CIS 83 Case Study
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Scenario:

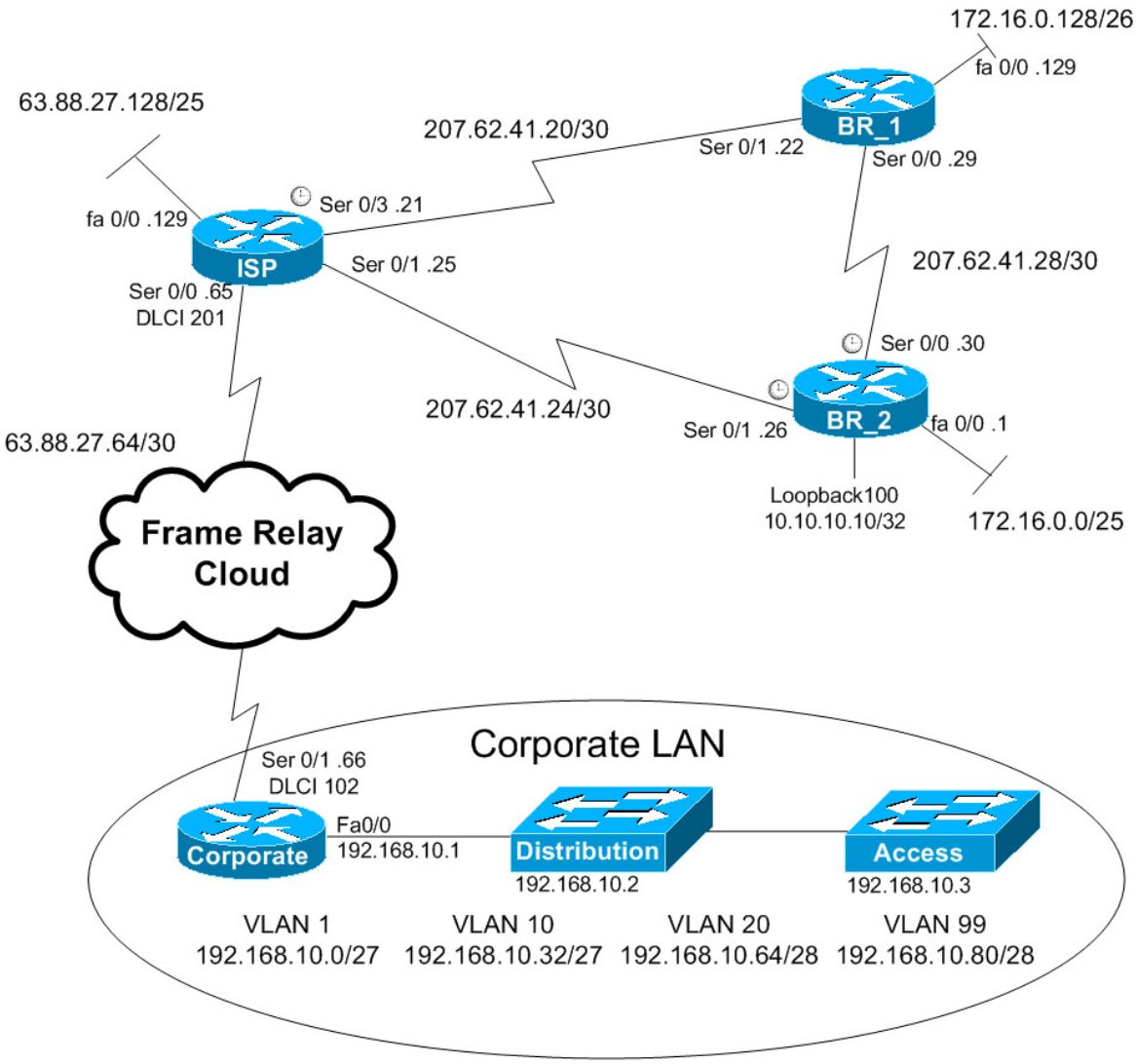
Corporate LAN contains a router connected to an ISP via Frame Relay. Corporate router does PAT and DHCP for Corporate LAN. Access and Distribution switches are configured with VLANs, trunking, and port security. The ISP router is connected to two branch office routers via serial links, using PPP and authenticated via CHAP. Configure a dynamic routing protocol on each of the three ISP routers. Each of the three ISP routers has a LAN attached.

Objective:

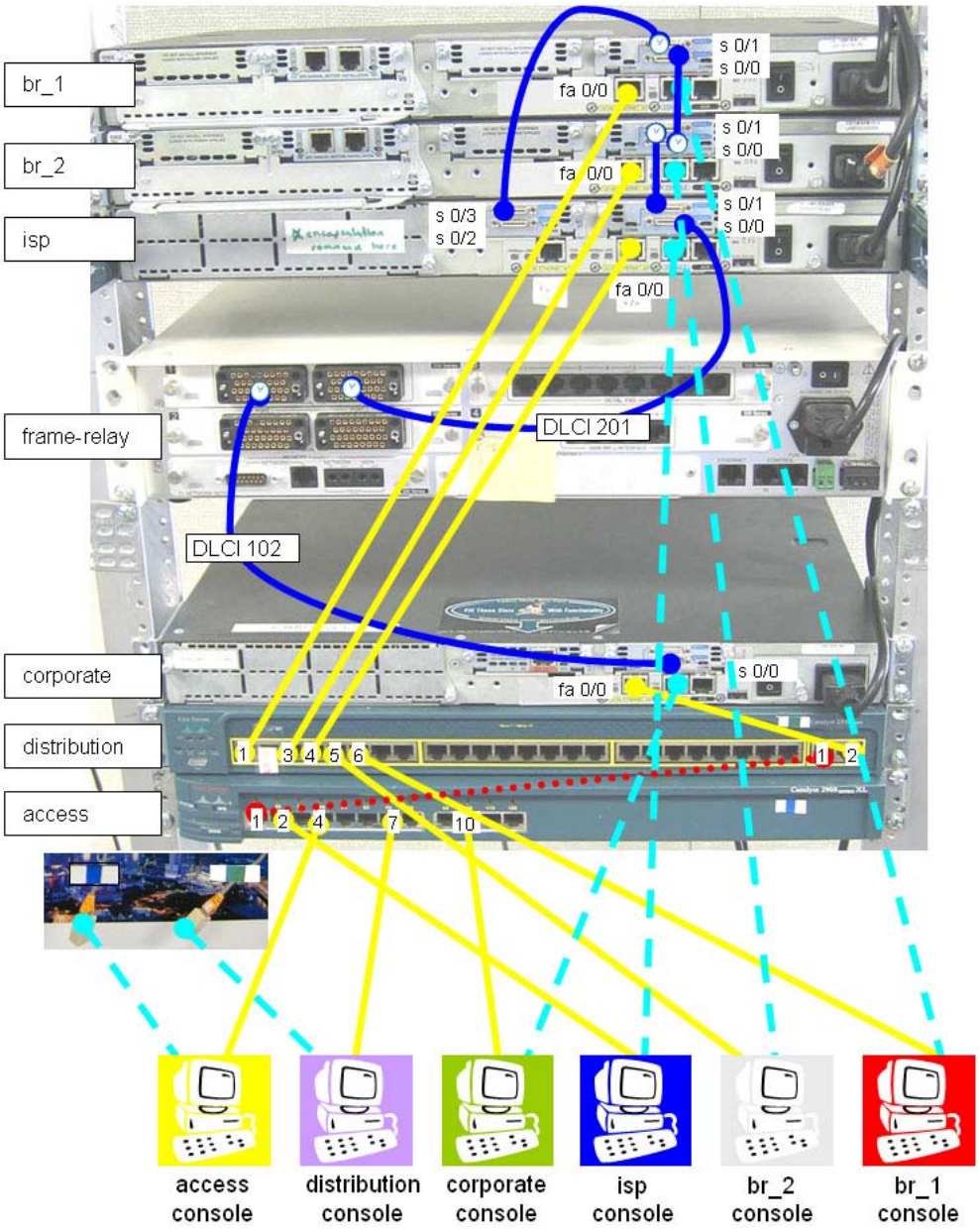
Determine an IP address scheme that fits this model. Configure serial links for ISP, Branch Office 1 (BR_1), and Branch Office 2 (BR_2) with PPP and CHAP authentication. Use /30 subnets for the serial links. Write configurations for both OSPF and EIGRP, to gain experience with both protocols. Default traffic needs to be sent to Loopback 100 on Branch Office 2. Branch Office 1 and Branch Office 2 have LANs, and need to be configured with VLSM networks that are part of 172.16.0.0.

On the Corporate router, it should be the default gateway, DHCP server, and PAT for the Corporate LAN. The Corporate LAN needs to be configured with RFC 1918 (private addressing). The Access and Distribution switches need to be configured with VLANs 1, 10, 20 and 99. Each switch must have one port on each VLAN. All ports are manually configured as access or trunk ports. Port security needs to be configured on all access ports to allow only 1 MAC address. STP Root Bridge is the Distribution switch and it needs to be configured as such. A discard route is also placed on the corporate router. A discard route prevents packets intended for the corporate VLANs to be sent out the default gateway in the event one of the corporate LANs becomes unreachable.

Network Diagram:



Physical Cabling:



Hardware:

BR_1 Cisco 2620 Router with 1 two port serial card, IOS version 12.2
BR_2 Cisco 2620 Router with 1 two port serial card, IOS version 12.2
ISP Cisco 2621 Router with 2 two port serial cards, IOS version 12.2

Corporate Cisco 2620 Router with 1 two port serial card and 1 ISDN card, IOS version 12.2
Distribution Cisco 2950 Switch with 24 Fast Ethernet ports and 2 Gigabit Copper ports, IOS version 12.1
Access Cisco 2900 Switch with 12 Fast Ethernet ports, IOS version 12.0

Corporate LAN VLANs:

	VLAN	Network	Subnet Mask
Default	1	192.168.10.0	255.255.255.224
Accounting	10	192.168.10.32	255.255.255.224
Marketing	20	192.168.10.64	255.255.255.240
Engineering	99	192.168.10.80	255.255.255.240

VLAN Port Assignment:

	Trunk	VLAN 1	VLAN 10	VLAN 20	VLAN 99
Distribution	Gig 0/1 & 0/2	Fa 1-6	Fa 7-12	Fa 13-18	Fa 19-24
Access	Fa 1	Fa 2-3	Fa 4-6	Fa 7-9	Fa 10-12

Running Configurations

We implemented this case study using both EIGRP and OSPF routing protocols. The running configurations below are labeled OSPF for the OSPF implementation and EIGRP for the EIGRP implementation. Note the actual change in routing protocols is only done to the isp, br_1 and br_2 routers. The running configurations for the corporate router and the two switches are the same in both implementations.

OSPF Running Configurations:

ISP 11/22/06 (OSPF)	BR_1 11/22/06 (OSPF)	BR_2 11/22/06 (OSPF)
Current configuration : 1255 bytes **<output omitted>** ! hostname isp ! enable secret 5 1PjZ2$S3t6XejUQpH4kRmEJgK6I0 ! username br_1 password 0 cisco username br_2 password 0 cisco ip subnet-zero ! no ip domain-lookup ! **<output omitted>** ! interface FastEthernet0/0 ip address 63.88.27.129 255.255.255.128 duplex auto speed auto ! interface Serial0/0 ip address 63.88.27.65 255.255.255.252 encapsulation frame-relay frame-relay map ip 63.88.27.66 201 ! interface FastEthernet0/1 no ip address shutdown duplex auto speed auto ! interface Serial0/1 ip address 207.62.41.25 255.255.255.252 encapsulation ppp ppp authentication chap ! interface Serial0/2 no ip address shutdown ! interface Serial0/3 ip address 207.62.41.21 255.255.255.252 encapsulation ppp ppp authentication chap ! router ospf 10 log-adjacency-changes passive-interface FastEthernet0/0 network 63.88.27.64 0.0.0.3 area 0 network 63.88.27.128 0.0.0.127 area 0 network 207.62.41.20 0.0.0.3 area 0	Current configuration : 1074 bytes **<output omitted>** ! hostname br_1 ! enable secret 5 1S3ry$Gh2CqXLrXefkJEjSkO6/r0 ! username br_2 password 0 cisco username isp password 0 cisco memory-size iomem 15 ip subnet-zero ! no ip domain-lookup ! **<output omitted>** ! interface FastEthernet0/0 ip address 172.16.0.129 255.255.255.192 duplex auto speed auto ! interface Serial0/0 ip address 207.62.41.29 255.255.255.252 encapsulation ppp no fair-queue ppp authentication chap ! interface Serial0/1 ip address 207.62.41.22 255.255.255.252 encapsulation ppp clockrate 64000 ppp authentication chap ! router ospf 10 log-adjacency-changes passive-interface FastEthernet0/0 network 172.16.0.128 0.0.0.63 area 0 network 207.62.41.20 0.0.0.3 area 0 network 207.62.41.28 0.0.0.3 area 0 ! ip classless ip http server ! ! voice-port 1/0/0 ! voice-port 1/0/1 ! dial-peer cor custom ! !	Current configuration : 1196 bytes **<output omitted>** ! hostname br_2 ! enable secret 5 $1$9vG0$GA5f0sPbCgyyELNRWssmj1 ! username br_1 password 0 cisco username isp password 0 cisco memory-size iomem 10 ip subnet-zero ! no ip domain-lookup ! **<output omitted>** ! interface Loopback100 ip address 10.10.10.10 255.255.255.252 ! interface FastEthernet0/0 ip address 172.16.0.1 255.255.255.128 duplex auto speed auto ! interface Serial0/0 ip address 207.62.41.30 255.255.255.252 encapsulation ppp clockrate 64000 ppp authentication chap ! interface Serial0/1 ip address 207.62.41.26 255.255.255.252 encapsulation ppp clockrate 64000 ppp authentication chap ! router ospf 10 log-adjacency-changes passive-interface FastEthernet0/0 network 172.16.0.0 0.0.0.127 area 0 network 207.62.41.24 0.0.0.3 area 0 network 207.62.41.28 0.0.0.3 area 0 default-information originate ! ip classless ip route 0.0.0.0 0.0.0.0 Loopback100 ip http server ! ! ! voice-port 1/0/0

ISP 11/22/06 (OSPF)	BR_1 11/22/06 (OSPF)	BR_2 11/22/06 (OSPF)
network 207.62.41.24 0.0.0.3 area 0 ! ip classless ip http server ! ! dial-peer cor custom ! ! ! ! line con 0 exec-timeout 0 0 logging synchronous line aux 0 line vty 0 4 password cisco login ! end	! ! line con 0 exec-timeout 0 0 logging synchronous line aux 0 line vty 0 4 password cisco login ! end	! voice-port 1/0/1 ! dial-peer cor custom ! ! ! ! ! line con 0 exec-timeout 0 0 logging synchronous line aux 0 line vty 0 4 password cisco login ! end

Corporate 11/22/06 (OSPF)	Distribution 11/22/06 (OSPF)	Access 11/22/06 (OSPF)
Current configuration : 2112 bytes **<output omitted>** ! hostname corporate ! enable secret 5 1p3Ob$4EGMu.8vfqTRzz/OBQOMV/ ! memory-size iomem 15 ip subnet-zero ! no ip domain-lookup ip dhcp excluded-address 192.168.10.1 192.168.10.3 ip dhcp excluded-address 192.168.10.33 ip dhcp excluded-address 192.168.10.65 ip dhcp excluded-address 192.168.10.81 ! ip dhcp pool vlan1 network 192.168.10.0 255.255.255.224 default-router 192.168.10.1 ! ip dhcp pool vlan10 network 192.168.10.32 255.255.255.224 default-router 192.168.10.33 ! ip dhcp pool vlan20 network 192.168.10.64 255.255.255.240 default-router 192.168.10.65 ! ip dhcp pool vlan99	Current configuration : 2766 bytes **<output omitted>** ! hostname distribution ! enable secret 5 1KU5Z$260U8/CK9RlIChyPOTzRY0 ! ip subnet-zero no ip domain-lookup ! spanning-tree extend system-id spanning-tree vlan 1 priority 24576 ! ! interface FastEthernet0/1 switchport mode access switchport port-security no ip address ! **<interfaces 2-6 like FastEthernet0/1>** ! interface FastEthernet0/7 switchport access vlan 10 switchport mode access switchport port-security no ip address ! **<interfaces 8-12 like FastEthernet0/7>** ! interface FastEthernet0/13	Current configuration: **<output omitted>** ! hostname access ! enable secret 5 1NKNh$qEBH.dDHIzWCvQ5nszU6/. ! ip subnet-zero no ip domain-lookup ! interface FastEthernet0/1 switchport trunk encapsulation dot1q switchport mode trunk ! interface FastEthernet0/2 port security max-mac-count 1 ! interface FastEthernet0/3 port security max-mac-count 1 ! interface FastEthernet0/4 port security max-mac-count 1 switchport access vlan 10 ! interface FastEthernet0/5 port security max-mac-count 1 switchport access vlan 10 ! interface FastEthernet0/6 port security max-mac-count 1

Corporate 11/22/06 (OSPF)	Distribution 11/22/06 (OSPF)	Access 11/22/06 (OSPF)
network 192.168.10.80 255.255.255.240 default-router 192.168.10.81 ! **<output omitted>** ! interface FastEthernet0/0 no ip address duplex auto speed auto ! interface FastEthernet0/0.1 encapsulation dot1Q 1 native ip address 192.168.10.1 255.255.255.224 ip nat inside ! interface FastEthernet0/0.10 encapsulation dot1Q 10 ip address 192.168.10.33 255.255.255.224 ip nat inside ! interface FastEthernet0/0.20 encapsulation dot1Q 20 ip address 192.168.10.65 255.255.255.240 ip nat inside ! interface FastEthernet0/0.99 encapsulation dot1Q 99 ip address 192.168.10.81 255.255.255.240 ip nat inside ! interface Serial0/0 ip address 63.88.27.66 255.255.255.252 ip nat outside encapsulation frame-relay frame-relay map ip 63.88.27.65 102 ! **<output omitted>** ! ip nat inside source list 1 interface Serial0/0 overload ip classless ip route 0.0.0.0 0.0.0.0 63.88.27.65 ip route 192.168.0.0 255.255.0.0 Null0 ip http server ! access-list 1 permit 192.168.10.0 0.0.0.31 access-list 1 permit 192.168.10.32 0.0.0.31 access-list 1 permit 192.168.10.64 0.0.0.15 access-list 1 permit 192.168.10.80 0.0.0.15 ! **<output omitted>** ! line con 0 exec-timeout 0 0 logging synchronous	switchport access vlan 20 switchport mode access switchport port-security no ip address ! **<interfaces 14-18 like FastEthernet0/13>** ! interface FastEthernet0/19 switchport access vlan 99 switchport mode access switchport port-security no ip address ! **<interfaces 20-24 like FastEthernet0/19>** ! interface GigabitEthernet0/1 switchport mode trunk no ip address ! interface GigabitEthernet0/2 switchport mode trunk no ip address ! interface Vlan1 ip address 192.168.10.2 255.255.255.224 no ip route-cache ! ip http server ! ! line con 0 exec-timeout 0 0 logging synchronous line vty 0 4 password cisco login line vty 5 15 login ! end	switchport access vlan 10 ! interface FastEthernet0/7 port security max-mac-count 1 switchport access vlan 20 ! interface FastEthernet0/8 port security max-mac-count 1 switchport access vlan 20 ! interface FastEthernet0/9 port security max-mac-count 1 switchport access vlan 20 ! interface FastEthernet0/10 port security max-mac-count 1 switchport access vlan 99 ! interface FastEthernet0/11 port security max-mac-count 1 switchport access vlan 99 ! interface FastEthernet0/12 port security max-mac-count 1 switchport access vlan 99 ! interface VLAN1 ip address 192.168.10.3 255.255.255.224 no ip directed-broadcast no ip route-cache ! mac-address-table secure 0002.b34b.a16f FastEthernet0/2 vlan 1 mac-address-table secure 0002.b34c.2383 FastEthernet0/7 vlan 20 mac-address-table secure 0002.b34c.33aa FastEthernet0/10 vlan 99 mac-address-table secure 0002.b35d.e8bf FastEthernet0/4 vlan 10 ! line con 0 exec-timeout 0 0 logging synchronous transport input none stopbits 1 line vty 0 4 password cisco login line vty 5 15 login ! end

Corporate 11/22/06 (OSPF)	Distribution 11/22/06 (OSPF)	Access 11/22/06 (OSPF)
line aux 0 line vty 0 4 password cisco login ! end		

OSPF Routing tables:

Corporate Router (OSPF)

```
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 63.88.27.65 to network 0.0.0.0

     192.168.10.0/24 is variably subnetted, 4 subnets, 2 masks
C       192.168.10.64/28 is directly connected, FastEthernet0/0.20
C       192.168.10.80/28 is directly connected, FastEthernet0/0.99
C       192.168.10.32/27 is directly connected, FastEthernet0/0.10
C       192.168.10.0/27 is directly connected, FastEthernet0/0.1
     63.0.0.0/30 is subnetted, 1 subnets
C       63.88.27.64 is directly connected, Serial0/0
S*   0.0.0.0/0 [1/0] via 63.88.27.65
S    192.168.0.0/16 is directly connected, Null0
```

ISP Router (OSPF)

```
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, 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 207.62.41.26 to network 0.0.0.0

     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
O       172.16.0.128/26 [110/65] via 207.62.41.22, 00:23:43, Serial0/3
O       172.16.0.0/25 [110/65] via 207.62.41.26, 00:23:43, Serial0/1
     207.62.41.0/24 is variably subnetted, 5 subnets, 2 masks
C       207.62.41.24/30 is directly connected, Serial0/1
C       207.62.41.26/32 is directly connected, Serial0/1
O       207.62.41.28/30 [110/845] via 207.62.41.22, 00:23:43, Serial0/3
                        [110/845] via 207.62.41.26, 00:23:43, Serial0/1
C       207.62.41.20/30 is directly connected, Serial0/3
C       207.62.41.22/32 is directly connected, Serial0/3
     63.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       63.88.27.64/30 is directly connected, Serial0/0
C       63.88.27.128/25 is directly connected, FastEthernet0/0
O*E2 0.0.0.0/0 [110/1] via 207.62.41.26, 00:23:46, Serial0/1
```

BR_1 Router (OSPF)

```
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, 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 207.62.41.30 to network 0.0.0.0

     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.0.128/26 is directly connected, FastEthernet0/0
O       172.16.0.0/25 [110/782] via 207.62.41.30, 00:26:34, Serial0/0
     207.62.41.0/24 is variably subnetted, 5 subnets, 2 masks
O       207.62.41.24/30 [110/845] via 207.62.41.21, 00:26:34, Serial0/1
C       207.62.41.28/30 is directly connected, Serial0/0
C       207.62.41.30/32 is directly connected, Serial0/0
C       207.62.41.20/30 is directly connected, Serial0/1
C       207.62.41.21/32 is directly connected, Serial0/1
     63.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
O       63.88.27.64/30 [110/845] via 207.62.41.21, 00:26:34, Serial0/1
O       63.88.27.128/25 [110/782] via 207.62.41.21, 00:26:34, Serial0/1
O*E2 0.0.0.0/0 [110/1] via 207.62.41.30, 00:26:34, Serial0/0
```

BR_2 Router (OSPF)

```
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 0.0.0.0 to network 0.0.0.0

     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
O       172.16.0.128/26 [110/782] via 207.62.41.29, 00:24:57, Serial0/0
C       172.16.0.0/25 is directly connected, FastEthernet0/0
     207.62.41.0/24 is variably subnetted, 5 subnets, 2 masks
C       207.62.41.24/30 is directly connected, Serial0/1
C       207.62.41.25/32 is directly connected, Serial0/1
C       207.62.41.28/30 is directly connected, Serial0/0
C       207.62.41.29/32 is directly connected, Serial0/0
O       207.62.41.20/30 [110/845] via 207.62.41.25, 00:24:58, Serial0/1
     10.0.0.0/30 is subnetted, 1 subnets
C       10.10.10.8 is directly connected, Loopback100
     63.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
O       63.88.27.64/30 [110/845] via 207.62.41.25, 00:24:58, Serial0/1
O       63.88.27.128/25 [110/782] via 207.62.41.25, 00:24:59, Serial0/1
S*   0.0.0.0/0 is directly connected, Loopback100
```

Corporate Outputs

```
corporate#show ip int brief
Interface                  IP-Address      OK? Method Status
Prot
ocol
FastEthernet0/0            unassigned      YES unset  up                    up

FastEthernet0/0.1          192.168.10.1    YES manual up                    up

FastEthernet0/0.10         192.168.10.33   YES manual up                    up

FastEthernet0/0.20         192.168.10.65   YES manual up                    up

FastEthernet0/0.99         192.168.10.81   YES manual up                    up

Serial0/0                  63.88.27.66     YES manual up                    up

BRI0/0                     unassigned      YES unset  administratively down
down

BRI0/0:1                   unassigned      YES unset  administratively down
down

BRI0/0:2                   unassigned      YES unset  administratively down
down

FastEthernet0/1            unassigned      YES unset  administratively down
down

Serial0/1                  unassigned      YES unset  administratively down
down

corporate#show frame-relay map
Serial0/0 (up): ip 0.0.0.0 dlci 104(0x68,0x1880)
              broadcast,
              CISCO, status defined, inactive
Serial0/0 (up): ip 0.0.0.0 dlci 103(0x67,0x1870)
              broadcast,
              CISCO, status defined, inactive
Serial0/0 (up): ip 63.88.27.65 dlci 102(0x66,0x1860), static,
              CISCO, status defined, active
corporate#show ip dhcp binding
IP address       Client-ID/              Lease expiration        Type
                 Hardware address
192.168.10.34    0100.02b3.5de8.bf       Mar 02 1993 12:18 AM    Automatic
192.168.10.66    0100.02b3.4c23.83       Mar 02 1993 12:19 AM    Automatic
192.168.10.82    0100.02b3.4c33.aa       Mar 02 1993 12:19 AM    Automatic
corporate#show ip nat statistics
Total active translations: 0 (0 static, 0 dynamic; 0 extended)
Outside interfaces:
  Serial0/0
Inside interfaces:
  FastEthernet0/0.1, FastEthernet0/0.10, FastEthernet0/0.20
  FastEthernet0/0.99
Hits: 531  Misses: 67
```

```
Expired translations: 67
Dynamic mappings:
-- Inside Source
[Id: 1] access-list 1 interface Serial0/0 refcount 0
```

Access Outputs

```
access#show vlan
VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
-
1    default                          active    Fa0/2, Fa0/3
10   accounting                       active    Fa0/4, Fa0/5, Fa0/6
20   marketing                        active    Fa0/7, Fa0/8, Fa0/9
99   engineering                      active    Fa0/10, Fa0/11, Fa0/12
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
10   enet  100010     1500  -      -      -        -    -        0      0
20   enet  100020     1500  -      -      -        -    -        0      0
99   enet  100099     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      0      -        -    -        0      0
1003 tr    101003     1500  -      0      -        -    srb      0      0
1004 fdnet 101004     1500  -      -      -        ieee -        0      0
1005 trnet 101005     1500  -      -      -        ibm  -        0      0

access#show spanning-tree

Spanning tree 1 is executing the IEEE compatible Spanning Tree protocol
  Bridge Identifier has priority 32768, address 0003.e334.a0c0
  Configured hello time 2, max age 20, forward delay 15
  Current root has priority 24577, address 000b.fc28.d400
  Root port is 13, cost of root path is 19
  Topology change flag not set, detected flag not set, changes 21
  Times:  hold 1, topology change 35, notification 2
          hello 2, max age 20, forward delay 15
  Timers: hello 0, topology change 0, notification 0

Interface Fa0/1 (port 13) in Spanning tree 1 is FORWARDING
   Port path cost 19, Port priority 128
   Designated root has priority 24577, address 000b.fc28.d400
   Designated bridge has priority 24577, address 000b.fc28.d400
   Designated port is 25, path cost 0
   Timers: message age 2, forward delay 0, hold 0
   BPDU: sent 6, received 8667

Interface Fa0/2 (port 14) in Spanning tree 1 is FORWARDING
   Port path cost 19, Port priority 128
   Designated root has priority 24577, address 000b.fc28.d400
   Designated bridge has priority 32768, address 0003.e334.a0c0
   Designated port is 14, path cost 19
   Timers: message age 0, forward delay 0, hold 0
   BPDU: sent 8695, received 0

Interface Fa0/3 (port 15) in Spanning tree 1 is down
   Port path cost 100, Port priority 128
```

Access Outputs

```
   Designated root has priority 24577, address 000b.fc28.d400
   Designated bridge has priority 32768, address 0003.e334.a0c0
   Designated port is 15, path cost 19
   Timers: message age 0, forward delay 0, hold 0
   BPDU: sent 2, received 0
access#show int fa 0/1 switchport
Name: Fa0/1
Switchport: Enabled
Administrative mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: Disabled
Access Mode VLAN: 0 ((Inactive))
Trunking Native Mode VLAN: 1 (default)
Trunking VLANs Enabled: ALL
Trunking VLANs Active: 1,10,20,99
Pruning VLANs Enabled: 2-1001

Priority for untagged frames: 0
Override vlan tag priority: FALSE
Voice VLAN: none
Appliance trust: none
```

Distribution Outputs

```
distribution#show vlan

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
-
1    default                           active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                 Fa0/5, Fa0/6
10   accounting                        active    Fa0/7, Fa0/8, Fa0/9, Fa0/10
                                                 Fa0/11, Fa0/12
20   marketing                         active    Fa0/13, Fa0/14, Fa0/15, Fa0/16
                                                 Fa0/17, Fa0/18
99   engineering                       active    Fa0/19, Fa0/20, Fa0/21, Fa0/22
                                                 Fa0/23, Fa0/24
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
10   enet  100010     1500  -      -      -        -    -        0      0
20   enet  100020     1500  -      -      -        -    -        0      0
99   enet  100099     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        0      0

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1003 tr    101003     1500  -      -      -        -    -        0      0
1004 fdnet 101004     1500  -      -      -        ieee -        0      0
```

Distribution Outputs

```
1005 trnet 101005     1500  -      -      -        ibm  -        0      0

Remote SPAN VLANs
------------------------------------------------------------------------------


Primary Secondary Type              Ports
------- --------- ----------------- ------------------------------------------


distribution#show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    24577
             Address     000b.fc28.d400
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    24577  (priority 24576 sys-id-ext 1)
             Address     000b.fc28.d400
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Port ID                     Designated                 Port ID
Name             Prio.Nbr      Cost Sts      Cost Bridge ID
Prio.Nbr
---------------- -------- --------- --- --------- -------------------- -------
-
Fa0/1            128.1           19 FWD         0 24577 000b.fc28.d400 128.1
Fa0/3            128.3           19 FWD         0 24577 000b.fc28.d400 128.3
Fa0/4            128.4           19 FWD         0 24577 000b.fc28.d400 128.4
Fa0/5            128.5           19 FWD         0 24577 000b.fc28.d400 128.5
Fa0/6            128.6           19 FWD         0 24577 000b.fc28.d400 128.6
Gi0/1            128.25          19 FWD         0 24577 000b.fc28.d400 128.25
Gi0/2            128.26          19 FWD         0 24577 000b.fc28.d400 128.26


VLAN0010
  Spanning tree enabled protocol ieee
  Root ID    Priority    32768
             Address     0003.e334.a0c1
             Cost        19
             Port        25 (GigabitEthernet0/1)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32778  (priority 32768 sys-id-ext 10)
             Address     000b.fc28.d400
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Port ID                     Designated                 Port ID
Name             Prio.Nbr      Cost Sts      Cost Bridge ID
Prio.Nbr
---------------- -------- --------- --- --------- -------------------- -------
```

Distribution Outputs

```
-
Gi0/1            128.25          19 FWD         0 32768 0003.e334.a0c1 128.13
Gi0/2            128.26          19 FWD        19 32778 000b.fc28.d400 128.26


VLAN0020
  Spanning tree enabled protocol ieee
  Root ID    Priority    32768
             Address     0003.e334.a0c2
             Cost        19
             Port        25 (GigabitEthernet0/1)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32788  (priority 32768 sys-id-ext 20)
             Address     000b.fc28.d400
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Port ID                     Designated                 Port ID
Name             Prio.Nbr      Cost Sts      Cost Bridge ID
Prio.Nbr
---------------- -------- --------- --- --------- -------------------- -------
-
Gi0/1            128.25          19 FWD         0 32768 0003.e334.a0c2 128.13
Gi0/2            128.26          19 FWD        19 32788 000b.fc28.d400 128.26


VLAN0099
  Spanning tree enabled protocol ieee
  Root ID    Priority    32768
             Address     0003.e334.a0c3
             Cost        19
             Port        25 (GigabitEthernet0/1)
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32867  (priority 32768 sys-id-ext 99)
             Address     000b.fc28.d400
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Port ID                     Designated                 Port ID
Name             Prio.Nbr      Cost Sts      Cost Bridge ID
Prio.Nbr
---------------- -------- --------- --- --------- -------------------- -------
-
Gi0/1            128.25          19 FWD         0 32768 0003.e334.a0c3 128.13
Gi0/2            128.26          19 FWD        19 32867 000b.fc28.d400 128.26

distribution# show int gi 0/1 switchport
Name: Gi0/1
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
```

Distribution Outputs

```
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Operational private-vlan: none
Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001

Protected: false

Voice VLAN: none (Inactive)
Appliance trust: none
distribution# show int gi 0/2 switchport
Name: Gi0/2
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Operational private-vlan: none
Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001

Protected: false

Voice VLAN: none (Inactive)
Appliance trust: none
```

EIGRP Running Configurations:

ISP 11/22/06 (EIGRP)	BR_1 11/22/06 (EIGRP)	BR_2 11/22/06 (EIGRP)
Current configuration : 1237 bytes **<output omitted>** ! hostname isp ! enable secret 5 $1$3hV6$gLtq9ql4ACLDRZ.lr5sD50 ! username br_1 password 0 cisco username br_2 password 0 cisco ip subnet-zero ! ! no ip domain-lookup ! **<output omitted>** ! interface FastEthernet0/0 ip address 63.88.27.129 255.255.255.128 duplex auto speed auto ! interface Serial0/0 ip address 63.88.27.65 255.255.255.252 encapsulation frame-relay frame-relay map ip 63.88.27.66 201 ! interface FastEthernet0/1 no ip address shutdown duplex auto speed auto ! interface Serial0/1 ip address 207.62.41.25 255.255.255.252 encapsulation ppp ppp authentication chap ! interface Serial0/2 no ip address shutdown ! interface Serial0/3 ip address 207.62.41.21 255.255.255.252 encapsulation ppp ppp authentication chap ! router eigrp 1 redistribute connected redistribute static passive-interface FastEthernet0/0 network 63.88.27.128 0.0.0.127	Current configuration : 1017 bytes **<output omitted>** ! hostname br_1 ! enable secret 5 $1$2F6h$lkPUjSNTHp44uCTXawKKh. ! username br_2 password 0 cisco username isp password 0 cisco memory-size iomem 15 ip subnet-zero ! no ip domain-lookup ! **<output omitted>** ! interface FastEthernet0/0 ip address 172.16.0.129 255.255.255.192 duplex auto speed auto ! interface Serial0/0 ip address 207.62.41.29 255.255.255.252 encapsulation ppp ppp authentication chap ! interface Serial0/1 ip address 207.62.41.22 255.255.255.252 encapsulation ppp clockrate 64000 ppp authentication chap ! router eigrp 1 passive-interface FastEthernet0/0 network 172.16.0.128 0.0.0.63 network 207.62.41.20 0.0.0.3 network 207.62.41.28 0.0.0.3 no auto-summary ! ip classless ip http server ! **<output omitted>** ! line con 0 exec-timeout 0 0 logging synchronous line aux 0 line vty 0 4 password cisco login	Current configuration : 1189 bytes **<output omitted>** ! hostname br_2 ! enable secret 5 1Vqwq$lE8e5tenjg47DNIgBrPVT0 ! username br_1 password 0 cisco username isp password 0 cisco memory-size iomem 15 ip subnet-zero ! no ip domain-lookup ! **<output omitted>** ! interface Loopback100 ip address 10.10.10.10 255.255.255.252 ! interface FastEthernet0/0 ip address 172.16.0.1 255.255.255.128 duplex auto speed auto ! interface Serial0/0 ip address 207.62.41.30 255.255.255.252 encapsulation ppp no fair-queue clockrate 64000 ppp authentication chap ! interface Serial0/1 ip address 207.62.41.26 255.255.255.252 encapsulation ppp clockrate 64000 ppp authentication chap ! router eigrp 1 redistribute static passive-interface FastEthernet0/0 network 172.16.0.0 0.0.0.127 network 207.62.41.24 0.0.0.3 network 207.62.41.28 0.0.0.3 no auto-summary ! ip classless ip route 0.0.0.0 0.0.0.0 Loopback100 ip http server ! **<output omitted>** !

ISP 11/22/06 (EIGRP)	BR_1 11/22/06 (EIGRP)	BR_2 11/22/06 (EIGRP)
network 207.62.41.20 0.0.0.3 network 207.62.41.24 0.0.0.3 no auto-summary ! ip classless ip http server ! <**output omitted**> ! line con 0 exec-timeout 0 0 logging synchronous line aux 0 line vty 0 4 password cisco login ! End	! end	line con 0 exec-timeout 0 0 logging synchronous line aux 0 line vty 0 4 password cisco login ! end

EIGRP Routing tables:

ISP Router (EIGRP)

```
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, 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 207.62.41.26 to network 0.0.0.0

     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
D       172.16.0.128/26 [90/2172416] via 207.62.41.22, 02:27:16, Serial0/3
D       172.16.0.0/25 [90/2172416] via 207.62.41.26, 02:27:02, Serial0/1
     207.62.41.0/24 is variably subnetted, 7 subnets, 2 masks
C       207.62.41.24/30 is directly connected, Serial0/1
C       207.62.41.26/32 is directly connected, Serial0/1
D       207.62.41.28/30 [90/21024000] via 207.62.41.26, 02:29:52, Serial0/1
                        [90/21024000] via 207.62.41.22, 02:29:52, Serial0/3
D       207.62.41.29/32 [90/21024000] via 207.62.41.26, 02:29:56, Serial0/1
D       207.62.41.30/32 [90/21024000] via 207.62.41.22, 02:29:52, Serial0/3
C       207.62.41.20/30 is directly connected, Serial0/3
C       207.62.41.22/32 is directly connected, Serial0/3
     63.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       63.88.27.64/30 is directly connected, Serial0/0
C       63.88.27.128/25 is directly connected, FastEthernet0/0
D*EX 0.0.0.0/0 [170/2297856] via 207.62.41.26, 02:29:58, Serial0/1
```

BR_1 Router (EIGRP)

```
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, 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 207.62.41.30 to network 0.0.0.0

     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.0.128/26 is directly connected, FastEthernet0/0
D       172.16.0.0/25 [90/20514560] via 207.62.41.30, 02:31:28, Serial0/0
     207.62.41.0/24 is variably subnetted, 7 subnets, 2 masks
D       207.62.41.24/30 [90/21024000] via 207.62.41.30, 02:34:17, Serial0/0
                        [90/21024000] via 207.62.41.21, 02:34:17, Serial0/1
D       207.62.41.25/32 [90/21024000] via 207.62.41.30, 02:34:19, Serial0/0
D       207.62.41.26/32 [90/21024000] via 207.62.41.21, 02:34:17, Serial0/1
C       207.62.41.28/30 is directly connected, Serial0/0
C       207.62.41.30/32 is directly connected, Serial0/0
C       207.62.41.20/30 is directly connected, Serial0/1
C       207.62.41.21/32 is directly connected, Serial0/1
     63.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
D EX    63.88.27.64/30 [170/21024000] via 207.62.41.21, 02:34:19, Serial0/1
D       63.88.27.128/25 [90/20514560] via 207.62.41.21, 02:31:15, Serial0/1
D*EX 0.0.0.0/0 [170/20640000] via 207.62.41.30, 02:34:19, Serial0/0
```

BR_2 Router (EIGRP)

```
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 0.0.0.0 to network 0.0.0.0

     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
D       172.16.0.128/26 [90/20514560] via 207.62.41.29, 00:02:54, Serial0/0
C       172.16.0.0/25 is directly connected, FastEthernet0/0
     207.62.41.0/24 is variably subnetted, 7 subnets, 2 masks
C       207.62.41.24/30 is directly connected, Serial0/1
C       207.62.41.25/32 is directly connected, Serial0/1
C       207.62.41.28/30 is directly connected, Serial0/0
C       207.62.41.29/32 is directly connected, Serial0/0
D       207.62.41.20/30 [90/21024000] via 207.62.41.25, 00:02:55, Serial0/1
                        [90/21024000] via 207.62.41.29, 00:02:55, Serial0/0
D       207.62.41.21/32 [90/21024000] via 207.62.41.29, 00:02:55, Serial0/0
D       207.62.41.22/32 [90/21024000] via 207.62.41.25, 00:02:57, Serial0/1
     10.0.0.0/30 is subnetted, 1 subnets
C       10.10.10.8 is directly connected, Loopback100
     63.0.0.0/25 is subnetted, 1 subnets
```

```
D       63.88.27.128 [90/20514560] via 207.62.41.25, 00:02:55, Serial0/1
S*   0.0.0.0/0 is directly connected, Loopback100
```

Command Summary:

Command	Description
#**delete flash:vlan.dat**	Clears the 'VLAN' data stored in flash
#**erase startup-config**	Erase any previous running configs stored in memory
#**reload**	Restarts the IOS after removing any stored startup-configs
#**clear mac-address-table secure**	Clears any previously stored MAC addresses
#**clear port-security dynamic**	Clears previously stored port-security data
#**vlan database**	Assign VLAN database to Cisco 2900XL
#**vtp client**	Assigns switch status to 'client' – Propagates data w/ 'server'
#**vtp server**	Create, delete, modify VLANS in 'vtp server mode'
#**vlan 20 name marketing**	Assings the name 'marketing' to VLAN 20
#**vtp domain corporate**	Assigns domain name 'corporate'.
#**vtp password cisco**	Assigns VLAN database password to 'cisco'
(config)#**int fa 0/7** (config-if)#**switchport mode access** (config-if)#**port security max 1** (config-if)#**switchport access vlan 20**	Configure interface port #7 of Cisco 2900XL switch Assigns port #7 as 'access mode' on 2900XL switch Assigns maximum 1 mac address to port #7 on the switch Assigns the 'access port #7' to 'VLAN 20'
(config)#**int vlan1** (config-if)#**ip add 192.168.10.3 255.255.255.224**	Assigns ip address and subnet mask to 'VLAN 1'
(config-if)#**spanning-tree vlan 1 root primary**	Assigns 2950 as root switch and enables 'spanning tree'
(config-if)#**switchport port-security**	Enables port security
(config-if)#**switchport port-security maximum 1**	Sets maximum MAC addresses = 1
(config-if)#**switchport port-security violation shutdown**	If port exceeds 1 MAC address, then action is to 'shutdown'
#**show port_security**	Shows port security messages
#**ip dhcp excluded-address 192.168.10.65**	Address cannot be issued during 'DHCP'
#**ip dhcp pool vlan1** #**network 192.168.10.0 255.255.255.224** #**default-router 192.168.10.1**	Assigns dhcp to VLAN 1 Assigns a range of ip addresses for VLAN 1 Assigns default gateway
(config)#**int fa0/0.1** #**encaps dot1q 1 native** #**ip add 192.168.10.1 255.255.255.224** #**ip nat inside**	Configure interface fast Ethernet 0/0.1 Enables the interface to accept 802.1Q VLAN packets Assigns ip address and subnet mask for interface Enables Network Address Translation on incoming packets
(config)#**ip nat inside source list 1 int s0/0 overload** #**access-list 1 permit 192.168.10.0**	Provide Access Lists for specified networks used for NAT Lists available ip address for a given network

0.0.0.31	
(config)#**int s0/0** (config-if)#**ip address 63.88.27.66 255.255.255.252** (config-if)#**ip nat outside** (config-if)#**encaps frame-relay** (config-if)#**frame-relay map ip 63.88.27.65 102**	Configure interface 'serial 0/0' Assign ip address and subnet mask to serial port 's0/0' Enable Network Address Translation on outgoing packets Encapsulation used = frame relay Map frame relay packets to DLCI 102 => 63.88.27.65
(config)#**int s0/1** (config-if)#**ip add 207.62.41.25 255.255.255.252** (config-if)#**encaps ppp** (config-if)#**ppp authentication chap**	Configure Serial interface 0/1 of ISP Assign ip address and subnet mask for S0/1 Use encapsulation PPP (Point to Point Protocol) Use 'chap'
(config)#**router ospf 10** (config-router)#**network 207.62.41.20 0.0.0.3 area 0**	Use OSPF Enter networks and reverse subnet mask w/ area *number*
Br-2(config)#**int loopback100** (config-if)#**ip add 10.10.10.10. 255.255.255.252**	Configure Loopback interface '100' Assign ip address and subnet mask to interface
(config)#**ip route 0.0.0.0 0.0.0.0 63.88.27.65**	Next hop address when going through frame relay

Troubleshooting/Reflection:

Problem: Static routes not being distributed between isp, br_1 and br_2.
Resolution:
a) Static routes can be defined with a local interface or the next hop IP address. We HAD TO SPECIFY the next hop instead of the interface on both sides of the frame relay before isp router's static route was distributed by eigrp to br_1 and br_2.
b) In addition Gary recommended we use "redistribute connections" on isp's EIGRP configuration to properly handle the frame-relay correctly.

Problem: Switches could not ping router.
Resolution: Forgot to "no shut" the vlan 1 interface on both switches which caused ping to fail on these devices.This command was added to the copy/paste command file to prevent happening again.

Problem: Switches could not ping the router
Resolution: A cross-over cable was initially connected between the distribution switch and the corporate router which caused dhcp to fail. Installing the correct straight through cable fixed this. Only one cross-over cable is needed and that is between the two switches.Revised the wiring diagram to better clarify which cables should be used to prevent this from happening again.

Problem: Incorrect routing tables on isp, br_1 and br_2.
Resolution: Typos were uncovered by visual inspections after the network did not converge. Most of the typos were network and IP addresses.

Problem: Hosts below the cloud could not ping the router or get dhcp addresses.
Resolution: The Max 1 port security configured on access switch was blocking ports 4, 7 and 10. The fix was to clear the mac addresses that were added to the running config with "no ..."'s.A simpler method was found later which is issue the command "clear mac-address-table secure" on access (2900XL) and "clear port-security dynamic" on the distribution (2950). These commands were added to the copy/paste config files to prevent it from reoccurring.

Problem: Unable to type any commands into TeraTerm serial interface to Corporate.
Resolution: Keyboard cable was not plugged in all the way into the back of the PC. Was dislodged by USB memory stick. Worked fine when pushed back in.

Problem: Istanbul host PC did not power up.
Resolution: The PCs have two power switches. The one on the back of the PC, on the power supply itselt, was switched off. Switching it back on solved the problem.

Problem: EIGRP error messages on adjacent neighbors.
Resolution: Added a "passive-interface fa 0/0" to the EIGRP section of ISP, br_1 and br_2. They were all connected into VLAN 1 ports on Distribution and even though they were configured as separate subnets the routing information was getting passed through the switch. The passive-interface command fixed this problem.

Problem: OSPF didn't like the no auto-summary command.

Resolution: Didn't use it and it still converged on Netlab and Cape Town.

Problem: OSPF did not distribute static route on ISP to br_1 and br_2
Resolution: Remove static route on ISP to Corporate and add that network into the OSPF networks instead. Also removed the redistribute static and redistribute connections from ISP. This worked and routing tables on br_1 and br_2 now included a route to the 63.88.27.64 network.

Test Plan:
The test methodology involved creating test cases for each Case Study requirement. For convergence this included end-to-end ping tests and verifying routing tables had routes to all networks. For NAT/PAT this included pinging both directions (outside to inside should fail) and using debug ip icmp to make sure address translation was happening. For DHCP testing we configured three hosts with DHCP on different corporate VLANs and then checked the assigned IP address for being in the proper subnet. To check VLSM we looked at the routing tables. We also check DHCP bindings on corporate. We used several commands on the switches to verify security and vlan configuration. Also we found one switch security defect with a peer review of running-configs. The test cases are documented in Appendix A.

Appendix A

Test Plan
Here is our test plan to make sure that everything is working.

BTC = Below the cloud
OTC = Over the cloud

BTC-1) Verify RFC 1918, VLSM, DHCP

On corporate
show ip route
verify we have four 192.168.x.x subnets and multiple subnet masks.
verify default gateway configured
save copy for the report

BTC-2) Verify DHCP

On host PCs
disable/enable network connections on Yellow. Purple and Green hosts
- Yellow is on VLAN 10 and should get IP 192.168.10.34+ and GW 192.168.10.33
- Purple is on VLAN 20 and should get IP 192.168.10.66+ and GW 192.168.10.65
- Green is on VLAN 99 and should get IP 192.168.10.82+ and GW 192.168.10.81

On corporate
show ip dhcp binding

BTC-3) Verify end-to-end convergence and NAT

On isp
should fail:
ping 192.168.10.1
ping 192.168.10.2
ping 192.168.10.3
ping 192.168.10.65
ping 192.168.10.81

debug ip icmp
all pings tests (below) from corporate LAN should only use 63.88.27.66

Yellow PC
!ping corporate ports and sub-ifs
ping 192.168.10.1
ping 192.168.10.33
ping 192.168.10.65

ping 192.168.10.81
ping 63.88.27.66

!ping isp ports
ping 63.88.27.65
ping 63.88.27.129
ping 207.62.41.21
ping 207.62.41.25

!ping isp host
ping 63.88.27.130

!ping br_1 ports
ping 172.16.0.129
ping 207.62.41.22
ping 207.62.41.29

!ping br_1 host
ping 172.16.0.130

!ping br_2 ports
ping 172.16.0.1
ping 207.62.41.30
ping 207.62.41.26
ping 10.10.10.10
traceroute 10.10.10.10

!ping br_2 host
ping 172.16.0.2

Purple PC

!ping corporate ports and sub-ifs
ping 192.168.10.1
ping 192.168.10.33
ping 192.168.10.65
ping 192.168.10.81
ping 63.88.27.66

!ping isp ports
ping 63.88.27.65
ping 63.88.27.129
ping 207.62.41.21
ping 207.62.41.25

!ping isp host
ping 63.88.27.130

```
!ping br_1 ports
 ping 172.16.0.129
 ping 207.62.41.22
 ping 207.62.41.29

!ping br_1 host
 ping 172.16.0.130

!ping br_2 ports
 ping 172.16.0.1
 ping 207.62.41.30
 ping 207.62.41.26
 ping 10.10.10.10
 traceroute 10.10.10.10

!ping br_2 host
 ping 172.16.0.2
```

Green PC

```
!ping corporate ports and sub-ifs
 ping 192.168.10.1
 ping 192.168.10.33
 ping 192.168.10.65
 ping 192.168.10.81
 ping 63.88.27.66

!ping isp ports
 ping 63.88.27.65
 ping 63.88.27.129
 ping 207.62.41.21
 ping 207.62.41.25

!ping isp host
 ping 63.88.27.130

!ping br_1 ports
 ping 172.16.0.129
 ping 207.62.41.22
 ping 207.62.41.29

!ping br_1 host
 ping 172.16.0.130

!ping br_2 ports
 ping 172.16.0.1
 ping 207.62.41.30
 ping 207.62.41.26
```

ping 10.10.10.10
traceroute 10.10.10.10

!ping br_2 host
ping 172.16.0.2

On corporate
show ip nat translation
show ip nat statistics
- save copy for report

BTC-4) Switch configuration

On both switches
!ping isp ports
ping 63.88.27.65
ping 63.88.27.129
ping 207.62.41.21
ping 207.62.41.25

!ping isp host
ping 63.88.27.130
ping 207.62.41.25

!ping br_1 ports
ping 172.16.0.129
ping 207.62.41.22
ping 207.62.41.29

!ping br_1 host
ping 172.16.0.130

!ping br_2 ports
ping 172.16.0.1
ping 207.62.41.30
ping 207.62.41.26
ping 10.10.10.10
traceroute 10.10.10.10

!ping br_2 host
ping 172.16.0.2

On Access
show vlan
- Verify each switch has at least one port on VLAN 1, 10, 20 and 99
- save copy for report
show run

- verify each port manually configured as manual or trunk port
- verify each access port has Max 1 security configured
- save copy for report

show spanning-tree
- verify access is not root switch
- save copy for report

show int fa 0/1 switchport
- verify trunking
- save copy for report

On Distribution

show vlan
- Verify each switch has at least one port on VLAN 1, 10, 20 and 99
- save copy for report

show run
- verify each port manually configured as manual or trunk port
- verify each access port has Max 1 security configured
- save copy for report

show spanning-tree
- verify distribution is the root switch
- save copy for report

show int gi 0/1 switchport
- verify trunking
- save copy for report

show int gi 0/2 switchport
- verify trunking
- save copy for report

BTC-5) Be able to telnet to all switches

On corporate

telnet 192.168.10.2
login and exit

telnet 192.168.10.3
login and exit

OTC-6) Convergence tests between top three routers

!ping isp ports
ping 63.88.27.65
ping 63.88.27.129
ping 207.62.41.21
ping 207.62.41.25

!ping isp host
ping 63.88.27.130

```
!ping br_1 ports
 ping 172.16.0.129
 ping 207.62.41.22
 ping 207.62.41.29

!ping br_1 host
 ping 172.16.0.130

!ping br_2 ports
 ping 172.16.0.1
 ping 207.62.41.30
 ping 207.62.41.26
 ping 10.10.10.10
 traceroute 10.10.10.10

!ping br_2 host
 ping 172.16.0.2
```

on isp, br_1 and br_2 verify ip routes for:

172.16.0.128/26
172.16.0.0/25

207.62.41.24/30
207.62.41.28/30
207.62.41.20/30

10.10.10.8

63.88.27.64/30
63.88.27.128/25

Default gateway (of last resort) is set

on br_2
telnet to isp, br_1, corporate and capture running configs
telnet to both switches (via corporate) and capture running configs

Appendix B

Case Study Requirements

Here we show the case study requirements and how we met each requirement.

Corporate LAN

1. IP Addressing

Use RFC 1918
Use VLSM

We subnetted using the following:

VLAN 1	192.168.10.0/27
VLAN 10	192.168.10.32/27
VLAN 20	192.168.10.64/28
VLAN 99	192.168.10.80/28

2. Access and Distribution Switches

A. Configure ports as a member of VLAN 1, 10, 20, 99. Each switch must have at least one port in each VLAN.

Distribution Switch

```
VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
-
1    default                           active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                 Fa0/5, Fa0/6
10   accounting                        active    Fa0/7, Fa0/8, Fa0/9, Fa0/10
                                                 Fa0/11, Fa0/12
20   marketing                         active    Fa0/13, Fa0/14, Fa0/15, Fa0/16
                                                 Fa0/17, Fa0/18
99   engineering                       active    Fa0/19, Fa0/20, Fa0/21, Fa0/22
                                                 Fa0/23, Fa0/24
```

Access Switch

```
VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
-
1    default                           active    Fa0/2, Fa0/3
10   accounting                        active    Fa0/4, Fa0/5, Fa0/6
20   marketing                         active    Fa0/7, Fa0/8, Fa0/9
99   engineering                       active    Fa0/10, Fa0/11, Fa0/12
```

B. All ports configured manually as access or trunk ports.

Distribution Switch – sample

```
interface FastEthernet0/24
 switchport access vlan 99
 switchport mode access
 switchport port-security
 no ip address
!
interface GigabitEthernet0/1
 switchport mode trunk
 no ip address
```

Access Switch – sample

```
interface FastEthernet0/1
 switchport trunk encapsulation dot1q
 switchport mode trunk
!
interface FastEthernet0/4
 port security max-mac-count 1
 switchport access vlan 10
```

C. Port security configured on all access ports to allow only 1 MAC address.

Distribution Switch – sample

```
distribution#show port-security
Secure Port  MaxSecureAddr  CurrentAddr  SecurityViolation  Security Action
               (Count)       (Count)          (Count)
-------------------------------------------------------------------------
      Fa0/1              1            0                  0         Shutdown
      Fa0/2              1            0                  0         Shutdown
      Fa0/3              1            0                  0         Shutdown
```

Access Switch – sample

```
access#show run

interface FastEthernet0/2
 port security max-mac-count 1
!
interface FastEthernet0/3
 port security max-mac-count 1
```

D. STP Root Bridge is the Distribution switch

```
distribution#show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    24577
             Address     000b.fc28.d400
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
```

3. Configure trunking to allow for all VLANs to intercommunicate.

```
distribution#show vtp status

VTP Version                     : 2
Configuration Revision          : 1
Maximum VLANs supported locally : 250
Number of existing VLANs        : 8
VTP Operating Mode              : Server
VTP Domain Name                 : corporate

Access#show vtp status

VTP Version                     : 2
Configuration Revision          : 1
Maximum VLANs supported locally : 68
Number of existing VLANs        : 8
VTP Operating Mode              : Client
VTP Domain Name                 : corporate

corporate#show ip route

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

     192.168.10.0/24 is variably subnetted, 4 subnets, 2 masks
C       192.168.10.64/28 is directly connected, FastEthernet0/0.20
C       192.168.10.80/28 is directly connected, FastEthernet0/0.99
C       192.168.10.32/27 is directly connected, FastEthernet0/0.10
C       192.168.10.0/27 is directly connected, FastEthernet0/0.1
     63.0.0.0/30 is subnetted, 1 subnets
C       63.88.27.64 is directly connected, Serial0/0
S*   0.0.0.0/0 [1/0] via 63.88.27.65
```

4. Corporate Router

A. Default Gateway for Corporate LAN

```
corporate#show ip route

Gateway of last resort is 63.88.27.65 to network 0.0.0.0
```

```
     63.0.0.0/30 is subnetted, 1 subnets
C       63.88.27.64 is directly connected, Serial0/0
S*   0.0.0.0/0 [1/0] via 63.88.27.65
```

B. DHCP Server for Corporate LAN

```
corporate#show run

ip dhcp excluded-address 192.168.10.1 192.168.10.3
ip dhcp excluded-address 192.168.10.33
ip dhcp excluded-address 192.168.10.65
ip dhcp excluded-address 192.168.10.81
!
ip dhcp pool vlan1
   network 192.168.10.0 255.255.255.224
   default-router 192.168.10.1
!
ip dhcp pool vlan10
   network 192.168.10.32 255.255.255.224
   default-router 192.168.10.33
!
ip dhcp pool vlan20
   network 192.168.10.64 255.255.255.240
   default-router 192.168.10.65
!
ip dhcp pool vlan99
   network 192.168.10.80 255.255.255.240
   default-router 192.168.10.81
```

C. NAT/PAT for Corporate LAN

```
corporate#show run

interface FastEthernet0/0.1
 encapsulation dot1Q 1 native
 ip address 192.168.10.1 255.255.255.224
 ip nat inside
!
interface FastEthernet0/0.10
 encapsulation dot1Q 10
 ip address 192.168.10.33 255.255.255.224
 ip nat inside
!
interface FastEthernet0/0.20
 encapsulation dot1Q 20
 ip address 192.168.10.65 255.255.255.240
 ip nat inside
!
interface FastEthernet0/0.99
 encapsulation dot1Q 99
 ip address 192.168.10.81 255.255.255.240
 ip nat inside
!
interface Serial0/0
 ip address 63.88.27.66 255.255.255.252
 ip nat outside
```

```
ip nat inside source list 1 interface Serial0/0 overload


corporate#show ip nat statistics

Total active translations: 0 (0 static, 0 dynamic; 0 extended)
Outside interfaces:
  Serial0/0
Inside interfaces:
  FastEthernet0/0.1, FastEthernet0/0.10, FastEthernet0/0.20
  FastEthernet0/0.99
Hits: 89  Misses: 35
Expired translations: 35
Dynamic mappings:
-- Inside Source
[Id: 1] access-list 1 interface Serial0/0 refcount 0


isp#debug ip icmp

ICMP packet debugging is on

isp#
02:54:17: ICMP: echo reply sent, src 63.88.27.65, dst 63.88.27.66
isp#
02:54:42: ICMP: echo reply sent, src 63.88.27.129, dst 63.88.27.66
isp#
02:55:14: ICMP: echo reply sent, src 207.62.41.21, dst 63.88.27.66
isp#
02:55:25: ICMP: echo reply sent, src 207.62.41.25, dst 63.88.27.66
```

D. Connected to ISP Router using Frame Relay

- **a. DLCI 102**
- **b. Use Frame Relay Map statement**
- **c. Default Route to ISP (use next hop address, issue with Adtran)**
- **d. /30 Subnet**

```
corporate#show run

interface Serial0/0
 ip address 63.88.27.66 255.255.255.252
 ip nat outside
 encapsulation frame-relay
 frame-relay map ip 63.88.27.65 102

corporate#show ip route

     63.0.0.0/30 is subnetted, 1 subnets
C       63.88.27.64 is directly connected, Serial0/0
S*   0.0.0.0/0 [1/0] via 63.88.27.65

corporate#show frame-relay map

Serial0/0 (up): ip 63.88.27.65 dlci 102(0x66,0x1860), static,
              CISCO, status defined, active
```

5. Other

A. Ability to remotely manage all switches (telnet).

```
corporate#telnet 192.168.10.2

Trying 192.168.10.2 ... Open

User Access Verification

Password:
distribution>en
Password:
distribution#copy run tftp
Address or name of remote host []? 63.88.27.130
Destination filename [distribution-confg]?
!!
2766 bytes copied in 3.792 secs (922 bytes/sec)
distribution#


corporate#telnet 192.168.10.3

Trying 192.168.10.3 ... Open

User Access Verification

Password:
access>en
Password:
access#copy run tftp
Address or name of remote host []? 63.88.27.130
Destination filename [running-config]?
!!
1801 bytes copied in 3.874 secs (600 bytes/sec)
```

Network

1. ISP Router

A. Static route to Corporate LAN

```
isp#sh ip route


     63.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       63.88.27.64/30 is directly connected, Serial0/0
C       63.88.27.128/25 is directly connected, FastEthernet0/0
O*E2 0.0.0.0/0 [110/1] via 207.62.41.26, 01:05:14, Serial0/1
```

```
isp#show run

ip route 63.88.27.64 255.255.255.252 63.88.27.66
```

B. Connected to ISP Router using Frame Relay
- **a. DLCI 201**
- **b. Use Frame Relay Map statement**
- **c. Default Route to ISP (use next hop address, issue with Adtran)**
- **d. /30 Subnet**

```
isp#show run

interface Serial0/0
 ip address 63.88.27.65 255.255.255.252
 encapsulation frame-relay
 frame-relay map ip 63.88.27.66 201
 frame-relay lmi-type ansi

isp#sh ip route

     63.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       63.88.27.64/30 is directly connected, Serial0/0
C       63.88.27.128/25 is directly connected, FastEthernet0/0
O*E2 0.0.0.0/0 [110/1] via 207.62.41.26, 01:05:14, Serial0/1

isp#show frame-relay map

Serial0/0 (up): ip 63.88.27.66 dlci 201(0xC9,0x3090), static,
              CISCO, status defined, active
```

2. ISP, Branch Office 1, Branch Office 2

A. Serial Connections
- **a. PPP**
- **b. Chap Authentication**
- **c. /30 Subnets**

ISP Router

```
isp#show run

interface Serial0/1
 ip address 207.62.41.25 255.255.255.252
 encapsulation ppp
 ppp authentication chap
!
interface Serial0/3
 ip address 207.62.41.21 255.255.255.252
 encapsulation ppp
 ppp authentication chap
```

BR_1 Router

```
BR_1#show run

interface Serial0/0
 ip address 207.62.41.29 255.255.255.252
 encapsulation ppp
 no fair-queue
 ppp authentication chap
!
interface Serial0/1
 ip address 207.62.41.22 255.255.255.252
 encapsulation ppp
 clockrate 64000
 ppp authentication chap
```

BR_2 Router

```
BR_2#show run

interface Serial0/0
 ip address 207.62.41.30 255.255.255.252
 encapsulation ppp
 clockrate 64000
 ppp authentication chap
!
interface Serial0/1
 ip address 207.62.41.26 255.255.255.252
 encapsulation ppp
 clockrate 64000
 ppp authentication chap
```

3. Routing Protocol

A. EIGRP or OSPF

We did both. Both running configurations & routing tables are included in the main document.

B. Default traffic sent to Branch Office 2, Loopback 100

```
br_2#sh ip int brief

Interface                  IP-Address      OK? Method Status
Protocol

FastEthernet0/0            172.16.0.1      YES manual up              up

Serial0/0                  207.62.41.30    YES manual up              up

Serial0/1                  207.62.41.26    YES manual up              up
```

```
Loopback100                10.10.10.10     YES manual up                    up


br_2#sh ip route

S*   0.0.0.0/0 is directly connected, Loopback100


br_1#sh ip route

Gateway of last resort is 207.62.41.30 to network 0.0.0.0

O*E2 0.0.0.0/0 [110/1] via 207.62.41.30, 01:00:31, Serial0/0
```

4. Configure LAN interfaces for Branch Office 1 and Branch Office 2

A. Branch Office 1 and Branch Office 2 are VLSM networks, part of 172.16.0.0

```
br_1#sh ip route

     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.0.128/26 is directly connected, FastEthernet0/0
O       172.16.0.0/25 [110/782] via 207.62.41.30, 01:00:31, Serial0/0


br_2#sh ip route

     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
O       172.16.0.128/26 [110/782] via 207.62.41.29, 00:53:04, Serial0/0
C       172.16.0.0/25 is directly connected, FastEthernet0/0
```

Verification

1. Workstation on Corporate LAN should be able to ping all other interfaces in network.

Sample

```
C:\Documents and Settings\cisco>ping 10.10.10.10

Pinging 10.10.10.10 with 32 bytes of data:

Reply from 10.10.10.10: bytes=32 time=49ms TTL=253
Reply from 10.10.10.10: bytes=32 time=48ms TTL=253
Reply from 10.10.10.10: bytes=32 time=51ms TTL=253
Reply from 10.10.10.10: bytes=32 time=49ms TTL=253

Ping statistics for 10.10.10.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 48ms, Maximum = 51ms, Average = 49ms
```

```
C:\Documents and Settings\cisco>ping 172.16.0.2

Pinging 172.16.0.2 with 32 bytes of data:

Reply from 172.16.0.2: bytes=32 time=58ms TTL=125
Reply from 172.16.0.2: bytes=32 time=51ms TTL=125
Reply from 172.16.0.2: bytes=32 time=49ms TTL=125
Reply from 172.16.0.2: bytes=32 time=48ms TTL=125


C:\Documents and Settings\cisco>ping 207.62.41.26

Pinging 207.62.41.26 with 32 bytes of data:

Reply from 207.62.41.26: bytes=32 time=51ms TTL=253
Reply from 207.62.41.26: bytes=32 time=49ms TTL=253
Reply from 207.62.41.26: bytes=32 time=48ms TTL=253
Reply from 207.62.41.26: bytes=32 time=46ms TTL=253



C:\Documents and Settings\cisco>ping 172.16.0.130

Pinging 172.16.0.130 with 32 bytes of data:

Reply from 172.16.0.130: bytes=32 time=55ms TTL=125
Reply from 172.16.0.130: bytes=32 time=48ms TTL=125
Reply from 172.16.0.130: bytes=32 time=51ms TTL=125
Reply from 172.16.0.130: bytes=32 time=50ms TTL=125


C:\Documents and Settings\cisco>ping 63.88.27.130

Pinging 63.88.27.130 with 32 bytes of data:

Reply from 63.88.27.130: bytes=32 time=37ms TTL=126
Reply from 63.88.27.130: bytes=32 time=35ms TTL=126
Reply from 63.88.27.130: bytes=32 time=34ms TTL=126
Reply from 63.88.27.130: bytes=32 time=32ms TTL=126


C:\Documents and Settings\cisco>ping 192.168.10.81

Pinging 192.168.10.81 with 32 bytes of data:

Reply from 192.168.10.81: bytes=32 time=1ms TTL=255
Reply from 192.168.10.81: bytes=32 time=1ms TTL=255
Reply from 192.168.10.81: bytes=32 time=1ms TTL=255
Reply from 192.168.10.81: bytes=32 time=1ms TTL=255
```