ASR 9000 — 瞭解和配置VPLS LSM

目錄

簡介

本檔案介紹執行Cisco IOS® XR軟體的聚合服務路由器(ASR)9000系列的虛擬私人LAN服務(VPLS)標籤交換多點傳送(LSM)。

必要條件

需求

本文件沒有特定需求。

採用元件

本文件所述內容不限於特定軟體和硬體版本。

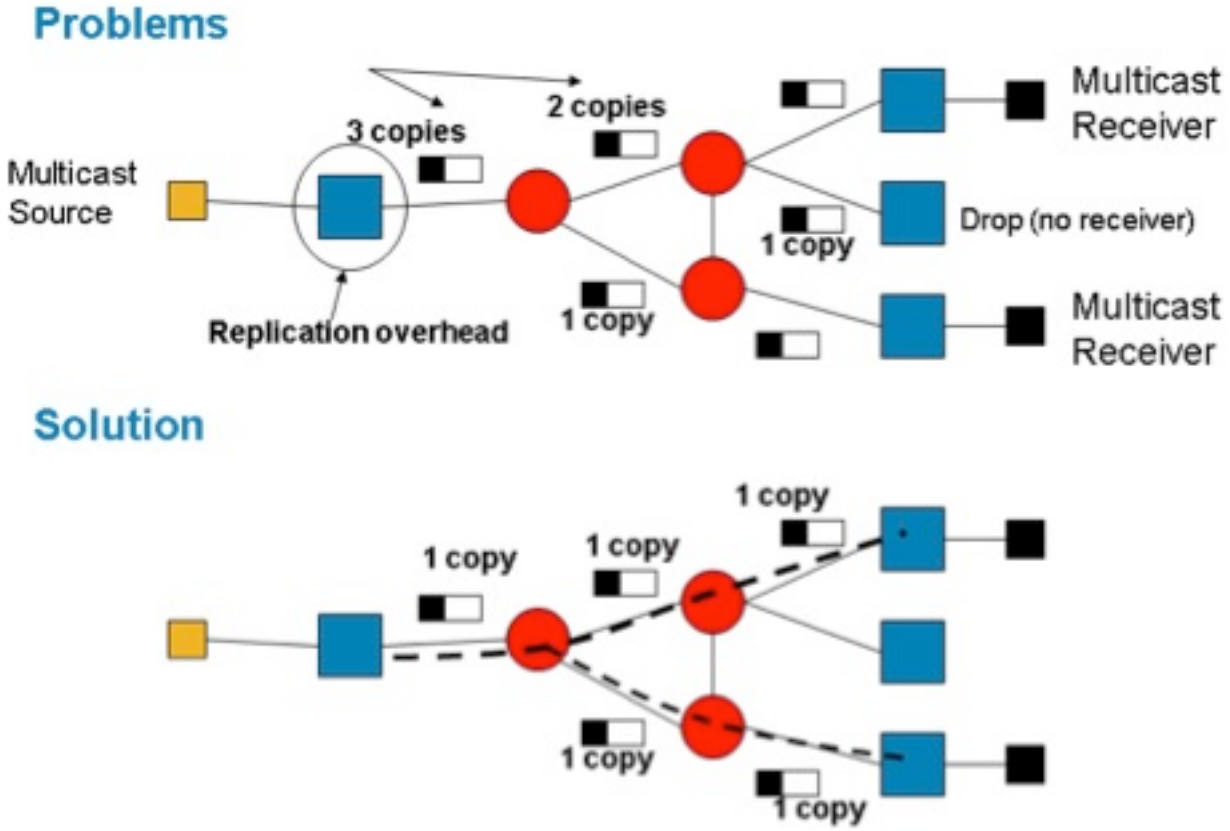
本文中的資訊是根據特定實驗室環境內的裝置所建立。文中使用到的所有裝置皆從已清除（預設）的組態來啟動。如果您的網路正在作用，請確保您已瞭解任何指令可能造成的影響。

VPLS標籤交換多點傳送(LSM)概觀

VPLS模擬跨多協定標籤交換(MPLS)核心的LAN服務。在參與VPLS域的所有提供商邊緣(PE)路由器之間設定全網狀點對點(P2P)偽線(PW)，以便提供VPLS模擬。廣播、組播和未知的單播流量在VPLS域中泛洪到所有PE。入口複製用於將泛洪流量通過每個P2P PW傳送到屬於同一VPLS域所有遠端PE路由器。

入口複製的缺點

- 入口複製頻寬效率低下，因為對於每個P2P PW，同一資料包可能通過同一鏈路傳送多次。
- 當廣播和組播VPLS流量較重時，入口複製可能會導致大量浪費鏈路頻寬。
- 入口複製也會佔用大量資源，因為入口PE路由器承擔了複製的全部負擔。



VPLS LSM功能

VPLS是一種廣泛部署的服務提供商L2VPN技術，也用於組播傳輸。雖然L2技術允許使用窺探來最佳化將多點傳播流量複製到L2偽線，但核心層仍不受多點傳播流量的影響。因此，同一流的多個副

本會遍歷核心網路。為了緩解這種低效率，將LSM與VPLS配對，以便在核心上引入LSM組播樹。在Cisco IOS-XR軟體版本5.1.0中，Cisco ASR 9000系列使用包含點對多點流量工程(P2MP-TE)的樹來實作VPLS LSM。通過使用資源預留協定流量工程(RSVP-TE)自動發現VPLS端點並設定P2MP-TE樹，而無需操作干預。

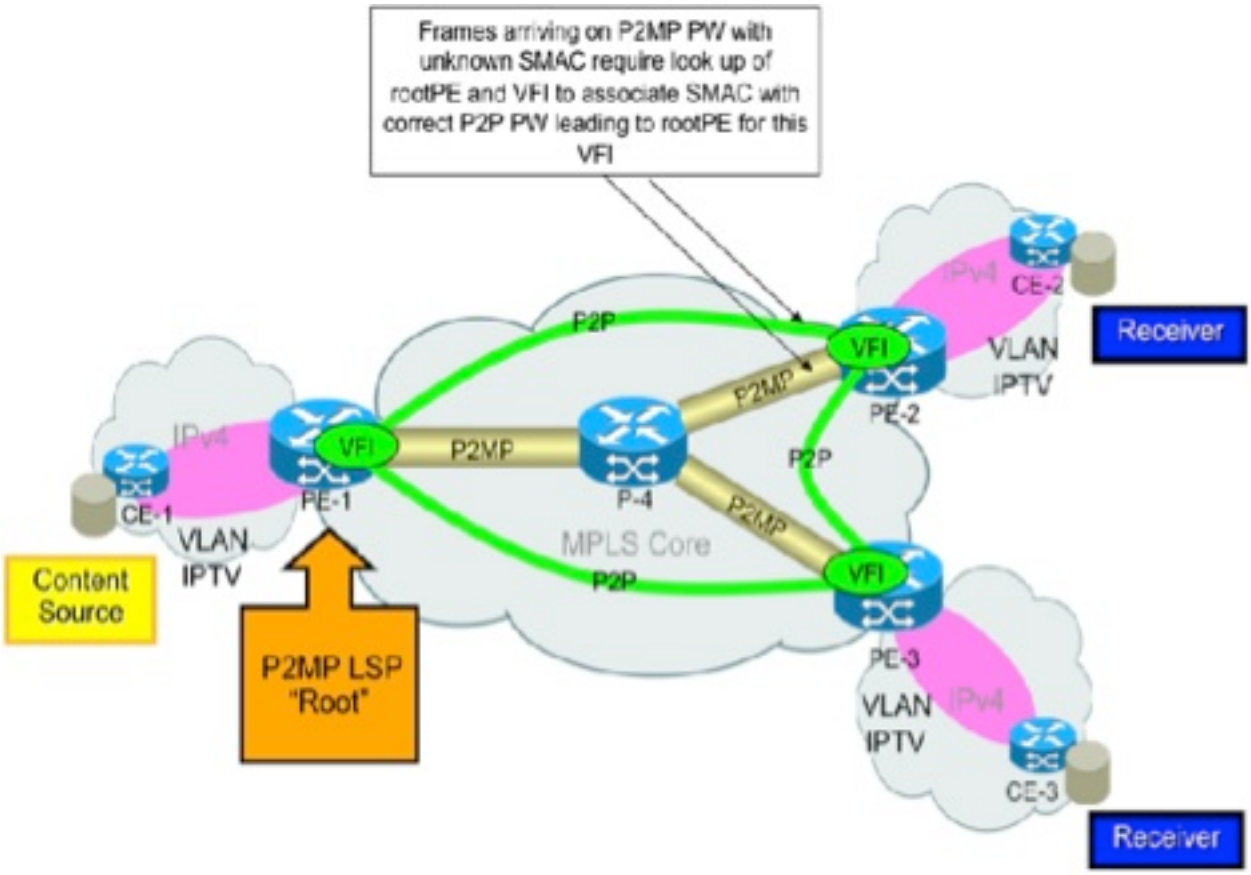
- VPLS LSM克服了入口複製的缺點。
- VPLS LSM解決方案在MPLS核心中使用P2MP LSP來承載VPLS域的廣播、組播和未知的單播流量。
- P2MP LSP允許在最佳節點的MPLS網路中複製，並將網路中的資料包複製量降至最低。
- VPLS LSM解決方案僅通過P2MP LSP傳送泛洪VPLS流量。
- 單播VPLS流量仍通過P2P PW傳送。通過接入PW傳送的流量繼續通過入口複製傳送。
- P2MP PW是單向的，而P2P PW是雙向的。
- VPLS LSM解決方案包括每個VPLS域建立P2MP PW，以便為VPLS域中的核心PW模擬VPLS P2MP服務。
- Cisco IOS XR 5.1.0版及更新版本支援VPLS LSM。

VPLS LSM限制

- Cisco IOS-XR版本5.1.0 VPLS LSM功能僅支援使用RSVP-TE設定的MPLS流量工程P2MP-TE樹。
- P2MP PW只能在Cisco IOS-XR 5.1.0版中使用BGP協定進行發訊號。在第一階段，使用BGP自動發現(BGP-AD)自動發現參與VPLS域的遠端PE。
- Cisco IOS XR 5.1.0版不支援靜態LDP信令。

媒體存取控制(MAC)學習

對於到達P2MP PW的幀，在枝葉PE上進行MAC學習就像在P2P PW上收到該幀，導致該P2MP PW的根PE。在此圖中，對於根位於PE-1的P2MP PW LSP上到達的幀，在PE-2上進行MAC學習，就好像幀在PE-1和PE-2之間的P2P PW上到達一樣。L2VPN控制平面負責使用P2P PW資訊對VPLS配置資訊進行程式設計，以用於P2MP LSP配置上的MAC學習。



網際網路群組管理通訊協定窺探(IGMPSN)支援

參與VPLS LSM的橋接域中P2MP P樹的頭部和尾部都支援網際網路組管理協定(IGMP)監聽(IGMPSN)。這允許通過虛擬轉發例項(VFI)PW的IGMPSN組播流量從P2MP LSP提供的資源最佳化中受益。如果在橋接域中啟用了IGMPSN，並且有一個或多個VFI PW參與VPLS LSM，則所有第二層(L2)組播流量都會通過與該橋接域關聯的P2MP P-tree Head傳送。L2多點傳送路由用於將流量轉送到不參與VPLS LSM的本地接收器、乙太網路流量點(EFP)、存取PW和VFI PW。

當在作為P2MP LSP尾的橋接域中啟用IGMPSN時，對本地接收器(即，連線電路(AC)橋接埠(BP)和接入PW BP)在P2MP LSP上接收到的L2組播流量進行最佳化配置。

註:Cisco IOS XR 5.1.0版不支援組播標籤分發協定(MLDP)監聽。

支援的擴展

Cisco IOS XR 5.1.0版最多支援每個頭/尾路由器**1000** P2MP隧道**或**1000 P2MP PW。

VPLS LSM配置

P2MP自動隧道配置

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

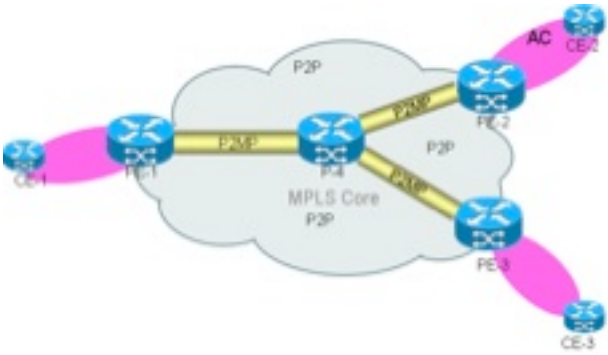
MPLS TE快速重新路由(FRR)組態

```
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
 !
```

L2VPN配置

```
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
    !
```

拓撲和配置示例



P2MP隧道是自動發現的隧道。不支援靜態P2MP通道。

不使用靜態隧道配置。如果自動P2MP隧道配置充當了bud節點，則必須在所有PE路由器以及P路由器上啟用。bud節點同時是中點和尾端路由器。

此處顯示具有配置的示例拓撲。在此拓撲中，P2MP PW在三個PE之間和作為bud節點的P路由器之間建立。所有三台PE路由器都充當Head（用於輸入流量）和Tail（用於輸出流量）。

PE1配置

```
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#
```

P配置

```
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#
```

PE2配置

```
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#
```

PE3配置

```
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#
```

驗證 — Show命令

以下show命令可用於調試和驗證P2MP PW和P2MP MPLS TE隧道的狀態。

- 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

以下是一些範例：

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#
```

排除VPLS LSM故障

常見配置問題

此處顯示了L2VPN中P2MP問題的最常見原因。

- LSM的BGP配置與BGP-AD的BGP配置完全相同。通過為BGP鄰居配置**address-family l2vpn vpls-vpws**，確保匯出/匯入l2vpn vpls-vpws地址系列路由。
- 存在MPLS和組播配置錯誤。

  必須在P2MP PW通過的介面上啟用MPLS流量工程。

```
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
```

- Cisco IOS XR 5.1.0版中LSM的L2VPN配置要求您：

  配置VFI的VPN ID配置為VFI配置組播P2MP。設定傳輸通訊協定和訊號通訊協定，如以下範例設定所示：

```
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
```

- 必須正確設定LSM頭/尾。在Cisco IOS XR 5.1.0版中，每個LSM尾端也是LSM頭，反之亦然。由於路由器之間沒有**明確的**LSM功能交換，因此啟用LSM的網橋域中的所有路由器都必須參與LSM。

L2VPN和L2FIB Show命令和故障排除

- L2VPN管理器進程(l2vpn_mgr)與MPLS流量工程(TE)控制進程(te_control)通訊並請求建立隧道。使用以下命令確保te_control和l2vpn_mgr進程處於運行狀態：
  show process l2vpn_mgrshow process te_control

- 檢查l2vpn_mgr進程是否已請求隧道建立。通道的專案應位於此show命令中：

```
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必須從te_control進程接收隧道資訊。驗證此show命令是否具有非零詳細資訊，例如tunnel-id、Ext.tunnel-id、tunnel-ifh和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必須向所有其他PE路由器通告提供商組播服務例項(PMSI)。檢查l2vpn_mgr是否已傳送已配置VFI的PMSI。VFI的事件歷史記錄中應包含事件**LSM Head:send PMSI**。

```
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 -  -
  ------------------------------------------------------------------------------
[...]
```

- 其他路由器上的L2VPN應接收剛剛傳送的PMSI。確保**LSM Tail: PMSI received**顯示在接收端的事件歷史記錄中：

```
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 -  -
  ------------------------------------------------------------------------------
[...]
```

- 每台路由器都是LSM頭部和尾部，應該傳送PMSI並從其他每台路由器接收PMSI。第一個檢查的路由器應該從其他每個節點接收PMSI。

- 第二層轉發資訊庫(L2FIB)必須接收來自L2VPN的HEAD資訊並將它們下載到線卡。

```
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必須收到每個PW的L2VPN的TAIL資訊，並且必須將其下載到平台。

```
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#
```

關於此翻譯

思科已使用電腦和人工技術翻譯本文件，讓全世界的使用者能夠以自己的語言理解支援內容。請注意，即使是最佳機器翻譯，也不如專業譯者翻譯的內容準確。Cisco Systems, Inc. 對這些翻譯的準確度概不負責，並建議一律查看原始英文文件（提供連結）。