在ASR1K中通过VRF感知L2TPv3进行Xconnect

目录

简介
背景信息
测试案例I:L2TPv3 Xconnect over IP网络，带VRF中的终端
测试案例II:L2TPv3 Xconnect over MPLS网络，带VRF中的终端

简介

本文档介绍在配置第2层隧道协议(L2TP)v3 IP Xconnect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拨号接入空间中提供虚拟专用网络(VPN)。

它结合了思科的第2层转发(L2F)协议和Microsoft的点对点隧道协议(PPTP)的优点。 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是传入呼叫的发起者和传出呼叫的接收者。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，其中PPP会话终止并进行身份验证。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）接受来自用户的PPP连接，并通过L2TP将PPP会话隧道化到ISP。新版本L2TPv3除了PPP（版本2支持的唯一负载）外，还设计用于承载任何第2层负载。具体而言，L2TPv3定义了L2TP协议，用于使用第2层VPN在IP核心网络上隧道传输第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伪线的配置示例：

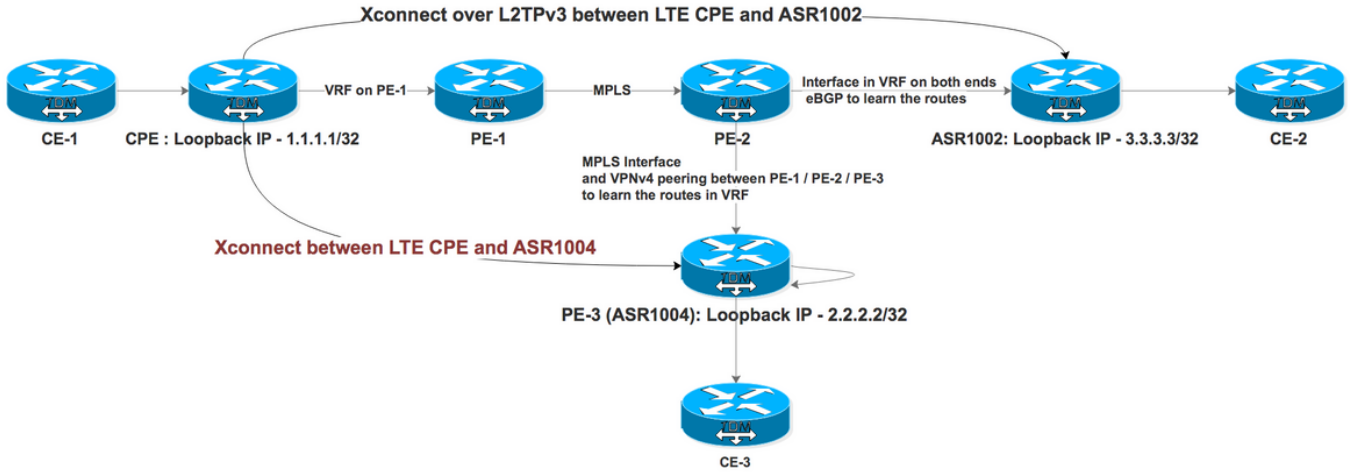
1.enable

2.configure终端

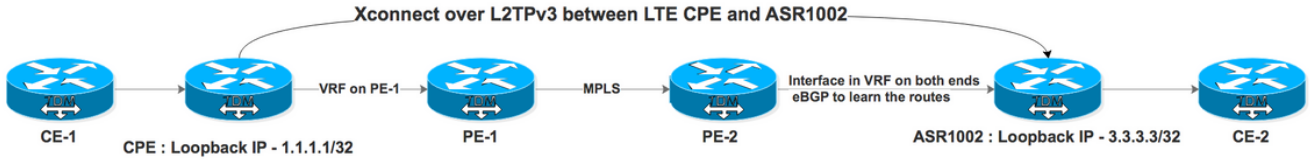
3.interface type slot/port

4.xconnectpeer-ip-address vc**id encapsulation l2tpv3 pw-class**pw-class-name

现在，看看使用VRF时L2TPv3 Xconnect的行为。这是用于演示的拓扑，其中我们在CPE和ASR1002(IP)和ASR1004(MPLS)之间配置了Xconnect，ASR1000中的终端VRF（ASR1000平台不支持VRF感知L2TPv3）。



测试案例I:L2TPv3 Xconnect over IP网络，带VRF中的终端



PE-1和PE-2为ISP建立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的接口上也有VRF。从ASR1002的CPE环回的可达性通过VRF over IP接口实现。

CPE上面向ASR1002的Xconnect配置：

```
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：

```
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
```

它表示网段2已关闭，这意味着从CPE到ASR1002的路径出现问题。但是，我们能够ping终端。CPE上的调试显示到终端的隧道失败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
administrative reasons(3)

*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:
```

此处的主要问题是终端可通过ASR1002上的VRF访问。Xconnect终端需要位于全局路由表中才能启动。现在，让我们在全局中为CPE Loopback 1.1.1.1/32配置一条路由，该路由指向VRF中的接口GigabitEthernet0/0/0.906。

```
 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将启动。您也可以将其指向Null0。这是一种解决方法，使路由器相信终端可通过全局非VRF访问，并且仅用于控制平面。实际数据平面流量将仅通过VRF。

以下是带VRF和不带VRF的ping结果：

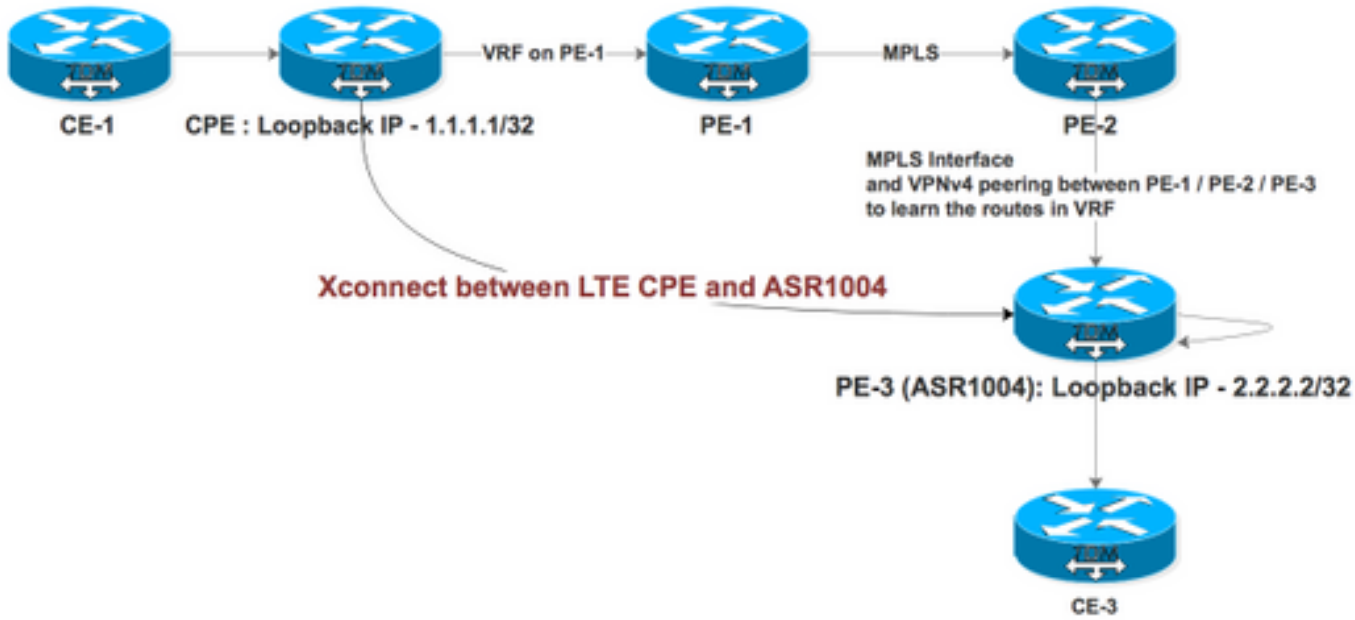
```
ASR1002 #ping 1.1.1.1

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Xconnect的状态：

```
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:L2TPv3 Xconnect over MPLS网络，带VRF中的终端



PE-1、PE-2和PE-3使ISP的MPLS网络具有PE-2作为路由反射器(RR)。CPE通过VRF连接到PE-1,ASR1004通过接口上启用的MPLS连接到PE-2。ASR1004还具有VRF，它应通过RR从PE-1接收VPNv4路由。从ASR1004的CPEloopback的可达性通过MPLS接口上的VRF实现。

CPE上面向ASR1004的Xconnect配置：

```
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：

```
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 1.1.1,1:2380          UP >>>>>>>>>>>>>>>>

            Interworking: vlan                   Session ID: 2543426569

                                                 Tunnel ID: 3352120314

                                                 Protocol State: UP

                                                 Remote Circuit State: UP

                                                 pw-class: PSEUDO_CLASS_VLAN
```

来自CPE的日志：

```
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 with ASR1004

           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 Stable with ASR1002

           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，不能配置静态路由，因为送出接口是启用MPLS的接口。解决方法是，有两个接口相互环回，并在VRF中配置一个全局接口。然后，在全局配置指向VRF接口的静态路由，此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 interface in Global

```
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会话信息隧道总数2会话2:

```
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
```
流量被视为ASR1004的情况：

- 当流量来自ASR1004上的CPE时，它会进入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的环路。

此解决方法的主要问题是ASR1000平台上的QFP利用率，因为数据包处理操作是两次：

```
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
```
此行为记录在文档错误中：CSCvi42964