ASR 9000 - VPLS LSM 이해 및 구성

목차

소개

이 문서에서는 Cisco IOS® XR 소프트웨어를 실행하는 ASR(Aggregation Services Router) 9000 Series용 VPLS(Virtual Private LAN Service) LSM(Label Switched Multicast)에 대해 설명합니다.

사전 요구 사항

요구 사항

이 문서에 대한 특정 요건이 없습니다.

사용되는 구성 요소

이 문서는 특정 소프트웨어 및 하드웨어 버전으로 한정되지 않습니다.

이 문서의 정보는 특정 랩 환경의 디바이스를 토대로 작성되었습니다. 이 문서에 사용된 모든 디바이스는 초기화된(기본) 컨피그레이션으로 시작되었습니다. 현재 네트워크가 작동 중인 경우, 모든 명령어의 잠재적인 영향을 미리 숙지하시기 바랍니다.

VPLS LSM(Label Switched Multicast) 개요

VPLS는 MPLS(Multiprotocol Label Switching) 코어에서 LAN 서비스를 에뮬레이션합니다. VPLS 에뮬레이션을 제공하기 위해 VPLS 도메인에 참여하는 모든 PE(Provider Edge) 라우터 간에 P2P(point-to-point) 의사 와이어(PW)의 전체 메시가 설정됩니다. 브로드캐스트, 멀티캐스트 및 알 수 없는 유니캐스트 트래픽은 VPLS 도메인에서 모든 PE에 플러딩됩니다. 인그레스 복제는 각 P2P PW를 통해 동일한 VPLS 도메인에 속한 모든 원격 PE 라우터로 플러딩된 트래픽을 전송하기 위해 사용됩니다.

인그레스 복제의 단점

- 인그레스 복제는 각 P2P PW에 대해 동일한 패킷을 동일한 링크를 통해 여러 번 전송할 수 있으므로 대역폭이 비효율적입니다.
- 인그레스 복제는 브로드캐스트 및 멀티캐스트 VPLS 트래픽이 많을 때 링크 대역폭을 크게 낭비할 수 있습니다.
- 인그레스 PE 라우터가 복제의 모든 부담을 담당하므로 인그레스 복제도 리소스를 많이 사용합니다.
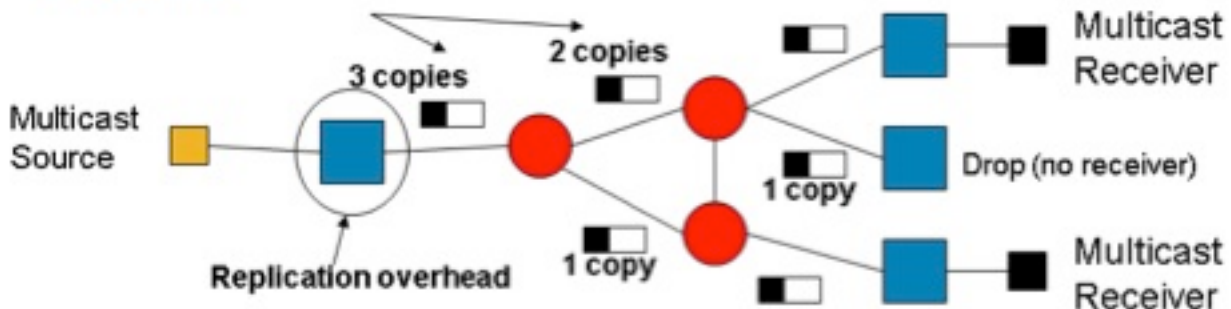
VPLS LSM 기능

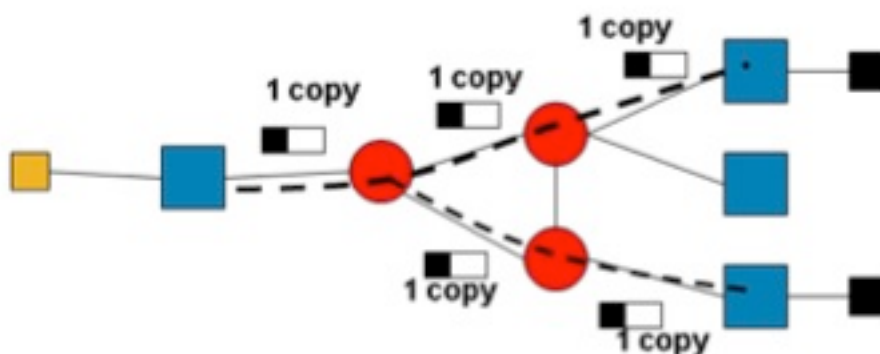VPLS는 멀티캐스트 전송에도 사용되는 널리 구축된 서비스 제공자 L2VPN 기술입니다. L2 기술을 사용하면 L2 의사 와이어로의 멀티캐스트 트래픽 복제를 최적화하기 위해 스누핑을 사용할 수 있지만, 코어는 멀티캐스트 트래픽에 구애받지 않습니다. 그 결과, 동일한 흐름의 여러 복사본이 코어 네트워크를 통과합니다. 이러한 비효율성을 완화하기 위해 LSM과 VPLS를 페어링하여 코어에 LSM 멀티캐스트 트리를 도입합니다. Cisco IOS-XR 소프트웨어 릴리스 5.1.0에서 Cisco ASR 9000 Series는 P2MP-TE(point-to-multipoint traffic engineering) 포함 트리를 사용하여 VPLS LSM을 구현합니다. VPLS 엔드포인트는 자동으로 검색되며, 운영 개입 없이 RSVP-TE(Resource Reservation Protocol Traffic Engineering)를 사용하여 P2MP-TE 트리가 설정됩니다.

- VPLS LSM은 인그레스 복제의 단점을 극복합니다.

- VPLS LSM 솔루션은 VPLS 도메인에 대한 브로드캐스트, 멀티캐스트 및 알 수 없는 유니캐스트 트래픽을 전달하기 위해 MPLS 코어에 P2MP LSP를 사용합니다.

- P2MP LSP는 가장 최적의 노드에서 MPLS 네트워크의 복제를 허용하며 네트워크의 패킷 복제량을 최소화합니다.

- VPLS LSM 솔루션은 P2MP LSP를 통해 플러딩된 VPLS 트래픽만 전송합니다.

- 유니캐스트 VPLS 트래픽은 여전히 P2P PW를 통해 전송됩니다. 액세스 PW를 통해 전송된 트래픽은 인그레스 복제를 통해 계속 전송됩니다.

- P2MP PW는 양방향인 P2P PW와 반대 단방향입니다.

- VPLS LSM 솔루션은 VPLS 도메인의 코어 PW에 대한 VPLS P2MP 서비스를 에뮬레이트하기 위해 VPLS 도메인당 P2MP PW를 생성합니다.

- VPLS LSM은 Cisco IOS XR 릴리스 5.1.0 이상에서 지원됩니다.

VPLS LSM 제한 사항

- Cisco IOS-XR 릴리스 5.1.0 VPLS LSM 기능은 RSVP-TE로 설정된 MPLS Traffic Engineering P2MP-TE 트리만 지원합니다.

- P2MP PW는 Cisco IOS-XR Release 5.1.0에서만 BGP 프로토콜로 신호를 보낼 수 있습니다. 이 첫 번째 단계에서는 VPLS 도메인에 참여하는 원격 PE가 BGP-AD(BGP Auto-Discovery)를 통해 자동 검색됩니다.

- 정적 LDP 신호 처리는 Cisco IOS XR 릴리스 5.1.0에서 지원되지 않습니다.

MAC(Media Access Control) 학습

P2MP PW에 도착하는 프레임의 Leaf PE에서의 MAC 학습은 해당 P2MP PW에 대한 Root PE로 이어지는 P2P PW에서 프레임이 수신되는 것처럼 수행됩니다. 이 그림에서 PE-1에 루팅된 P2MP PW LSP에 도착한 프레임에 대한 PE-2의 MAC 학습은 프레임이 PE-1과 PE-2 사이의 P2P PW에 도착한 것처럼 수행됩니다. L2VPN 제어 평면은 P2MP LSP 속성에 대한 MAC 학습을 위해 VPLS

속성 정보를 P2P PW 정보로 프로그래밍하는 역할을 합니다.
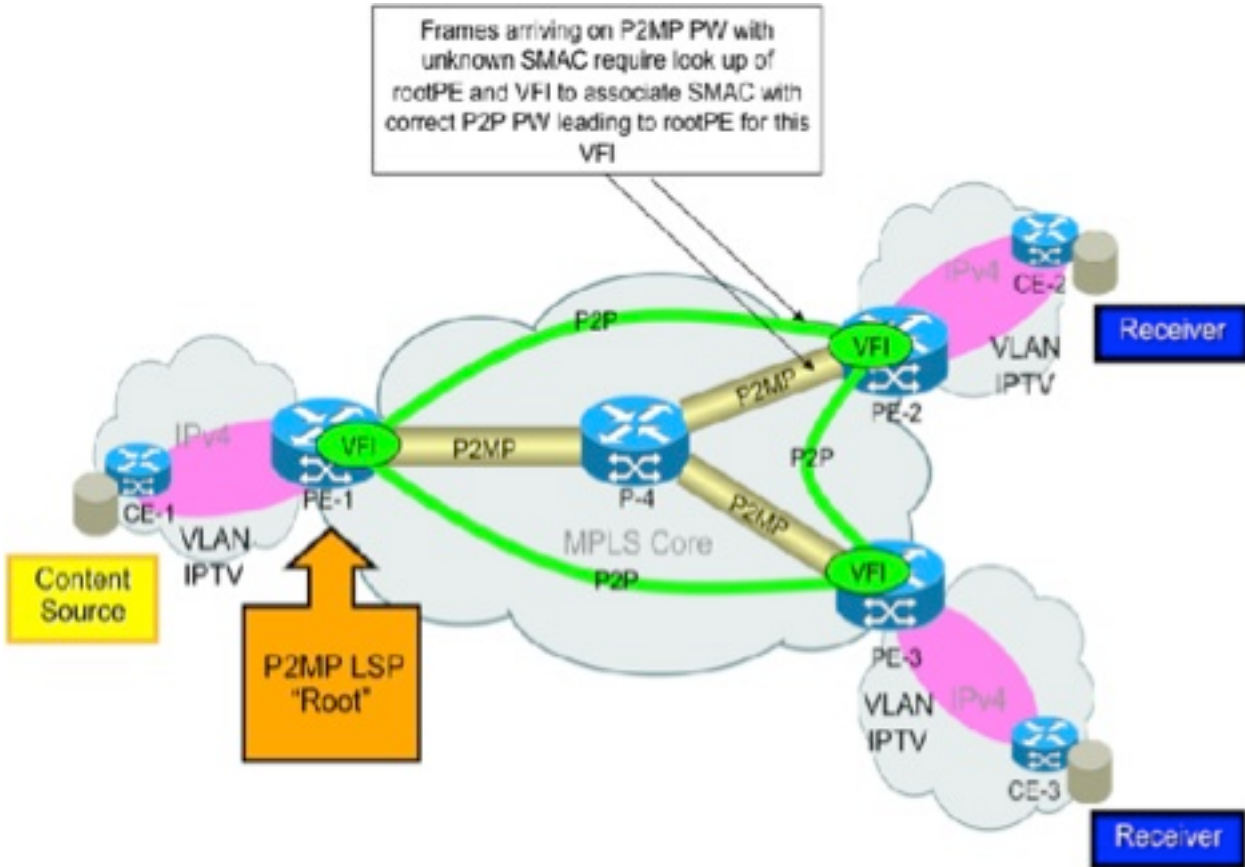
IGMPSN(Internet Group Management Protocol Snooping) 지원

IGMP(Internet Group Management Protocol) 스누핑(IGMPSN)은 VPLS LSM에 참여하는 브리지 도메인의 P2MP P-트리의 헤드와 테일 모두에서 지원됩니다. 이렇게 하면 VFI(Virtual Forwarding Instance) PW를 통한 IGMPSN 멀티캐스트 트래픽에서 P2MP LSP가 제공하는 리소스 최적화를 활용할 수 있습니다. IGMPSN이 VPLS LSM에 참여하는 하나 이상의 VFI PW가 있는 브리지 도메인에서 활성화되면 모든 L2(Layer 2) 멀티캐스트 트래픽이 브리지 도메인과 연결된 P2MP P-tree Head를 통해 전송됩니다. L2 멀티캐스트 경로는 VPLS LSM에 참여하지 않는 로컬 수신기, EFP(Ethernet Flow Point), 액세스 PW 및 VFI PW에 트래픽을 전달하기 위해 사용됩니다.

P2MP LSP 테일인 브리지 도메인에서 IGMPSN이 활성화되면 로컬 수신기(즉, AC(Attachment Circuit) BP(Bridge Port) 및 액세스 PW BP)에 대해 P2MP LSP에서 수신된 L2 멀티캐스트 트래픽의 최적화된 처리가 수행됩니다.

> **참고**: MLDP(Multicast Label Distribution Protocol) 스누핑은 Cisco IOS XR 릴리스 5.1.0에서 지원되지 않습니다.

지원되는 확장

Cisco IOS XR Release 5.1.0은 헤드/테일 라우터당 최대 **1000**개의 P2MP 터널 또는 **1000**개의 P2MP PW를 지원합니다.

VPLS LSM 컨피그레이션

P2MP 자동 터널 컨피그레이션

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

MPLS FRR(TE Fast Reroute) 컨피그레이션

```
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 컨피그레이션

```
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
  !
```

샘플 토폴로지 및 컨피그레이션
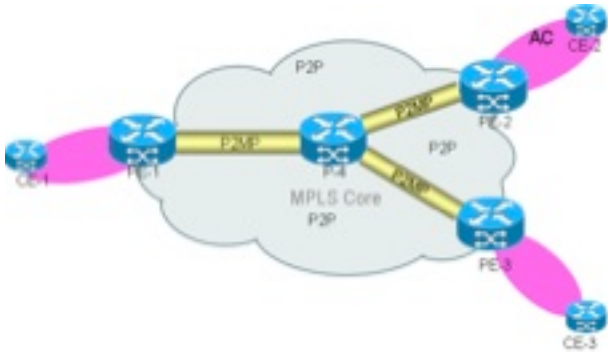
P2MP 터널은 자동 검색된 터널입니다. 고정 P2MP 터널은 지원되지 **않습니다**.

고정 터널 컨피그레이션은 사용되지 않습니다. 자동 P2MP 터널 컨피그레이션은 모든 PE 라우터에서 활성화되어야 하며, P 라우터가 버드 노드로 작동하는 경우 P 라우터에서도 활성화되어야 합니다. 버드 노드는 중간 지점과 최종 라우터를 동시에 의미합니다.

컨피그레이션이 포함된 샘플 토폴로지가 여기에 표시됩니다. 이 토폴로지에서 P2MP PW는 3개의 PE와 버드 노드(bud node) 역할을 하는 P 라우터 사이에 생성됩니다. 세 PE 라우터 모두 헤드(인그레스 트래픽용) 및 테일(이그레스 트래픽용)의 역할을 합니다.

PE1 컨피그레이션


```
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 컨피그레이션

```
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 컨피그레이션

```
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 컨피그레이션

```
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#
```

Verify - 명령 표시

이러한 show 명령은 P2MP PW 및 P2MP MPLS TE 터널의 상태를 디버깅하고 확인하는 데 유용합니다.

- 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

몇 가지 예를 들면 다음과 같습니다.

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#
```

VPLS LSM 문제 해결

일반적인 컨피그레이션 문제

L2VPN에서 P2MP 문제가 발생하는 가장 일반적인 원인은 다음과 같습니다.

- LSM에 대한 BGP 컨피그레이션은 BGP-AD에 대한 컨피그레이션과 정확히 동일합니다. BGP 네이버에 대해 **주소군** l2vpn vpls-vpws를 구성하여 l2vpn vpls-**vpws 주소군 경로**를 내보내거나 가져와야 합니다.

- MPLS 및 멀티캐스트 컨피그레이션 오류가 있습니다.

  MPLS Traffic Engineering은 P2MP PW가 통과하는 인터페이스에서 활성화되어야 합니다.

  ```
  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 Release 5.1.0의 LSM에 대한 L2VPN 컨피그레이션에서는 다음을 수행해야 합니다.

  VFI에 대한 VPN ID 컨피그레이션 구성VFI에 대한 멀티캐스트 P2MP를 구성합니다. 이 예제 컨피그레이션과 같이 전송 프로토콜 및 신호 처리 프로토콜을 구성합니다.
  ```
  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
  ```

- LSM Head/Tail(LSM 헤드/테일)을 올바르게 설정해야 합니다. Cisco IOS XR 릴리스 5.1.0에서는 각 LSM 테일도 LSM 헤드이며 그 반대의 경우도 마찬가지입니다. 라우터 간 명시적 LSM **기능 교환**이 없으므로 LSM 지원 브리지 도메인의 모든 라우터가 LSM에 참여해야 합니다.

L2VPN 및 L2FIB Show 명령 및 문제 해결

- L2VPN 관리자 프로세스(l2vpn_mgr)는 MPLS TE(Traffic Engineering) 제어 프로세스(te_control)와 통신하고 터널 생성을 요청합니다. te_control 및 l2vpn_mgr 프로세스가 다음 명령을 사용하여 실행 중인지 확인합니다.
  프로세스 l2vpn_mgr 표시show process te_control

- l2vpn_mgr 프로세스가 터널 생성을 요청했는지 확인합니다. 터널에 대한 항목은 다음 show 명령에 있어야 합니다.

```
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
```

- L2VPN은 te_control 프로세스에서 터널 정보를 수신해야 합니다. 이 show 명령에 tunnel-id, Ext.tunnel-id, tunnel-ifh 및 p2mp-id와 같은 0이 아닌 세부 정보가 있는지 확인합니다.

```
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
```

- L2VPN은 PMSI(Provider Multicast Service Instance)를 다른 모든 PE 라우터에 광고해야 합니다. l2vpn_mgr에서 구성된 VFI에 대한 PMSI를 보냈는지 확인합니다. 이벤트 LSM **헤드: PMSI 전송은** VFI에 대한 이벤트 기록에 있어야 합니다.

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

- 다른 라우터의 L2VPN은 방금 전송된 PMSI를 수신해야 합니다. LSM **Tail: PMSI received**가 수신 측의 이벤트 기록에 표시되는지 확인합니다.

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

- 각 라우터는 LSM 헤드 및 테일이며 PMSI를 전송하고 다른 라우터 각각에서 PMSI를 수신해야 합니다. 선택한 첫 번째 라우터는 다른 노드 각각에서 PMSI를 수신해야 합니다.

- L2FIB(Layer Two Forwarding Information Base)는 L2VPN에서 HEAD 정보를 받아 라인 카드로 다운로드해야 합니다.

```
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
```

- L2FIB는 각 PW에 대해 L2VPN에서 TAIL 정보를 받아 플랫폼으로 다운로드해야 합니다.

```
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#
```