PLS VPN over ATM: with OSPF on the Customer Side (without A

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MPLS VPN over ATM: with OSPF on the Customer Side (without Area 0)

Introduction

This document provides a sample configuration of a Multiprotocol Label Switching (MPLS) VPN over ATM when Open Shortest Path First (OSPF) is present on the customer side, *without* area 0.

The Virtual Private Network (VPN) feature, when used with MPLS, allows several sites to transparently interconnect through a service provider's network. One service provider network can support several different IP VPNs. Each of these appears to its users as a private network, separate from all other networks. Within a VPN, each site can send IP packets to any other site in the same VPN.

Each VPN is associated with one or more VPN routing or forwarding instances (VRFs). A VRF consists of an IP routing table, a derived Cisco express forwarding (CEF) table and a set of interfaces that use this forwarding table.

The router maintains a separate routing and CEF table for each VRF. This prevents information being sent outside the VPN and allows the same subnet to be used in several VPNs without causing duplicate IP address problems.

The router using Border Gateway Protocol (BGP) distributes the VPN routing information using the BGP extended communities.

For more information regarding the propagation of updates through a VPN, see the following URLs:

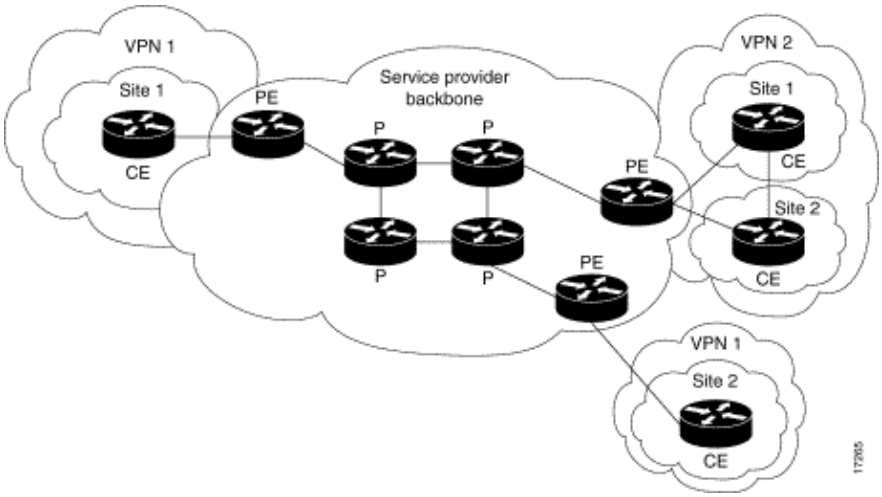
- VPN Route Target Communities.
- BGP Distribution of VPN Routing Information.
- MPLS Forwarding.

Conventions

The letters below represent the different types of routers and switches used:

- P: Provider's core router
- PE: Provider's edge router
- CE: Customer's edge router
- C: Customer's router

This diagram shows a typical configuration using these conventions:



Hardware and Software Versions

This configuration has been developed and tested using the software and hardware versions below:

- **PE routers:**
    - ♦ Software − Cisco IOS® Software Release 12.1(3)T . The MPLS VPN features appear in Release 12.0(5)T. The OSPF as PE−CE routing protocol appears in Release 12.0(7)T.
    - ♦ Hardware − The Cisco 3660 or 7206 routers. For details of other hardware you can use, refer to the Designing MPLS for ATM guide.
- **CE routers:** Any router able to exchange routing information with its PE router can be used.
- **P routers and switches:** The MPLS VPN integration function resides only on the edge of the MPLS network, so any MPLS−capable switch can be used. In this sample configuration, the MPLS cloud is composed of an 8540 MSR and a LightStream 1010. If you are using the LightStream 1010, we recommend that you use software version WA4.8d or higher. You can also use other ATM switches like the Cisco BPX 8650 or MGX 8850 in the ATM core network.

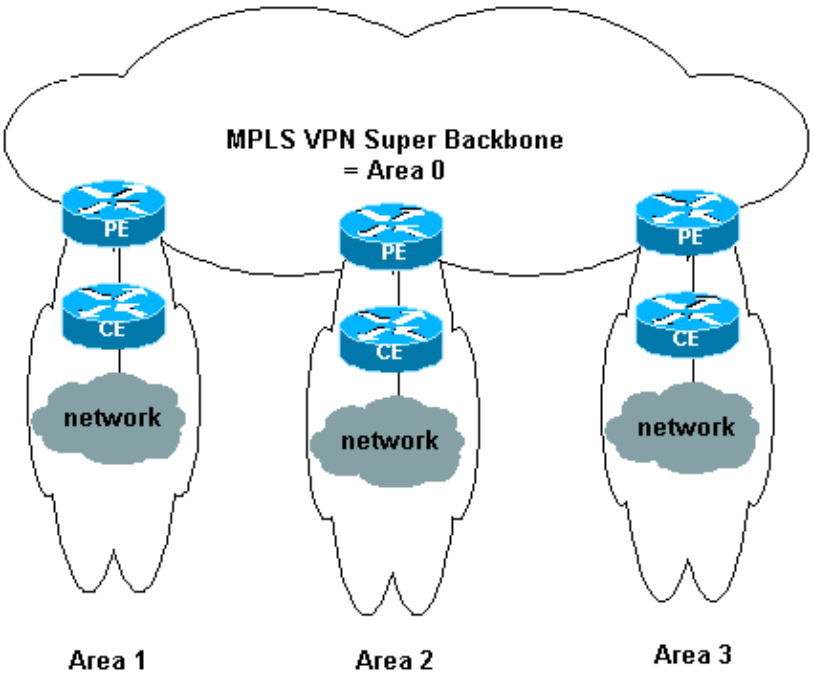
Using OSPF

Traditionally, an elaborate OSPF network consists of a backbone area (area 0) and a number of areas connected to this backbone via an area border router (ABR).

By using an MPLS backbone for VPN with OSPF on the customer's site, you can introduce a third level in the hierarchy of the OSPF model. This third level is called the MPLS VPN super backbone.

In simple cases, the MPLS VPN super backbone is combined with the traditional area 0 backbone. This means that there is no area 0 backbone on the customer network, since the MPLS VPN super backbone plays the same role as the area 0 backbone. This is shown in the diagram below:

MPLS VPN over ATM: with OSPF on the Customer Side (without Area 0)

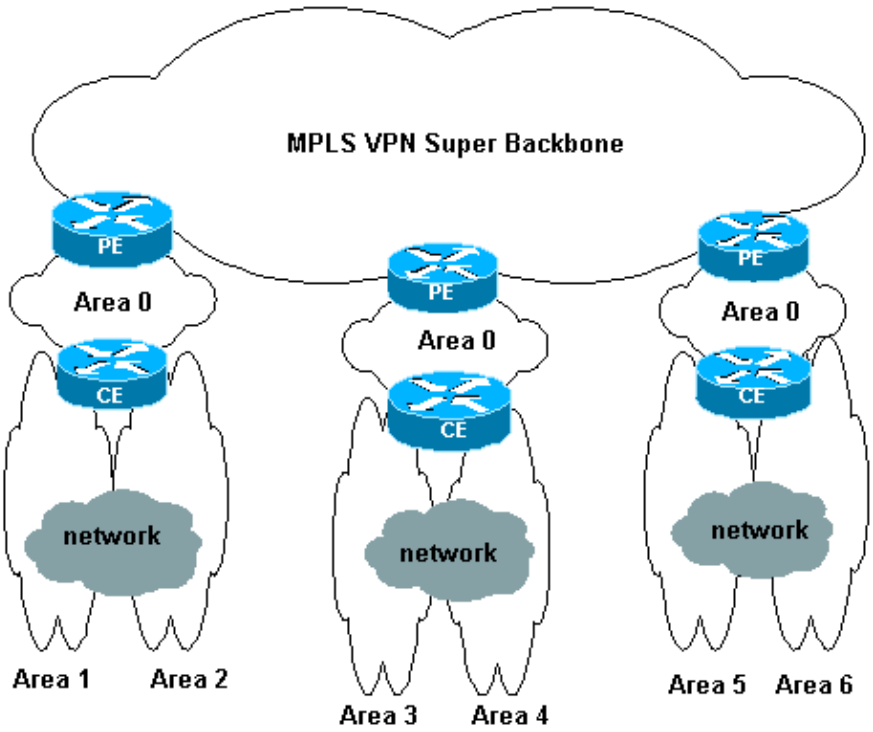


In this diagram:

- The provider−edge (PE) routers are ABR and autonomous system boundary router (ASBR) routers.
- The customer−edge (CE) routers are simple OSPF routers.
- The VPN information is transported via BGP extended communities from PEs to other PEs and is re−injected into the OSPF areas as Summary Network (type 3) link−state advertisements (LSAs).

The MPLS VPN super backbone also enables customers to use multiple area 0 backbones on their sites. Each site can have a separate area 0 as long as it is connected to the MPLS VPN super backbone. The result is the same as a partitioned area 0 backbone. This is shown in the diagram below:

MPLS VPN over ATM: with OSPF on the Customer Side (without Area 0)



In this case:

- The PE routers are ABR and ASBR routers.
- The CE routers are ABR routers.
- The LSAs containing VPN information are transported using BGP extended communities from PEs to other PEs. In Summary Network (type 3) LSAs, information is transported between PEs and CEs.

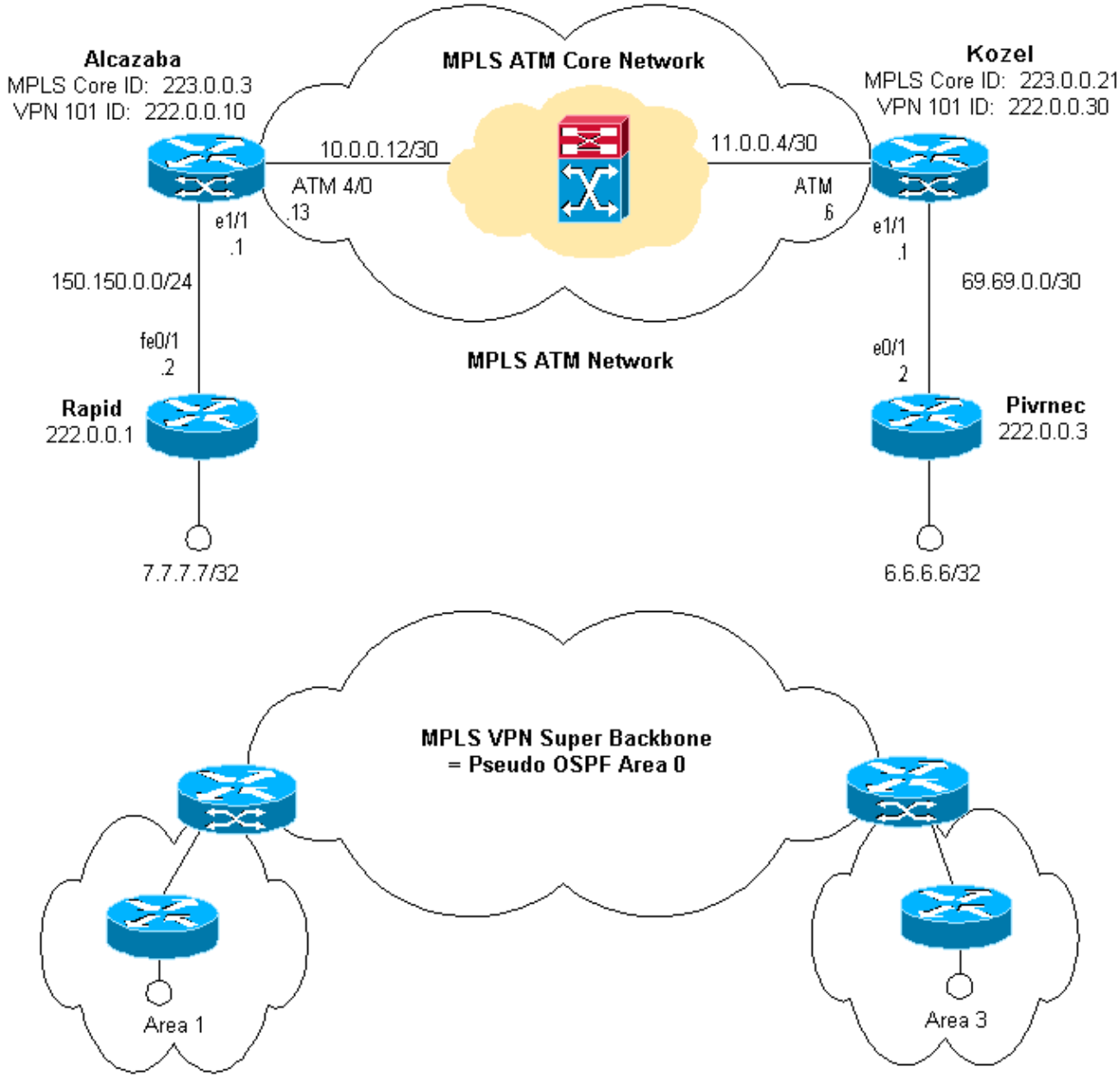
This sample configuration is based on the first setup shown above. You can find a sample configuration that uses the second setup in MPLS VPN over ATM: with OSPF on the Customer Side (with Area 0).

OSPF information is transported with BGP extended community attributes (including one that identifies the OSPF network). Each VPN must have its own OSPF process. To specify this, you can use the command:

router ospf <*process ID*> vrf <*VPN routing/forwarding instance name*>

Network Diagram

MPLS VPN over ATM: with OSPF on the Customer Side (without Area 0)



Configuration Procedure

The Cisco IOS documentation (MPLS Virtual Private Networks) also describes this configuration procedure.

Part I

Make sure that **ip cef** is enabled. If you are using a Cisco 7500 router, you should ensure that **ip cef distributed** is enabled. On the PEs, once MPLS is set up:

1. Create one VRF for each VPN connected using the **ip vrf <*VPN routing/forwarding instance name*>** command. When doing this:

    - Specify the correct route distinguisher used for that VPN. This is used to extend the IP address so that you can identify which VPN it belongs to.

rd <*VPN route distinguisher*>

- Set up the import and export properties for the BGP extended communities. These are used for filtering the import and export process.

  route−target *[export|import|both]* <*target VPN extended community*>

2. Configure the forwarding details for the respectives interfaces using this command:

   ip vrf forwarding <*table name*>

   Remember to set up the IP address after doing this.

3. Depending on the PE−CE routing protocol you are using, you should now do one or more of the following:

- Configure the static routes as follows:

  ip route vrf *vrf−name prefix mask* [*next−hop−address*] [*interface* {*interface−number*}]

- Configure the RIP using the command:

  address−family ipv4 vrf <*VPN routing/forwarding instance name*>

  Once you have done this part, enter the normal RIP configuration commands.

  Note that:

  - this is only applied to the forwarding interfaces for the current VRF.
  - you have to redistribute the correct BGP into RIP. When doing this, remember to also specify the metric used.

- Declare the BGP neighbor information.

- Configure the OSPF using the new IOS command:

  router ospf <*process ID*> vrf <*VPN routing/forwarding instance name*>.

  Note that:

  - this is only applied to the forwarding interfaces for the current VRF.
  - you have to redistribute the correct BGP into OSPF. When doing this, remember to also specify the metric used.
  - once you attribute the OSPF process to a VRF, this process number is always used for this particular VRF. This applies even if you do not specify it in the command line.

Part II

Configure BGP between the PE routers. There are several ways to configure BGP, such as using the route reflector or confederation methods. The method we are using here – direct neighbor configuration – is the simplest and the least scalable.

1. Declare the different neighbors.
2. Enter the **address−family ipv4 vrf <*VPN routing/forwarding instance name*>** for each VPN present at this PE router. Carry out one or more of the following steps, as necessary:
    - ♦ Redistribute the static routing information.
    - ♦ Redistribute the RIP routing informations.
    - ♦ Redistribute the OSPF routing information.
    - ♦ Activate BGP neighboring with the CE routers.
3. Enter the **address−family vpnv4** mode, and:
    - ♦ Activate the neighbors.
    - ♦ Specify that extended community must be used. This is mandatory.

Configurations

Note: Only the relevant parts of the following output are included here.

Alcazaba

```
ip cef
!
ip vrf vpn1
 rd 1:101
 route−target export 1:101
 route−target import 1:101
!
interface Loopback0
 ip address 223.0.0.3 255.255.255.255
!
interface Loopback1
 ip vrf forwarding vpn1
 ip address 222.0.0.10 255.255.255.255
!
interface Ethernet1/1
 ip vrf forwarding vpn1
 ip address 150.150.0.1 255.255.255.0
 no ip mroute−cache
!
interface ATM4/0
 no ip address
 no ip mroute−cache
 atm sonet stm−1
 no atm ilmi−keepalive
!
```

```
interface ATM4/0.1 tag-switching
 ip address 10.0.0.13 255.255.255.252
 tag-switching atm vpi 2-4
 tag-switching ip
!
router ospf 1
 log-adjacency-changes
 network 10.0.0.0 0.0.0.255 area 0
 network 150.150.0.0 0.0.0.255 area 0
 network 223.0.0.3 0.0.0.0 area 0
!
router ospf 2 vrf vpn1
 log-adjacency-changes
 redistribute bgp 1 metric-type 1 subnets
 network 150.150.0.0 0.0.0.255 area 1
 network 222.0.0.0 0.0.0.255 area 1
!
router bgp 1
 neighbor 223.0.0.21 remote-as 1
 neighbor 223.0.0.21 update-source Loopback0
 !
 address-family ipv4 vrf vpn1
 redistribute ospf 2
 no auto-summary
 no synchronization
 exit-address-family
 !
 address-family vpnv4
 neighbor 223.0.0.21 activate
 neighbor 223.0.0.21 send-community extended
 exit-address-family
!
```

Kozel

```
!
ip cef
!
ip vrf vpn1
 rd 1:101
 route-target export 1:101
 route-target import 1:101
!
interface Loopback0
 ip address 223.0.0.21 255.255.255.255
!
interface Loopback1
 ip vrf forwarding vpn1
 ip address 222.0.0.30 255.255.255.255
!
interface Ethernet1/1
 ip vrf forwarding vpn1
 ip address 69.69.0.1 255.255.255.252
 no ip mroute-cache
 tag-switching ip
!
interface ATM4/0
 no ip address
 no atm scrambling cell-payload
 no atm ilmi-keepalive
 pvc qsaal 0/5 qsaal
```

```
 !
 pvc ilmi 0/16 ilmi
 !
!
interface ATM4/0.1 tag-switching
 ip address 11.0.0.6 255.255.255.252
 tag-switching atm vpi 2-4
 tag-switching ip
!
router ospf 1
 log-adjacency-changes
 network 11.0.0.0 0.0.0.255 area 0
 network 223.0.0.21 0.0.0.0 area 0
 mpls traffic-eng router-id Loopback0
 mpls traffic-eng area 0
!
router ospf 2 vrf vpn1
 log-adjacency-changes
 redistribute bgp 1 metric-type 1 subnets
 network 69.69.0.0 0.0.0.255 area 3
 network 222.0.0.0 0.0.0.255 area 3
!
router bgp 1
 neighbor 223.0.0.3 remote-as 1
 neighbor 223.0.0.3 update-source Loopback0
 neighbor 223.0.0.11 remote-as 1
 neighbor 223.0.0.11 update-source Loopback0
 !
 address-family ipv4 vrf vpn1
 redistribute ospf 2
 no auto-summary
 no synchronization
 exit-address-family
 !
 address-family vpnv4
 neighbor 223.0.0.3 activate
 neighbor 223.0.0.3 send-community extended
 neighbor 223.0.0.11 activate
 neighbor 223.0.0.11 send-community extended
 exit-address-family
!
```

Rapid

```
!
interface Loopback0
 ip address 222.0.0.1 255.255.255.255
!
interface Loopback2
 ip address 7.7.7.7 255.255.255.0
!
interface FastEthernet0/1
 ip address 150.150.0.2 255.255.255.0
 duplex auto
 speed auto
!
router ospf 1
 network 7.7.7.7 0.0.0.0 area 1
 network 150.150.0.0 0.0.0.255 area 1
 network 222.0.0.1 0.0.0.0 area 1
!
```

MPLS VPN over ATM: with OSPF on the Customer Side (without Area 0)

Pivrnec

```
!
interface Loopback0
 ip address 222.0.0.3 255.255.255.255
!
interface Loopback1
 ip address 6.6.6.6 255.255.255.255
!
interface FastEthernet0/1
 ip address 69.69.0.2 255.255.255.252
 duplex auto
 speed auto
!
router ospf 1
 log-adjacency-changes
 network 6.6.6.6 0.0.0.0 area 3
 network 69.69.0.0 0.0.0.255 area 3
 network 222.0.0.3 0.0.0.0 area 3
!
```

show Commands

- **show ip route vrf <*VPN routing or forwarding instance name*>**
- **show ip bgp vpnv4 vrf <*VPN routing or forwarding instance name*> <*A.B.C.D*>**
- **show ip ospf <*process ID number*>**
- **show ip ospf <*process ID number*> interface**
- **show ip ospf <*process ID number*> database**
- **show tag-switching forwarding-table vrf <*VPN routing or forwarding instance name*>**

The command below shows the VRF for a particular VPN at the PE router:

```
Alcazaba#show ip route vrf vpn1
Codes: C - connected, S - static, I - IGRP, 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, E - EGP
       i - IS-IS, 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

     69.0.0.0/30 is subnetted, 1 subnets
B       69.69.0.0 [200/0] via 223.0.0.21, 00:19:39
     222.0.0.0/32 is subnetted, 4 subnets
B       222.0.0.30 [200/0] via 223.0.0.21, 00:19:39
C       222.0.0.10 is directly connected, Loopback1
B       222.0.0.3 [200/11] via 223.0.0.21, 00:20:39
O       222.0.0.1 [110/11] via 150.150.0.2, 00:20:59, Ethernet1/1
     6.0.0.0/32 is subnetted, 1 subnets
B       6.6.6.6 [200/11] via 223.0.0.21, 00:20:39
     7.0.0.0/32 is subnetted, 1 subnets
O       7.7.7.7 [110/11] via 150.150.0.2, 00:21:00, Ethernet1/1
     150.150.0.0/24 is subnetted, 1 subnets
C       150.150.0.0 is directly connected, Ethernet1/1
```

You can also display the BGP information for a particular VRF using the **show ip bgp vpnv4 vrf** command. The PE-PE results from the internal BGP (IBGP) are indicated by an `i`.

```
Alcazaba#show ip bgp vpnv4 vrf vpn1
```

```
BGP table version is 21, local router ID is 223.0.0.3
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
Route Distinguisher: 1:101 (default for vrf vpn1)
*>i6.6.6.6/32       223.0.0.21               11    100      0 ?
*> 7.7.7.7/32       150.150.0.2              11         32768 ?
*>i69.69.0.0/30     223.0.0.21                0    100      0 ?
*> 150.150.0.0/24   0.0.0.0                   0         32768 ?
*> 222.0.0.1/32     150.150.0.2              11         32768 ?
*>i222.0.0.3/32     223.0.0.21               11    100      0 ?
*> 222.0.0.10/32    0.0.0.0                   0         32768 ?
*>i222.0.0.30/32    223.0.0.21                0    100      0 ?
```

You can check the details of an entry. To show this, we have marked the BGP extended communities in **red** and the route distinguisher in **blue**.

```
Alcazaba#show ip bgp vpnv4 vrf vpn1 6.6.6.6
BGP routing table entry for 1:101:6.6.6.6/32, version 28
Paths: (1 available, best #1, table vpn1)
  Not advertised to any peer
  Local
    223.0.0.21 (metric 4) from 223.0.0.21 (223.0.0.21)
      Origin incomplete, metric 11, localpref 100, valid, internal, best
      Extended Community: RT:1:101 OSPF RT:3:2:0

Alcazaba#show ip bgp vpnv4 vrf vpn1 7.7.7.7
BGP routing table entry for 1:101:7.7.7.7/32, version 20
Paths: (1 available, best #1, table vpn1)
  Advertised to non peer-group peers:
  223.0.0.21
  Local
    150.150.0.2 from 0.0.0.0 (223.0.0.3)
      Origin incomplete, metric 11, localpref 100, weight 32768, valid, sourced, best
      Extended Community: RT:1:101 OSPF RT:1:2:0
```

The **show ip route** command on a CE router is the primary means of verifying the routing tables:

```
rapid#show ip route
Codes: C - connected, S - static, I - IGRP, 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, E - EGP
       i - IS-IS, 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

     69.0.0.0/30 is subnetted, 1 subnets
O IA    69.69.0.0 [110/11] via 150.150.0.1, 00:20:25, FastEthernet0/1
     222.0.0.0/32 is subnetted, 4 subnets
O IA    222.0.0.30 [110/11] via 150.150.0.1, 00:20:25, FastEthernet0/1
O       222.0.0.10 [110/11] via 150.150.0.1, 00:21:46, FastEthernet0/1
O IA    222.0.0.3 [110/21] via 150.150.0.1, 00:21:25, FastEthernet0/1
C       222.0.0.1 is directly connected, Loopback0
     6.0.0.0/32 is subnetted, 1 subnets
O IA    6.6.6.6 [110/21] via 150.150.0.1, 00:21:25, FastEthernet0/1
     7.0.0.0/24 is subnetted, 1 subnets
C       7.7.7.0 is directly connected, Loopback2
     10.0.0.0/22 is subnetted, 1 subnets
C       10.200.8.0 is directly connected, FastEthernet0/0
```

MPLS VPN over ATM: with OSPF on the Customer Side (without Area 0)

```
     150.150.0.0/24 is subnetted, 1 subnets
C       150.150.0.0 is directly connected, FastEthernet0/1
S    158.0.0.0/8 is directly connected, Null0
```

OSPF−Specific Commands

You can use all of the **show ip ospf** commands. When doing this, remember to indicate the process id. We have marked the most important parts of the output below in **bold** text.

OSPF LSAs of type 9, 10 and 11 (also known as Opaque LSAs) are used for traffic engineering.

Commands for a PE Router

```
Alcazaba#show ip ospf 2
 Routing Process "ospf 2" with ID 222.0.0.10
 Supports only single TOS(TOS0) routes
 Supports opaque LSA
 Connected to MPLS VPN super backbone
 It is an area border and autonomous system boundary router
 Redistributing External Routes from,
    bgp 1, includes subnets in redistribution
 SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
 Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
 Number of external LSA 0. Checksum Sum 0x0
 Number of opaque AS LSA 0. Checksum Sum 0x0
 Number of DCbitless external and opaque AS LSA 0
 Number of DoNotAge external and opaque AS LSA 0
 Number of areas in this router is 1. 1 normal 0 stub 0 nssa
 External flood list length 0
    Area 1
        Number of interfaces in this area is 2
        Area has no authentication
        SPF algorithm executed 4 times
        Area ranges are
        Number of LSA 7. Checksum Sum 0x420BE
        Number of opaque link LSA 0. Checksum Sum 0x0
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 0
        Flood list length 0

Alcazaba#show ip ospf 2 interface
Loopback1 is up, line protocol is up
  Internet Address 222.0.0.10/32, Area 1
  Process ID 2, Router ID 222.0.0.10, Network Type LOOPBACK, Cost: 1
  Loopback interface is treated as a stub Host
Ethernet1/1 is up, line protocol is up
  Internet Address 150.150.0.1/24, Area 1
  Process ID 2, Router ID 222.0.0.10, Network Type BROADCAST, Cost: 10
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 222.0.0.10, Interface address 150.150.0.1
  Backup Designated router (ID) 222.0.0.1, Interface address 150.150.0.2
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:07
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 2, maximum is 3
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 222.0.0.1  (Backup Designated Router)
  Suppress hello for 0 neighbor(s)
```

```
Alcazaba#show ip ospf 2 database

            OSPF Router with ID (222.0.0.10) (Process ID 2)

                Router Link States (Area 1)

Link ID         ADV Router      Age         Seq#       Checksum Link count
222.0.0.1       222.0.0.1       1364        0x80000013 0x7369   3
222.0.0.10      222.0.0.10      1363        0x80000002 0xFEFE   2

                Net Link States (Area 1)

Link ID         ADV Router      Age         Seq#       Checksum
150.150.0.1     222.0.0.10      1363        0x80000001 0xEC6D

                Summary Net Link States (Area 1)

Link ID         ADV Router      Age         Seq#       Checksum
6.6.6.6         222.0.0.10      1328        0x80000001 0x4967
69.69.0.0       222.0.0.10      1268        0x80000001 0x2427
222.0.0.3       222.0.0.10      1328        0x80000001 0xEEF7
222.0.0.30      222.0.0.10      1268        0x80000001 0x7B5A
```

Commands for a CE Router

```
rapid#show ip ospf interface
FastEthernet0/1 is up, line protocol is up
  Internet Address 150.150.0.2/24, Area 1
  Process ID 1, Router ID 222.0.0.1, Network Type BROADCAST, Cost: 10
  Transmit Delay is 1 sec, State BDR, Priority 1
  Designated Router (ID) 222.0.0.10, Interface address 150.150.0.1
  Backup Designated router (ID) 222.0.0.1, Interface address 150.150.0.2
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:04
  Index 2/2, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 2
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 222.0.0.10  (Designated Router)
  Suppress hello for 0 neighbor(s)
Loopback0 is up, line protocol is up
  Internet Address 222.0.0.1/32, Area 1
  Process ID 1, Router ID 222.0.0.1, Network Type LOOPBACK, Cost: 1
  Loopback interface is treated as a stub Host
Loopback2 is up, line protocol is up
  Internet Address 7.7.7.7/24, Area 1
  Process ID 1, Router ID 222.0.0.1, Network Type LOOPBACK, Cost: 1
  Loopback interface is treated as a stub Host

rapid#show ip ospf database

       OSPF Router with ID (222.0.0.1) (Process ID 1)

                Router Link States (Area 1)

Link ID         ADV Router      Age         Seq#       Checksum Link count
222.0.0.1       222.0.0.1       1350        0x80000013 0x7369   3
222.0.0.10      222.0.0.10      1350        0x80000002 0xFEFE   2

                Net Link States (Area 1)

Link ID         ADV Router      Age         Seq#       Checksum
```

MPLS VPN over ATM: with OSPF on the Customer Side (without Area 0)

```
150.150.0.1     222.0.0.10      1351        0x80000001 0xEC6D

                Summary Net Link States (Area 1)

Link ID         ADV Router      Age         Seq#       Checksum
6.6.6.6         222.0.0.10      1316        0x80000001 0x4967
69.69.0.0       222.0.0.10      1256        0x80000001 0x2427
222.0.0.3       222.0.0.10      1316        0x80000001 0xEEF7
222.0.0.30      222.0.0.10      1256        0x80000001 0x7B5A

Alcazaba#show tag-switching forwarding-table vrf vpn1
Local  Outgoing    Prefix            Bytes tag  Outgoing   Next Hop
tag    tag or VC   or Tunnel Id      switched   interface
24     Aggregate   222.0.0.10/32[V]  0
25     Aggregate   150.150.0.0/24[V] 0
27     Untagged    7.7.7.7/32[V]     1710       Et1/1      150.150.0.2
28     Untagged    222.0.0.1/32[V]   0          Et1/1      150.150.0.2
```

MPLS Labels

You can check the label stack used for a particular route as follows:

```
Alcazaba#show tag-switching forwarding-table vrf vpn1 6.6.6.6 detail
Local  Outgoing    Prefix            Bytes tag  Outgoing   Next Hop
tag    tag or VC   or Tunnel Id      switched   interface
None   2/41        6.6.6.6/32        0          AT4/0.1    point2point
        MAC/Encaps=4/12, MTU=4466, Tag Stack{2/41(vcd=10) 16}
        000A8847 0000A00000010000
```

Debugging Output

Here is an excerpt from the route exchange debugging information. This shows how a particular route is imported.

```
Alcazaba#debug ip bgp vpnv4 import
Tag VPN import processing debugging is on
*Aug  5 05:10:09.283: vpn: Start import processing for: 1:101:222.0.0.3
*Aug  5 05:10:09.283: vpn: Import check for vpn1; flags mtch, impt
*Aug  5 05:10:09.283: vpn: Import for vpn1 permitted; import flags mtch, impt
*Aug  5 05:10:09.283: vpn: Same RD import for vpn1
*Aug  5 05:10:09.283: vpn: 1:101:222.0.0.3 (ver 29), imported as:
*Aug  5 05:10:09.283: vpn: 1:101:222.0.0.3 (ver 29)
*Aug  5 05:10:09.287: VPN: Scanning for import check is done.
```

Testing Output

You can now use **ping** to test that everything is fine:

```
Pivrnec#ping 7.7.7.7

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 7.7.7.7, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
```

The **traceroute** command displays the following output:

```
Pivrnec#traceroute 7.7.7.7
```

```
Type escape sequence to abort.
Tracing the route to 7.7.7.7

  1 69.69.0.1 0 msec 0 msec 0 msec
  2 150.150.0.1 0 msec 0 msec 20 msec
  3 150.150.0.2 0 msec 0 msec *
```

The MLPS hosts are missing from here because they do not see the IP header. The MPLS hosts only check the incoming label or interface and then forward it.

The operation on the IP Time To Live (TTL) field is only carried out on the edge LSR. The hop count shown is therefore less than the actual hop count.

Related Information

- **More MPLS over ATM Information**
- **ATM Technology Support Pages**
- **More ATM Information**