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Avaya Solution & Interoperability Test Lab

Configuring Avaya Communication Manager with Avaya G350 Media Gateway in a Cisco MPLS Networks - Issue 1.0

Abstract

These Application Notes present a sample configuration of an Avaya Voice over IP infrastructure in enterprise data networks. Under normal operation, a main and a branch office communicate over the primary corporate network. If the primary corporate network is out of service, the Multiprotocol Label Switching (MPLS) network will be used as a backup. An Avaya G350 Media Gateway is used in a remote office and communicates with all the other offices through the MPLS network. Quality of Service (QoS) and Fax over IP are also covered in these Application Notes. This was done to support a customer Proof of Concept.

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1 Introduction

The network configuration diagram in **Figure 1** shows three offices. The Main Office contains a pair of Avaya S8710 Media Servers controlling a local Avaya G650 Media Gateway (Carrier A and Carrier B) in a high redundancy configuration. The Branch Office contains a local Avaya S8500 Media Server configured as an Enterprise Survivable Server (ESS) and an Avaya G650 Media Gateway. The Remote Office contains an Avaya S8300 Media Server Local Survivable Processor (LSP) and an Avaya G350 Media Gateway.

Refer to [1] for detailed configuration of the Avaya Voice over IP components as shown in **Figure 1**.

In **Figure 1**, the Main Office and Branch Office have both corporate and Multiprotocol Label Switching (MPLS) network access. The corporate network is a primary link and the MPLS network is used as a backup between the Main Office and Branch Office. The Remote Office communicates with the Main Office and Branch Office through the MPLS network. Fax machines are connected to the Avaya Media G650 Gateways in the Main Office and Branch Office. Quality of Service (QoS) and Fax over IP are also covered.
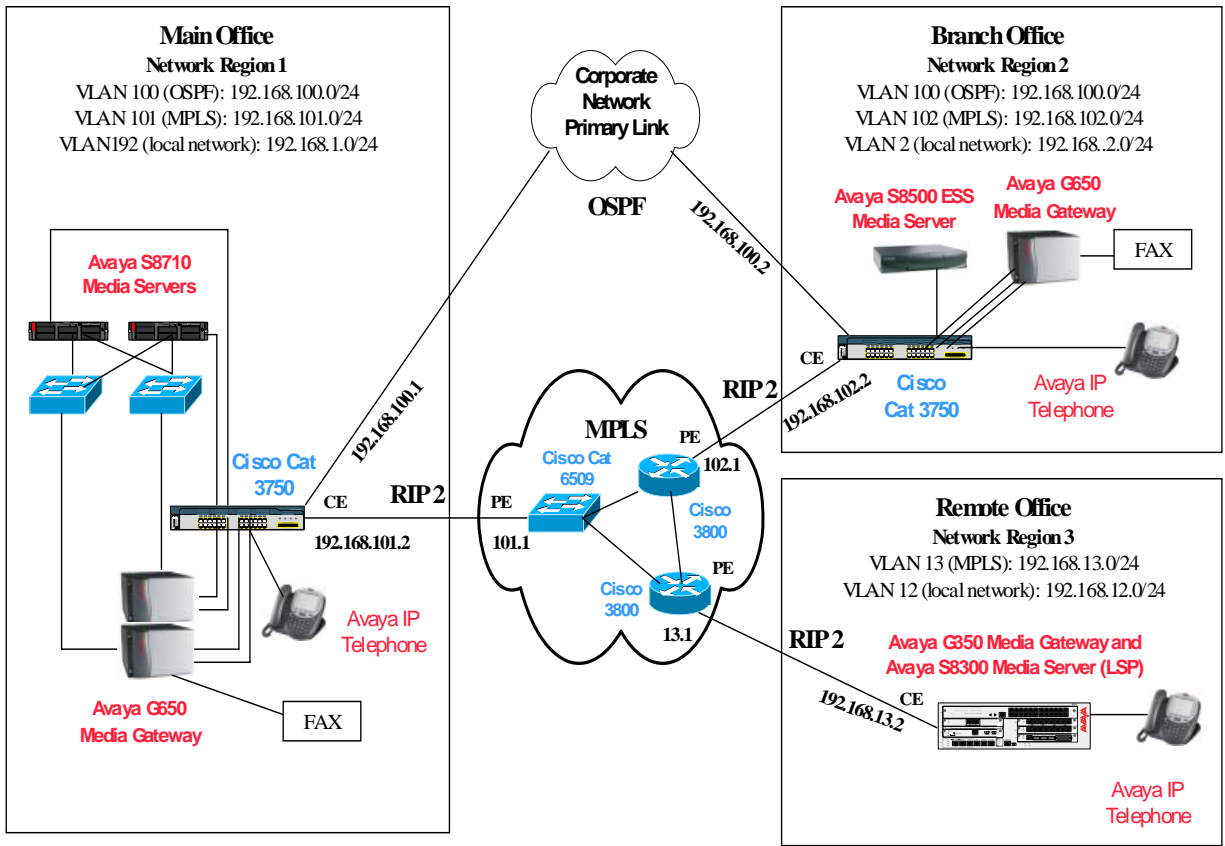

Figure 1: Network Configuration

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2 Equipment and Software Validated

Table 1 below shows the versions verified in these Application Notes.

Equipment	Software
Avaya Communication Manager	
Avaya S8710 Media Server	3.0.1
Avaya S8500 Media Server (ESS)	3.0.1
Avaya S8300 Media Server (LSP)	3.0.1
Avaya G650 Media Gateway	
IPSI (TN2312BP)	HW12 FW021
C-LAN (TN799DP)	HW01 FW016
MEDPRO (TN2302AP)	HW11 FW108
Avaya G350 Media Gateway	24.21.0
Cisco Catalyst 3750 Switch	12.1(19r)EA1b
Cisco Catalyst 6509	12.2(18)SXD5
Cisco 3800 Integrated Access Router	12.3(11r)T1

Table 1: Equipment and Software Validated

3 Configurations

The Open Shortest Path First (OSPF) routing protocol is used on the corporate network between the Main Office and Branch Office. The Routing Information Protocol (RIP) is used between the MPLS Customer Edge (CE) devices and the MPLS Provider Edge (PE) devices. When the corporate and MPLS networks are up, the Main Office and Branch Office will use OSPF entries for IP routing between them since the OSPF routing protocol has a lower default administration distance (distance 110) than the RIP routing protocol (distance 120). When the corporate network is out of service, the RIP routing entries will be used between the Main Office and Branch Office. Refer to Cisco Web site for details on MPLS configuration.

3.1 Configure the Avaya G350 Media Gateway In the Remote Office

The Avaya G350 Media Gateway can be configured as a DHCP and TFTP server. Refer to [2] for detailed configuration. The DHCP configuration is shown below. VLAN 12 is associated with network 192.168.12.0/24. This is a local network used by the Avaya G350 Media Gateway, the Avaya S8300 Media Server LSP and Avaya IP telephones in the Remote Office.

```
ip dhcp-server
ip dhcp pool 1
 start-ip-addr 192.168.12.100
 end-ip-addr 192.168.12.110
 default-router 192.168.12.2
 option 176
  value ascii "MCIPADD=192.168.1.10"
 exit
exit
ip dhcp activate pool 1

 interface Vlan 12
 icc-vlan
 ip address 192.168.12.2    255.255.255.0
 pmi
 exit
```

RIP version 2 is configured between the Avaya G350 Media Gateway and the Cisco 3800 MPLS PE router via FastEthernet 10/2 (Eth WAN port).

```
router rip
 redistribute connected
 network 192.168.12.0    0.0.0.255
 network 192.168.13.0    0.0.0.255

interface FastEthernet 10/2
 ip address 192.168.13.2    255.255.255.0
 ip rip rip-version 2
```

3.2 Configure the Cisco Catalyst 3750 In the Main Office

The Cisco Catalyst 3750 in the Main Office has both corporate and MPLS network access. The OSPF protocol is used on the corporate network and RIP is used on the MPLS network. When both links are up, the OSPF routing table will take preference over the RIP routing protocol. The following shows the VLAN and OSPF configuration. VLAN 192 is associated with network 192.168.1.0/24. This is a local network used by the Avaya S8710 Media Servers, Avaya G650 Media Gateway and Avaya IP telephones in the Main Office. VLAN 100 is used for the interconnection between the Cisco Catalyst 3750 in the Main Office and the Cisco Catalyst 3750 in the Branch Office.

```
! --- Interface configuration between the Main Office and the Branch Office

interface Vlan100
 ip address 192.168.100.1 255.255.255.0

! --- A local network configuration in the Main Office.

interface Vlan192
 ip address 192.168.1.254 255.255.255.0

! --- OSPF configuration

router ospf 1
 log-adjacency-changes
 network 192.168.1.0 0.0.0.255 area 0
 network 192.168.100.0 0.0.0.255 area 0
```

The following shows the RIP configuration on the MPLS CE-PE link.

```
! --- Interface configuration on the MPLS CE-PE link

interface Vlan101
 ip address 192.168.101.2 255.255.255.0

! --- RIP version 2 configuration between the CE and the PE

router rip
 version 2
 network 192.168.1.0
 network 192.168.101.0
 no auto-summary
```

For the sample configuration, all Avaya components are configured with DSCP value 46 and 802.1p value 5. Auto QoS is enabled on the ports connected to the Avaya VoIP components including Avaya Media Servers, Avaya Media Gateways and Avaya IP telephones. Auto QoS is also enabled on the infrastructure ports (access to the corporate network and MPLS network). By default, the Auto QoS will prioritize the DSCP 46 or 802.1p 5. Refer to [1] for detailed QoS configuration on the Avaya VoIP components.

The following shows the configuration on interface FastEthernet 1/0/13 connected to an Avaya VoIP component. Trust DSCP is used in the sample configuration.

```
interface FastEthernet1/0/13
 switchport access vlan 192
 duplex full
 srr-queue bandwidth share 10 10 60 20
 srr-queue bandwidth shape  10  0  0  0
 mls qos trust dscp
 auto qos voip trust
 spanning-tree portfast
```

3.3 Configure the Cisco Catalyst 3750 In the Branch Office

The Cisco Catalyst 3750 in the Branch Office has both corporate and MPLS network access. The OSPF protocol is used on the corporate network and RIP is used on the MPLS network. When both links are up, the OSPF routing table will take preference over the RIP routing protocol. The following shows the VLAN and OSPF configuration. VLAN 2 is associated with network 192.168.2.0/24. This is a local network used by the Avaya S8500 Media Server configured as an ESS, Avaya G650 Media Gateway and Avaya IP telephones in the Branch Office. VLAN 100 is used for the interconnection between the Cisco Catalyst 3750 in the Main Office and the Cisco Catalyst 3750 in the Branch Office.

```
! --- Local network configuration in the Branch Office.

interface Vlan2
 ip address 192.168.2.254 255.255.255.0

! --- Interface configuration between the Main Office and Branch Office

interface Vlan100
 ip address 192.168.100.2 255.255.255.0

! --- OSPF configuration

router ospf 1
 log-adjacency-changes
 network 192.168.2.0 0.0.0.255 area 0
 network 192.168.100.0 0.0.0.255 area 0
```

The following shows the RIP configuration on the MPLS CE-PE link.

```
! --- Interface configuration on the MPLS CE-PE link

interface Vlan102
 ip address 192.168.102.2 255.255.255.0

! --- RIP version 2 configuration between the MPLS CE and PE

router rip
 version 2
 network 192.168.2.0
 network 192.168.102.0
 no auto-summary
```

Auto QoS is configured in the same way as on the Cisco Catalyst 3750 in the Main Office. The following shows the configuration on interface GigabitEthernet 1/0/2 connected to an Avaya VoIP component.

```
interface GigabitEthernet1/0/2
 switchport access vlan 2
 srr-queue bandwidth share 10 10 60 20
 srr-queue bandwidth shape  10  0  0  0
 mls qos trust dscp
 auto qos voip trust
```

3.4 Configure the Cisco Catalyst 6509 as a MPLS PE Device for the Main Office

The following shows the Label Discovery Protocol (LDP) configuration. Cisco Express Forwarding (CEF) and LDP must be enabled to support MPLS.

```
! --- Enable CEF globally
ip cef distributed
! --- Enable LDP on the MPLS interfaces

interface GigabitEthernet2/3
 ip address 10.1.1.5 255.255.255.252
 mpls label protocol ldp
 tag-switching ip
!
interface FastEthernet3/5
 ip address 10.1.1.1 255.255.255.252
 mpls label protocol ldp
 mls qos trust dscp
 tag-switching ip
```

The following shows the annotated configuration for the following items:
- VRF
- RIP version 2 (CE-PE)
- EIGRP
- Meshed IBGP
- VPNV4 for MPLS over IBGP (MPLS control plane)
- Redistribution between RIP and IBGP routing protocols

```
! --- VRF configuration

ip vrf VRFNY
 rd 1:10
 route-target export 1:10
 route-target import 1:10

! --- Apply VRF to interface vlan 101 (connected to the Main Office)

interface Vlan101
 ip vrf forwarding VRFNY
 ip address 192.168.101.1 255.255.255.0
!

! --- Loopback configuration

interface Loopback0
 ip address 10.10.10.1 255.255.255.255
!
! --- EIGPR configuration for the MPLS cloud

router eigrp 10
 network 10.0.0.0
 no auto-summary

! --- RIP configuration between the MPLS CE and PE
! --- Redistribution from the IBGP to the RIP

router rip
 version 2
 !
 address-family ipv4 vrf VRFNY
 redistribute bgp 65001 metric transparent
 network 192.168.101.0
 no auto-summary
 exit-address-family
!
! --- Meshed IBGP configuration

router bgp 65001
 no synchronization
 bgp log-neighbor-changes
 neighbor 10.10.10.2 remote-as 65001
 neighbor 10.10.10.2 update-source Loopback0
```

```
 neighbor 10.10.10.3 remote-as 65001
 neighbor 10.10.10.3 update-source Loopback0
 no auto-summary
 !
! --- Enable VPNV4 with all  IBGP peers
 address-family vpnv4
 neighbor 10.10.10.2 activate
 neighbor 10.10.10.2 next-hop-self
 neighbor 10.10.10.2 send-community both
 neighbor 10.10.10.3 activate
 neighbor 10.10.10.3 next-hop-self
 neighbor 10.10.10.3 send-community both
 exit-address-family
 !
! --- Redistribution from RIP to the IBGP
 address-family ipv4 vrf VRFNY
 redistribute rip
 no auto-summary
 no synchronization
 exit-address-family
```

Assume that the MPLS network is part of an enterprise network; QoS can be enabled on the port connected to the Cisco Catalyst 3750 in the Main Office. The following shows that DSCP value will be trusted on that port. By default, DSCP value 46 will be prioritized on the Cisco Catalyst 6509.

```
interface FastEthernet3/4
 no ip address
 mls qos trust dscp
 switchport
 switchport access vlan 101
```

3.5 Configure Cisco 3800 Router as a MPLS PE Device for the Branch Office

The MPLS configuration on the Cisco 3800 PE router for the Branch Office is similar to the configuration on the Cisco Catalyst 6509 PE router for the Main Office. The following shows the configuration.

```
ip vrf VRFNY
 rd 1:10
 route-target export 1:10
 route-target import 1:10
!
interface Loopback0
 ip address 10.10.10.2 255.255.255.255
!
interface GigabitEthernet0/0
 ip address 10.1.1.2 255.255.255.252
```

```
 media-type rj45
 mpls label protocol ldp
 tag-switching ip
!
interface GigabitEthernet0/1
 ip address 10.1.1.9 255.255.255.252
 mpls label protocol ldp
 tag-switching ip
!
interface FastEthernet1/0
 ip vrf forwarding VRFNY
 ip address 192.168.102.1 255.255.255.0
 service-policy output mpls-qos
 duplex auto
 speed auto
!
router eigrp 10
 network 10.0.0.0
 no auto-summary
!
router rip
 version 2
 !
 address-family ipv4 vrf VRFNY
 redistribute bgp 65001 metric transparent
 network 192.168.102.0
 no auto-summary
 exit-address-family
!
router bgp 65001
 no synchronization
 bgp log-neighbor-changes
 neighbor 10.10.10.1 remote-as 65001
 neighbor 10.10.10.1 update-source Loopback0
 neighbor 10.10.10.3 remote-as 65001
 neighbor 10.10.10.3 update-source Loopback0
 no auto-summary
 !
 address-family vpnv4
 neighbor 10.10.10.1 activate
 neighbor 10.10.10.1 next-hop-self
 neighbor 10.10.10.1 send-community both
 neighbor 10.10.10.3 activate
 neighbor 10.10.10.3 next-hop-self
 neighbor 10.10.10.3 send-community both
 exit-address-family
 !
 address-family ipv4 vrf VRFNY
 redistribute rip
 no auto-summary
 no synchronization
 exit-address-family
```

Assume that the MPLS network is part of an enterprise network; QoS can be enabled on the PE router. The following shows the policy-map configuration, which is applied on the interfaces connected to all the other PE routers. By default, the first three DSCP bits for an incoming IP packet are copied to the MPLS EXP bits. For DSCP value 46, the MPLS EXP bits will be set to 5. The following policy map configuration will prioritize MPLS EXP value 5.

```
! --- Policy map configuration (prioritize MPLS bits 5)

class-map match-any voip
 match mpls experimental topmost 5
policy-map mpls-qos
 class voip
  priority 50
 class class-default

! Apply policy map to the outgoing interfaces

interface GigabitEthernet0/0
 ip address 10.1.1.2 255.255.255.252
 service-policy output mpls-qos
 duplex auto
 speed auto
 media-type rj45
 mpls label protocol ldp
 tag-switching ip

interface GigabitEthernet0/1
 ip address 10.1.1.9 255.255.255.252
 service-policy output mpls-qos
 duplex auto
 speed auto
 media-type rj45
 mpls label protocol ldp
 tag-switching ip
```

3.6 Configure Cisco 3800 Router as a MPLS PE for the Remote Office

The MPLS configuration on the Cisco 3800 PE router for the Remote Office is similar to the configuration on the Cisco 3800 PE router for the Branch Office. The following shows the configuration.

```
class-map match-any voip
 match mpls experimental topmost 5
policy-map mpls-qos
 class voip
  priority 50
 class class-default

ip vrf VRFNY
 rd 1:10
 route-target export 1:10
 route-target import 1:10
!
ip domain name yourdomain.com
no ftp-server write-enable
voice-card 0
 no dspfarm
!
interface Loopback0
 ip address 10.10.10.3 255.255.255.255
!
interface GigabitEthernet0/0
 ip address 10.1.1.6 255.255.255.252
 service-policy output mpls-qos
 duplex full
 speed auto
 media-type rj45
 mpls label protocol ldp
 tag-switching ip
!
interface GigabitEthernet0/1
 ip address 10.1.1.10 255.255.255.252
 service-policy output mpls-qos
 duplex auto
 speed auto
 media-type rj45
 mpls label protocol ldp
 tag-switching ip
!
interface FastEthernet1/0
 ip vrf forwarding VRFNY
 ip address 192.168.13.1 255.255.255.0
 duplex auto
 speed auto
!
router eigrp 10
 network 10.0.0.0
 no auto-summary
!
router rip
 version 2
 !
 address-family ipv4 vrf VRFNY
 redistribute bgp 65001 metric transparent
 network 192.168.13.0
 no auto-summary
```

```
 exit-address-family
!
router bgp 65001
 no synchronization
 bgp log-neighbor-changes
 neighbor 10.10.10.1 remote-as 65001
 neighbor 10.10.10.1 update-source Loopback0
 neighbor 10.10.10.2 remote-as 65001
 neighbor 10.10.10.2 update-source Loopback0
 no auto-summary
 !
 address-family vpnv4
 neighbor 10.10.10.1 activate
 neighbor 10.10.10.1 next-hop-self
 neighbor 10.10.10.1 send-community both
 neighbor 10.10.10.2 activate
 neighbor 10.10.10.2 next-hop-self
 neighbor 10.10.10.2 send-community both
 exit-address-family
 !
 address-family ipv4 vrf VRFNY
 redistribute rip
 no auto-summary
 no synchronization
 exit-address-family
!
```

3.7 Fax Over IP Configuration On Avaya Communication Manager

Avaya Communication Manager supports Fax over IP in three modes: pass-through, relay and T.38 standard. It is recommended to use Fax relay mode within Avaya VoIP infrastructure and T.38 standard with the third party products. The pass through mode can be used if a high quality data network is available with minimal packet loss, jitter and delay.

An IP Codec Set can be configured between two network regions and Fax over IP mode is associated with an IP Codec Set. In the sample configuration, IP Codec Set 2 is configured for inter-regions calls. Log into the System Access Terminal (SAT), and use the command **change ip-network-region <region #>** to configure the IP Codec Set between two network regions.

```
change ip-network-region 1                                     Page   3 of  19

                    Inter Network Region Connection Management

 src dst  codec  direct                                      Dynamic CAC
 rgn rgn   set     WAN      WAN-BW-limits   Intervening-regions    Gateway
IGAR
 1   1     1
 1   2     2       y        100:Calls                                     n
 1   3     2       y        100:Calls                                     n
```

Use the command **change ip-codec set <codec-set #>** to configure Fax mode. The following shows that Fax relay mode is configured for IP Codec Set 2. If packet loss is high in a data network, **Redundancy** can be configured. When **Redundancy** is set to 1, the same Fax over IP packet will be sent twice.

```
change ip-codec-set 2                                          Page   2 of   2

                         IP Codec Set
Allow Direct-IP Multimedia? n

                    Mode              Redundancy
     FAX            relay                 1
     Modem          off                   0
     TDD/TTY        US                    3
     Clear-channel  n                     0
```

4 Verification

4.1 Verify IP Routing Operation on the Cisco Catalyst 3750 In the Main Office

When both the corporate and MPLS networks are up, the Catalyst 3750 in the Main Office will use OSPF link with the Branch Office and RIP with the Remote Office. The following shows the routing entries when both links are up.

```
main3750#show ip route
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, E - EGP
       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
Gateway of last resort is not set

R    192.168.12.0/24 [120/2] via 192.168.101.1, 00:00:02, Vlan101
R    192.168.13.0/24 [120/1] via 192.168.101.1, 00:00:02, Vlan101
C    192.168.11.0/24 is directly connected, Vlan11
R    192.168.102.0/24 [120/1] via 192.168.101.1, 00:00:02, Vlan101
C    192.168.1.0/24 is directly connected, Vlan192
O    192.168.2.0/24 [110/2] via 192.168.100.2, 00:00:40, Vlan100
C    192.168.100.0/24 is directly connected, Vlan100
C    192.168.101.0/24 is directly connected, Vlan101
```

If the OSPF link is out of service, RIP entries will be used between the Main Office and Branch Office.

```
main3750#show ip route
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, E - EGP
       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 rou
Gateway of last resort is not set

R    192.168.12.0/24 [120/2] via 192.168.101.1, 00:00:22, Vlan101
R    192.168.13.0/24 [120/1] via 192.168.101.1, 00:00:22, Vlan101
C    192.168.11.0/24 is directly connected, Vlan11
R    192.168.102.0/24 [120/1] via 192.168.101.1, 00:00:22, Vlan101
C    192.168.1.0/24 is directly connected, Vlan192
R    192.168.2.0/24 [120/2] via 192.168.101.1, 00:00:22, Vlan101
C    192.168.100.0/24 is directly connected, Vlan100
C    192.168.101.0/24 is directly connected, Vlan101
```

4.2 Verify IP Routing Operation on the Cisco Catalyst 3750 In the Branch Office

When both the corporate and MPLS networks are up, the Catalyst 3750 in the Branch Office will use the OSPF link with the Main Office, and RIP with the Remote Office. The following shows the routing entries.

```
ESS-C3750-L3#show ip route
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, E - EGP
       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

Gateway of last resort is not set

R    192.168.12.0/24 [120/2] via 192.168.102.1, 00:00:08, Vlan102
R    192.168.13.0/24 [120/1] via 192.168.102.1, 00:00:08, Vlan102
C    192.168.102.0/24 is directly connected, Vlan102
O    192.168.1.0/24 [110/2] via 192.168.100.1, 00:03:36, Vlan100
C    192.168.2.0/24 is directly connected, Vlan2
C    192.168.100.0/24 is directly connected, Vlan100
R    192.168.101.0/24 [120/1] via 192.168.102.1, 00:00:08, Vlan102
```

If the OSPF link is out of service, RIP entries will be used between the Branch Office and Main Office.

```
ESS-C3750-L3#show ip route
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, E - EGP
       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

Gateway of last resort is not set

R    192.168.12.0/24 [120/2] via 192.168.102.1, 00:00:21, Vlan102
R    192.168.13.0/24 [120/1] via 192.168.102.1, 00:00:21, Vlan102
C    192.168.102.0/24 is directly connected, Vlan102
R    192.168.1.0/24 [120/2] via 192.168.102.1, 00:00:21, Vlan102
C    192.168.2.0/24 is directly connected, Vlan2
C    192.168.100.0/24 is directly connected, Vlan100
R    192.168.101.0/24 [120/1] via 192.168.102.1, 00:00:21, Vlan102
```

4.3 Verify IP Routing Operation on the Avaya G350 Media Gateway

The following shows the IP routing entries on the Avaya G350 Media Gateway in the Remote Office. All entries are learned by the RIP routing protocol.

```
G350-002(super)# show ip route
Showing 7 rows
   Network       Mask       Interface             Next-Hop        Cost  TTL
Source
--------------- ---- ------------------- ------------------- ----- --- -----
192.168.1.0      24 FastEth  10/2        192.168.13.1            3 175 RIP
192.168.2.0      24 FastEth  10/2        192.168.13.1            3 175 RIP
192.168.12.0     24 Vlan     12          192.168.12.2            1 n/a LOCAL
192.168.13.0     24 FastEth  10/2        192.168.13.2            1 n/a LOCAL
192.168.101.0    24 FastEth  10/2        192.168.13.1            2 175 RIP
192.168.102.0    24 FastEth  10/2        192.168.13.1            2 175 RIP
```

4.4 Verify MPLS Operation

This section only provides the commands used to verify MPLS operation on the Cisco Catalyst 6509. These commands can also be used on the Cisco3800 MPLS PE routers.

Use the command **show mpls ldp neighbor** to display LDP neighbor information.

```
main6509#show mpls ldp neighbor
    Peer LDP Ident: 10.10.10.2:0; Local LDP Ident 10.10.10.1:0
        TCP connection: 10.10.10.2.62744 - 10.10.10.1.646
        State: Oper; Msgs sent/rcvd: 7797/7802; Downstream
        Up time: 4d17h
        LDP discovery sources:
          FastEthernet3/5, Src IP addr: 10.1.1.2
        Addresses bound to peer LDP Ident:
          10.10.10.2      10.1.1.2         10.1.1.9
    Peer LDP Ident: 10.10.10.3:0; Local LDP Ident 10.10.10.1:0
        TCP connection: 10.10.10.3.35812 - 10.10.10.1.646
        State: Oper; Msgs sent/rcvd: 1396/1398; Downstream
        Up time: 20:09:02
        LDP discovery sources:
          GigabitEthernet2/3, Src IP addr: 10.1.1.6
        Addresses bound to peer LDP Ident:
          10.10.10.3      10.1.1.6         10.1.1.10
```

Use the command **show ip bgp neighbors** to display detailed information on TCP and BGP neighbor connections.

```
main6509#show ip bgp nei
BGP neighbor is 10.10.10.2,  remote AS 65001, internal link
  BGP version 4, remote router ID 10.10.10.2
  BGP state = Established, up for 1w0d
  Last read 00:00:10, hold time is 180, keepalive interval is 60 seconds
…

BGP neighbor is 10.10.10.3,  remote AS 65001, internal link
  BGP version 4, remote router ID 10.10.10.3
  BGP state = Established, up for 1w0d
  Last read 00:00:58, hold time is 180, keepalive interval is 60 seconds

 …
```

Use the command **show ip bgp vpnv4 vrf <vrf name>** to display VPN Routing/Forwarding instance.

```
main6509#show ip bgp vpnv4 vrf VRFNY
BGP table version is 58, local router ID is 10.10.10.1
Status codes: s suppressed, d damped, h history, * valid, > best, i -
internal,
            S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
Route Distinguisher: 1:10 (default for vrf VRFNY)
*> 192.168.1.0      192.168.101.2            1          32768 ?
*>i192.168.2.0      10.10.10.2               1    100      0 ?
*>i192.168.12.0     10.10.10.3               1    100      0 ?
*>i192.168.13.0     10.10.10.3               0    100      0 ?
*> 192.168.101.0    0.0.0.0                  0          32768 ?
*>i192.168.102.0    10.10.10.2               0    100      0 ?
```

Use the command **show ip router vrf <vrf name>** to display routes from a VPN Routing/Forwarding instance.

```
main6509#show ip route vrf VRFNY

Routing Table: VRFNY
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, E - EGP
       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

B    192.168.12.0/24 [200/1] via 10.10.10.3, 1w0d
B    192.168.13.0/24 [200/0] via 10.10.10.3, 1w0d
B    192.168.102.0/24 [200/0] via 10.10.10.2, 1w0d
R    192.168.1.0/24 [120/1] via 192.168.101.2, 00:00:05, Vlan101
B    192.168.2.0/24 [200/1] via 10.10.10.2, 1w0d
C    192.168.101.0/24 is directly connected, Vlan101
```

Use the command **show ip bgp vpn4 vrf <vrf name> tags** to display MPLS tags information.

```
main6509#show ip bgp vpnv4 vrf VRFNY tags
   Network          Next Hop       In tag/Out tag
Route Distinguisher: 1:10 (VRFNY)
   192.168.1.0      192.168.101.2   16/notag
   192.168.2.0      10.10.10.2      notag/19
   192.168.12.0     10.10.10.3      notag/22
   192.168.13.0     10.10.10.3      notag/21
   192.168.101.0    0.0.0.0
   192.168.102.0    Per VRF Aggregate Tag:20/aggregate(VRFNY)
   192.168.102.0    10.10.10.2      notag/21
```

4.5 Verify Fax Over IP Operation

The following shows a trace of a Fax call from extension 23100 in the Main Office to extension 23200 in the Branch Office in Fax Relay mode.

```
list trace station 23100
                         LIST TRACE
time            data

17:52:35     tone-receiver     01AXX06 cid 0x23d9
17:52:35     active station    23100 cid 0x23d9
17:52:38     dial 23200
17:52:38     ring station    23200 cid 0x23d9
17:52:38     xoip: fax:Relay modem:off tty:US 192.168.1.21:2820 (igc)
17:52:38     xoip: fax:Relay modem:off tty:US 192.168.2.11:2124 (igc)
17:52:38     G711MU ss:off ps:20 rn:1/2 192.168.1.21:2820 192.168.2.11:2124
17:52:46     active station    23200 cid 0x23d9
             VOIP data from: 192.168.1.21:2820
17:52:48     Jitter:0 0 0 0 0 0 0 0 0 0: Buff:8 WC:3 Avg:0
17:52:48     Pkloss:0 0 0 0 0 0 0 0 0 0: Oofo:0 WC:0 Avg:0
17:52:49     Start Fax Relay aux:none tone:CED from voip: 192.168.2.11:2124
17:52:49     Start Fax Relay aux:none tone:none from voip: 192.168.1.21:2820
             VOIP data from: 192.168.2.11:2124
…
             VOIP data from: 192.168.1.21:2820
17:53:18     Jitter:0 0 0 0 0 0 0 0 0 0: Buff:8 WC:3 Avg:0
17:53:18     Pkloss:* * * * * * * * * *: Oofo:0 WC:0 Avg:0
17:53:19     Jitter:0 0 0 0 0 0 0 0 0 0: Buff:8 WC:1 Avg:0
17:53:19     Pkloss:0 0 0 0 0 0 0 0 0 0: Oofo:0 WC:0 Avg:0
17:53:24     Disc Fax Relay aux:none tone:none from voip: 192.168.1.21:2820
17:53:24     idle station    23100 cid 0x23d9
```

5 Conclusion

As illustrated in these Application Notes, the MPLS network can be used to back up a primary corporate network. The Avaya G350 Media Gateway can be configured as a MPLS CE device to communicate with a Cisco MPLS PE device via the RIP routing protocol. The corporate and MPLS networks can be configured to prioritize Avaya VoIP traffic based on the DSCP value configured on the Avaya VoIP devices. Fax over IP works successfully between two Avaya Media Gateways.

6 Additional References

The following Applications Notes can be found at http://www.avaya.com.

[1]   *Configuring Avaya Communication Manager with Avaya Inter-Gateway Alternate Routing (IGAR) Using Avaya Dynamic Call Admission Control (D-CAC) and Respond Time Report (RTR) Features*

[2]   *Configuring DHCP and TFTP Servers on Avaya G350 and G250 Media Gateways for Avaya IP 4600 Series Telephones*

7. Glossary

Technical Term	Definition as it pertains to this document
MPLS	Multiprotocol Label Switching
CE	Customer Edge
PE	Provider Edge
VRF	VPN Routing and Forwarding