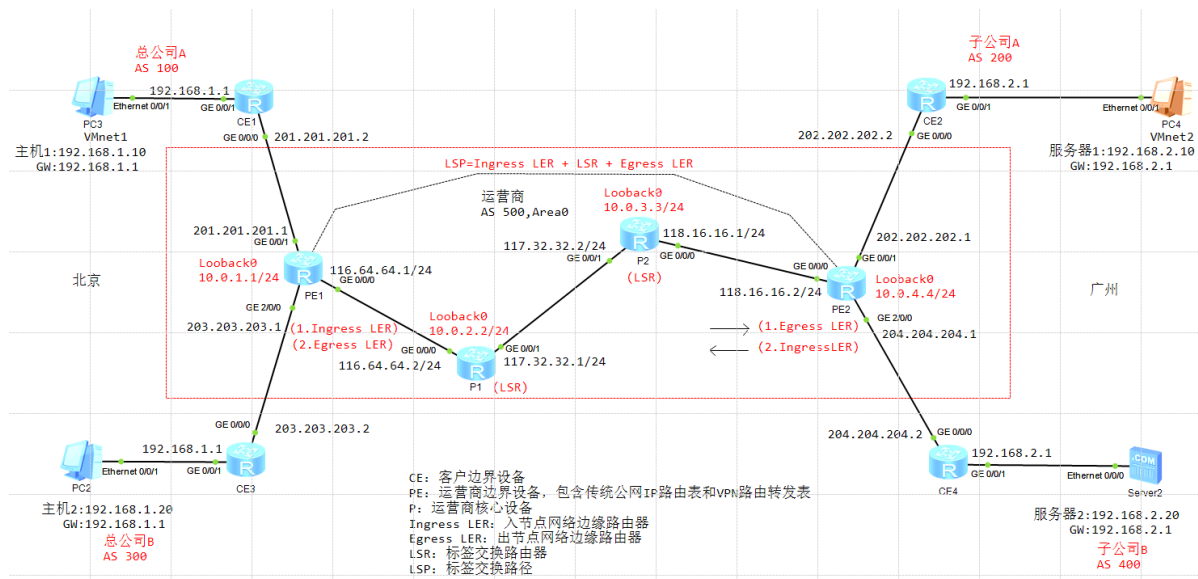


点对点MPLS-BGP

实验拓扑



基本配置

路由器接口IP配置

CE1

```
1 <Huawei>sys
2 Enter system view, return user view with Ctrl+Z.
3 [Huawei]sys CE1
4 [CE1]undo info en
5 Info: Information center is disabled.
6 [CE1]user-int con 0
7 [CE1-ui-console0]idle 0 0
8 [CE1-ui-console0]q
9 [CE1]int g0/0/1
10 [CE1-GigabitEthernet0/0/1]ip add 192.168.1.1 24
11 [CE1-GigabitEthernet0/0/1]q
12 [CE1]int g0/0/0
13 [CE1-GigabitEthernet0/0/0]ip add 201.201.201.2 24
14 [CE1-GigabitEthernet0/0/0]q
15 [CE1]
```

CE2

```
1 <Huawei>sys
2 Enter system view, return user view with Ctrl+Z.
3 [Huawei]sys CE2
4 [CE2]undo info en
5 Info: Information center is disabled.
6 [CE2]user-int con 0
7 [CE2-ui-console0]idle 0 0
8 [CE2-ui-console0]q
9 [CE2]int g0/0/1
```

```
10 [CE2-GigabitEthernet0/0/1]ip add 192.168.2.1 24
11 [CE2-GigabitEthernet0/0/1]q
12 [CE2]int g0/0/0
13 [CE2-GigabitEthernet0/0/0]ip add 202.202.202.2 24
14 [CE2-GigabitEthernet0/0/0]
```

CE3

```
1 <Huawei>sys
2 Enter system view, return user view with Ctrl+Z.
3 [Huawei]sys CE3
4 [CE3]undo info en
5 Info: Information center is disabled.
6 [CE3]user-int con 0
7 [CE3-ui-console0]idle 0 0
8 [CE3-ui-console0]int g0/0/1
9 [CE3-GigabitEthernet0/0/1]ip add 192.168.1.1 24
10 [CE3-GigabitEthernet0/0/1]q
11 [CE3]int g0/0/0
12 [CE3-GigabitEthernet0/0/0]ip add 203.203.203.2 24
13 [CE3-GigabitEthernet0/0/0]q
14 [CE3]
```

CE4

```
1 <Huawei>sys
2 Enter system view, return user view with Ctrl+Z.
3 [Huawei]sys CE4
4 [CE4]undo info en
5 Info: Information center is disabled.
6 [CE4]user-int con 0
7 [CE4-ui-console0]idle 0 0
8 [CE4-ui-console0]q
9 [CE4]int g0/0/0
10 [CE4-GigabitEthernet0/0/0]ip add 204.204.204.2 24
11 [CE4-GigabitEthernet0/0/0]q
12 [CE4]int g0/0/1
13 [CE4-GigabitEthernet0/0/1]ip add 192.168.2.1 24
14 [CE4-GigabitEthernet0/0/1]q
15 [CE4]
```

PE1

```
1 <Huawei>sys
2 Enter system view, return user view with Ctrl+Z.
3 [Huawei]sys PE1
4 [PE1]undo info en
5 Info: Information center is disabled.
6 [PE1]user-int con 0
7 [PE1-ui-console0]idle 0 0
8 [PE1-ui-console0]q
9 [PE1]int g0/0/1
10 [PE1-GigabitEthernet0/0/1]ip add 201.201.201.1 24
11 [PE1-GigabitEthernet0/0/1]q
```

```

12 [PE1]int g0/0/0
13 [PE1-GigabitEthernet0/0/0]ip add 116.64.64.1 24
14 [PE1-GigabitEthernet0/0/0]q
15 [PE1]int g2/0/0
16 [PE1-GigabitEthernet2/0/0]ip add 203.203.203.1 24
17 [PE1-GigabitEthernet2/0/0]q
18 [PE1]int loopback 0
19 [PE1-LoopBack0]ip add 10.0.1.1 24
20 [PE1-LoopBack0]
21 [PE1]

```

PE2

```

1 <Huawei>sys
2 Enter system view, return user view with Ctrl+Z.
3 [Huawei]sys PE2
4 [PE2]undo info en
5 Info: Information center is disabled.
6 [PE2]user-int con 0
7 [PE2-ui-console0]idle 0 0
8 [PE2-ui-console0]q
9 [PE2]int g0/0/1
10 [PE2-GigabitEthernet0/0/1]ip add 202.202.202.1 24
11 [PE2-GigabitEthernet0/0/1]q
12 [PE2]int g0/0/0
13 [PE2-GigabitEthernet0/0/0]ip add 118.16.16.2 24
14 [PE2-GigabitEthernet0/0/0]q
15 [PE2]int g2/0/0
16 [PE2-GigabitEthernet2/0/0]ip add 204.204.204.1 24
17 [PE2-GigabitEthernet2/0/0]q
18 [PE2]int loopback 0
19 [PE2-LoopBack0]ip add 10.0.4.4 24
20 [PE2-LoopBack0]

```

P1

```

1 <Huawei>sys
2 Enter system view, return user view with Ctrl+Z.
3 [Huawei]sys p1
4 [p1]undo info en
5 Info: Information center is disabled.
6 [p1]user-int con 0
7 [p1-ui-console0]idle 0 0
8 [p1-ui-console0]q
9 [p1]int g0/0/0
10 [p1-GigabitEthernet0/0/0]ip add 116.64.64.2 24
11 [p1-GigabitEthernet0/0/0]q
12 [p1]int g0/0/1
13 [p1-GigabitEthernet0/0/1]ip add 117.32.32.1 24
14 [p1-GigabitEthernet0/0/1]q
15 [p1]int loopback 0
16 [p1-LoopBack0]ip add 10.0.2.2 24
17 [p1-LoopBack0]q
18 [p1]

```

```

1 <Huawei>sys
2 Enter system view, return user view with Ctrl+Z.
3 [Huawei]sys P2
4 [P2]undo info en
5 Info: Information center is disabled.
6 [P2]user-int con 0
7 [P2-ui-console0]idle 0 0
8 [P2-ui-console0]q
9 [P2]int g0/0/1
10 [P2-GigabitEthernet0/0/1]ip add 117.32.32.2 24
11 [P2-GigabitEthernet0/0/1]q
12 [P2]int g0/0/0
13 [P2-GigabitEthernet0/0/0]ip add 118.16.16.1 24
14 [P2-GigabitEthernet0/0/0]q
15 [P2]int loopback 0
16 [P2-LoopBack0]ip add 10.0.3.3 24
17 [P2-LoopBack0]q
18 [P2]

```

配置运营商内网OSPF路由

PE1

```

1 [PE1]ospf router-id 10.0.1.1
2 [PE1-ospf-1]area 0
3 [PE1-ospf-1-area-0.0.0.0]network 116.64.64.0 0.0.0.255
4 [PE1-ospf-1-area-0.0.0.0]network 10.0.1.1 0.0.0.0
5 [PE1-ospf-1-area-0.0.0.0]q
6 [PE1-ospf-1]q
7 [PE1]

```

PE2

```

1 [PE2]ospf router-id 10.0.4.4
2 [PE2-ospf-1]area 0
3 [PE2-ospf-1-area-0.0.0.0]network 118.16.16.0 0.0.0.255
4 [PE2-ospf-1-area-0.0.0.0]network 10.0.4.4 0.0.0.0
5 [PE2-ospf-1-area-0.0.0.0]q
6 [PE2-ospf-1]q
7 [PE2]

```

P1

```

1 [p1]ospf router-id 10.0.2.2
2 [p1-ospf-1]area 0
3 [p1-ospf-1-area-0.0.0.0]network 116.64.64.0 0.0.0.255
4 [p1-ospf-1-area-0.0.0.0]network 117.32.32.0 0.0.0.255
5 [p1-ospf-1-area-0.0.0.0]network 10.0.2.2 0.0.0.0
6 [p1-ospf-1-area-0.0.0.0]q
7 [p1-ospf-1]q
8 [p1]

```

```

1 [P2]ospf router-id 10.0.3.3
2 [P2-ospf-1]area 0
3 [P2-ospf-1-area-0.0.0.0]network 117.32.32.0 0.0.0.255
4 [P2-ospf-1-area-0.0.0.0]network 118.16.16.0 0.0.0.255
5 [P2-ospf-1-area-0.0.0.0]network 10.0.3.3 0.0.0.0
6 [P2-ospf-1-area-0.0.0.0]q
7 [P2-ospf-1]q
8 [P2]

```

OSPF路由配置完成后，在路由器P1和P2查看邻居关系

P1

```

[pl]disp ospf peer brief

      OSPF Process 1 with Router ID 10.0.2.2
      Peer Statistic Information
-----
Area Id          Interface                Neighbor id      State
0.0.0.0          GigabitEthernet0/0/0        10.0.1.1        Full
0.0.0.0          GigabitEthernet0/0/1        10.0.3.3        Full
-----

```

P2

```

[P2]disp ospf peer brief

      OSPF Process 1 with Router ID 10.0.3.3
      Peer Statistic Information
-----
Area Id          Interface                Neighbor id      State
0.0.0.0          GigabitEthernet0/0/1        10.0.2.2        Full
0.0.0.0          GigabitEthernet0/0/0        10.0.4.4        Full
-----

```

测试PE1的连通性

```

[PE1]ping -a 10.0.1.1 10.0.4.4
PING 10.0.4.4: 56 data bytes, press CTRL_C to break
Reply from 10.0.4.4: bytes=56 Sequence=1 ttl=253 time=50 ms
Reply from 10.0.4.4: bytes=56 Sequence=2 ttl=253 time=50 ms
Reply from 10.0.4.4: bytes=56 Sequence=3 ttl=253 time=30 ms
Reply from 10.0.4.4: bytes=56 Sequence=4 ttl=253 time=40 ms
Reply from 10.0.4.4: bytes=56 Sequence=5 ttl=253 time=30 ms

--- 10.0.4.4 ping statistics ---
 5 packet(s) transmitted
 5 packet(s) received
 0.00% packet loss
round-trip min/avg/max = 30/40/50 ms

```

配置PE1与PE2之间MP-BGP邻居关系

PE1与PE2通过Loopback0虚拟接口建立IBGP邻居关系

```

1 [PE1]bgp 500
2 [PE1-bgp]peer 10.0.4.4 as-number 500
3 [PE1-bgp]peer 10.0.4.4 connect-interface loopback 0
4 [PE1-bgp]

```

```

1 [PE2]bgp 500
2 [PE2-bgp]peer 10.0.1.1 as-number 500
3 [PE2-bgp]peer 10.0.1.1 conn
4 [PE2-bgp]peer 10.0.1.1 connect-interface loopback 0
5 [PE2-bgp]

```

在AR1上查看BGP邻居关系

```

1 [PE1-bgp]disp bgp peer
2
3 BGP local router ID : 201.201.201.1
4 Local AS number : 500
5 Total number of peers : 1      Peers in established state : 1
6
7 Peer          V          AS  MsgRcvd  MsgSent  OutQ  Up/Down      State
8 10.0.4.4      4          500      3         5       0  00:01:14
   Established      0

```

在PE1与PE2启用IPv4-Family子族VPNv4地址族，允许PE1与PE2之间交换VPNv4路由信息

```

1 [PE1-bgp]ipv4
2 [PE1-bgp]ipv4-family vpnv4
3 [PE1-bgp-af-vpnv4]peer 10.0.4.4 en
4 [PE1-bgp-af-vpnv4]peer 10.0.4.4 advertise-community
5 [PE1-bgp-af-vpnv4]q
6 [PE1-bgp]q
7 [PE1]

```

```

1 [PE2-bgp]ipv4-family vpnv4
2 [PE2-bgp-af-vpnv4]peer 10.0.1.1 en
3 [PE2-bgp-af-vpnv4]peer 10.0.1.1 advertise-community
4 [PE2-bgp-af-vpnv4]q
5 [PE2-bgp]q
6 [PE2]

```

在处于LSP路径上的四个路由器上启用LDP标签自动分发协议

PE1

```

1 [PE1]mpls lsr-id 10.0.1.1
2 [PE1]mpls
3 Info: Mpls starting, please wait... OK!
4 [PE1-mpls]mpls ldp
5 [PE1-mpls-ldp]q
6 [PE1]int g0/0/0
7 [PE1-GigabitEthernet0/0/0]mpls
8 [PE1-GigabitEthernet0/0/0]mpls ldp
9 [PE1-GigabitEthernet0/0/0]q
10 [PE1]

```

PE2

```
1 [PE2]mpls lsr-id 10.0.4.4
2 [PE2]mpls
3 Info: Mpls starting, please wait... OK!
4 [PE2-mpls]mpls ldp
5 [PE2-mpls-ldp]q
6 [PE2]int g0/0/0
7 [PE2-GigabitEthernet0/0/0]mpls
8 [PE2-GigabitEthernet0/0/0]mpls ldp
9 [PE2-GigabitEthernet0/0/0]q
10 [PE2]
```

P1

```
1 [p1]mpls lsr-id 10.0.2.2
2 [p1]mpls
3 Info: Mpls starting, please wait... OK!
4 [p1-mpls]mpls ldp
5 [p1-mpls-ldp]q
6 [p1]int g0/0/0
7 [p1-GigabitEthernet0/0/0]mpls
8 [p1-GigabitEthernet0/0/0]mpls ldp
9 [p1-GigabitEthernet0/0/0]q
10 [p1]int g0/0/1
11 [p1-GigabitEthernet0/0/1]mpls
12 [p1-GigabitEthernet0/0/1]mpls ldp
13 [p1-GigabitEthernet0/0/1]q
14 [p1]
```

P2

```
1 [P2]mpls lsr-id 10.0.3.3
2 [P2]mpls
3 Info: Mpls starting, please wait... OK!
4 [P2-mpls]mpls ldp
5 [P2-mpls-ldp]q
6 [P2]int g0/0/0
7 [P2-GigabitEthernet0/0/0]mpls
8 [P2-GigabitEthernet0/0/0]mpls ldp
9 [P2-GigabitEthernet0/0/0]q
10 [P2]int g0/0/1
11 [P2-GigabitEthernet0/0/1]mpls
12 [P2-GigabitEthernet0/0/1]mpls ldp
13 [P2-GigabitEthernet0/0/1]q
14 [P2]
```

验证LSP路径上四个路由器LDP会话状态

P1

```
[pl]disp mpls ldp session

LDP Session(s) in Public Network
Codes: LAM(Label Advertisement Mode), SsnAge Unit(DDDD:HH:MM)
A '*' before a session means the session is being deleted.
-----
PeerID           Status      LAM  SsnRole  SsnAge      KASent/Rcv
-----
10.0.1.1:0       Operational DU    Active  0000:00:06  27/27
10.0.3.3:0       Operational DU    Passive 0000:00:04  19/18
-----
TOTAL: 2 session(s) Found.
```

P2

image-20231113112229504

查看MPLS标签转发表和标签交换路径

在PE1查看MPLS标签转发表

```
[PE1]tracert lsp ip 10.0.4.4 32
LSP Trace Route FEC: IPV4 PREFIX 10.0.4.4/32 , press CTRL_C to break.
TTL   Replier           Time    Type      Downstream
0      116.64.64.2          10 ms   Transit   116.64.64.2/[1026 ]
1      117.32.32.2          20 ms   Transit   117.32.32.2/[1026 ]
2      118.16.16.2          30 ms   Transit   118.16.16.2/[3 ]
3      10.0.4.4             30 ms   Egress
```

在PE2查看MPLS标签转发表

```
[PE2]tracert lsp ip 10.0.1.1 32
LSP Trace Route FEC: IPV4 PREFIX 10.0.1.1/32 , press CTRL_C to break.
TTL   Replier           Time    Type      Downstream
0      118.16.16.1          10 ms   Transit   118.16.16.1/[1024 ]
1      117.32.32.1          30 ms   Transit   117.32.32.1/[1024 ]
2      116.64.64.1          30 ms   Transit   116.64.64.1/[3 ]
3      10.0.1.1             30 ms   Egress
```

在P1查看完整标签交换路径LSP表


```
[pl]disp mpls ldp lsp
```

LDP LSP Information				
DestAddress/Mask	In/OutLabel	UpstreamPeer	NextHop	OutInterface
10.0.1.1/32	NULL/3	-	116.64.64.1	GE0/0/0
10.0.1.1/32	1024/3	10.0.1.1	116.64.64.1	GE0/0/0
10.0.1.1/32	1024/3	10.0.3.3	116.64.64.1	GE0/0/0
*10.0.1.1/32	Liberal/1024		DS/10.0.3.3	
10.0.2.2/32	3/NULL	10.0.1.1	127.0.0.1	InLoop0
10.0.2.2/32	3/NULL	10.0.3.3	127.0.0.1	InLoop0
*10.0.2.2/32	Liberal/1024		DS/10.0.1.1	
*10.0.2.2/32	Liberal/1025		DS/10.0.3.3	
10.0.3.3/32	NULL/3	-	117.32.32.2	GE0/0/1
10.0.3.3/32	1025/3	10.0.1.1	117.32.32.2	GE0/0/1
10.0.3.3/32	1025/3	10.0.3.3	117.32.32.2	GE0/0/1
*10.0.3.3/32	Liberal/1025		DS/10.0.1.1	
10.0.4.4/32	NULL/1026	-	117.32.32.2	GE0/0/1
10.0.4.4/32	1026/1026	10.0.1.1	117.32.32.2	GE0/0/1
10.0.4.4/32	1026/1026	10.0.3.3	117.32.32.2	GE0/0/1
*10.0.4.4/32	Liberal/1026		DS/10.0.1.1	

```

TOTAL: 11 Normal LSP(s) Found.
TOTAL: 5 Liberal LSP(s) Found.
TOTAL: 0 Frr LSP(s) Found.
A '*' before an LSP means the LSP is not established
A '*' before a Label means the USCB or DSCB is stale
A '*' before a UpstreamPeer means the session is stale
A '*' before a DS means the session is stale
A '*' before a NextHop means the LSP is FRR LSP

```

在路由器PE1创建A公司VPN实例，并与接口绑定

```

1 [PE1]ip vpn-instance vpn_company_A
2 [PE1-vpn-instance-vpn_company_A]ipv4-family
3 [PE1-vpn-instance-vpn_company_A-af-ipv4]route-distinguisher 100:1
4 [PE1-vpn-instance-vpn_company_A-af-ipv4]vpn-target 20:1 export-extcommunity
5   EVT Assignment result:
6 Info: VPN-Target assignment is successful.
7 [PE1-vpn-instance-vpn_company_A-af-ipv4]vpn-target 20:1 import-extcommunity
8   IVT Assignment result:
9 Info: VPN-Target assignment is successful.
10
11
12 [PE1-vpn-instance-vpn_company_A-af-ipv4]q
13 [PE1-vpn-instance-vpn_company_A]q
14 [PE1]int g0/0/1
15 [PE1-GigabitEthernet0/0/1]ip binding vpn-instance vpn_company_A
16 Info: All IPv4 related configurations on this interface are removed!
17 Info: All IPv6 related configurations on this interface are removed!
18 [PE1-GigabitEthernet0/0/1]ip add 201.201.201.1 24
19 [PE1-GigabitEthernet0/0/1]q
20
21
22 [PE1]ping -vpn-instance vpn_company_A 201.201.201.2
23   PING 201.201.201.2: 56 data bytes, press CTRL_C to break
24     Reply from 201.201.201.2: bytes=56 Sequence=1 ttl=255 time=60 ms
25     Reply from 201.201.201.2: bytes=56 Sequence=2 ttl=255 time=20 ms
26     Reply from 201.201.201.2: bytes=56 Sequence=3 ttl=255 time=20 ms
27     Reply from 201.201.201.2: bytes=56 Sequence=4 ttl=255 time=30 ms

```

```
28      Reply from 201.201.201.2: bytes=56 Sequence=5 ttl=255 time=20 ms
29
30      --- 201.201.201.2 ping statistics ---
31          5 packet(s) transmitted
32          5 packet(s) received
33          0.00% packet loss
34          round-trip min/avg/max = 20/30/60 ms
```

在PE1上创建B公司VPN实例并与接口绑定

```
1  [PE1]ip vpn-instance vpn_company_B
2  [PE1-vpn-instance-vpn_company_B]ipv4-family
3  [PE1-vpn-instance-vpn_company_B-af-ipv4]route-distinguisher 300:1
4  [PE1-vpn-instance-vpn_company_B-af-ipv4]vpn-target 20:2 both
5  IVT Assignment result:
6  Info: VPN-Target assignment is successful.
7  EVT Assignment result:
8  Info: VPN-Target assignment is successful.
9  [PE1-vpn-instance-vpn_company_B-af-ipv4]q
10 [PE1-vpn-instance-vpn_company_B]q
11 [PE1]int g2/0/0
12 [PE1-GigabitEthernet2/0/0]ip binding vpn-instance vpn_company_B
13 Info: All IPV4 related configurations on this interface are removed!
14 Info: All IPV6 related configurations on this interface are removed!
15 [PE1-GigabitEthernet2/0/0]ip add 203.203.203.1 24
16 [PE1-GigabitEthernet2/0/0]q
17 [PE1]
```

在PE2上创建A公司VPN实例并与接口绑定

```
1  [PE2]ip vpn-instance vpn_company_A
2  [PE2-vpn-instance-vpn_company_A]ipv4-family
3  [PE2-vpn-instance-vpn_company_A-af-ipv4]route-distinguisher 200:1
4  [PE2-vpn-instance-vpn_company_A-af-ipv4]vpn-target 20:1 both
5  IVT Assignment result:
6  Info: VPN-Target assignment is successful.
7  EVT Assignment result:
8  Info: VPN-Target assignment is successful.
9  [PE2-vpn-instance-vpn_company_A-af-ipv4]q
10 [PE2-vpn-instance-vpn_company_A]q
11 [PE2]int g0/0/1
12 [PE2-GigabitEthernet0/0/1]ip binding vpn-instance vpn_company_A
13 Info: All IPV4 related configurations on this interface are removed!
14 Info: All IPV6 related configurations on this interface are removed!
15 [PE2-GigabitEthernet0/0/1]ip add 202.202.202.1 24
16 [PE2-GigabitEthernet0/0/1]q
17 [PE2]
```

在PE2上创建B公司VPN实例并与接口进行绑定

```
1 [PE2]ip vpn-instance vpn_company_B
2 [PE2-vpn-instance-vpn_company_B]ipv4-family
3 [PE2-vpn-instance-vpn_company_B-af-ipv4]route-distinguisher 400:1
4 [PE2-vpn-instance-vpn_company_B-af-ipv4]vpn-target 20:2 both
5   IVT Assignment result:
6 Info: VPN-Target assignment is successful.
7   EVT Assignment result:
8 Info: VPN-Target assignment is successful.
9 [PE2-vpn-instance-vpn_company_B-af-ipv4]q
10 [PE2-vpn-instance-vpn_company_B]q
11 [PE2]int g2/0/0
12 [PE2-GigabitEthernet2/0/0]ip binding vpn-instance vpn_company_B
13 Info: All IPV4 related configurations on this interface are removed!
14 Info: All IPV6 related configurations on this interface are removed!
15 [PE2-GigabitEthernet2/0/0]ip add 204.204.204.1 24
16 [PE2-GigabitEthernet2/0/0]q
17 [PE2]
```

CE1与PE1,CE2与PE2建立BGP邻居并通告公司A私网路由

CE1与PE1建立EBGP邻居关系

```
1 [CE1]bgp 100
2 [CE1-bgp]peer 201.201.201.1 as-number 500
3 [CE1-bgp]network 192.168.1.0
```

```
1 [PE1]bgp 500
2 [PE1-bgp]ipv4-family vpn-ins
3 [PE1-bgp]ipv4-family vpn-instance vpn_company_A
4 [PE1-bgp-vpn_company_A]peer 201.201.201.2 as-number 100
5 [PE1-bgp-vpn_company_A]
```

```
1 [CE1-bgp]disp bgp peer
2
3   BGP local router ID : 192.168.1.1
4   Local AS number : 100
5   Total number of peers : 1           Peers in established state : 1
6
7   Peer                V           AS   MsgRcvd  MsgSent  OutQ   Up/Down      State
8   201.201.201.1      4           500      2         5       0   00:00:07
9   Established        0
10
11 [CE1-bgp]
12 [PE1]disp bgp peer
13
14   BGP local router ID : 201.201.201.1
15   Local AS number : 500
16   Total number of peers : 1           Peers in established state : 1
17
```

```

18 Peer                V                AS  MsgRcvd  MsgSent  OutQ  Up/Down          State
    Pre fRcv
19 10.0.4.4            4                500      47       49     0   00:43:15
    Established        0
20 [PE1]
21
22
23 [PE1]disp bgp vpnv4 vpn-instance vpn_company_A peer
24
25 BGP local router ID : 201.201.201.1
26 Local AS number : 500
27
28 VPN-Instance vpn_company_A, Router ID 201.201.201.1:
29 Total number of peers : 1          Peers in established state : 1
30
31 Peer                V                AS  MsgRcvd  MsgSent  OutQ  Up/Down          State
    Pre fRcv
32 201.201.201.2       4                100       4        3     0   00:01:56
    Established        1
33 [PE1]

```

CE2与PE2建立EBGP邻居关系

```

1 [CE2]bgp 200
2 [CE2-bgp]peer 202.202.202.1 as-number 500
3 [CE2-bgp]network 192.168.2.0
4 [CE2-bgp]

```

```

1 [PE2]bgp 500
2 [PE2-bgp]ipv4-family vpn-instance vpn_company_A
3 [PE2-bgp-vpn_company_A]peer 202.202.202.2 as-number 200
4 [PE2-bgp-vpn_company_A]

```

```

1 [PE1]disp bgp vpnv4 vpn-instance vpn_company_A routing-table
2
3 BGP Local router ID is 201.201.201.1
4 Status codes: * - valid, > - best, d - damped,
5               h - history, i - internal, s - suppressed, S - Stale
6               Origin : i - IGP, e - EGP, ? - incomplete
7
8
9 VPN-Instance vpn_company_A, Router ID 201.201.201.1:
10
11 Total Number of Routes: 2
12      Network                NextHop          MED           LocPrf        PrefVal Path/Ogn
13
14 *> 192.168.1.0              201.201.201.2    0                0             100i
15 *>i 192.168.2.0              10.0.4.4         0               100            0             200i
16 [PE1]
17
18
19 [PE2]disp bgp vpnv4 vpn-instance vpn_company_A routing-table
20
21 BGP Local router ID is 202.202.202.1

```

```

22 Status codes: * - valid, > - best, d - damped,
23               h - history, i - internal, s - suppressed, S - Stale
24               Origin : i - IGP, e - EGP, ? - incomplete
25
26
27 VPN-Instance vpn_company_A, Router ID 202.202.202.1:
28
29 Total Number of Routes: 2
30
31      Network          NextHop          MED          LocPrf      PrefVal Path/Ogn
32
33 *>i 192.168.1.0        10.0.1.1          0           100         0       100i
34 *> 192.168.2.0        202.202.202.2    0           0           0       200i
35 [PE2]

```

相互通告私网络后 在PE1和PE2查看公司A基于MPLS VPN完整标注路径

```

[PE1]disp mpls lsp
-----
LSP Information: BGP LSP
-----
FEC          In/Out Label  In/Out IF          Vrf Name
-----
192.168.1.0/24  1027/NULL    -/-                vpn_company_A
-----
LSP Information: LDP LSP
-----
FEC          In/Out Label  In/Out IF          Vrf Name
-----
10.0.2.2/32   NULL/3        -/GE0/0/0
10.0.2.2/32   1024/3        -/GE0/0/0
10.0.1.1/32   3/NULL        -/-
10.0.3.3/32   NULL/1025     -/GE0/0/0
10.0.3.3/32   1025/1025     -/GE0/0/0
10.0.4.4/32   NULL/1026     -/GE0/0/0
10.0.4.4/32   1026/1026     -/GE0/0/0

```

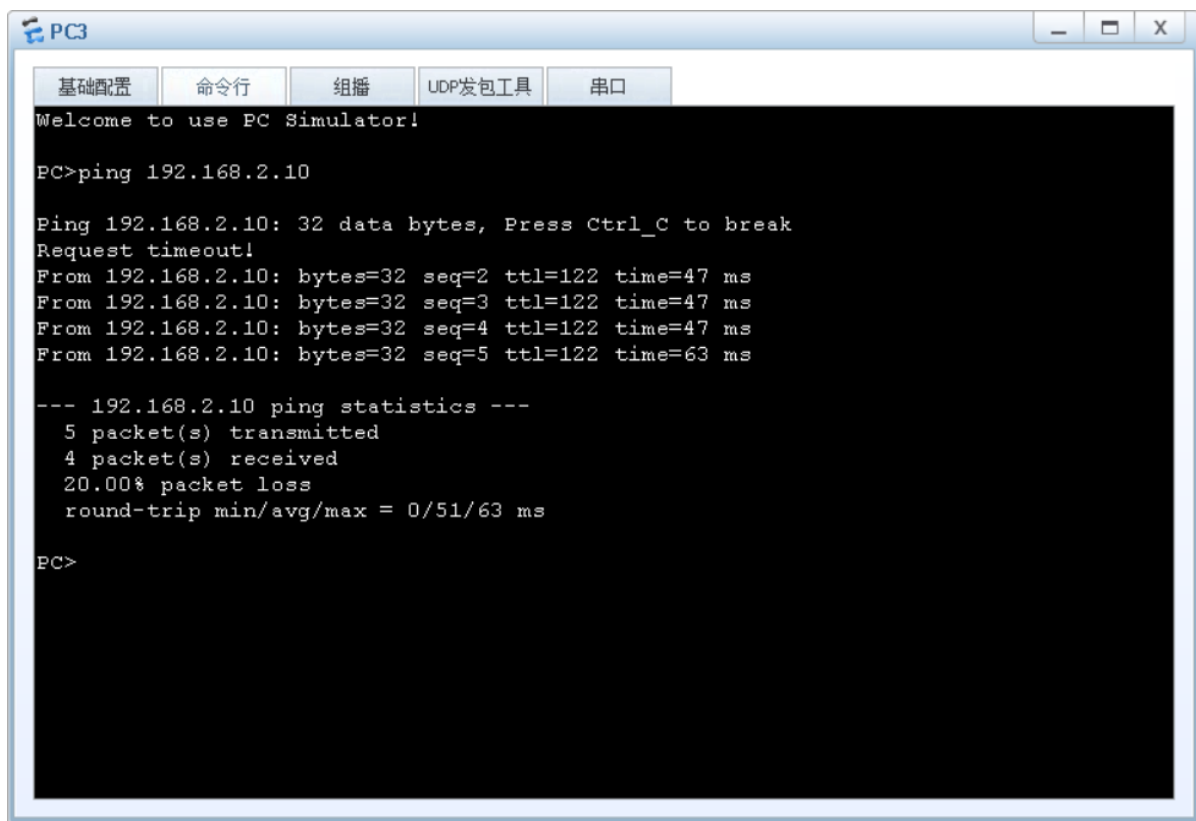
```

[PE2]disp mpls lsp
-----
LSP Information: BGP LSP
-----
FEC          In/Out Label  In/Out IF          Vrf Name
-----
192.168.2.0/24  1027/NULL    -/-                vpn_company_A
-----
LSP Information: LDP LSP
-----
FEC          In/Out Label  In/Out IF          Vrf Name
-----
10.0.1.1/32   NULL/1024     -/GE0/0/0
10.0.1.1/32   1024/1024     -/GE0/0/0
10.0.2.2/32   NULL/1025     -/GE0/0/0
10.0.2.2/32   1025/1025     -/GE0/0/0
10.0.3.3/32   NULL/3        -/GE0/0/0
10.0.3.3/32   1026/3        -/GE0/0/0
10.0.4.4/32   3/NULL        -/-

```

任务验证

在主机1命令行输入ping 192.168.2.10 可以连通服务器1



CE3与PE1，CE4与PE2建立BGP邻居并通告公司B私网路由

CE3与PE1建立EBGP

```

1 [CE3]bgp 300
2 [CE3-bgp]peer 203.203.203.1 as-number 500
3 [CE3-bgp]network 192.168.1.0

```

```

1 [PE1]bgp 500
2 [PE1-bgp]ipv4-family vpn-instance vpn_company_B
3 [PE1-bgp-vpn_company_B]peer 203.203.203.2 as-number 300
4 [PE1-bgp-vpn_company_B]

```

CE4与PE2建立EBGP邻居关系

```

1 [CE4]bgp 400
2 [CE4-bgp]peer 204.204.204.1 as-number 500
3 [CE4-bgp]network 192.168.2.0
4 [CE4-bgp]

```

```

1 [PE2]bgp 500
2 [PE2-bgp]ipv4-family vpn-instance vpn_company_B
3 [PE2-bgp-vpn_company_B]peer 204.204.204.2 as-number 400
4 [PE2-bgp-vpn_company_B]

```

在PE1和PE2查看vpn_company_B实例的VPNv4路由表

```

1 [PE1]disp bgp vpnv4 vpn-instance vpn_company_B routing-table
2
3 BGP Local router ID is 116.64.64.1

```

```

4 Status codes: * - valid, > - best, d - damped,
5               h - history, i - internal, s - suppressed, S - Stale
6               Origin : i - IGP, e - EGP, ? - incomplete
7
8
9 VPN-Instance vpn_company_B, Router ID 116.64.64.1:
10
11 Total Number of Routes: 2
12
13      Network          NextHop          MED          LocPrf      PrefVal Path/Ogn
14 *> 192.168.1.0        203.203.203.2    0              0           300i
15 *>i 192.168.2.0        10.0.4.4         0             100          0         400i
16 [PE1]

```

```

1 [PE2]disp bgp vpnv4 vpn-instance vpn_company_B routing-table
2
3 BGP Local router ID is 118.16.16.2
4 Status codes: * - valid, > - best, d - damped,
5               h - history, i - internal, s - suppressed, S - Stale
6               Origin : i - IGP, e - EGP, ? - incomplete
7
8
9 VPN-Instance vpn_company_B, Router ID 118.16.16.2:
10
11 Total Number of Routes: 2
12
13      Network          NextHop          MED          LocPrf      PrefVal Path/Ogn
14 *>i 192.168.1.0        10.0.1.1         0             100          0         300i
15 *> 192.168.2.0        204.204.204.2    0              0           400i
16 [PE2]

```

相互通告私网路由后，在PE1和PE2查看公司B基于MPLS VPN完整标签路径

```

[PE1]disp mpls lsp
-----
LSP Information: BGP LSP
-----
FEC          In/Out Label  In/Out IF          Vrf Name
-----
192.168.1.0/24  1027/NULL    -/-                vpn_company_A
192.168.1.0/24  1028/NULL    -/-                vpn_company_B
-----

LSP Information: LDP LSP
-----
FEC          In/Out Label  In/Out IF          Vrf Name
-----
10.0.2.2/32   NULL/3        -/GEO/0/0
10.0.2.2/32   1024/3        -/GEO/0/0
10.0.1.1/32   3/NULL        -/-
10.0.3.3/32   NULL/1025     -/GEO/0/0
10.0.3.3/32   1025/1025     -/GEO/0/0
10.0.4.4/32   NULL/1026     -/GEO/0/0
10.0.4.4/32   1026/1026     -/GEO/0/0

```

```
[PE2]disp mpls lsp
```

LSP Information: BGP LSP			
FEC	In/Out Label	In/Out IF	Vrf Name
192.168.2.0/24	1027/NULL	-/-	vpn_company_A
192.168.2.0/24	1028/NULL	-/-	vpn_company_B

LSP Information: LDP LSP			
FEC	In/Out Label	In/Out IF	Vrf Name
10.0.3.3/32	NULL/3	-/GEO/0/0	
10.0.3.3/32	1024/3	-/GEO/0/0	
10.0.4.4/32	3/NULL	-/-	
10.0.1.1/32	NULL/1025	-/GEO/0/0	
10.0.1.1/32	1025/1025	-/GEO/0/0	
10.0.2.2/32	NULL/1026	-/GEO/0/0	
10.0.2.2/32	1026/1026	-/GEO/0/0	

任务验证

在主机2命令行输入命令ping 192.168.2.20,可以连通服务器2

```

PC2
基础配置 命令行 组播 UDP发包工具 串口
Welcome to use PC Simulator!

PC>ping 192.168.2.20

Ping 192.168.2.20: 32 data bytes, Press Ctrl_C to break
Request timeout!
From 192.168.2.20: bytes=32 seq=2 ttl=249 time=46 ms
From 192.168.2.20: bytes=32 seq=3 ttl=249 time=47 ms
From 192.168.2.20: bytes=32 seq=4 ttl=249 time=47 ms
From 192.168.2.20: bytes=32 seq=5 ttl=249 time=47 ms

--- 192.168.2.20 ping statistics ---
 5 packet(s) transmitted
 4 packet(s) received
20.00% packet loss
round-trip min/avg/max = 0/46/47 ms

PC>
  
```

在主机2命令行输入命令ping 192.168.2.10, 不可以连通服务器1


```
PC2
基础配置 命令行 组播 UDP发包工具 串口
From 192.168.2.20: bytes=32 seq=2 ttl=249 time=46 ms
From 192.168.2.20: bytes=32 seq=3 ttl=249 time=47 ms
From 192.168.2.20: bytes=32 seq=4 ttl=249 time=47 ms
From 192.168.2.20: bytes=32 seq=5 ttl=249 time=47 ms

--- 192.168.2.20 ping statistics ---
 5 packet(s) transmitted
 4 packet(s) received
20.00% packet loss
round-trip min/avg/max = 0/46/47 ms

PC>ping 192.168.2.10

Ping 192.168.2.10: 32 data bytes, Press Ctrl_C to break
Request timeout!
Request timeout!
Request timeout!
Request timeout!
Request timeout!

--- 192.168.2.10 ping statistics ---
 5 packet(s) transmitted
 0 packet(s) received
100.00% packet loss

PC>
```

防范策略

- 1.可在服务器上部署IIS(Internet Information Services,互联网信息服务)时选择https协议, 通过SSL证书对Web站点数据加密
- 2.MPLS属于2.5层VPN, 不能使用IPSec(第三层协议)保护MPLS报文安全性,即不可能有MPLS Over IPSec技术。
- 3.路由器只能保证数据包的完整性和来源的可靠性,不对其内部具体数据负责,也不负责弥补非路由器转发导致的安全漏洞

任务总结

- 1.对于所有企业而言, 一般认为数据包在自身内网中传输是安全的, 而在公网中传输是不安全的。MPLS优点是转发效率高, 低延迟, 但缺少安全协议, 难以保证MPLS报文在公网中传输的安全性
- 2.IPSec(Internet Protocol Security,互联网安全协议)属于第三层协议, 通过重新封装IP头部字段并实施加密以实现数据包在公网中传输的安全性。但MPLS属于2.5层隧道, 路由器不会拆封MPLS报文的IP头部字段并查询IP路由表转发(MPLS报文IP头部目的地址为私网IP, 即使拆封也无法在公网中投递),而是采用类似二层交换机的方式对MPLS报文标签查询转发,因此不能通过IPSec协议保证其在公网投递的安全性。