ASR1K中通过VRF感知L2TPv3的Xconnect

目录

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简介

背景信息

测试案例I:通过IP网络的L2TPv3 Xconnect，在VRF中具有终端

测试案例II:通过MPLS网络的L2TPv3 Xconnect与VRF中的终端

简介

本文档介绍在配置第2层隧道协议(L2TP)v3 Xconnect over IP和多协议标签交换(MPLS)网络时如何使用虚拟路由和转发(VRF)。

背景信息

L2TP是Internet服务提供商(ISP)使用的隧道协议，用于在Internet上的拨号接入空间中提供虚拟专用网络(VPN)。

它结合了思科第2层转发(L2F)协议和Microsoft的点对点隧道协议(PPTP)的优势。 L2TP的主要组件是L2TP访问控制器(LAC)和L2TP网络服务器(LNS)。

L2TP访问控制器：LAC是连接到公共交换电话网(PSTN)的接入服务器。LAC是传入呼叫的发起方和传出呼叫的接收方。它通过LAN或WAN连接到LNS。

L2TP网络服务器：LNS是L2TP协议的网络服务器，PPP会话在此协议中终止并经过身份验证。LNS是呼出呼叫的发起者和呼入呼叫的接收者。

L2TPv2旨在通过IP网络传输PPP流量。网络接入设备（DSL、电缆调制解调器或拨号接入接口）接受用户的PPP连接，并通过L2TP将PPP会话通过隧道传输到ISP。新版本L2TPv3设计为除PPP外还承载任何第2层负载，PPP是第2版支持的唯一负载。具体而言，L2TPv3定义了L2TP协议，用于使用第2层VPN在IP核心网络上隧道化第2层负载。此功能的优点包括：

- L2TPv3简化了VPN的部署
- L2TPv3不需要MPLS
- L2TPv3支持任何负载的IP第2层隧道

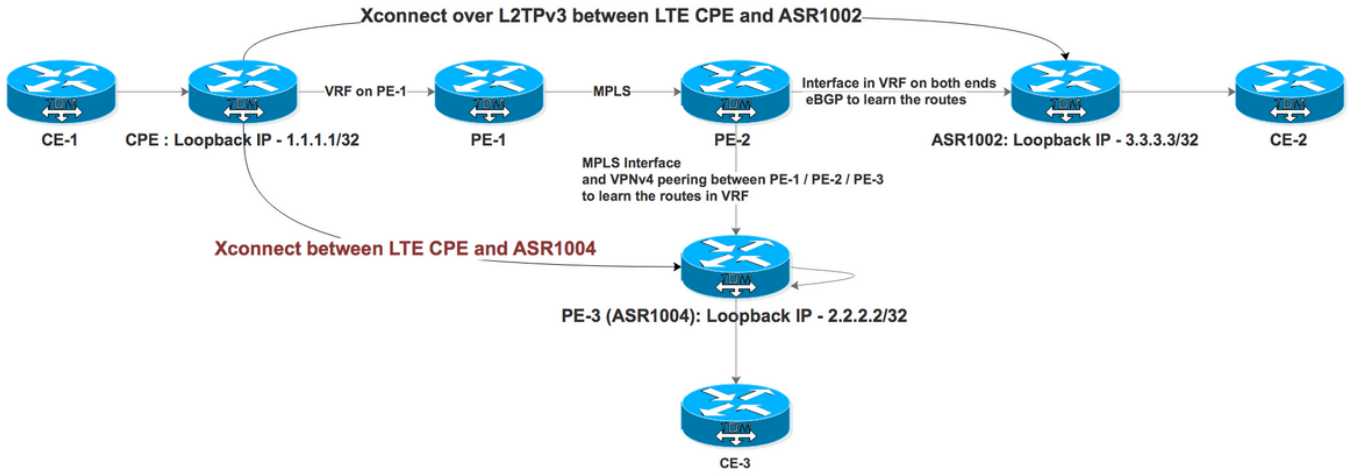
以下是L2TPv3伪线的示例配置：

1. enable
2. configure终端

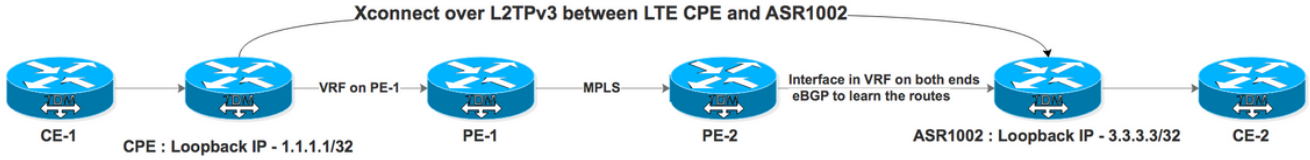
3. interface type slot/port

4. xconnectpeer-ip-address vcidencapsulation l2tpv3pw-classpw-class-name

现在我们来了解一下L2TPv3 Xconnect在使用VRF时的行为方式。以下是用于演示的拓扑，在该拓扑中，我们在CPE与ASR1002(IP)和ASR1004(MPLS)之间配置Xconnect，在VRF中终端位于ASR1000（ASR1000平台不支持VRF感知L2TPv3）。



测试案例I:通过IP网络的L2TPv3 Xconnect，在VRF中具有终端



PE-1和PE-2使ISP成为MPLS网络。CPE通过VRF连接到PE-1,ASR1002通过VRF连接到PE-2。ASR1002在连接到PE-2的接口上也具有VRF。从ASR1002的CPE环回的可达性通过IP接口上的VRF实现。

在CPE上配置用于ASR1002的Xconnect:

```
interface FastEthernet4.2381

encapsulation dot1Q 2381

xconnect 3.3.3.3 2381 encapsulation l2tpv3 pw-class PSEUDO_CLASS >>>>>>>>>>> Xconnect with ASR1002


pseudowire-class PSEUDO_CLASS

encapsulation l2tpv3
```

```
interworking vlan
protocol l2tpv3 L2TP_CLASS
ip local interface Loopback0
ip tos reflect

l2tp-class L2TP_CLASS
authentication
password cisco

interface Gigabit0/1
ip address 192.168.8.190 255.255.255.0
end

Interface Loopback0
ip address 1.1.1.1 255.255.255.255
end

ip route 0.0.0.0 0.0.0.0 192.168.8.1 >>>>>>>>>>>>>> Default route towards PE-1
```

ASR1002上的工作配置：

```
interface GigabitEthernet0/0/0.906 ------------------> Interface connected to PE-2 is in VRF
encapsulation dot1Q 906
ip vrf forwarding L2TP_VRF
ip address 10.1.1.1 255.255.255.252

interface GigabitEthernet0/0/1.2381
encapsulation dot1Q 2381
xconnect 1.1.1.1 2381 encapsulation l2tpv3 pw-class PSEUDO_CLASS

pseudowire-class PSEUDO_CLASS
```

```
encapsulation l2tpv3

interworking vlan

protocol l2tpv3 L2TP_CLASS

ip local interface Loopback11



l2tp-class L2TP_CLASS

authentication

password cisco


interface Loopback11

ip vrf forwarding L2TP_VRF ------------------------------> Source is in VRF

ip address 3.3.3.3 255.255.255.255


router bgp 1


address-family ipv4 vrf L2TP_VRF

redistribute connected

neighbor 10.1.1.2 remote-as 2 ----------------> eBGP with PE-2 in VRF

neighbor 10.1.1.2 activate

neighbor 10.1.1.2 soft-reconfiguration inbound

exit-address-family
```

VRF L2TP_VRF:

```
B       1.1.1.1/32 [20/0] via 10.1.1.2, 1d ----------> Xconnect end point learned via eBGP in VRF
```

现在让我们检查CPE上Xconnect的状态：

<#root>

```
CPE #sh xconnect all de
```

```
Legend:    XC ST=Xconnect State  S1=Segment1 State  S2=Segment2 State
  UP=Up       DN=Down             AD=Admin Down      IA=Inactive
  SB=Standby  HS=Hot Standby      RV=Recovering      NH=No Hardware

XC ST  Segment 1                         S1 Segment 2                         S2
------+--------------------------------+--+--------------------------------+--

UP pri   ac Fa4.2381:2381(Eth VLAN)      UP l2tp 3.3.3.3:2381
DOWN

            Interworking: vlan                   Session ID: 1906980494
                                                 Tunnel ID: 2886222725
                                                Protocol State: DOWN
                                                Remote Circuit State: DOWN
                                                pw-class: PSEUDO_CLASS_VLAN
```

它表示数据段2已关闭，这意味着从CPE到ASR1002的路径有问题。但是，我们可以对终端执行ping操作。CPE上的调试显示到终端的隧道发生故障或没有到终端的路由。

```
*Feb 15 08:12:47.225: L2TP _____:18136:8DF92CB9/uid:0[1.1.1.1/2381]: I CDN, flg TLS, ver 3, len 80
*Feb 15 08:12:47.225: L2TP _____:18136:8DF92CB9/uid:0[1.1.1.1/2381]:IETF v2:
*Feb 15 08:12:47.225: L2TP _____:18136:8DF92CB9/uid:0[1.1.1.1/2381]:Result Code
*Feb 15 08:12:47.225: L2TP _____:18136:8DF92CB9/uid:0[1.1.1.1/2381]:   Call disconnected for administra
*Feb 15 08:12:47.225: L2TP _____:18136:8DF92CB9/uid:0[1.1.1.1/2381]:   Error code
*Feb 15 08:12:47.225: L2TP _____:18136:8DF92CB9/uid:0[1.1.1.1/2381]:     No error(0)
*Feb 15 08:12:47.225: L2TP _____:18136:8DF92CB9/uid:0[1.1.1.1/2381]:   Optional msg
*Feb 15 08:12:47.225: L2TP _____:18136:8DF92CB9/uid:0[1.1.1.1/2381]:       "Tunnel failed to 3.3.3.3" >
*Feb 15 08:12:47.225: L2TP _____:18136:8DF92CB9/uid:0[1.1.1.1/2381]:Cisco v3:
```

此处的主要问题是通过ASR1002上的VRF可访问终端。Xconnect终端需要位于全局路由表中才能启

动。现在，让我们配置一条全局指向接口GigabitEthernet0/0/0.906（自身位于VRF中）的CPE Loopback 1.1.1.1/32路由。

<#root>

```
 ip route 1.1.1.1 255.255.255.255 GigabitEthernet0/0/0.906 10.1.1.2


              S        1.1.1.1/32 [1/0] via 10.1.1.2, GigabitEthernet0/0/0.906
```

配置完虚拟静态路由后，Xconnect便会启动。您也可以将其指向Null0。这是一种解决方法，让路由器相信可通过全局而不是VRF访问终端，并且仅用于控制平面。实际数据平面流量将仅通过VRF。

以下是使用VRF和不使用VRF时的ping结果：

```
ASR1002 #ping 1.1.1.1

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:

.....

Success rate is 0 percent (0/5)


Ping vrf L2TP_VRF 1.1.1.1

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 33/50/72 ms
```

CPE上的Xconnect状态：

<#root>

```
CPE #sh xconnect all de

Legend:    XC ST=Xconnect State  S1=Segment1 State  S2=Segment2 State

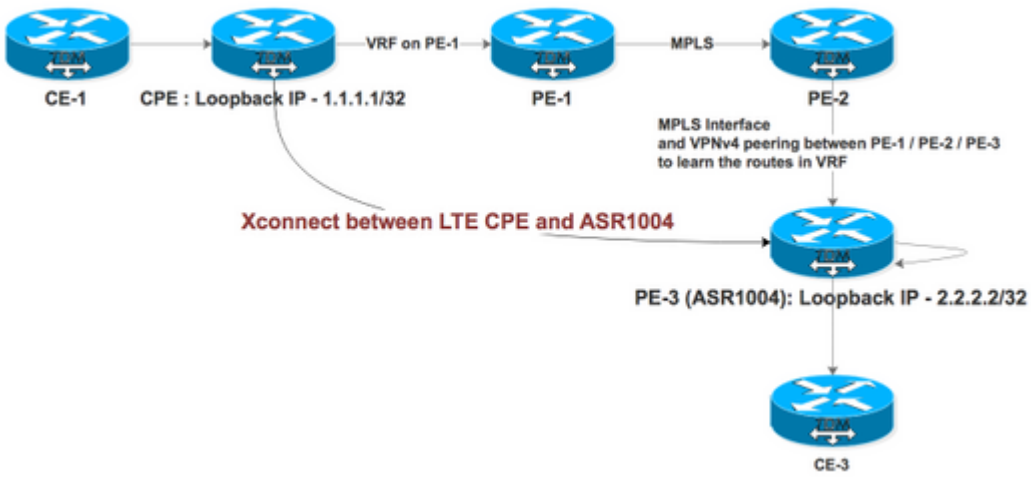
  UP=Up       DN=Down             AD=Admin Down      IA=Inactive

  SB=Standby  HS=Hot Standby      RV=Recovering      NH=No Hardware
```

```
XC ST  Segment 1                          S1 Segment 2                          S2
------+---------------------------------+--+---------------------------------+--
UP pri   ac Fa4.2381:2381(Eth VLAN)      UP l2tp3.3.3.3:2381
UP
```

```
            Interworking: vlan                    Session ID: 1906980494
                                                  Tunnel ID: 2886222725
                                                 Protocol State: UP
                                                 Remote Circuit State: UP
                                                 pw-class: PSEUDO_CLASS_VLAN
```

测试案例II:通过MPLS网络的L2TPv3 Xconnect与VRF中的终端



PE-1、PE-2和PE-3使ISP的MPLS网络充当PE-2充当路由反射器(RR)。CPE通过VRF连接到PE-1,ASR1004通过接口上启用MPLS连接到PE-2。ASR1004还具有VRF，其中应通过RR从PE-1接收VPNv4路由。从ASR1004的CPE looback的可达性通过MPLS接口上的VRF实现。

在CPE上配置用于ASR1004的Xconnect:

```
interface FastEthernet4.2380
encapsulation dot1Q 2380
xconnect 2.2.2.2 2380 encapsulation l2tpv3 pw-class PSEUDO_CLASS  >>>>>>>>>>Xconnect with ASR1004
```

```
interface FastEthernet4.2381

encapsulation dot1Q 2381

xconnect 3.3.3.3 2381 encapsulation l2tpv3 pw-class PSEUDO_CLASS >>>>>>>>>>> Xconnect with ASR1002


pseudowire-class PSEUDO_CLASS

encapsulation l2tpv3

interworking vlan

protocol l2tpv3 L2TP_CLASS

ip local interface Loopback0

ip tos reflect


l2tp-class L2TP_CLASS

authentication

password cisco


interface Gigabit0/1

ip address 192.168.8.190 255.255.255.0

end


Interface Loopback0

ip address 1.1.1.1 255.255.255.255

end


ip route 0.0.0.0 0.0.0.0 192.168.8.1 >>>>>>>>>>>>>> Default route towards PE-1
```

ASR1004上的配置：

```
interface GigabitEthernet0/0/1

no ip address

negotiation auto
```

```
service instance 2 ethernet
encapsulation dot1q 2380
xconnect 1.1.1.1 2380 encapsulation l2tpv3 pw-class PSEUDO_CLASS_VLAN
!
end

interface Loopback11
ip vrf forwarding L2TP_VRF ------------------> Source Loopback in in VRF
ip address 2.2.2.2 255.255.255.255
end

pseudowire-class PSEUDO_CLASS_VLAN
encapsulation l2tpv3
interworking vlan
protocol l2tpv3 L2TP_CLASS
ip local interface Loopback11


l2tp-class L2TP_CLASS
authentication
password cisco

router bgp 2
address-family ipv4 vrf L2TP_VRF
redistribute connected
redistribute static
default-information originate
exit-address-family
```

Xconnect终端的路由条目：

<#root>

```
ASR1004#sh ip rou vrf L2TP_VRF 1.1.1.1 .   ------------------> Xconnect End Point also learned via VRF

Routing Table: L2TP_VRF
Routing entry for 1.1.1.1/32
 Known via "bgp 2", distance 200, metric 0, type internal
 Last update from 11.11.11.11 6d17h ago
 Routing Descriptor Blocks:
 * 11.11.11.11 (default), from 22.22.22.22, 6d17h ago
 Route metric is 0, traffic share count is 1
 AS Hops 0
 MPLS label: 18
 MPLS Flags: MPLS Required



We observed that Segment 2 was continuously flapping on both ends.



ASR1004#sh xc all de

Legend:    XC ST=Xconnect State  S1=Segment1 State  S2=Segment2 State

  UP=Up       DN=Down             AD=Admin Down      IA=Inactive

  SB=Standby  HS=Hot Standby      RV=Recovering      NH=No Hardware


XC ST  Segment 1                         S1 Segment 2                         S2

------+---------------------------------+--+---------------------------------+--

DN pri   ac Gi0/0/1:2380(Eth VLAN)       UP l2tp 1.1.1.1:2380
DN

  >>>>>>>>>>>>>>

            Interworking: vlan                   Session ID: 2543426569

                                                 Tunnel ID: 3352120314

                                                 Protocol State: DOWN

                                                 Remote Circuit State: DOWN

                                                 pw-class: PSEUDO_CLASS_VLAN

ASR1004#sh xc all de

Legend:    XC ST=Xconnect State  S1=Segment1 State  S2=Segment2 State

  UP=Up       DN=Down             AD=Admin Down      IA=Inactive

  SB=Standby  HS=Hot Standby      RV=Recovering      NH=No Hardware


XC ST  Segment 1                         S1 Segment 2                         S2
```

```
------+--------------------------------+--+--------------------------------+--
UP pri   ac Gi0/0/1:2380(Eth VLAN)       UP l2tp 1.1.1.1,1:2380
UP
 >>>>>>>>>>>>>>>>
            Interworking: vlan                    Session ID: 2543426569
                                                  Tunnel ID: 3352120314
                                                  Protocol State: UP
                                                  Remote Circuit State: UP
                                                  pw-class: PSEUDO_CLASS_VLAN
```

CPE中的日志：

<#root>

```
CPE#sh xconnect all de
Legend:    XC ST=Xconnect State  S1=Segment1 State  S2=Segment2 State
  UP=Up       DN=Down             AD=Admin Down      IA=Inactive
  SB=Standby  HS=Hot Standby      RV=Recovering      NH=No Hardware

XC ST  Segment 1                         S1 Segment 2                          S2
------+--------------------------------+--+--------------------------------+--
DN pri   ac Fa4.2380:2380(Eth VLAN)      UP l2tp 2.2.2.2:2380            DN ---------------à Flapping w
            Interworking: vlan                    Session ID: 3434660693
                                                  Tunnel ID: 1760690853
                                                  Protocol State: DOWN
                                                  Remote Circuit State: DOWN
                                                  pw-class: PSEUDO_CLASS
UP pri   ac Fa4.2381:2381(Eth VLAN)      UP l2tp 3.3.3.3:2381              UP ---------------------à St
            Interworking: vlan                    Session ID: 1906980494
                                                  Tunnel ID: 2886222725
                                                  Protocol State: UP
                                                  Remote Circuit State: UP
                                                  pw-class: PSEUDO_CLASS
```

```
CPE#sh l2tp session

L2TP Session Information Total tunnels 2 sessions 2

LocID      RemID      TunID      Username, Intf/      State  Last Chg Uniq ID
                                 Vcid, Circuit
2714490989 3697021268 1760690853 2380, Fa4.2380:2380  est
00:00:03 0
  --------> Flapping with ASR1004
1906980494 2361475239 2886222725 2381, Fa4.2381:2381  est
15:37:06 0
       --------> Stable with ASR1002
```

在这种情况下，无法配置静态路由，因为送出接口是启用MPLS的接口。作为解决方法，有两个接口相互环回，并且在VRF中配置了一个接口，而在全局中配置另一个接口。然后在全局中配置一个指向VRF接口的静态路由，这样Xconnect变得稳定。

```
ASR1004#sh run int gi0/0/2
Building configuration...

Current configuration : 95 bytes
!
interface GigabitEthernet0/0/2 ----------> Looped to Gi0/0/3
ip address 20.20.20.2 255.255.255.252
negotiation auto
end

#sh run int gi0/0/3
Building configuration...

Current configuration : 126 bytes
```

```
!
interface GigabitEthernet0/0/3
ip vrf forwarding L2TP_VRF
ip address 20.20.20.1 255.255.255.252
negotiation auto
end


ip route 10.246.131.62 255.255.255.255 20.20.20.1 -------> Static route pointing towards an IP interfac


CPE#sh xconnect all de
Legend:    XC ST=Xconnect State  S1=Segment1 State  S2=Segment2 State
  UP=Up       DN=Down             AD=Admin Down      IA=Inactive
  SB=Standby  HS=Hot Standby      RV=Recovering      NH=No Hardware

XC ST  Segment 1                         S1 Segment 2                          S2
------+---------------------------------+--+---------------------------------+--
DN pri   ac Fa4.2380:2380(Eth VLAN)      UP l2tp 2.2.2.2:2380            UP
            Interworking: vlan                   Session ID: 3434660693
                                                 Tunnel ID: 1760690853
                                                 Protocol State: DOWN
                                                 Remote Circuit State: DOWN
                                                 pw-class: PSEUDO_CLASS
UP pri   ac Fa4.2381:2381(Eth VLAN)      UP l2tp 3.3.3.3:2381              UP
            Interworking: vlan                   Session ID: 1906980494
                                                 Tunnel ID: 2886222725
                                                 Protocol State: UP
                                                 Remote Circuit State: UP
                                                 pw-class: PSEUDO_CLASS
```

```
CPE#sh l2tp session
```

L2TP会话信息总计隧道2会话2:

```
<#root>
LocID       RemID       TunID       Username, Intf/      State  Last Chg Uniq ID
                                    Vcid, Circuit
2714490989 3697021268 1760690853 2380, Fa4.2380:2380  est
00:20:03 0

1906980494 2361475239 2886222725 2381, Fa4.2381:2381  est
15:37:06 0
```

ASR1004的流量被视为这种情况：

- 当流量来自ASR1004上的CPE时，它进入MPLS接口Gi0/0/1，并直接交换到Gi0/0/0接入端口。
- 当流量来自接入端口Gi0/0/0时，它采用Gi0/0/0 -> Gi0/0/2 -> Gi0/0/3 -> Gi0/0/1的循环路径。

此解决方法的主要问题是数据包处理两次时在ASR1000平台上的QFP使用率：

```
ASR1004#  show platform packet-trace summary
Pkt   Input              Output             State  Reason
0     Gi0/0/3            Gi0/0/1            FWD
1     Gi0/0/3            Gi0/0/1            FWD
2     Gi0/0/3            Gi0/0/1            FWD
3     Gi0/0/0            Gi0/0/2            FWD
4     Gi0/0/0            Gi0/0/2            FWD
5     Gi0/0/0            Gi0/0/2            FWD
6     Gi0/0/0            Gi0/0/2            FWD
7     Gi0/0/0            Gi0/0/2            FWD
```

此行为记录在Doc Bug:CSCvi42964

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