Lab 1: OSPF With Three Routers

The physical topology is as shown in FIG 18.1 - Advanced OSPF Lab.

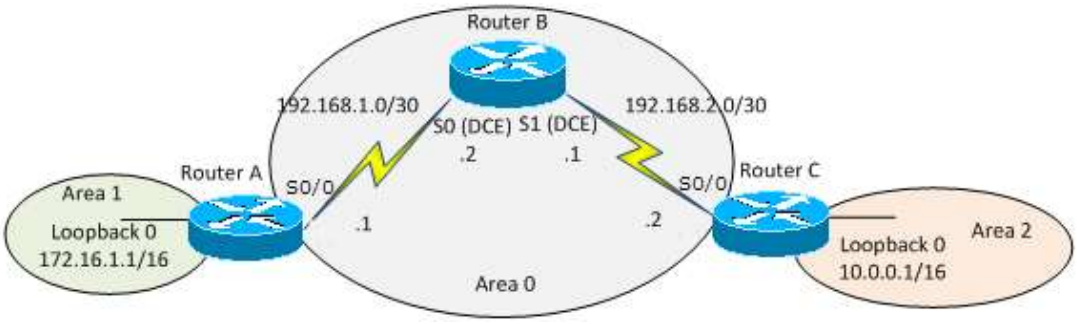

FIG 18.1 - Advanced OSPF Lab

Lab Exercise

Your task is to configure the network in FIG 18.1 - Advanced OSPF Lab to allow full connectivity using OSPF. Router A should see routes for and be able to ping the loopback interface on router C and vice versa. Please feel free to try the lab without following the Lab Walk-Through section.

Text written in `courier new font` indicates commands that can be entered on the router.

Lab Objectives

1. Use the IP addressing scheme depicted in FIG X.
2. Set telnet access for the router to use the local login permissions of username `banbury` and the password `ccna`.
3. Configure the `enable password` to be `cisco`.
4. Configure IP addressing on all three routers.
5. Configure OSPF areas 0, 1, and 2.
6. Finally, test that the link is up and working by sending a ping across the link.

Purpose

Being able to configure and troubleshoot three routers will enable you to easily tackle issues that will arise in the lab.

Lab Walk-Through

1. To set the IP addresses on an interface, you will need to do the following:

```
Router#config t
Router(config)#hostname RouterA
RouterA(config)#
RouterA(config)#interface serial 0/0
RouterA(config-if)#ip address 192.168.1.1 255.255.255.252
RouterA(config-if)#no shutdown
RouterA(config-if)#interface loopback 0
RouterA(config-if)#ip address 172.16.1.1 255.255.0.0
RouterA(config-if)#^Z
```

```
RouterA#
```

Router B:

```
Router#config t
Router(config)#hostname RouterB
RouterB(config)#
RouterB(config)#interface serial 0
RouterB(config-if)#ip address 192.168.1.2 255.255.255.252
RouterB(config-if)#clock rate 64000
RouterB(config-if)#no shutdown
RouterB(config-if)#interface serial 1
RouterB(config-if)#ip address 192.168.2.1 255.255.255.252
RouterB(config-if)#clock rate 64000
RouterB(config-if)#no shutdown
RouterB(config-if)#^Z
RouterB#
```

Router C:

```
Router#config t
Router#(config)#hostname RouterC
RouterC(config)#
RouterC(config)#interface serial 0/0
RouterC(config-if)#ip address 192.168.2.2 255.255.255.252
RouterC(config-if)#no shutdown
RouterC(config-if)#interface loopback 0
RouterC(config-if)#ip address 10.0.0.1 255.255.0.0
RouterC(config-if)#^Z
RouterC#
```

Ping across the serial link now from A to B and then B to C. You will not be able to ping from A to C until you configure a routing protocol.

2. To set telnet access, you need to configure the VTY lines to allow telnet access. To do this, type (from configuration mode):

```
RouterA(config)#line vty 0 4
RouterA(config-line)#login local
RouterA(config-line)#exit
RouterA(config)#username banbury password ccna
```

Router B:

```
RouterB(config)#line vty 0 4
RouterB(config-line)#login local
RouterB(config-line)#exit
RouterB(config)#username banbury password ccna
```

Router C:

```
RouterC(config)#line vty 0 4
RouterC(config-line)#login local
RouterC(config-line)#exit
RouterC(config)#username banbury password ccna
```

3. To set the `enable password` do the following:

```
RouterA(config)#enable secret cisco
```

Router B:

```
RouterB(config)#enable secret cisco
```

Router C:

```
RouterC(config)#enable secret cisco
```

4. To configure OSPF on a router, there are two steps: first, enable the routing protocol and second, specify the networks to be advertised by OSPF:

```
RouterA(config)#router ospf 20
RouterA(config-router)#network 192.168.1.0 0.0.0.3 area 0
RouterA(config-router)#network 172.16.0.0 0.0.255.255 area 1
```

Router B:

```
RouterB(config)#router ospf 20
RouterB(config-router)#network 192.168.1.0 0.0.0.3 area 0
RouterB(config-router)#network 192.168.2.0 0.0.0.3 area 0
```

Router C:

```
RouterC(config)#router ospf 20
RouterC(config-router)#network 192.168.2.0 0.0.0.3 area 0
RouterC(config-router)#network 10.0.0.0 0.0.255.255 area 2

03:19:29: %OSPF-5-ADJCHG: Process 20, Nbr 192.168.2.1 on
Serial0 from LOADING to FULL, Loading Done
```

5. Make sure all the interfaces on the routers are up up with the `show ip interface brief` command.

```
RouterA#show ip interface brief
Interface   IP-Address    OK? Method Status
Protocol
Loopback0    172.16.1.1      YES manual up
up
Serial0/0     192.168.1.1     YES manual up
up
```

Make sure you can see all of the networks including the loopback interfaces.

```
RouterA#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M -
mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF
inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external
type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E
- EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia -
IS-IS inter area
       * - candidate default, U - per-user static route, o -
ODR
       P - periodic downloaded static route


Gateway of last resort is not set
```

```
C    172.16.0.0/16 is directly connected, Loopback0
     10.0.0.0/32 is subnetted, 1 subnets
O IA    10.0.0.1 [110/129] via 192.168.1.2, 00:00:07,
Serial0/0
     192.168.1.0/30 is subnetted, 1 subnets
C       192.168.1.0 is directly connected, Serial0/0
     192.168.2.0/30 is subnetted, 1 subnets
O       192.168.2.0 [110/128] via 192.168.1.2,00:00:07,
Serial0/0
```

Check the protocol settings:

```
RouterA#show ip protocols
Routing Protocol is ospf 20
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 172.16.1.1
  It is an area border router
  Number of areas in this router is 2. 2 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    172.16.0.0 0.0.255.255 area 1
    192.168.1.0 0.0.0.3 area 0
  Routing Information Sources:
    Gateway         Distance      Last Update
    10.0.0.1             110      00:03:54
    192.168.2.1          110      00:03:54
    172.16.1.1           110      00:03:54
  Distance: (default is 110)
```

Ping the loopback interfaces:

```
RouterA#ping 10.0.0.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.0.1, timeout is 2
seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max =
56/64/76 ms
RouterA#
```

6. Now reload the routers.

Show Runs

```
RouterA#show run
Building configuration...

Current configuration : 697 bytes
!
version 15.1
no service single-slot-reload-enable
service timestamps debug uptime

no service password-encryption
!
hostname RouterA
```

```
!
enable secret 5 $1$SJxM$QL6.HXWDKQJBbfBa.tOg/0
!
username banbury password 0 ccna
!
ip subnet-zero
!
interface Loopback0
 ip address 172.16.1.1 255.255.0.0
!
!
interface Serial0/0
 ip address 192.168.1.1 255.255.255.252
!
router ospf 20
 log-adjacency-changes
 network 172.16.0.0 0.0.255.255 area 1
 network 192.168.1.0 0.0.0.3 area 0
!
ip classless
no ip http server
!
line con 0
line aux 0
line vty 0 4
 login local
!
end

-----

RouterB#show run
Building configuration...
!
version 15.1
no service single-slot-reload-enable
service timestamps debug uptime

no service password-encryption
!
hostname RouterB
!
enable secret 5 $1$C2Wp$S2ox/WQFXjyshkwnFX6Iu0
!
username banbury password 0 ccna
!
ip subnet-zero
!
interface Serial0
 ip address 192.168.1.2 255.255.255.252
 clockrate 64000
!
interface Serial1
 ip address 192.168.2.1 255.255.255.252
 clockrate 64000
!
```

```
router ospf 20
 log-adjacency-changes
 network 192.168.1.0 0.0.0.3 area 0
 network 192.168.2.0 0.0.0.3 area 0
!
line con 0
line aux 0
line vty 0 4
 login local
!
end

RouterB#
---

RouterC#show run
Building configuration...

Current configuration : 726 bytes
!
version 15.1
service timestamps debug uptime

no service password-encryption
!
hostname RouterC
!
enable secret 5 $1$1AZx$UzhYsYlIpc7I4vJI3ZI4U.
!
username banbury password 0 cisco
!
ip subnet-zero
!
interface Loopback0
 ip address 10.0.0.1 255.255.0.0
!
interface Serial0/0
 ip address 192.168.2.2 255.255.255.252
!
router ospf 20
 log-adjacency-changes
 network 10.0.0.0 0.0.255.255 area 2
 network 192.168.2.0 0.0.0.3 area 0
!
ip classless
no ip http server
!
line con 0
line aux 0
line vty 0 4
 login local
!
end
RouterC#
```

Lab 2: OSPF with Access-Lists

Lab Exercise

Your task is to configure the network in FIG 18.2 - OSPF with Access-list to allow full connectivity using OSPF. Router A is to block ICMP from Router C, and Router C is to deny any traffic on port 80. Please feel free to try the lab without following the Lab Walk-Through section.

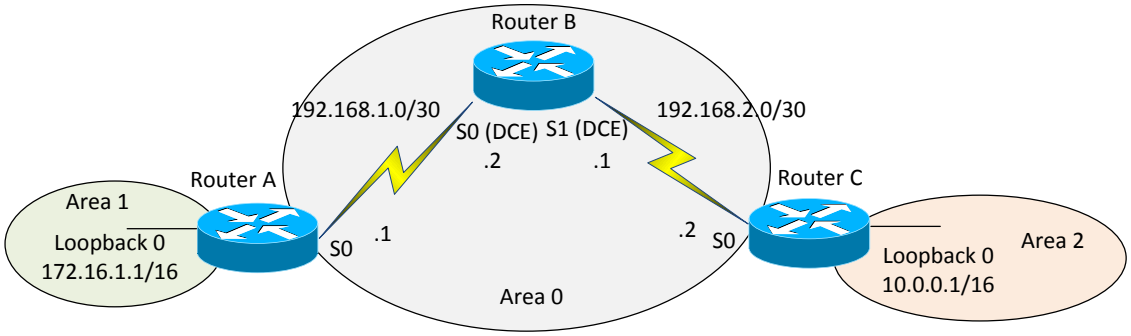

FIG 18.2 - OSPF with Access-lists

Text written in `courier new type` indicates commands that can be entered on the router.

Purpose

A three-router lab is the typical scenario you will face in the CCNA exam. You must be comfortable with configuring three routers with a basic config and then applying a routing protocol and access-list.

Lab Objectives

1. Use the IP-addressing scheme depicted in FIG 18.2 - OSPF with Access-list.
2. Set telnet access for the router to use the local login permissions of username `banbury` and the password `ccna`.
3. Configure the `enable password` to be `cisco`.
4. Configure IP addressing on all three routers.
5. Configure OSPF areas 0, 1, and 2.
6. Add an access-list on the serial interfaces of both routers A and C. Router A is to block all ping traffic from network `192.168.2.0`. Router C is to block all HTTP traffic from any network.

Lab Walk-Through

Follow the configuration from the previous lab.

1. Configure the access-lists on both Routers A and C and apply them to the serial interfaces.

```
RouterA(config)#access-list 100 deny icmp 192.168.2.0
0.0.0.255 any
RouterA(config)#access-list 100 permit ip any any
RouterA(config)#interface serial 0/0
RouterA(config-if)#ip access-group 100 in

RouterC(config)#access-list 100 deny tcp any any eq 80
```

```
RouterC(config)#access-list 100 permit ip any any
RouterC(config)#ip http server
RouterC(config)#interface serial 0/0
RouterC(config-if)#ip access-group 100 in
```

2. Telnet from Router A to Router C. A normal telnet will work. However, a telnet on port 80 (HTTP) will fail.

```
RouterA#telnet 192.168.2.2
Trying 192.168.2.2 ... Open

User Access Verification

Username:
```

[EXIT BACK TO RouterA]

```
RouterA#telnet 192.168.2.2 80
Trying 192.168.2.2, 80 ... Open

exit
HTTP/1.0 501 Not Implemented
Date: Mon, 01 Mar 1993 00:22:17 UTC
Content-type: text/html
Expires: Thu, 16 Feb 1989 00:00:00 GMT

[H1]501 Not Implemented[/H1]


[Connection to 192.168.2.2 closed by foreign host]
```

3. Now ping Router A from Router C. The ping from the serial interface (the blocked network) will fail. A ping from loopback 0 (10.0.0.1) will however, work.

```
RouterC#ping 192.168.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.1, timeout is 2
seconds:
U.U.U
Success rate is 0 percent (0/5)

RouterC#ping
Protocol [ip]:
Target IP address: 192.168.1.1
Repeat count [5]:
Datagram size [100]:
Timeout in seconds [2]:
Extended commands [n]: y
Source address or interface: 10.0.0.1
Type of service [0]:
Set DF bit in IP header? [no]:
Validate reply data? [no]:
Data pattern [0xABCD]:
Loose, Strict, Record, Timestamp, Verbose[none]:
Sweep range of sizes [n]:
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 192.168.1.1, timeout is 2
seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max =
60/60/64 ms
RouterC#
```

Show Runs

```
RouterA#show run
Building configuration...

Current configuration : 900 bytes
!
version 15.1
no service single-slot-reload-enable
service timestamps debug uptime

no service password-encryption
!
hostname RouterA
!
enable secret 5 $1$rujI$BJ8GgiK8U9p5cdfXyApPr/
!
username banbury password 0 ccna
!
interface Loopback0
 ip address 172.16.1.1 255.255.0.0
!
interface Serial0/0
 ip address 192.168.1.1 255.255.255.252
 ip access-group 100 in
!
router ospf 20
 log-adjacency-changes
 network 172.16.0.0 0.0.255.255 area 1
 network 192.168.1.0 0.0.0.3 area 0
!
ip classless
no ip http server
!
access-list 100 deny  icmp 192.168.2.0 0.0.0.255 any
access-list 100 permit ip any any
!
line con 0
 password letmein
 login
line 1 8
line aux 0
line vty 0 4
 login local
!
end

---
```

```
RouterB#show run
Building configuration...

Current configuration : 827 bytes
!
version 15.1
no service single-slot-reload-enable
service timestamps debug uptime

no service password-encryption
!
hostname RouterB
!
enable secret 5 $1$oXft$UMJZc/BQzbfpeHVCApF3H0
!
username banbury password 0 ccna
!
ip subnet-zero
!
interface Serial0
 ip address 192.168.1.2 255.255.255.252
 clockrate 64000
!
interface Serial1
 ip address 192.168.2.1 255.255.255.252
 clockrate 64000
!
router ospf 20
 log-adjacency-changes
 network 192.168.1.0 0.0.0.3 area 0
 network 192.168.2.0 0.0.0.3 area 0
!
ip classless
no ip http server
!
line con 0
 password letmein
 login
line aux 0
line vty 0 4
 login local
!
end

RouterB#

---

RouterC#show run
Building configuration...

Current configuration:
!
version 15.1
service timestamps debug uptime
```

```
no service password-encryption
!
hostname RouterC
!
enable secret 5 $1$1AZx$UzhYsYlIpc7I4vJI3ZI4U.
!
username banbury password 0 cisco
ip subnet-zero
!
!
interface Loopback0
 ip address 10.0.0.1 255.255.0.0
!
interface Serial0/0
 ip address 192.168.2.2 255.255.255.252
 ip access-group 100 in
 no ip mroute-cache
!
router ospf 20
 network 10.0.0.0 0.0.255.255 area 2
 network 192.168.2.0 0.0.0.3 area 0
!
ip classless
!
access-list 100 deny   tcp any any eq www
access-list 100 permit ip any any
!
line con 0
line 1 16
line aux 0
line vty 0 4
 login local
!
end

RouterC#
```

Lab 3: Multi-protocol Topology

The physical topology is as shown in the figure below:

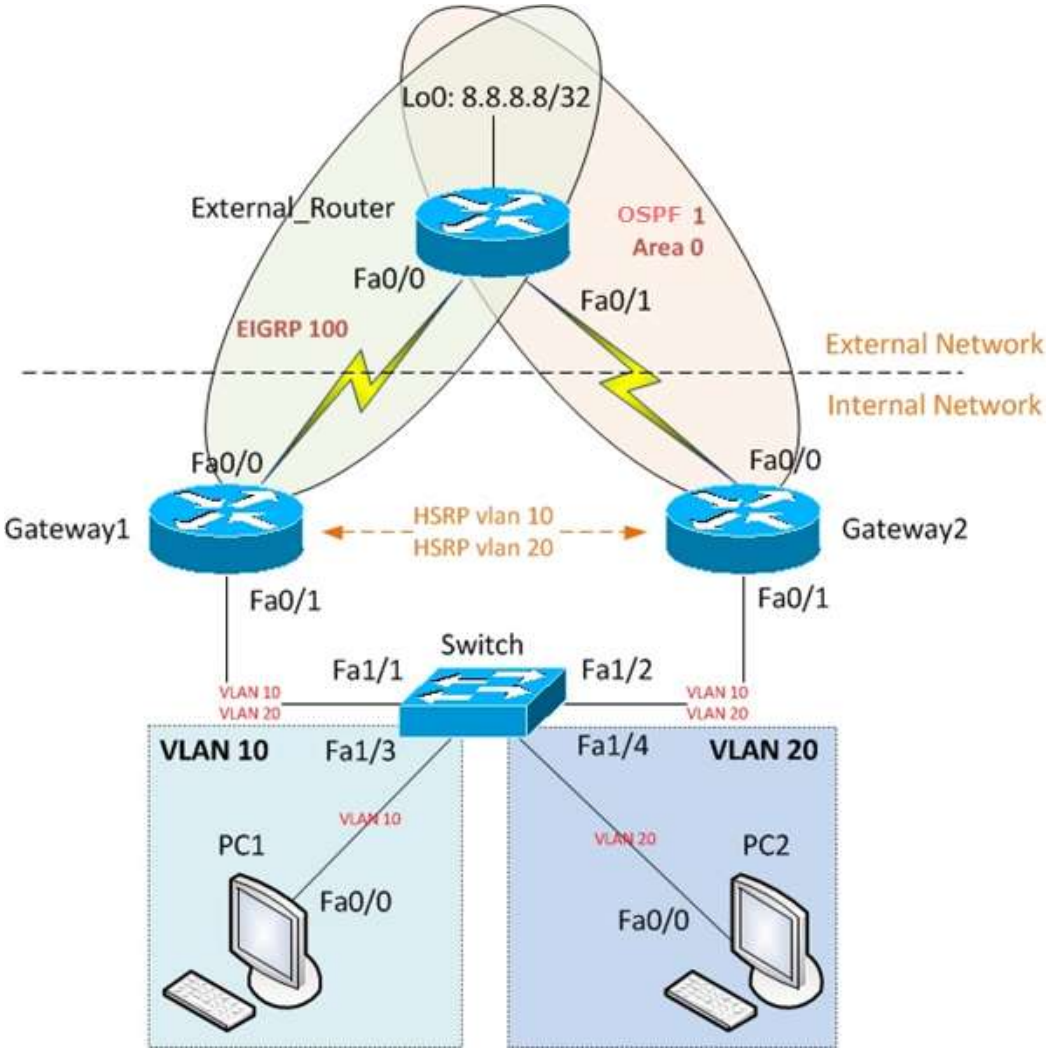

FIG 18.3 - Multi-Protocol Lab

Lab Exercise

This exercise will simulate a real word scenario in which a company might use two gateways to balance traffic going out into external networks (Internet for example).

Your task is to configure the network in the diagram above to allow connectivity between PC1 and PC2 to the external network 8.8.8.8/32. PC1 will use Gateway 1 as the default gateway with Gateway 2 as secondary and PC2 will use Gateway 2 as the primary default gateway with Gateway 1 as secondary. PC1 will be located in VLAN 10, while PC2 will be located in VLAN20. HSRP will be configured for each VLAN between the two gateways. Gateway 1 will learn the external network through EIGRP, while Gateway 2 will learn about the external network through OSPF. The gateways will be configured with NAT.

IP addressing details:

External_router Fa0/0: 192.168.1.1/24

External_router Fa0/1: 192.168.2.1/24

Gateway1 Fa0/0: 192.168.1.2/24

Gateway1 Fa0/1.10: 10.0.10.1/24

Gateway1 Fa0/1.20: 10.0.20.1/24

Gateway2 Fa0/0: 192.168.2.2/24

Gateway2 Fa0/1.10: 10.0.10.2/24

Gateway2 Fa0/1.20: 10.0.20.2/24

VLAN 10 HSRP address: 10.0.10.3

VLAN 20 HSRP address: 10.0.20.3

PC1: 10.0.10.10/24, gateway: 10.0.10.3

PC2: 10.0.20.10/24, gateway: 10.0.20.3

VLAN 10 NAT Pool on Gateway1: 192.168.1.10

VLAN 20 NAT Pool on Gateway1: 192.168.1.11

VLAN 10 NAT Pool on Gateway2: 192.168.2.10

VLAN 20 NAT Pool on Gateway2: 192.168.2.11

Lab Objectives

1. Configure VLANs on the Switch;
2. Configure full Layer 3 addressing between the devices;
3. Configure EIGRP;
4. Configure OSPF;
5. Configure HSRP;
6. Configure NAT on the gateways;
7. Test connectivity.

Purpose

Practice the following technologies:

- OSPF
- EIGRP

- VLANs
- HSRP
- Access-lists
- NAT

Lab Walk-Through

1. Configure the necessary VLANs on the switch. We need trunk ports towards the gateways (carrying VLANs 10 and 20) and access ports towards the PCs.

```
Switch(config)#int fa1/1
Switch(config)#sw mode trunk
Switch(config)#sw trunk encapsulation dot
Switch(config)#sw trunk all vlan 10,20
Switch(config)#no shut

Switch(config)#int fa1/2
Switch(config)#sw mode trunk
Switch(config)#sw trunk encapsulation dot
Switch(config)#sw trunk all vlan 10,20
Switch(config)#no shut


Switch(config)#int fa1/3
Switch(config)#sw mode access
Switch(config)#sw access vlan 10
Switch(config)#no shut


Switch(config)#int fa1/4
Switch(config)#sw mode access
Switch(config)#sw access vlan 20
Switch(config)#no shut
```

2. Configure Layer 3 addressing on the devices.

External_Router:

```
interface FastEthernet0/0
 ip address 192.168.1.1 255.255.255.0
interface FastEthernet0/1
 ip address 192.168.2.1 255.255.255.0

External_Router#sho ip int br
Interface      IP-Address      OK? Method Status          Protocol
FastEthernet0/0  192.168.1.1   YES manual up                    up
Serial0/0       unassigned     YES manual administratively down down
FastEthernet0/1  192.168.2.1    YES manual up                    up
Serial0/1       unassigned     YES manual administratively down down
Loopback0        8.8.8.8         YES manual up                    up
```

Gateway1:

```
interface FastEthernet0/0
 ip address 192.168.1.2 255.255.255.0
interface FastEthernet0/1.10
 encapsulation dot1Q 10
 ip address 10.0.10.1 255.255.255.0
interface FastEthernet0/1.20
 encapsulation dot1Q 20
 ip address 10.0.20.1 255.255.255.0

Gateway1#sho ip int br
Any interface listed with OK? value NO does not have a valid
configuration

Interface        IP-Address      OK? Method Status          Protocol
FastEthernet0/0  192.168.1.2     YES manual up                    up
```

```
Serial0/0      unassigned      YES manual administratively down down
FastEthernet0/1  unassigned      YES manual up                    up
FastEthernet0/1.10 10.0.10.1     YES manual up                    up
FastEthernet0/1.20 10.0.20.1     YES manual up                    up
Serial0/1      unassigned      YES manual administratively down down
NVI0           unassigned      NO  unset  up                    up
```

Gateway2:

```
interface FastEthernet0/0
 ip address 192.168.2.2 255.255.255.0
interface FastEthernet0/1.10
 encapsulation dot1Q 10
 ip address 10.0.10.2 255.255.255.0
interface FastEthernet0/1.20
 encapsulation dot1Q 20
 ip address 10.0.20.2 255.255.255.0

Gateway2#sho ip int br
Any interface listed with OK? value NO does not have a valid
configuration

Interface   IP-Address      OK? Method Status                Protocol
FastEthernet0/0 192.168.2.2    YES manual up                    up
Serial0/0      unassigned      YES manual administratively down down
FastEthernet0/1  unassigned     YES manual up                    up
FastEthernet0/1.10 10.0.10.2     YES manual up                    up
FastEthernet0/1.20 10.0.20.2     YES manual up                    up
Serial0/1      unassigned      YES manual administratively down down
```

```
NVI0               unassigned      NO  unset  up                    up
```

***Note**: you can use both real workstations or routers for PC1 and PC2. We have choosen to use routers for this exercise for simplicity. In order to configure a router to react as a workstation with 1 NIC, just disable IP routing, set the default gateway and the IP address on the interface.*

We will also configure the default gateway on PC1 and PC2. This is the HSRP address of VLAN10 for PC1 and the HSRP address of VLAN20 for PC2.

```
PC1(config)#no ip routing
PC1(config)#ip default-gateway 10.0.10.3
PC1(config)#int fa0/0
PC1(config-if)#ip add 10.0.10.10 255.255.255.0

PC2(config)#no ip routing
PC2(config)#ip default-gateway 10.0.20.3
PC2(config)#int fa0/0
PC2(config-if)#ip add 10.0.20.10 255.255.255.0
```

3. Configure EIGRP between the External_Router and Gateway1, advertise 8.8.8.8/32 towards the internal network via EIGRP.

```
External_Router(config)#router eigrp 100
External_Router(config-router)#network 8.8.8.8 0.0.0.0
External_Router(config-router)#network 192.168.1.0 0.0.0.255
External_Router(config-router)#no auto-summary

Gateway1(config)#router eigrp 100
Gateway1(config-router)#network 192.168.1.0 0.0.0.255
```

```
Gateway1(config-router)#no auto-summary


External_Router#show ip eigrp neighbors
IP-EIGRP neighbors for process 100
H   Address                 Interface       Hold Uptime   SRTT   RTO
Q  Seq
                                            (sec)         (ms)
Cnt Num
0   192.168.1.2             Fa0/0             13 01:10:05 1267  5000
0  4


Gateway1#show ip eigrp neighbors
IP-EIGRP neighbors for process 100
H   Address                 Interface       Hold Uptime   SRTT   RTO
Q  Seq
                                            (sec)         (ms)
Cnt Num
0   192.168.1.1             Fa0/0             12 01:09:57   70   420
0  3


Gateway1#show ip route eigrp
     8.0.0.0/32 is subnetted, 1 subnets
D       8.8.8.8 [90/409600] via 192.168.1.1, 01:10:24,
FastEthernet0/0
```

We can see the 8.8.8.8/32 network is being learned by Gateway1 via EIGRP.

4. Configure OSPF between the External_Router and Gateway2, advertise 8.8.8.8/32 towards the internal network via OSPF. Yes, we will advertise the same subnet via both EIGRP and OSPF to different neighbors. This is possible in Cisco IOS.

```
External_Router(config)#int fa0/1
External_Router(config-if)#ip ospf 1 area 0
External_Router(config-if)#lo0
External_Router(config-if)#ip ospf 1 area 0

Gateway2(config)#int fa0/1
Gateway2(config-if)#ip ospf 1 area 0


External_Router#show ip ospf nei

Neighbor ID     Pri   State           Dead Time   Address
Interface
192.168.2.2       1   FULL/DR         00:00:38    192.168.2.2
FastEthernet0/1

Gateway2#show ip ospf nei

Neighbor ID     Pri   State           Dead Time   Address
Interface
8.8.8.8           1   FULL/BDR        00:00:36    192.168.2.1
FastEthernet0/0

Gateway2#show ip route ospf
     8.0.0.0/32 is subnetted, 1 subnets
O       8.8.8.8 [110/11] via 192.168.2.1, 01:21:28, FastEthernet0/0
```

We can see the 8.8.8.8/32 network is being learned by Gateway2 via OSPF.

5. Configure HSRP for both VLANs. Gateway1 will be the primary gateway for VLAN10 and Gateway2 will be the primary gateway for VLAN20. If either of the routers fails, the other will assume default gateway functionality.

   We will configure Gateway1 with priority 110 for VLAN 10 and with priority 100 for VLAN 20 (default) and the other way around for Gateway 2.

```
Gateway1(config)#int fa0/1.10
Gateway1(config-subif)#standby 10 ip 10.0.10.3
Gateway1(config-subif)#standby 10 priority 110
Gateway1(config-subif)#standby 10 preempt

Gateway1(config)#int fa0/1.20
Gateway1(config-subif)#standby 20 ip 10.0.20.3
Gateway1(config-subif)#standby 20 preempt

Gateway2(config)#int fa0/1.10
Gateway2(config-subif)#standby 10 ip 10.0.10.3
Gateway2(config-subif)#standby 10 preempt

Gateway2(config)#int fa0/1.20
Gateway2(config-subif)#standby 20 ip 10.0.20.3
Gateway2(config-subif)#standby 20 priority 110
Gateway2(config-subif)#standby 20 preempt

Gateway1#show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby
Virtual IP
```

```
Fa0/1.10     10    110 P Active  local           10.0.10.2
10.0.10.3
Fa0/1.20     20    100 P Standby 10.0.20.2       local
10.0.20.3


Gateway2#show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby
Virtual IP
Fa0/1.10     10    100 P Standby 10.0.10.1       local
10.0.10.3
Fa0/1.20     20    110 P Active  local           10.0.20.1
10.0.20.3
```

6. Configure NAT.

On Gateway1 we want to translate the internal address for any packet sourced from VLAN 10 to 192.168.1.10. In the same time, we want to translate the internal address for any packet souced from VLAN 20 to 192.168.1.11. Even though traffic originated in VLAN 20 will not reach Gateway1 in a normal day of operations, this will happen if Gateway2 is down, as Gateway1 will assume the role of primary HSRP gateway. So we want to configure rules for both VLAN 10 and VLAN 20 on both routers.

On Gateway2, we will assign an external IP address of 192.168.2.10 for traffic sourced in VLAN 10 and of 192.168.2.11 for traffic sourced in VLAN 20.

We will also configure PAT (also known NAT overload) on both devices, so multiple internal sources in the same VLAN can share the same external IP address.

```
Gateway1(config)#int fa0/0
Gateway1(config-if)#ip nat outside
Gateway1(config)#int fa0/1.10
Gateway1(config-if)#ip nat inside
Gateway1(config)#int fa0/1.20
```

```
Gateway1(config-if)#ip nat inside


Gateway1(config)#ip nat inside source list VLAN10 pool VLAN10_OUT
overload

Gateway1(config)#ip nat inside source list VLAN20 pool VLAN20_OUT
overload

Gateway1(config)#ip nat pool VLAN10_OUT 192.168.1.10 192.168.1.10
netmask 255.255.255.0

Gateway1(config)#ip nat pool VLAN20_OUT 192.168.1.11 192.168.1.11
netmask 255.255.255.0

Gateway1(config)#ip access-list standard VLAN10

Gateway1(config-std-nacl)# permit 10.0.10.0 0.0.0.255

Gateway1(config)#ip access-list standard VLAN20

Gateway1(config-std-nacl)# permit 10.0.20.0 0.0.0.255

Gateway2(config)#int fa0/0

Gateway2(config-if)#ip nat outside

Gateway2(config)#int fa0/1.10

Gateway2(config-if)#ip nat inside

Gateway2(config)#int fa0/1.20

Gateway2(config-if)#ip nat inside


Gateway2(config)#ip nat inside source list VLAN10 pool VLAN10_OUT
overload

Gateway2(config)#ip nat inside source list VLAN20 pool VLAN20_OUT
overload

Gateway2(config)#ip nat pool VLAN10_OUT 192.168.2.10 192.168.2.10
netmask 255.255.255.0

Gateway2(config)#ip nat pool VLAN20_OUT 192.168.2.11 192.168.2.11
netmask 255.255.255.0

Gateway2(config)#ip access-list standard VLAN10

Gateway2(config-std-nacl)# permit 10.0.10.0 0.0.0.255

Gateway2(config)#ip access-list standard VLAN20
```

```
Gateway2(config-std-nacl)# permit 10.0.20.0 0.0.0.255
```

7. Test connectivity from PC1 and PC2 towards the external network. We will issue a ping both from PC1 and PC2 towards the external destination and we will then check traffic from each PC will hit a different gateway router. In this way traffic is load balanced toward the external networks.

```
PC1#ping 8.8.8.8

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 8.8.8.8, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 24/44/72
ms

PC2#ping 8.8.8.8

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 8.8.8.8, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 16/62/140
ms

Gateway1#sho ip nat translations
Pro Inside global      Inside local       Outside local      Outside
global
icmp 192.168.1.10:3    10.0.10.10:3       8.8.8.8:3
8.8.8.8:3

Gateway2#sho ip nat translations
```

```
Pro Inside global      Inside local       Outside local      Outside
global

icmp 192.168.2.11:5    10.0.20.10:5       8.8.8.8:5
8.8.8.8:5
```

As you can see from the output of show ip nat translation, traffic sourced from 10.0.10.10 (VLAN 10) is translated on Gateway1 and traffic sourced from 10.0.20.10 (VLAN 20) is translated on Gateway2.

Show Runs

```
External_Router#show run
Building configuration...

Current configuration : 1305 bytes
!
version 15.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname External_Router
!
boot-start-marker
boot-end-marker
!
no aaa new-model
memory-size iomem 5
no ip icmp rate-limit unreachable
ip cef
!
no ip domain lookup
!
multilink bundle-name authenticated
!
archive
 log config
  hidekeys
!
ip tcp synwait-time 5
ip ssh version 1
```

```
!
interface Loopback0
 ip address 8.8.8.8 255.255.255.255
 ip ospf 1 area 0
!
interface FastEthernet0/0
 ip address 192.168.1.1 255.255.255.0
 duplex auto
 speed auto
!
interface Serial0/0
 no ip address
 shutdown
 clock rate 2000000
!
interface FastEthernet0/1
 ip address 192.168.2.1 255.255.255.0
 ip ospf 1 area 0
 duplex auto
 speed auto
!
interface Serial0/1
 no ip address
 shutdown
 clock rate 2000000
!
router eigrp 100
 network 8.8.8.8 0.0.0.0
 network 192.168.1.0
 no auto-summary
!
router ospf 1
 log-adjacency-changes
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
!
no cdp log mismatch duplex
!
control-plane
!
line con 0
 exec-timeout 0 0
 privilege level 15
 logging synchronous
```

```
line aux 0
 exec-timeout 0 0
 privilege level 15
 logging synchronous
line vty 0 4
 login
!
End

Gateway1#show run
Building configuration...

Current configuration : 1907 bytes
!
version 15.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname Gateway1
!
boot-start-marker
boot-end-marker
!
!
no aaa new-model
memory-size iomem 5
no ip icmp rate-limit unreachable
ip cef
!
no ip domain lookup
!
multilink bundle-name authenticated
!
archive
 log config
  hidekeys
!
ip tcp synwait-time 5
ip ssh version 1
!
interface FastEthernet0/0
 ip address 192.168.1.2 255.255.255.0
 ip nat outside
 ip virtual-reassembly
 duplex auto
 speed auto
!
```

```
interface Serial0/0
 no ip address
 shutdown
 clock rate 2000000
!
interface FastEthernet0/1
 no ip address
 duplex auto
 speed auto
!
interface FastEthernet0/1.10
 encapsulation dot1Q 10
 ip address 10.0.10.1 255.255.255.0
 ip nat inside
 ip virtual-reassembly
 standby 10 ip 10.0.10.3
 standby 10 priority 110
 standby 10 preempt
!
interface FastEthernet0/1.20
 encapsulation dot1Q 20
 ip address 10.0.20.1 255.255.255.0
 ip nat inside
 ip virtual-reassembly
 standby 20 ip 10.0.20.3
 standby 20 preempt
!
interface Serial0/1
 no ip address
 shutdown
 clock rate 2000000
!
router eigrp 100
 network 192.168.1.0
 no auto-summary
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
ip nat pool VLAN10_OUT 192.168.1.10 192.168.1.10 netmask
255.255.255.0
ip nat pool VLAN20_OUT 192.168.1.11 192.168.1.11 netmask
255.255.255.0
ip nat inside source list VLAN10 pool VLAN10_OUT overload
ip nat inside source list VLAN20 pool VLAN20_OUT overload
!
```

```
ip access-list standard VLAN10
 permit 10.0.10.0 0.0.0.255
ip access-list standard VLAN20
 permit 10.0.20.0 0.0.0.255
!
no cdp log mismatch duplex
!
control-plane
!
line con 0
 exec-timeout 0 0
 privilege level 15
 logging synchronous
line aux 0
 exec-timeout 0 0
 privilege level 15
 logging synchronous
line vty 0 4
 login
!
!
End


Gateway2#show run
Building configuration...

Current configuration : 1907 bytes
!
version 15.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname Gateway2
!
boot-start-marker
boot-end-marker
!
no aaa new-model
memory-size iomem 5
no ip icmp rate-limit unreachable
ip cef
!
no ip domain lookup
!
multilink bundle-name authenticated
!
```

```
archive
 log config
  hidekeys
!
ip tcp synwait-time 5
ip ssh version 1
!
interface FastEthernet0/0
 ip address 192.168.2.2 255.255.255.0
 ip nat outside
 ip virtual-reassembly
 ip ospf 1 area 0
 duplex auto
 speed auto
!
interface Serial0/0
 no ip address
 shutdown
 clock rate 2000000
!
interface FastEthernet0/1
 no ip address
 duplex auto
 speed auto
!
interface FastEthernet0/1.10
 encapsulation dot1Q 10
 ip address 10.0.10.2 255.255.255.0
 ip nat inside
 ip virtual-reassembly
 standby 10 ip 10.0.10.3
 standby 10 preempt
!
interface FastEthernet0/1.20
 encapsulation dot1Q 20
 ip address 10.0.20.2 255.255.255.0
 ip nat inside
 ip virtual-reassembly
 standby 20 ip 10.0.20.3
 standby 20 priority 110
 standby 20 preempt
!
interface Serial0/1
 no ip address
 shutdown
 clock rate 2000000
!
router ospf 1
```

```
 log-adjacency-changes
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
ip nat pool VLAN20_OUT 192.168.2.11 192.168.2.11 netmask
255.255.255.0
ip nat pool VLAN10_OUT 192.168.2.10 192.168.2.10 netmask
255.255.255.0
ip nat inside source list VLAN10 pool VLAN10_OUT overload
ip nat inside source list VLAN20 pool VLAN20_OUT overload
!
ip access-list standard VLAN10
 permit 10.0.10.0 0.0.0.255
ip access-list standard VLAN20
 permit 10.0.20.0 0.0.0.255
!
no cdp log mismatch duplex
!
control-plane
!
line con 0
 exec-timeout 0 0
 privilege level 15
 logging synchronous
line aux 0
 exec-timeout 0 0
 privilege level 15
 logging synchronous
line vty 0 4
 login
!
!
End
```

```
PC1#show run
Building configuration...

Current configuration : 1186 bytes
!
version 15.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
```

```
!
hostname PC1
!
boot-start-marker
boot-end-marker
!
no aaa new-model
memory-size iomem 5
no ip routing
no ip icmp rate-limit unreachable
no ip cef
!
no ip domain lookup
!
multilink bundle-name authenticated
!
archive
 log config
  hidekeys
!
ip tcp synwait-time 5
ip ssh version 1
!
interface FastEthernet0/0
 ip address 10.0.10.10 255.255.255.0
 no ip route-cache
 duplex auto
 speed auto
!
interface Serial0/0
 no ip address
 no ip route-cache
 shutdown
 clock rate 2000000
!
interface FastEthernet0/1
 no ip address
 no ip route-cache
 shutdown
 duplex auto
 speed auto
!
interface Serial0/1
 no ip address
 no ip route-cache
 shutdown
 clock rate 2000000
!
```

```
ip default-gateway 10.0.10.3
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
!
no cdp log mismatch duplex
!
control-plane
!
line con 0
 exec-timeout 0 0
 privilege level 15
 logging synchronous
line aux 0
 exec-timeout 0 0
 privilege level 15
 logging synchronous
line vty 0 4
 login
!
end


PC2#show run
Building configuration...

Current configuration : 1208 bytes
!
version 15.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname PC2
!
boot-start-marker
boot-end-marker
!
no aaa new-model
memory-size iomem 5
no ip routing
no ip icmp rate-limit unreachable
no ip cef
!
no ip domain lookup
!
```

```
multilink bundle-name authenticated
!
ip tcp synwait-time 5
ip ssh version 1
!
interface FastEthernet0/0
 ip address 10.0.20.10 255.255.255.0
 no ip route-cache
 duplex auto
 speed auto
!
interface Serial0/0
 no ip address
 no ip route-cache
 shutdown
 clock rate 2000000
!
interface FastEthernet0/1
 ip address 10.0.20.10 255.255.255.0
 no ip route-cache
 shutdown
 duplex auto
 speed auto
!
interface Serial0/1
 no ip address
 no ip route-cache
 shutdown
 clock rate 2000000
!
ip default-gateway 10.0.20.3
ip forward-protocol nd
!
line con 0
 exec-timeout 0 0
 privilege level 15
 logging synchronous
line aux 0
 exec-timeout 0 0
 privilege level 15
 logging synchronous
line vty 0 4
 login
!
!
end
```