router bgp 100
 nsr
 bgp router-id 209.165.200.227
 bgp graceful-restart
 address-family l2vpn vpls-vpws
 !
 neighbor 209.165.200.225
 remote-as 100
 update-source Loopback0
 address-family l2vpn vpls-vpws
 !
 !
 neighbor 209.165.200.226
 remote-as 100
 update-source Loopback0
 address-family l2vpn vpls-vpws
 !
 !
 neighbor 209.165.200.228
 remote-as 100
 update-source Loopback0
 address-family l2vpn vpls-vpws
 !
 !
!
l2vpn
 bridge group bg1
 bridge-domain bg1_bd1
  interface GigabitEthernet0/3/0/2.1
  !
  vfi bg1_bd1_vfi
   vpn-id 1
   autodiscovery bgp
    rd auto
    route-target 209.165.201.1:1
    signaling-protocol bgp
     ve-id 300
    !
   !
   multicast p2mp
    signaling-protocol bgp
    !
    transport rsvp-te
     attribute-set p2mp-te set1
    !
   !
  !
```

```
 !
 !
!
rsvp
 interface GigabitEthernet0/3/0/3
 bandwidth 100000
 !
!
mpls traffic-eng
 interface GigabitEthernet0/3/0/3
 !
 auto-tunnel p2mp
 tunnel-id min 100 max 200
 !
 auto-tunnel backup
 tunnel-id min 1000 max 1500
 !
 attribute-set p2mp-te set1
 bandwidth 10000
 fast-reroute
 record-route
 !
!
mpls ldp
 nsr
 graceful-restart
 router-id 209.165.200.227
 interface GigabitEthernet0/3/0/3
 !
!
end

RP/0/RSP0/CPU0:PE2#
```

Configuración de PE3

```
RP/0/RSP0/CPU0:PE3#show run
hostname PE3
ipv4 unnumbered mpls traffic-eng Loopback0

interface Loopback0
 ipv4 address 209.165.200.228 255.255.255.255
!
interface GigabitEthernet0/2/1/8
 description connected to P router
 ipv4 address 209.165.201.102 255.255.255.224
 transceiver permit pid all
!
interface GigabitEthernet0/2/1/11
 transceiver permit pid all
!
interface GigabitEthernet0/2/1/11.1 l2transport
 encapsulation dot1q 1
!
router ospf 100
 nsr
 router-id 209.165.200.228
 nsf cisco
 area 0
 mpls traffic-eng
 interface Loopback0
```

```
 !
 interface GigabitEthernet0/2/1/8
 !
 !
 mpls traffic-eng router-id 209.165.200.228
!
router bgp 100
 nsr
 bgp router-id 209.165.200.228
 bgp graceful-restart
 address-family l2vpn vpls-vpws
 !
 neighbor 209.165.200.225
 remote-as 100
 update-source Loopback0
 address-family l2vpn vpls-vpws
 !
 !
 neighbor 209.165.200.226
 remote-as 100
 update-source Loopback0
 address-family l2vpn vpls-vpws
 !
 !
 neighbor 209.165.200.227
 remote-as 100
 update-source Loopback0
 address-family l2vpn vpls-vpws
 !
 !
!
l2vpn
 bridge group bg1
 bridge-domain bg1_bd1
  interface GigabitEthernet0/2/1/11.1
  !
  vfi bg1_bd1_vfi
   vpn-id 1
   autodiscovery bgp
    rd auto
    route-target 209.165.201.1:1
    signaling-protocol bgp
     ve-id 400
    !
   !
   multicast p2mp
    signaling-protocol bgp
    !
    transport rsvp-te
     attribute-set p2mp-te set1
    !
   !
  !
 !
 !
!
rsvp
 interface GigabitEthernet0/2/1/8
 bandwidth 1000000
 !
!
mpls traffic-eng
 interface GigabitEthernet0/2/1/8
 !
```

```
 auto-tunnel p2mp
 tunnel-id min 100 max 200
 !
 auto-tunnel backup
 tunnel-id min 1000 max 1500
 !
 attribute-set p2mp-te set1
 bandwidth 10000
 fast-reroute
 record-route
 !
!
mpls ldp
 nsr
 graceful-restart
 router-id 209.165.200.228
 interface GigabitEthernet0/2/1/8
 !
!
end

RP/0/RSP0/CPU0:PE3#
```

Verificar - Mostrar comandos

Estos comandos show son útiles para depurar y verificar el estado de los túneles P2MP PW y P2MP MPLS TE.

- **show l2vpn bridge-domain**
- **show l2vpn bridge-domain detail**
- **show mpls traffic-eng tunnels p2mp**
- **show mpls forwarding labels <label> detail**
- **show mpls traffic-eng tunnels p2mp tabular**

A continuación, se incluyen algunos ejemplos:

```
 show l2vpn bridge-domain

RP/0/RSP0/CPU0:PE1#show l2vpn bridge-domain
Legend: pp = Partially Programmed.
Bridge group: bg1, bridge-domain: bg1_bd1, id: 0, state: up, ShgId: 0, MSTi: 0
 Aging: 300 s, MAC limit: 4000, Action: none, Notification: syslog
 Filter MAC addresses: 0
 ACs: 1 (1 up), VFIs: 1, PWs: 3 (3 up), PBBs: 0 (0 up)
 List of ACs:
   GigabitEthernet0/1/1/10.1, state: up, Static MAC addresses: 0
 List of Access PWs:
 List of VFIs:
   VFI bg1_bd1_vfi (up)
     P2MP: RSVP-TE, BGP, 1, Tunnel Up
     Neighbor 209.165.200.226 pw-id 1, state: up, Static MAC addresses: 0
     Neighbor 209.165.200.227 pw-id 1, state: up, Static MAC addresses: 0
     Neighbor 209.165.200.228 pw-id 1, state: up, Static MAC addresses: 0
RP/0/RSP0/CPU0:PE1#
```

```
show l2vpn bridge-domain detail

RP/0/RSP0/CPU0:PE1#show l2vpn bridge-domain detail
```

```
Legend: pp = Partially Programmed.
Bridge group: bg1, bridge-domain: bg1_bd1, id: 0, state: up, ShgId: 0, MSTi: 0
 Coupled state: disabled
 MAC learning: enabled
 MAC withdraw: enabled
   MAC withdraw for Access PW: enabled
   MAC withdraw sent on: bridge port up
   MAC withdraw relaying (access to access): disabled
 Flooding:
   Broadcast & Multicast: enabled
   Unknown unicast: enabled
 MAC aging time: 300 s, Type: inactivity
 MAC limit: 4000, Action: none, Notification: syslog
 MAC limit reached: no
 MAC port down flush: enabled
 MAC Secure: disabled, Logging: disabled
 Split Horizon Group: none
 Dynamic ARP Inspection: disabled, Logging: disabled
 IP Source Guard: disabled, Logging: disabled
 DHCPv4 snooping: disabled
 IGMP Snooping: enabled
  IGMP Snooping profile: none
 MLD Snooping profile: none
 Storm Control: disabled
 Bridge MTU: 1500
 MIB cvplsConfigIndex: 1
 Filter MAC addresses:
 P2MP PW: enabled
 Create time: 18/02/2014 03:47:59 (00:41:54 ago)
 No status change since creation
 ACs: 1 (1 up), VFIs: 1, PWs: 3 (3 up), PBBs: 0 (0 up)
 List of ACs:
   AC: GigabitEthernet0/1/1/10.1, state is up
     Type VLAN; Num Ranges: 1
     VLAN ranges: [1, 1]
     MTU 1504; XC ID 0x8802a7; interworking none
     MAC learning: enabled
     Flooding:
       Broadcast & Multicast: enabled
       Unknown unicast: enabled
     MAC aging time: 300 s, Type: inactivity
     MAC limit: 4000, Action: none, Notification: syslog
     MAC limit reached: no
     MAC port down flush: enabled
     MAC Secure: disabled, Logging: disabled
     Split Horizon Group: none
     Dynamic ARP Inspection: disabled, Logging: disabled
     IP Source Guard: disabled, Logging: disabled
     DHCPv4 snooping: disabled
     IGMP Snooping: enabled
     IGMP Snooping profile: none
     MLD Snooping profile: none
     Storm Control: disabled
     Static MAC addresses:
     Statistics:
       packets: received 0, sent 0
       bytes: received 0, sent 0
     Storm control drop counters:
       packets: broadcast 0, multicast 0, unknown unicast 0
       bytes: broadcast 0, multicast 0, unknown unicast 0
     Dynamic ARP inspection drop counters:
       packets: 0, bytes: 0
     IP source guard drop counters:
       packets: 0, bytes: 0
```

```
 List of Access PWs:
 List of VFIs:
   VFI bg1_bd1_vfi (up)
     P2MP:
        Type RSVP-TE, BGP signaling, PTree ID 1
        P2MP Status: Tunnel Up
        P2MP-TE attribute-set: set1
        Tunnel tunnel-mte100, Local Label: 289994
      VPN-ID: 1, Auto Discovery: BGP, state is Provisioned (Service Connected)
Route Distinguisher:  (auto) 209.165.200.225:32768
     Import Route Targets:
       209.165.201.1:1
     Export Route Targets:
       209.165.201.1:1
     Signaling protocol: BGP
     Local VE-ID: 100 ,  Advertised Local VE-ID : 100
     VE-Range: 10
     PW: neighbor 209.165.200.226, PW ID 1, state is up ( established )
       PW class not set, XC ID 0xc0000001
       Encapsulation MPLS, Auto-discovered (BGP), protocol BGP
       Source address 209.165.200.225
       PW type VPLS, control word disabled, interworking none
       Sequencing not set

         MPLS         Local                          Remote
         ------------ ------------------------------ -------------------------
         Label        289959                         16030
         MTU          1500                           1500
         Control word disabled                       disabled
         PW type      VPLS                           VPLS
         VE-ID        100                            200
         ------------ ------------------------------ -------------------------
       MIB cpwVcIndex: 3221225473
       Create time: 18/02/2014 03:58:31 (00:31:23 ago)
       Last time status changed: 18/02/2014 03:58:31 (00:31:23 ago)
       MAC withdraw messages: sent 0, received 0
       Static MAC addresses:
       Statistics:
         packets: received 0, sent 0
         bytes: received 0, sent 0
       Storm control drop counters:
         packets: broadcast 0, multicast 0, unknown unicast 0
         bytes: broadcast 0, multicast 0, unknown unicast 0
     DHCPv4 snooping: disabled
     IGMP Snooping profile: none
     MLD Snooping profile: none
       P2MP-PW:
           FEC            Local                          Remote
           -------------- ---------------------------- ---------------------
           Label          NULL (inclusive tree)          NULL (inclusive tree)
           P2MP ID        100                            100
           Flags          0x00                           0x00
           PTree Type     RSVP-TE                        RSVP-TE
           Tunnel ID      100                            100
           Ext. Tunnel ID 209.165.200.225                209.165.200.226
         Statistics:
           packets: received 0
           bytes: received 0
     PW: neighbor 209.165.200.227, PW ID 1, state is up ( established )
       PW class not set, XC ID 0xc0000002
       Encapsulation MPLS, Auto-discovered (BGP), protocol BGP
       Source address 209.165.200.225
       PW type VPLS, control word disabled, interworking none
       Sequencing not set
```

```
      MPLS         Local                          Remote
      ------------ ------------------------------ -------------------------
      Label        289944                         16030
      MTU          1500                           1500
      Control word disabled                       disabled
      PW type      VPLS                           VPLS
      VE-ID        100                            300
      ------------ ------------------------------ -------------------------
    MIB cpwVcIndex: 3221225474
    Create time: 18/02/2014 04:05:25 (00:24:29 ago)
    Last time status changed: 18/02/2014 04:05:25 (00:24:29 ago)
    MAC withdraw messages: sent 0, received 0
    Static MAC addresses:
    Statistics:
      packets: received 0, sent 0
      bytes: received 0, sent 0
    Storm control drop counters:
      packets: broadcast 0, multicast 0, unknown unicast 0
      bytes: broadcast 0, multicast 0, unknown unicast 0
  DHCPv4 snooping: disabled
  IGMP Snooping profile: none
  MLD Snooping profile: none
    P2MP-PW:
        FEC            Local                        Remote
        -------------- ---------------------------- ---------------------
        Label          NULL (inclusive tree)        NULL (inclusive tree)
        P2MP ID        100                          100
        Flags          0x00                         0x00
        PTree Type     RSVP-TE                      RSVP-TE
        Tunnel ID      100                          100
        Ext. Tunnel ID 209.165.200.225              209.165.200.227
      Statistics:
        packets: received 0
        bytes: received 0
  PW: neighbor 209.165.200.228, PW ID 1, state is up ( established )
    PW class not set, XC ID 0xc0000003
    Encapsulation MPLS, Auto-discovered (BGP), protocol BGP
    Source address 209.165.200.225
    PW type VPLS, control word disabled, interworking none
    Sequencing not set

      MPLS         Local                          Remote
      ------------ ------------------------------ -------------------------
      Label        289929                         16045
      MTU          1500                           1500
      Control word disabled                       disabled
      PW type      VPLS                           VPLS
      VE-ID        100                            400
      ------------ ------------------------------ -------------------------
    MIB cpwVcIndex: 3221225475
    Create time: 18/02/2014 04:08:11 (00:21:43 ago)
    Last time status changed: 18/02/2014 04:08:11 (00:21:43 ago)
    MAC withdraw messages: sent 0, received 0
    Static MAC addresses:
    Statistics:
      packets: received 0, sent 0
      bytes: received 0, sent 0
    Storm control drop counters:
      packets: broadcast 0, multicast 0, unknown unicast 0
      bytes: broadcast 0, multicast 0, unknown unicast 0
  DHCPv4 snooping: disabled
  IGMP Snooping profile: none
  MLD Snooping profile: none
```

```
      P2MP-PW:
          FEC            Local                         Remote
          -------------- ----------------------------- ----------------------
          Label          NULL (inclusive tree)         NULL (inclusive tree)
          P2MP ID        100                           100
          Flags          0x00                          0x00
          PTree Type     RSVP-TE                       RSVP-TE
          Tunnel ID      100                           100
          Ext. Tunnel ID 209.165.200.225               209.165.200.228
        Statistics:
          packets: received 0
          bytes: received 0
    VFI Statistics:
      drops: illegal VLAN 0, illegal length 0
RP/0/RSP0/CPU0:PE1#
```

show mpls traffic-eng tunnels p2mp

```
RP/0/RSP0/CPU0:PE1#show mpls traffic-eng tunnels p2mp


Name: tunnel-mte100 (auto-tunnel for VPLS (l2vpn))
  Signalled-Name: auto_PE1_mt100
  Status:
    Admin: up  Oper: up (Up for 00:32:35)

    Config Parameters:
     Bandwidth: 0 kbps (CT0) Priority: 7 7 Affinity: 0x0/0xffff
     Interface Bandwidth: 10000 kbps
     Metric Type: TE (default)
     Fast Reroute: Enabled, Protection Desired: Any
     Record Route: Enabled
     Reoptimization after affinity failure: Enabled

     Attribute-set: set1 (type p2mp-te)
     Destination summary: (3 up, 0 down, 0 disabled) Affinity: 0x0/0xffff
     Auto-bw: disabled
     Destination: 209.165.200.226
       State: Up for 00:32:35
       Path options:
         path-option 10 dynamic     [active]
     Destination: 209.165.200.227
       State: Up for 00:25:41
       Path options:
         path-option 10 dynamic     [active]
     Destination: 209.165.200.228
       State: Up for 00:22:55
       Path options:
         path-option 10 dynamic     [active]

   Current LSP:
     lsp-id: 10004 p2mp-id: 100 tun-id: 100 src: 209.165.200.225 extid:
209.165.200.225
     LSP up for: 00:32:35 (since Tue Feb 18 03:58:31 UTC 2014)
     Reroute Pending: No
     Inuse Bandwidth: 0 kbps (CT0)
     Number of S2Ls: 3 connected, 0 signaling proceeding, 0 down

     S2L Sub LSP: Destination 209.165.200.226 Signaling Status: connected
       S2L up for: 00:32:35 (since Tue Feb 18 03:58:31 UTC 2014)
       Sub Group ID: 1 Sub Group Originator ID: 209.165.200.225
       Path option path-option 10 dynamic    (path weight 1)
       Path info (OSPF 100 area 0)
```

```
          209.165.201.2
          209.165.200.226

      S2L Sub LSP: Destination 209.165.200.227 Signaling Status: connected
        S2L up for: 00:25:41 (since Tue Feb 18 04:05:25 UTC 2014)
        Sub Group ID: 2 Sub Group Originator ID: 209.165.200.225
        Path option path-option 10 dynamic    (path weight 2)
        Path info (OSPF 100 area 0)
          209.165.201.2
          209.165.201.61
          209.165.201.62
          209.165.200.227

      S2L Sub LSP: Destination 209.165.200.228 Signaling Status: connected
        S2L up for: 00:22:55 (since Tue Feb 18 04:08:11 UTC 2014)
        Sub Group ID: 4 Sub Group Originator ID: 209.165.200.225
        Path option path-option 10 dynamic    (path weight 2)
        Path info (OSPF 100 area 0)
          209.165.201.2
          209.165.201.101
          209.165.201.102
          209.165.200.228

    Reoptimized LSP (Install Timer Remaining 0 Seconds):
      None
    Cleaned LSP (Cleanup Timer Remaining 0 Seconds):
      None

LSP Tunnel 209.165.200.226 100 [10005] is signalled, connection is up
 Tunnel Name: auto_P_mt100 Tunnel Role: Tail
 InLabel: GigabitEthernet0/1/1/0, 289995
 Signalling Info:
    Src 209.165.200.226 Dst 209.165.200.225, Tun ID 100, Tun Inst 10005, Ext ID
209.165.200.226
    Router-IDs: upstream   209.165.200.226
                local      209.165.200.225
    Bandwidth: 0 kbps (CT0) Priority:  7  7 DSTE-class: 0
    Soft Preemption: None
    Path Info:
      Incoming Address: 209.165.201.1
      Incoming:
      Explicit Route:
        Strict, 209.165.201.1
        Strict, 209.165.200.225
      Record Route:
        IPv4 209.165.201.2, flags 0x0
      Tspec: avg rate=0 kbits, burst=1000 bytes, peak rate=0 kbits
      Session Attributes: Local Prot: Set, Node Prot: Not Set, BW Prot: Not Set
                          Soft Preemption Desired: Not Set
    Resv Info: None
      Record Route: Empty
      Resv Info:
        Record Route: Empty
        Fspec: avg rate=0 kbits, burst=1000 bytes, peak rate=0 kbits

LSP Tunnel 209.165.200.227 100 [10003] is signalled, connection is up
 Tunnel Name: auto_PE2_mt100 Tunnel Role: Tail
 InLabel: GigabitEthernet0/1/1/0, 289998
 Signalling Info:
    Src 209.165.200.227 Dst 209.165.200.225, Tun ID 100, Tun Inst 10003, Ext ID
209.165.200.227
    Router-IDs: upstream   209.165.200.226
                local      209.165.200.225
    Bandwidth: 0 kbps (CT0) Priority:  7  7 DSTE-class: 0
```

```
   Soft Preemption: None
   Path Info:
     Incoming Address: 209.165.201.1
     Incoming:
     Explicit Route:
       Strict, 209.165.201.1
       Strict, 209.165.200.225
     Record Route:
       IPv4 209.165.201.2, flags 0x0
       IPv4 209.165.201.62, flags 0x0
     Tspec: avg rate=0 kbits, burst=1000 bytes, peak rate=0 kbits
     Session Attributes: Local Prot: Set, Node Prot: Not Set, BW Prot: Not Set
                         Soft Preemption Desired: Not Set
   Resv Info: None
     Record Route: Empty
     Resv Info:
       Record Route: Empty
       Fspec: avg rate=0 kbits, burst=1000 bytes, peak rate=0 kbits

LSP Tunnel 209.165.200.228 100 [10004] is signalled, connection is up
 Tunnel Name: auto_PE3_mt100 Tunnel Role: Tail
 InLabel: GigabitEthernet0/1/1/0, 289970
 Signalling Info:
   Src 209.165.200.228 Dst 209.165.200.225, Tun ID 100, Tun Inst 10004, Ext ID
209.165.200.228
   Router-IDs: upstream   209.165.200.226
               local      209.165.200.225
   Bandwidth: 0 kbps (CT0) Priority:  7  7 DSTE-class: 0
   Soft Preemption: None
   Path Info:
     Incoming Address: 209.165.201.1
     Incoming:
     Explicit Route:
       Strict, 209.165.201.1
       Strict, 209.165.200.225
     Record Route:
       IPv4 209.165.201.2, flags 0x0
       IPv4 209.165.201.102, flags 0x0
     Tspec: avg rate=0 kbits, burst=1000 bytes, peak rate=0 kbits
     Session Attributes: Local Prot: Set, Node Prot: Not Set, BW Prot: Not Set
                         Soft Preemption Desired: Not Set
   Resv Info: None
     Record Route: Empty
     Resv Info:
       Record Route: Empty
       Fspec: avg rate=0 kbits, burst=1000 bytes, peak rate=0 kbits
Displayed 1 (of 2) heads, 0 (of 0) midpoints, 3 (of 4) tails
Displayed 1 up, 0 down, 0 recovering, 0 recovered heads
RP/0/RSP0/CPU0:PE1#
```

show mpls forwarding labels detail

```
RP/0/RSP0/CPU0:PE1#show mpls forwarding labels 289994 detail
Local  Outgoing    Prefix             Outgoing     Next Hop        Bytes
Label  Label       or ID              Interface                    Switched
------ ----------- ------------------ ------------ --------------- ------------
289994             P2MP TE: 100
      Updated Feb 18 03:58:32.360
      TE Tunnel Head, tunnel ID: 100, tunnel ifh: 0x8000e20
      IPv4 Tableid: 0xe0000000, IPv6 Tableid: 0xe0800000
      Flags:IP Lookup:not-set, Expnullv4:not-set, Expnullv6:set
            Payload Type v4:set, Payload Type v6:not-set, l2vpn:set
```

```
            Head:set, Tail:not-set, Bud:not-set, Peek:not-set, inclusive:set
            Ingress Drop:not-set, Egress Drop:not-set
      Platform Data&colon;{0x2000000, 0x2000000, 0x0, 0x0}, RPF-ID:0x80003
      VPLS Disposition: Bridge ID: 0, SHG ID: 0, PW Xconnect ID: 0x0

      mpls paths: 1, local mpls paths: 0, protected mpls paths: 1

      16005       P2MP TE: 100       Gi0/1/1/0    209.165.201.2   0
        Updated Feb 18 03:58:32.360
        My Nodeid:65, Interface Nodeid:2065, Backup Interface Nodeid:2065
Packets Switched: 0

RP/0/RSP0/CPU0:PE1#
```

show mpls traffic-eng tunnels p2mp tabular

```
RP/0/RSP0/CPU0:PE1#show mpls traffic-eng tunnels p2mp tabular

          Tunnel    LSP     Destination          Source            FRR  LSP  Path
            Name     ID         Address         Address  State  State Role  Prot
----------------- ----- --------------- --------------- ------ ------ ---- -----
  ^tunnel-mte100 10004 209.165.200.226 209.165.200.225     up  Ready Head
  ^tunnel-mte100 10004 209.165.200.227 209.165.200.225     up  Ready Head
  ^tunnel-mte100 10004 209.165.200.228 209.165.200.225     up  Ready Head
    auto_P_mt100 10005 209.165.200.225 209.165.200.226     up  Inact Tail
  auto_PE2_mt100 10003 209.165.200.225 209.165.200.227     up  Inact Tail
  auto_PE3_mt100 10004 209.165.200.225 209.165.200.228     up  Inact Tail
* = automatically created backup tunnel
^ = automatically created P2MP tunnel
RP/0/RSP0/CPU0:PE1#
```

Troubleshooting de VPLS LSM

Problemas comunes de configuración

Aquí se muestran las causas más comunes de los problemas P2MP en L2VPN.

- La configuración BGP para LSM es exactamente la misma que para BGP-AD. Asegúrese de exportar/importar las rutas de la familia de direcciones l2vpn vpls-vpws configurando **address-family l2vpn vpls-vpws** para los vecinos BGP.
- Hay errores de configuración de MPLS y multidifusión.

  MPLS Traffic Engineering debe activarse en las interfaces por las que pasan los PW P2MP.

```
mpls traffic-eng
interface gigabit <>

auto-tunnel p2mp
 tunnel-id min 100 max 200

Enable multicast-routing for interfaces.

multicast-routing
address-family ipv4
```

```
interface all enable
```

- La configuración L2VPN para LSM en Cisco IOS XR Release 5.1.0 requiere que:

  Configure la configuración de la ID de VPN para la VFIConfigure el P2MP multicast para el VFI. Configure el protocolo de transporte y el protocolo de señalización, como en este ejemplo de configuración:
```
l2vpn
bridge group bg
 bridge-domain bd1
  vfi vf1
   vpn-id 1
   autodiscovery bgp
    rd auto
    route-target 209.165.201.7:1
    signaling-protocol bgp
      ve-id 1
  multicast p2mp
     signaling-protocol bgp
     transport rsvp-te
```

- El LSM Head/Tail debe configurarse correctamente. En Cisco IOS XR Release 5.1.0, cada cola de LSM también es una cabeza de LSM y viceversa. Debido a que no hay intercambio explícito de **capacidad LSM** entre los routers, todos los routers en un dominio de puente habilitado para LSM deben participar en LSM.

Comandos Show y Troubleshooting de L2VPN y L2FIB

- El proceso del administrador de L2VPN (l2vpn_mgr) se comunica con el proceso de control de MPLS Traffic Engineering (TE) (te_control) y solicita la creación del túnel. Asegúrese de que los procesos te_control y l2vpn_mgr se encuentren en el estado de ejecución con estos comandos:
  show process l2vpn_mgrshow process te_control

- Verifique que el proceso l2vpn_mgr haya solicitado la creación del túnel. Una entrada para el túnel debe estar en este comando show:

```
RP/0/RSP0/CPU0:PE1#show l2vpn atom-db preferred-path
Tunnel               BW Tot/Avail/Resv    Peer ID            VC ID
----------------------------------------------------------------------
tunnel-mte1 0/0/0                         209.165.200.226    1
                                                    209.165.200.227    1
                                                    209.165.200.228    1
```

- L2VPN tiene que recibir la información del túnel del proceso te_control. Verifique que este comando show tenga detalles distintos de cero como tunnel-id, Ext.tunnel-id, tunnel-ifh y p2mp-id:

```
RP/0/RSP0/CPU0:PE1#show l2vpn atom-db preferred-path private
Tunnel tunnel-mte1 0/0/0:
 Peer ID: 209.165.200.226, VC-ID 1
 Peer ID: 209.165.200.227, VC-ID 1
 Peer ID: 209.165.200.228, VC-ID 1
 MTE details:
      tunnel-ifh: 0x08000e20
     local-label: 289994
         p2mp-id: 100
       tunnel-id: 100
   Ext.tunnel-id: 209.165.200.225
```

- L2VPN debe anunciar la instancia de servicio de multidifusión del proveedor (PMSI) a todos los demás routers PE. Verifique que l2vpn_mgr haya enviado la PMSI para el VFI configurado. El evento **LSM Head: send PMSI** debe estar presente en el historial de eventos para el VFI.

```
RP/0/0/CPU0:one#show l2vpn bridge-domain p2mp private
[...]
  Object: VFI
  Base info: version=0x0, flags=0x0, type=0, reserved=0
  VFI event trace history  [Num events: 5]
  ----------------------------------------------------------------------------
    Time                Event                          Flags      Flags
    ====                =====                          =====      =====
    Dec  3 08:52:37.504 LSM Head: P2MP Provision      00000001, 00000000 -  -
    Dec  3 08:52:37.504 BD VPN Add                    00000000, 00000000 M  -
    Dec  3 08:55:56.672 LSM Head: MTE updated         00000001, 00000000 -  -
    Dec  3 08:55:56.672 LSM Head: send PMSI           00000480, 00002710 -  -
  ----------------------------------------------------------------------------
[...]
```

- L2VPN en los otros routers debe recibir la PMSI que se acaba de enviar. Asegúrese de que **LSM Tail: PMSI received** se muestre en el historial de eventos en el lado de recepción:

```
RP/0/0/CPU0:two#show l2vpn bridge-domain p2mp private
[...]
  VFI event trace history  [Num events: 7]
  ----------------------------------------------------------------------------
    Time                Event                          Flags      Flags
    ====                =====                          =====      =====
    Dec  3 08:42:49.216 LSM Head: P2MP Provision      00000001, 00000000 -  -
    Dec  3 08:42:50.240 LSM Head: MTE updated         00000001, 00000070 -  -
    Dec  3 08:42:50.240 LSM Head: send PMSI           00000480, 00002710 -  -
    Dec  3 08:43:51.680 BD VPN Add                    00000000, 00000000 -  -
    Dec  3 08:44:59.776 LSM Tail: PMSI received       0100a8c0, 00002710 -  -
    Dec  3 08:45:00.288 LSM Head: MTE updated         00000001, 00000000 -  -
  ----------------------------------------------------------------------------
[...]
```

- Cada router es tanto un LSM Head como un LSM Tail y debe enviar la PMSI y recibir las

PMSI de cada uno de los otros routers. El primer router verificado debe recibir PMSI de cada uno de los otros nodos.

- La Base de información de reenvío de capa 2 (L2FIB) debe recibir la información HEAD de L2VPN y descargarla en la tarjeta de línea.

```
RP/0/RSP0/CPU0:PE1#show l2vpn forwarding bridge-domain detail location 0/1/CPU0

Bridge-domain name: bg1:bg1_bd1, id: 0, state: up
 MAC learning: enabled
MAC port down flush: enabled
Flooding:
  Broadcast & Multicast: enabled
  Unknown unicast: enabled
 MAC aging time: 300 s, Type: inactivity
 MAC limit: 4000, Action: none, Notification: syslog
MAC limit reached: no
 MAC Secure: disabled, Logging: disabled
DHCPv4 snooping: profile not known on this node
 Dynamic ARP Inspection: disabled, Logging: disabled
 IP Source Guard: disabled, Logging: disabled
IGMP snooping: disabled, flooding: enabled
 MLD snooping: disabled, flooding: disabled
 Storm control: disabled
 P2MP PW: enabled
 Ptree type: RSVP-TE, TE i/f: tunnel-mte100,
 nhop valid: TRUE, Status: Bound, Label: 289994
 Bridge MTU: 1500 bytes
 Number of bridge ports: 4
 Number of MAC addresses: 0
 Multi-spanning tree instance: 0
```

- L2FIB debe recibir la información de TAIL de L2VPN para cada PW y debe descargarla a la plataforma.

```
RP/0/RSP0/CPU0:PE1#show l2vpn forwarding bridge-domain  hardware ingress detail
location 0/1/CPU0

Bridge-domain name: bg1:bg1_bd1, id: 0, state: up
 MAC learning: enabled
 MAC port down flush: enabled
 Flooding:
  Broadcast & Multicast: enabled
  Unknown unicast: enabled
 MAC aging time: 300 s, Type: inactivity
 MAC limit: 4000, Action: none, Notification: syslog
 MAC limit reached: no
 MAC Secure: disabled, Logging: disabled
 DHCPv4 snooping: profile not known on this node
 Dynamic ARP Inspection: disabled, Logging: disabled
 IP Source Guard: disabled, Logging: disabled
 IGMP snooping: disabled, flooding: enabled
 MLD snooping: disabled, flooding: disabled
 Storm control: disabled
 P2MP PW: enabled
 Ptree type: RSVP-TE, TE i/f: tunnel-mte100,
```

```
            nhop valid: TRUE, Status: Bound, Label: 289994
 Bridge MTU: 1500 bytes
 Number of bridge ports: 4
 Number of MAC addresses: 0
 Multi-spanning tree instance: 0

 Platform Bridge context:
   Last notification sent at: 02/18/2014 21:58:55
   Ingress Bridge Domain: 0, State: Created
   static MACs: 0, port level static MACs: 0, MAC limit: 4000, current MAC limit:
4000,    MTU: 1500, MAC limit action: 0
   Rack 0 FGIDs:shg0: 0x00000000, shg1: 0x00000002, shg2: 0x00000002
   Rack 1 FGIDs:shg0: 0x00000000, shg1: 0x00000000, shg2: 0x00000000
     Flags: Virtual Table ID Disable, P2MP Enable, CorePW Attach
     P2MP Head-end Info: Head end bound
     Tunnel ifhandle: 0x08000e20, Internal Label: 289994, Local LC NP mask: 0x0,
       Head-end Local LC NP mask: 0x0, All L2 Mcast routes local LC NP mask: 0x0
   Rack: 0, Physical slot: 1, shg 0 members: 1, shg 1 members: 0, shg 2 members: 0


 Platform Bridge HAL context:
   Number of NPs: 4, NP mask: 0x0008, mgid index: 513, learn key: 0
   NP: 3, shg 0 members: 1, shg 1 members: 0, shg 2 members: 0
   MAC limit counter index: 0x00ec1e60

   Platform Bridge Domain Hardware Information:
     Bridge Domain: 0 NP 0
       Flags: Virtual Table, Learn Enable, P2MP Tree Enabled
       Head-end P-Tree Int Label: 289994
       Num Members: 0, Learn Key: 0x00, Half Age: 5
       fgid shg0: 0x0000, fgid shg1: 0x0002, fgid shg2: 0x0002, mgid index: 513
       BD learn cntr: 0x00ec1e60
     Bridge Domain: 0 NP 1
       Flags: Virtual Table, Learn Enable, P2MP Tree Enabled
       Head-end P-Tree Int Label: 289994
       Num Members: 0, Learn Key: 0x00, Half Age: 5
       fgid shg0: 0x0000, fgid shg1: 0x0002, fgid shg2: 0x0002, mgid index: 513
       BD learn cntr: 0x00ec1e60
     Bridge Domain: 0 NP 2
       Flags: Virtual Table, Learn Enable, P2MP Tree Enabled
       Head-end P-Tree Int Label: 289994
       Num Members: 0, Learn Key: 0x00, Half Age: 5
       fgid shg0: 0x0000, fgid shg1: 0x0002, fgid shg2: 0x0002, mgid index: 513
       BD learn cntr: 0x00ec1e60
     Bridge Domain: 0 NP 3
       Flags: Virtual Table, Learn Enable, P2MP Tree Enabled
       Head-end P-Tree Int Label: 289994
       Num Members: 1, Learn Key: 0x00, Half Age: 5
       fgid shg0: 0x0000, fgid shg1: 0x0002, fgid shg2: 0x0002, mgid index: 513
       BD learn cntr: 0x00ec1e60
       Bridge Member 0, copy 0
         Flags: Active, XID: 0x06c002a7
       Bridge Member 0, copy 1
         Flags: Active, XID: 0x06c002a7


 GigabitEthernet0/1/1/10.1, state: oper up
   Number of MAC: 0
   Statistics:
     packets: received 0, sent 0
     bytes: received 0, sent 0
   Storm control drop counters:
     packets: broadcast 0, multicast 0, unknown unicast 0
     bytes: broadcast 0, multicast 0, unknown unicast 0
```

```
    Dynamic arp inspection drop counters:
      packets: 0, bytes: 0
    IP source guard drop counters:
      packets: 0, bytes: 0
  Platform Bridge Port context:
  Last notification sent at: 02/18/2014 21:58:56
  Ingress State: Bound
    Flags: None

  Platform AC context:
  Ingress AC: VPLS, State: Bound
    Flags: Port Level MAC Limit
  XID: 0x06c002a7, SHG: None
  uIDB: 0x001a, NP: 3, Port Learn Key: 0
  Slot flood mask rack 0: 0x200000 rack 1: 0x0 NP flood mask: 0x0008
  NP3
    Ingress uIDB:
      Flags: L2, Status, Racetrack Eligible, VPLS
      Stats Ptr: 0x5302c9, uIDB index: 0x001a, Wire Exp Tag: 1
      BVI Bridge Domain: 0, BVI Source XID: 0x00000000
      VLAN1: 0, VLAN1 etype: 0x0000, VLAN2: 0, VLAN2 etype: 0x0000
      L2 ACL Format: 0, L2 ACL ID: 0, IPV4 ACL ID: 0, IPV6 ACL ID: 0
      QOS ID: 0, QOS Format ID: 0
      Local Switch dest XID: 0x06c002a7
      UIDB IF Handle: 0x02001042, Source Port: 0, Num VLANs: 0
    Xconnect ID: 0x06c002a7, NP: 3
      Type: AC
      Flags: Learn enable, VPLS
      uIDB Index: 0x001a
      Bridge Domain ID: 0, Stats Pointer: 0xec1e62
      Split Horizon Group: None
    Bridge Port     :  Bridge 0 Port 0
      Flags: Active Member
      XID: 0x06c002a7
    Bridge Port Virt:  Bridge 0 Port 0
      Flags: Active Member
      XID: 0x06c002a7
    Storm Control not enabled

  Nbor 209.165.200.226 pw-id 1
    Number of MAC: 0
    Statistics:
      packets: received 0, sent 2
      bytes: received 0, sent 192
    Storm control drop counters:
      packets: broadcast 2, multicast 0, unknown unicast 0
      bytes: broadcast 192, multicast 0, unknown unicast 0
    Dynamic arp inspection drop counters:
      packets: 0, bytes: 0
    IP source guard drop counters:
      packets: 0, bytes: 0
    Statistics P2MP:
      packets: received 0
      bytes: received 0

  Platform Bridge Port context:
  Last notification sent at: 02/18/2014 21:58:55
  Ingress State: Bound
    Flags: None
    P2MP PW enabled, P2MP Role: tail
   Platform PW context:
   Ingress PW: VPLS, State: Bound
  XID: 0xc0008000, bridge: 0, MAC limit: 4000, l2vpn ldi index: 0x0001, vc label:
 16030,  nr_ldi_hash: 0xab, r_ldi_hash: 0xbd, lag_hash: 0x17, SHG: VFI Enabled
```

```
  Flags: MAC Limit Port Level
Port Learn Key: 0
Trident Layer Flags: None
Slot flood mask rack 0: 0x0 rack 1: 0x0 NP flood mask: 0x0000
Primary L3 path: ifhandle: 0x02000100, sfp_or_lagid: 0x00d2
Backup L3 path: Not set
NP0
  Xconnect ID: 0xc0008000, NP: 0
    Type: Pseudowire (no control word)
    Flags: Learn enable, Type 5, Local replication, VPLS
    VC label hash, nR-LDI Hash: 0xab, R-LDI Hash: 0xb7, LAG Hash: 0x17,
    VC output label: 0x03e9e (16030), LDI: 0x0001, stats ptr: 0x00530258
    Bridge Domain ID: 0, Stats Pointer: 0xec1e62
    Split Horizon Group: VFI Enabled
NP1
  Xconnect ID: 0xc0008000, NP: 1
    Type: Pseudowire (no control word)
    Flags: Learn enable, Type 5, Local replication, VPLS
    VC label hash, nR-LDI Hash: 0xab, R-LDI Hash: 0xb7, LAG Hash: 0x17,
    VC output label: 0x03e9e (16030), LDI: 0x0001, stats ptr: 0x00530258
    Bridge Domain ID: 0, Stats Pointer: 0xec1e62
    Split Horizon Group: VFI Enabled
NP2
  Xconnect ID: 0xc0008000, NP: 2
    Type: Pseudowire (no control word)
    Flags: Learn enable, Type 5, Local replication, VPLS
    VC label hash, nR-LDI Hash: 0xab, R-LDI Hash: 0xb7, LAG Hash: 0x17,
    VC output label: 0x03e9e (16030), LDI: 0x0001, stats ptr: 0x00530300
    Bridge Domain ID: 0, Stats Pointer: 0xec1e62
    Split Horizon Group: VFI Enabled
NP3
  Xconnect ID: 0xc0008000, NP: 3
    Type: Pseudowire (no control word)
    Flags: Learn enable, Type 5, Local replication, VPLS
    VC label hash, nR-LDI Hash: 0xab, R-LDI Hash: 0xb7, LAG Hash: 0x17,
    VC output label: 0x03e9e (16030), LDI: 0x0001, stats ptr: 0x00530488
    Bridge Domain ID: 0, Stats Pointer: 0xec1e64
    Split Horizon Group: VFI Enabled

Nbor 209.165.200.227 pw-id 1
  Number of MAC: 0
  Statistics:
    packets: received 0, sent 1
    bytes: received 0, sent 96
  Storm control drop counters:
    packets: broadcast 0, multicast 0, unknown unicast 0
    bytes: broadcast 0, multicast 0, unknown unicast 0
  Dynamic arp inspection drop counters:
    packets: 0, bytes: 0
  IP source guard drop counters:
    packets: 0, bytes: 0
  Statistics P2MP:
    packets: received 0
    bytes: received 0

Platform Bridge Port context:
Last notification sent at: 02/18/2014 21:58:55
Ingress State: Bound
  Flags: None
  P2MP PW enabled, P2MP Role: tail
 Platform PW context:
 Ingress PW: VPLS, State: Bound
XID: 0xc0008001, bridge: 0, MAC limit: 4000, l2vpn ldi index: 0x0002, vc label:
16030,  nr_ldi_hash: 0xab, r_ldi_hash: 0xbd, lag_hash: 0x17, SHG: VFI Enabled
```

```
  Flags: MAC Limit Port Level
Port Learn Key: 0
Trident Layer Flags: None
Slot flood mask rack 0: 0x0 rack 1: 0x0 NP flood mask: 0x0000
Primary L3 path: ifhandle: 0x02000100, sfp_or_lagid: 0x00d2
Backup L3 path: Not set
NP0
  Xconnect ID: 0xc0008001, NP: 0
    Type: Pseudowire (no control word)
    Flags: Learn enable, Type 5, Local replication, VPLS
    VC label hash, nR-LDI Hash: 0xab, R-LDI Hash: 0xb7, LAG Hash: 0x17,
    VC output label: 0x03e9e (16030), LDI: 0x0002, stats ptr: 0x0053025e
    Bridge Domain ID: 0, Stats Pointer: 0xec1e64
    Split Horizon Group: VFI Enabled
NP1
  Xconnect ID: 0xc0008001, NP: 1
    Type: Pseudowire (no control word)
    Flags: Learn enable, Type 5, Local replication, VPLS
    VC label hash, nR-LDI Hash: 0xab, R-LDI Hash: 0xb7, LAG Hash: 0x17,
    VC output label: 0x03e9e (16030), LDI: 0x0002, stats ptr: 0x0053025e
    Bridge Domain ID: 0, Stats Pointer: 0xec1e64
    Split Horizon Group: VFI Enabled
NP2
  Xconnect ID: 0xc0008001, NP: 2
    Type: Pseudowire (no control word)
    Flags: Learn enable, Type 5, Local replication, VPLS
    VC label hash, nR-LDI Hash: 0xab, R-LDI Hash: 0xb7, LAG Hash: 0x17,
    VC output label: 0x03e9e (16030), LDI: 0x0002, stats ptr: 0x00530306
    Bridge Domain ID: 0, Stats Pointer: 0xec1e64
    Split Horizon Group: VFI Enabled
NP3
  Xconnect ID: 0xc0008001, NP: 3
    Type: Pseudowire (no control word)
    Flags: Learn enable, Type 5, Local replication, VPLS
    VC label hash, nR-LDI Hash: 0xab, R-LDI Hash: 0xb7, LAG Hash: 0x17,
    VC output label: 0x03e9e (16030), LDI: 0x0002, stats ptr: 0x0053048e
    Bridge Domain ID: 0, Stats Pointer: 0xec1e66
    Split Horizon Group: VFI Enabled

Nbor 209.165.200.228 pw-id 1
  Number of MAC: 0
  Statistics:
    packets: received 0, sent 0
    bytes: received 0, sent 0
  Storm control drop counters:
    packets: broadcast 0, multicast 0, unknown unicast 0
    bytes: broadcast 0, multicast 0, unknown unicast 0
  Dynamic arp inspection drop counters:
    packets: 0, bytes: 0
  IP source guard drop counters:
    packets: 0, bytes: 0
  Statistics P2MP:
    packets: received 0
    bytes: received 0

Platform Bridge Port context:
Last notification sent at: 02/18/2014 21:58:55
Ingress State: Bound
  Flags: None
  P2MP PW enabled, P2MP Role: tail
 Platform PW context:
 Ingress PW: VPLS, State: Bound
XID: 0xc0008002, bridge: 0, MAC limit: 4000, l2vpn ldi index: 0x0003, vc label:
16045,  nr_ldi_hash: 0x7b, r_ldi_hash: 0xb3, lag_hash: 0xa8, SHG: VFI Enabled
```

```
   Flags: MAC Limit Port Level
 Port Learn Key: 0
 Trident Layer Flags: None
 Slot flood mask rack 0: 0x0 rack 1: 0x0 NP flood mask: 0x0000
 Primary L3 path: ifhandle: 0x02000100, sfp_or_lagid: 0x00d2
 Backup L3 path: Not set
 NP0
   Xconnect ID: 0xc0008002, NP: 0
     Type: Pseudowire (no control word)
     Flags: Learn enable, Type 5, Local replication, VPLS
     VC label hash, nR-LDI Hash: 0x7b, R-LDI Hash: 0xd6, LAG Hash: 0xa8,
     VC output label: 0x03ead (16045), LDI: 0x0003, stats ptr: 0x00530264
     Bridge Domain ID: 0, Stats Pointer: 0xec1e66
     Split Horizon Group: VFI Enabled
 NP1
   Xconnect ID: 0xc0008002, NP: 1
     Type: Pseudowire (no control word)
     Flags: Learn enable, Type 5, Local replication, VPLS
     VC label hash, nR-LDI Hash: 0x7b, R-LDI Hash: 0xd6, LAG Hash: 0xa8,
     VC output label: 0x03ead (16045), LDI: 0x0003, stats ptr: 0x00530264
     Bridge Domain ID: 0, Stats Pointer: 0xec1e66
     Split Horizon Group: VFI Enabled
 NP2
   Xconnect ID: 0xc0008002, NP: 2
     Type: Pseudowire (no control word)
     Flags: Learn enable, Type 5, Local replication, VPLS
     VC label hash, nR-LDI Hash: 0x7b, R-LDI Hash: 0xd6, LAG Hash: 0xa8,
     VC output label: 0x03ead (16045), LDI: 0x0003, stats ptr: 0x0053030c
     Bridge Domain ID: 0, Stats Pointer: 0xec1e66
     Split Horizon Group: VFI Enabled
 NP3
   Xconnect ID: 0xc0008002, NP: 3
     Type: Pseudowire (no control word)
     Flags: Learn enable, Type 5, Local replication, VPLS
     VC label hash, nR-LDI Hash: 0x7b, R-LDI Hash: 0xd6, LAG Hash: 0xa8,
     VC output label: 0x03ead (16045), LDI: 0x0003, stats ptr: 0x00530494
     Bridge Domain ID: 0, Stats Pointer: 0xec1e68
     Split Horizon Group: VFI Enabled

RP/0/RSP0/CPU0:PE1#
```

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