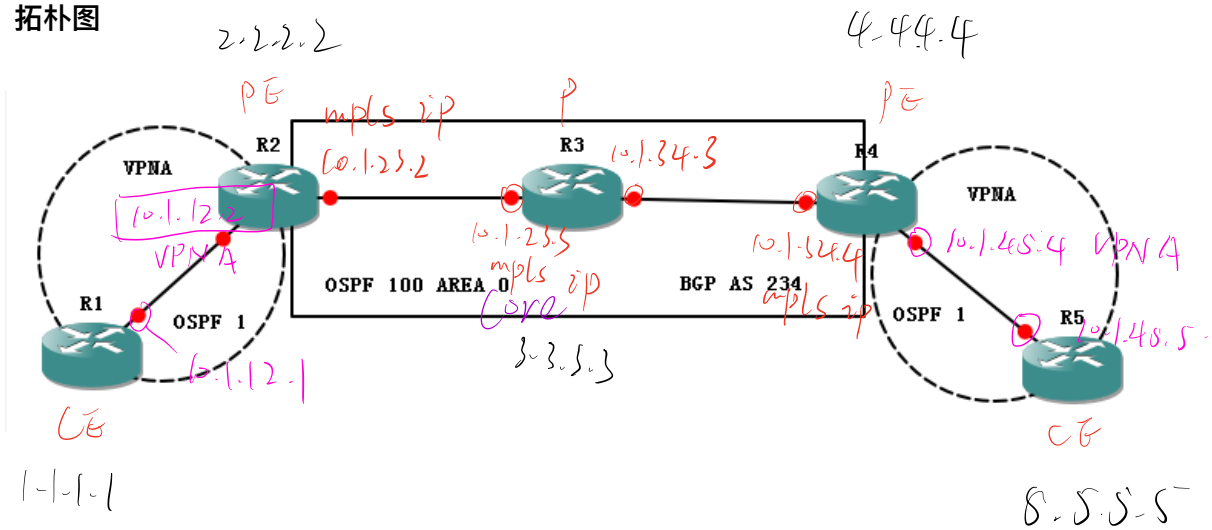


MPLS VPN 实验

一、拓扑图



说明:

- 1、设备接互联地址：如R1与R2间的互联地址为10.1.12.0/24；LOOKBACK接口地址为：1.1.1.1/32；
- 2、CORE内运行OSPF（进行号100,area 0），激活MPLS；
- 3、PE上创建VRF（VPNA），PE与CE间通过OSPF互联（进程号：1）；
- 4、R2与R4两台PE间建立MP-IBGP邻接关系，（BGP AS234）
- 5、完成PE-CE间的路由重发布；

二、配置信息:

R1: (CE1)

```
R1#show run
!
hostname R1
!
ip cef
!
```

```
interface Loopback0
ip address 1.1.1.1 255.255.255.255
ip ospf network point-to-point
!
interface FastEthernet0/0
ip address 10.1.12.1 255.255.255.0
duplex auto
speed auto
mpls ip
!
interface FastEthernet0/1
no ip address
shutdown
duplex auto
speed auto
!
router ospf 1
router-id 1.1.1.1
log-adjacency-changes
network 1.1.1.1 0.0.0.0 area 0
network 10.1.12.1 0.0.0.0 area 0
!
!
end
```

R1#



session-192.168.197.1 2001-20170116.log

R2: (PE1)

```
R2#
R2#show run
!
hostname R2
!
ip cef
!
```

```
ip vrf vpna
rd 1:1
route- target export 234:2
route- target import 234:4
!
mpls label range 200 299
mpls ldp router- id Loopback0
!
!
interface Loopback0
ip address 2.2.2.2 255.255.255.255
!
interface FastEthernet0/0
ip vrf forwarding vpna
ip address 10.1.12.2 255.255.255.0
duplex auto
speed auto
!
interface FastEthernet0/1
ip address 10.1.23.2 255.255.255.0
duplex auto
speed auto
mpls ip
!
router ospf 1 vrf vpna
log- adjacency- changes
redistribute bgp 234 subnets
network 10.1.12.2 0.0.0.0 area 0
!
router ospf 100
router- id 2.2.2.2
log- adjacency- changes
network 2.2.2.2 0.0.0.0 area 0
network 10.1.23.2 0.0.0.0 area 0
!
router bgp 234
bgp router- id 2.2.2.2
no bgp default ipv4- unicast
bgp log- neighbor- changes
neighbor 4.4.4.4 remote- as 234
neighbor 4.4.4.4 update- source Loopback0
!
address- family vpnv4
```

```
neighbor 4.4.4.4 activate
neighbor 4.4.4.4 send- community extended
exit- address- family
!
address- family ipv4 vrf vpna
redistribute ospf 1 vrf vpna match internal external 1 external 2
no auto- summary
no synchronization
exit- address- family
!
!
end
```

R2#



session-192.168.197.1 2002-20170116.log

R3: (P)

```
R3#
R3#show run
!
hostname R3
!
ip cef
!
mpls label range 300 399
mpls ldp router- id Loopback0
!
!
interface Loopback0
ip address 3.3.3.3 255.255.255.255
!
interface FastEthernet0/0
ip address 10.1.23.3 255.255.255.0
duplex auto
speed auto
mpls ip
!
```

```
interface FastEthernet0/1
ip address 10.1.34.3 255.255.255.0
duplex auto
speed auto
mpls ip
!
router ospf 100
router-id 3.3.3.3
log-adjacency-changes
network 3.3.3.3 0.0.0.0 area 0
network 10.1.23.3 0.0.0.0 area 0
network 10.1.34.3 0.0.0.0 area 0
!
!
end
```

R3#



session-192.168.197.1 2003-20170116.log

R4: (PE2)

```
R4#
R4#show run
Building configuration...
!
hostname R4
!
ip cef
!
ip vrf vpna
rd 1:1
route-target export 234:4
route-target import 234:2
!
mpls label range 400 499
mpls ldp router-id Loopback0
!
!
interface Loopback0
ip address 4.4.4.4 255.255.255.255
!
interface FastEthernet0/0
```

```
ip address 10.1.34.4 255.255.255.0
duplex auto
speed auto
mpls ip
!
interface FastEthernet0/1
ip vrf forwarding vpna
ip address 10.1.45.4 255.255.255.0
duplex auto
speed auto
!
router ospf 1 vrf vpna
log-adjacency-changes
redistribute bgp 234 subnets
network 10.1.45.4 0.0.0.0 area 0
!
router ospf 100
router-id 4.4.4.4
log-adjacency-changes
network 4.4.4.4 0.0.0.0 area 0
network 10.1.34.4 0.0.0.0 area 0
!
router bgp 234
bgp router-id 4.4.4.4
no bgp default ipv4-unicast
bgp log-neighbor-changes
neighbor 2.2.2.2 remote-as 234
neighbor 2.2.2.2 update-source Loopback0
!
address-family vpnv4
neighbor 2.2.2.2 activate
neighbor 2.2.2.2 send-community extended
exit-address-family
!
address-family ipv4 vrf vpna
redistribute ospf 1 vrf vpna match internal external 1 external 2
no auto-summary
no synchronization
exit-address-family
!
end
```



session-192.168.197.1 2004-20170116.log

R5: (CE2)

```
R5#
R5#show run
Building configuration...
!
hostname R5
!
ip cef
!
interface Loopback0
 ip address 5.5.5.5 255.255.255.0
 ip ospf network point- to- point
!
interface FastEthernet0/0
 ip address 10.1.45.5 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
router ospf 1
 router- id 5.5.5.5
 log- adjacency- changes
 network 5.5.5.5 0.0.0.0 area 0
 network 10.1.45.5 0.0.0.0 area 0
!
end
```

R5#



session-192.168.197.1 2005-20170116.log

三、相关检查命令：

1、R2#sh ip ospf neighbor //查PE的OSPF邻居

R2#sh ip ospf neighbor //查PE的OSPF邻居

Neighbor ID	Pri	State	Dead Time	Address	Interface
3.3.3.3	1	FULL/DR	00:00:30	10.1.23.3	FastEthernet0/1
1.1.1.1	1	FULL/BDR	00:00:30	10.1.12.1	FastEthernet0/0

2、R2#sh mpls ldp neighbor //查PE上的MPLS邻居信息

R2#sh mpls ldp neighbor //查PE上的MPLS邻居信息

Peer LDP Ident: 3.3.3.3:0; Local LDP Ident 2.2.2.2:0

TCP connection: 3.3.3.3.19951 - 2.2.2.2.646

State: Oper; Msgs sent/rcvd: 11/11; Downstream

Up time: 00:03:23

LDP discovery sources:

FastEthernet0/1, Src IP addr: 10.1.23.3

Addresses bound to peer LDP Ident:

10.1.23.3	3.3.3.3	10.1.34.3
-----------	---------	-----------

3、R2#sh mpls forwarding- table //查PE上的MPLS标签转发表

R2#sh mpls forwarding- table //查PE上的MPLS标签转发表

Local tag	Outgoing tag or VC	Prefix or Tunnel Id	Bytes tag switched	Outgoing interface	Next Hop
200	Pop tag	10.1.34.0/24	0	Fa0/1	10.1.23.3
201	Pop tag	3.3.3.3/32	0	Fa0/1	10.1.23.3
202	300	4.4.4.4/32	0	Fa0/1	10.1.23.3
203	Untagged	1.1.1.1/32[V]	3138	Fa0/0	10.1.12.1
204	Aggregate	10.1.12.0/24[V]	0		

R2#

4、R2#sh ip bgp vpnv4 all summary // 查PE上的VPNV4邻居信息

```
R2#sh ip bgp vpnv4 all summary // 查PE上的VPNV4邻居信息:
BGP router identifier 2.2.2.2, local AS number 234
BGP table version is 9, main routing table version 9
4 network entries using 548 bytes of memory
4 path entries using 272 bytes of memory
5/4 BGP path/bestpath attribute entries using 620 bytes of memory
2 BGP extended community entries using 80 bytes of memory
0 BGP route- map cache entries using 0 bytes of memory
0 BGP filter- list cache entries using 0 bytes of memory
BGP using 1520 total bytes of memory
BGP activity 4/0 prefixes, 4/0 paths, scan interval 15 secs
```

Neighbor	V	AS	MsgRcvd	MsgSent	TblVer	InQ	OutQ	Up/Down	State/PfxRcd	
4.4.4.4		4	234	19	19		9	0	0 00:12:01	2

5、R2#sh ip bgp vpnv4 all // 查PE上的VPNV4路由信息，可判断路由重发布是否正确

```
R2#sh ip bgp vpnv4 all // 查PE上的VPNV4路由信息，可判断路由重发布是否正确
BGP table version is 9, local router ID is 2.2.2.2
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
               r RIB- failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
```

Network	Next Hop	Metric	LocPrf	Weight	Path
Route Distinguisher: 1:1 (default for vrf vpna)					
*> 1.1.1.1/32	10.1.12.1	2	32768	?	
*>i5.5.5.0/24	4.4.4.4	2	100	0	?
*> 10.1.12.0/24	0.0.0.0	0	32768	?	
*>i10.1.45.0/24	4.4.4.4			0	100 0 ?

6、R2#sh ip ro vrf vpna // 查看VRF下的路由表信息

```
R2#sh ip ro vrf vpna // 查看VRF下的路由表信息
```

```
Routing Table: vpna
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
```

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
 N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
 E1 - OSPF external type 1, E2 - OSPF external type 2
 i - IS- IS, su - IS- IS summary, L1 - IS- IS level- 1, L2 - IS- IS level- 2
 ia - IS- IS inter area, * - candidate default, U - per- user static route
 o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

```

1.0.0.0/32 is subnetted, 1 subnets
O    1.1.1.1 [110/2] via 10.1.12.1, 00:17:52, FastEthernet0/0
5.0.0.0/24 is subnetted, 1 subnets
B    5.5.5.0 [200/2] via 4.4.4.4, 00:17:02
10.0.0.0/24 is subnetted, 2 subnets
C    10.1.12.0 is directly connected, FastEthernet0/0
B    10.1.45.0 [200/0] via 4.4.4.4, 00:17:02
R2#
  
```

7、R2#sh ip cef //查看CEF表

```

R2#sh ip cef //查看CEF表
Prefix      Next Hop      Interface
0.0.0.0/0   drop          Null0 (default route handler entry)
0.0.0.0/32   receive
2.2.2.2/32   receive
3.3.3.3/32   10.1.23.3     FastEthernet0/1
4.4.4.4/32   10.1.23.3     FastEthernet0/1
10.1.23.0/24 attached      FastEthernet0/1
10.1.23.0/32 receive
10.1.23.2/32 receive
10.1.23.3/32 10.1.23.3     FastEthernet0/1
10.1.23.255/32 receive
10.1.34.0/24 10.1.23.3     FastEthernet0/1
224.0.0.0/4  drop
224.0.0.0/24 receive
255.255.255.255/32 receive
R2#
  
```

8、R1#ping 5.5.5.5 source 1.1.1.1 //在CE1上带源地址pingCE2

R1#ping 5.5.5.5 source 1.1.1.1 // 在CE1上带源地址拼CE2

Type escape sequence to abort.

Sending 5, 100- byte ICMP Echos to 5.5.5.5, timeout is 2 seconds:

Packet sent with a source address of 1.1.1.1

!!!!

9、R1#traceroute 5.5.5.5 source 1.1.1.1 // 在CE1上带源地址路由跟踪CE2

R1#traceroute 5.5.5.5 source 1.1.1.1 // 在CE1上带源地址路由跟踪CE2

Type escape sequence to abort.

Tracing the route to 5.5.5.5

1 10.1.12.2 128 msec 188 msec 196 msec

2 10.1.23.3 [MPLS: Labels 300/ 403 Exp 0] 664 msec 600 msec 616 msec

3 10.1.45.4 [MPLS: Label 403 Exp 0] 372 msec 408 msec 560 msec

4 10.1.45.5 624 msec 764 msec 576 msec

R1#

10、R1#show ip ospf neighbor // 查看CE1上的OSPF邻居表

R1#show ip ospf neighbor // 查看CE1上的OSPF邻居表

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.1.12.2	1	FULL/DR	00:00:38	10.1.12.2	FastEthernet0/0

R1#

11、R1#sh ip ro // 查CEF上的路由表

R1#sh ip ro // 查CEF上的路由表

Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2

i - IS- IS, su - IS- IS summary, L1 - IS- IS level- 1, L2 - IS- IS level- 2
ia - IS- IS inter area, * - candidate default, U - per- user static route
o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

1.0.0.0/32 is subnetted, 1 subnets

C 1.1.1.1 is directly connected, Loopback0

5.0.0.0/24 is subnetted, 1 subnets

O IA 5.5.5.0 [110/3] via 10.1.12.2, 00:02:00, FastEthernet0/0

10.0.0.0/24 is subnetted, 2 subnets

C 10.1.12.0 is directly connected, FastEthernet0/0

O IA 10.1.45.0 [110/2] via 10.1.12.2, 00:02:00, FastEthernet0/0

R1#