

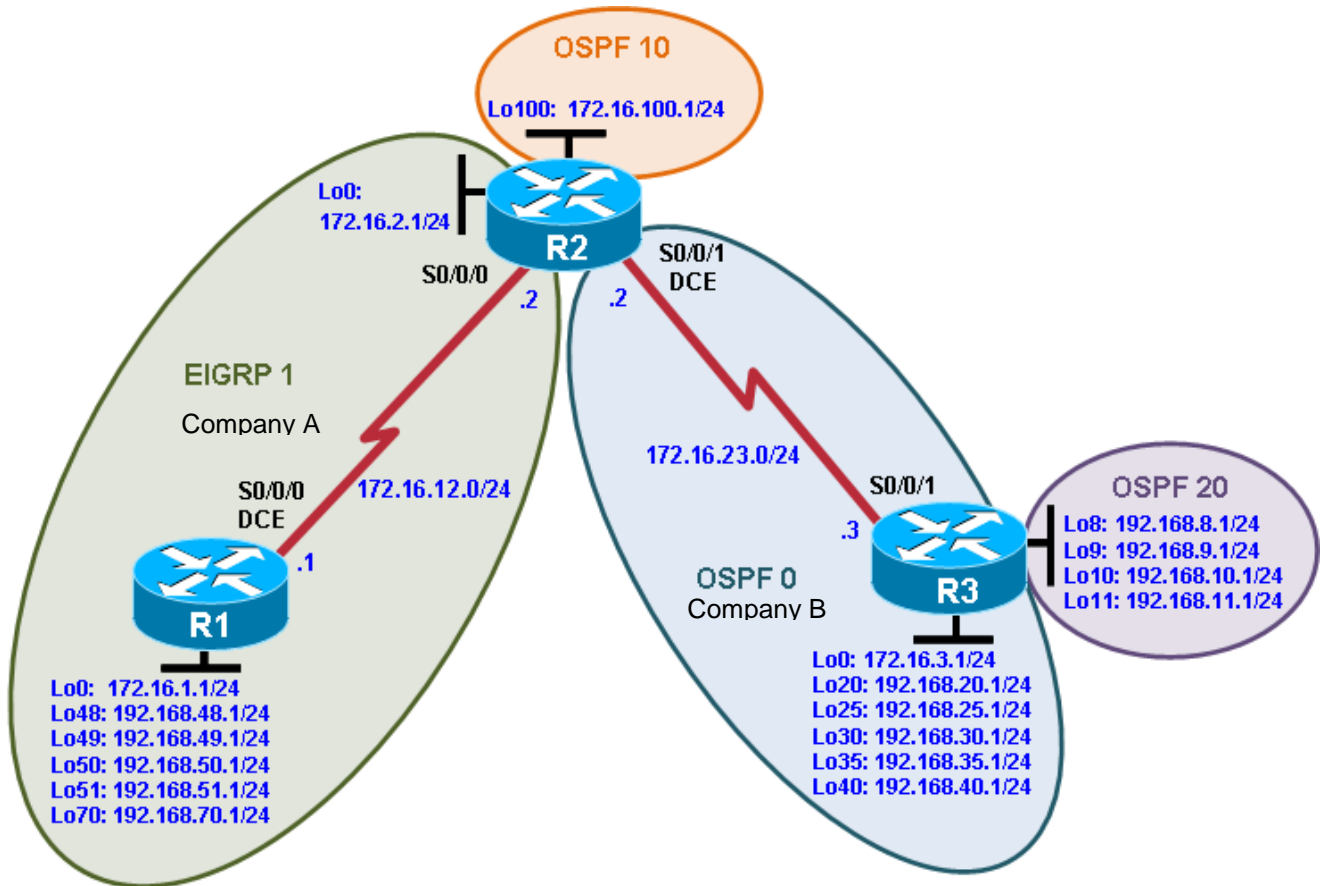
# Routing And Switching Lab – 2019

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## Redistribution between EIGRP and OSPF

### Topology



### Introduction

Two online Companies, Company A and Company B, have merged and now need a short-term solution to inter-domain routing. Since these companies provide client services to Internet users, it is essential to have minimal downtime during the transition.

Company A is running EIGRP while Company B is running a multi-area OSPF. Because it is imperative that the two booksellers continuously deliver Internet services, you should bridge these two routing domains without interfering with each router's path through its own routing domain to the Internet.

The CIO determines that it is preferable to keep the two protocol domains shown in the diagram during the transition period, because the network engineers on each side need to understand the other's network before deploying a long-term solution. Redistribution will be a short-term solution.

In this scenario, R1 and R2 are running EIGRP while R2 is the OSPF autonomous system border router (ASBR) consisting of areas 0, 10, and 20. You need to configure R2 to enable these two routing protocols to interact to allow full connectivity between all networks.

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In this lab, R1 is running EIGRP and R3 is running multi-area OSPF. Your task is to configure redistribution on R2 to enable these two routing protocols to interact, allowing full connectivity between all networks.

## Required Resources

- 3 routers.
- Serial, console and Ethernet cables.

## Step 1: Configure loopbacks and assign addresses.

- a. Configure all loopback interfaces on the three routers in the diagram. Configure the serial interfaces with the IP addresses, bring them up, and set a DCE clock rate where appropriate.

```
R1(config)# interface Loopback0
R1(config-if)# ip address 172.16.1.1 255.255.255.0
R1(config-if)# exit
R1(config)# interface Loopback48
R1(config-if)# ip address 192.168.48.1 255.255.255.0
R1(config-if)# exit
R1(config)# interface Loopback49
R1(config-if)# ip address 192.168.49.1 255.255.255.0
R1(config-if)# exit
R1(config)# interface Loopback50
R1(config-if)# ip address 192.168.50.1 255.255.255.0
R1(config-if)# exit
R1(config)# interface Loopback51
R1(config-if)# ip address 192.168.51.1 255.255.255.0
R1(config-if)# exit
R1(config)# interface Loopback70
R1(config-if)# ip address 192.168.70.1 255.255.255.0
R1(config-if)# exit
R1(config)# interface Serial0/0/0
R1(config-if)# ip address 172.16.12.1 255.255.255.0
R1(config-if)# clock rate 64000
R1(config-if)# bandwidth 64
R1(config-if)# no shutdown
```

```
R2(config)# interface Loopback0
R2(config-if)# ip address 172.16.2.1 255.255.255.0
R2(config-if)# exit
R2(config)# interface loopback 100
R2(config-if)# ip address 172.16.100.1 255.255.255.0
R2(config-if)# exit
R2(config)# interface Serial0/0/0
R2(config-if)# ip address 172.16.12.2 255.255.255.0
R2(config-if)# bandwidth 64
R2(config-if)# no shutdown
R2(config-if)# exit
R2(config)# interface Serial0/0/1
R2(config-if)# ip address 172.16.23.2 255.255.255.0
R2(config-if)# clock rate 64000
R2(config-if)# bandwidth 64
R2(config-if)# no shutdown
```

```
R3(config)# interface Loopback0
R3(config-if)# ip address 172.16.3.1 255.255.255.0
R3(config-if)# exit
R3(config)# interface loopback 8
```

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```
R3(config-if)# ip address 192.168.8.1 255.255.255.0
R3(config-if)# exit
R3(config)# interface loopback 9
R3(config-if)# ip address 192.168.9.1 255.255.255.0
R3(config-if)# exit
R3(config)# interface loopback 10
R3(config-if)# ip address 192.168.10.1 255.255.255.0
R3(config-if)# exit
R3(config)# interface loopback 11
R3(config-if)# ip address 192.168.11.1 255.255.255.0
R3(config-if)# exit
R3(config)# interface Loopback20
R3(config-if)# ip address 192.168.20.1 255.255.255.0
R3(config-if)# exit
R3(config)# interface Loopback25
R3(config-if)# ip address 192.168.25.1 255.255.255.0
R3(config-if)# exit
R3(config)# interface Loopback30
R3(config-if)# ip address 192.168.30.1 255.255.255.0
R3(config-if)# exit
R3(config)# interface Loopback35
R3(config-if)# ip address 192.168.35.1 255.255.255.0
R3(config-if)# exit
R3(config)# interface Loopback40
R3(config-if)# ip address 192.168.40.1 255.255.255.0
R3(config-if)# exit
R3(config)# interface Serial0/0/1
R3(config-if)# ip address 172.16.23.3 255.255.255.0
R3(config-if)# bandwidth 64
R3(config-if)# no shutdown
```

- b. Verify that you can ping across the serial links when you are finished. Use the following Tcl script to check full and partial connectivity throughout this lab.

```
R1# tclsh
```

```
foreach address {
172.16.1.1
192.168.48.1
192.168.49.1
192.168.50.1
192.168.51.1
192.168.70.1
172.16.12.1
172.16.12.2
172.16.2.1
172.16.100.1
172.16.23.2
172.16.23.3
172.16.3.1
192.168.8.1
192.168.9.1
192.168.10.1
192.168.11.1
192.168.20.1
192.168.25.1
192.168.30.1
192.168.35.1
```

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```
192.168.40.1
} { ping $address }
```

Which pings are successful and why?

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## Step 2: Configure EIGRP.

- a. Configure R1 and R2 to run EIGRP in autonomous system 1. On R1, add in all connected interfaces either with classful **network** commands or with wildcard masks. Use a classful **network** statement on R2 and disable automatic summarization.

```
R1(config)# router eigrp 1
R1(config-router)# no auto-summary
R1(config-router)# network 172.16.0.0
R1(config-router)# network 192.168.0.0 0.0.255.255
```

```
R2(config)# router eigrp 1
R2(config-router)# no auto-summary
R2(config-router)# network 172.16.0.0
```

- b. Verify the EIGRP configuration using the **show ip eigrp neighbors** and **show ip route eigrp** commands on R1.

```
R1# show ip eigrp neighbors
```

```
EIGRP-IPv4 Neighbors for AS(1)
```

H	Address	Interface	Hold Uptime (sec)	SRTT (ms)	RTO	Q Cnt	Seq Num
0	172.16.12.2	Se0/0/0	10 00:00:22	42	2340	0	3

```
R1#
```

```
R1# show ip route eigrp
```

<Output omitted>

```
172.16.0.0/16 is variably subnetted, 7 subnets, 2 masks
D      172.16.2.0/24 [90/40640000] via 172.16.12.2, 00:00:31, Serial0/0/0
D      172.16.23.0/24 [90/41024000] via 172.16.12.2, 00:00:31, Serial0/0/0
D      172.16.100.0/24 [90/40640000] via 172.16.12.2, 00:00:31, Serial0/0/0
R1#
```

- c. Verify the EIGRP configuration on R2.

```
R2# show ip eigrp neighbors
```

```
EIGRP-IPv4 Neighbors for AS(1)
```

H	Address	Interface	Hold Uptime (sec)	SRTT (ms)	RTO	Q Cnt	Seq Num
0	172.16.12.1	Se0/0/0	11 00:04:14	35	2340	0	3

```
R2#
```

```
R2# show ip route eigrp
```

<Output omitted>

```
172.16.0.0/16 is variably subnetted, 9 subnets, 2 masks
```

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```
D      172.16.1.0/24 [90/40640000] via 172.16.12.1, 00:01:40, Serial0/0/0
D      192.168.48.0/24 [90/40640000] via 172.16.12.1, 00:01:40, Serial0/0/0
D      192.168.49.0/24 [90/40640000] via 172.16.12.1, 00:01:40, Serial0/0/0
D      192.168.50.0/24 [90/40640000] via 172.16.12.1, 00:01:40, Serial0/0/0
D      192.168.51.0/24 [90/40640000] via 172.16.12.1, 00:01:40, Serial0/0/0
D      192.168.70.0/24 [90/40640000] via 172.16.12.1, 00:01:40, Serial0/0/0
R2#
```

- d. Verify that R1 and R2 can reach all of the networks in the EIGRP routing domain using the following Tcl script.

```
R1# tclsh
```

```
foreach address {
172.16.1.1
192.168.48.1
192.168.49.1
192.168.50.1
192.168.51.1
192.168.70.1
172.16.12.1
172.16.12.2
172.16.2.1
} { ping $address }
```

All pings should be successful. Troubleshoot if necessary.

## Step 3: Manually summarize with EIGRP.

To make routing updates more efficient and ultimately reduce the size of routing tables, contiguous EIGRP routes can be summarized out an interface by using the **ip summary-address eigrp** as *network mask* interface configuration command.

- a. On R1, advertise one supernet route summarizing the networks of loopback 48 and 49 to R2.

```
R1(config)# interface Serial0/0/0
R1(config-if)# ip summary-address eigrp 1 192.168.48.0 255.255.254.0
R1(config-if)#
*Oct 26 15:46:36.839: %DUAL-5-NBRCHANGE: EIGRP-IPv4 1: Neighbor 172.16.12.2
(Serial0/0/0) is resync: summary configured
R1(config-if)# exit
R1#
```

- b. Verify the routing table of R1 using the **show ip route eigrp** command.

```
R1# show ip route eigrp
```

<Output omitted>

```
172.16.0.0/24 is subnetted, 6 subnets
D      172.16.23.0 [90/41024000] via 172.16.12.2, 00:45:21, Serial0/0/0
D      172.16.2.0 [90/40640000] via 172.16.12.2, 00:45:21, Serial0/0/0
D      172.16.100.0 [90/40640000] via 172.16.12.2, 00:08:12, Serial0/0/0
D      192.168.48.0/23 is a summary, 04:27:07, Null0

R1#
```

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Notice how EIGRP now has a route to the summarized address going to the Null 0 interface in the routing table.

- c. Verify the specifics for the summarized routes using the **show ip route 192.168.48.0 255.255.254.0** command on R1.

```
R1# show ip route 192.168.48.0 255.255.254.0
Routing entry for 192.168.48.0/23, supernet
  Known via "eigrp 1", distance 5, metric 128256, type internal
  Redistributing via eigrp 1
  Routing Descriptor Blocks:
    * directly connected, via Null0
      Route metric is 128256, traffic share count is 1
      Total delay is 5000 microseconds, minimum bandwidth is 10000000 Kbit
      Reliability 255/255, minimum MTU 1514 bytes
      Loading 1/255, Hops 0
```

Notice the low administrative distance (AD) for this route. Why does EIGRP add the summarized route pointing to the Null 0 interface with a low AD?

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- d. Verify the routing table of R2 using the **show ip route eigrp** command.

```
R2# show ip route eigrp
```

<Output omitted>

```
172.16.0.0/16 is variably subnetted, 9 subnets, 2 masks
D    172.16.1.0/24 [90/40640000] via 172.16.12.1, 00:09:49, Serial0/0/0
D    192.168.48.0/23 [90/40640000] via 172.16.12.1, 00:09:49, Serial0/0/0
D    192.168.50.0/24 [90/40640000] via 172.16.12.1, 00:09:49, Serial0/0/0
D    192.168.51.0/24 [90/40640000] via 172.16.12.1, 00:09:49, Serial0/0/0
D    192.168.70.0/24 [90/40640000] via 172.16.12.1, 00:09:49, Serial0/0/0
R2#
```

Notice how the routing table is slightly smaller as the entry to 192.168.49.0/24 is now missing. However, 192.168.49.1 is still reachable due to the summarized route to 192.168.48.0/23. Verify by pinging the loopback 49 interface from R2.

```
R2# ping 192.168.49.1
```

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 192.168.49.1, timeout is 2 seconds:

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 28/28/28 ms

```
R2#
```

## Step 4: Configure OSPF.

By default, loopback interfaces are advertised as a host route with a /32 mask. To advertise them as network routes, the loopback interface network type must be changed point-to-point. In this step, you will advertise the loopback interfaces as point-to-point and configure multi-area OSPF between R2 and R3.

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- a. On R2, configure the loopback 100 interface as a point-to-point network.

```
R2(config)# interface Loopback100
R2(config-if)# ip ospf network point-to-point
R2(config-if)# exit
R2(config)#
```

- b. Next advertise serial link connecting to R3 in area 0 and the loopback 100 network is area 10.

```
R2(config)# router ospf 1
R2(config-router)# network 172.16.23.0 0.0.0.255 area 0
R2(config-router)# network 172.16.100.0 0.0.0.255 area 10
```

- c. On R3, change the network type for the 10 loopback interfaces to point-to-point so that they are advertised with the correct subnet mask (/24 instead of /32). Start with loopback 0.

```
R3(config)# interface Loopback0
R3(config-if)# ip ospf network point-to-point
R3(config-if)# exit
```

- d. Although we could manually configure all 9 other interface individually, we can also use the **interface range** command to simultaneously configure several interfaces. Loopback interfaces are contiguous and therefore configured by using a hyphen. The remainder of the interfaces are separated using a comma.

```
R3(config)# interface range lo 8 - 11
R3(config-if-range)# ip ospf network point-to-point
R3(config-if-range)# exit
R3(config)#
R3(config)# interface range lo 20, lo 25, lo 30, lo 35, lo 40
R3(config-if-range)# ip ospf network point-to-point
R3(config-if-range)# exit
R3(config)#
```

- e. On R3, include the serial link and all loopback interfaces in area 0 and the loopbacks in area 20.

```
R3(config)# router ospf 1
R3(config-router)# network 172.16.0.0 0.0.255.255 area 0
R3(config-router)# network 192.168.0.0 0.0.255.255 area 0
R3(config-router)# network 192.168.8.0 0.0.3.255 area 20
R3(config-router)#
*Jul 27 08:22:05.503: %OSPF-5-ADJCHG: Process 1, Nbr 172.16.100.1 on
Serial0/0/1 from LOADING to FULL, Loading Done
R3(config-router)#
```

- f. Verify that your adjacencies come up with the **show ip ospf neighbor** command, and make sure that you have routes from OSPF populating the R2 routing table using the **show ip route ospf** command.

```
R2# show ip ospf neighbor
```

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.40.1	0	FULL/ -	00:00:39	172.16.23.3	Serial0/0/1

```
R2#
```

```
R2# show ip route ospf
```

<Output omitted>

```
172.16.0.0/16 is variably subnetted, 10 subnets, 2 masks
O       172.16.3.0/24 [110/1563] via 172.16.23.3, 00:04:24, Serial0/0/1
O IA    192.168.8.0/24 [110/1563] via 172.16.23.3, 00:04:24, Serial0/0/1
```

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```
O IA 192.168.9.0/24 [110/1563] via 172.16.23.3, 00:04:24, Serial0/0/1
O IA 192.168.10.0/24 [110/1563] via 172.16.23.3, 00:04:24, Serial0/0/1
O IA 192.168.11.0/24 [110/1563] via 172.16.23.3, 00:04:24, Serial0/0/1
O    192.168.20.0/24 [110/1563] via 172.16.23.3, 00:04:24, Serial0/0/1
O    192.168.25.0/24 [110/1563] via 172.16.23.3, 00:04:24, Serial0/0/1
O    192.168.30.0/24 [110/1563] via 172.16.23.3, 00:04:24, Serial0/0/1
O    192.168.35.0/24 [110/1563] via 172.16.23.3, 00:04:24, Serial0/0/1
O    192.168.40.0/24 [110/1563] via 172.16.23.3, 00:04:24, Serial0/0/1
R2#
```

- g. Verify that your adjacencies and routing table of R3.

```
R3# show ip ospf neighbor
```

Neighbor ID	Pri	State	Dead Time	Address	Interface
172.16.100.1	0	FULL/ -	00:00:39	172.16.23.2	Serial0/0/1

```
R3#
```

```
R3# show ip route ospf
```

<Output omitted>

```
172.16.0.0/16 is variably subnetted, 5 subnets, 2 masks
O IA 172.16.100.0/24 [110/1563] via 172.16.23.2, 00:07:02, Serial0/0/1
R3#
```

- h. Verify that R1 and R2 can reach all of the networks in the OSPF routing domain using the following Tcl script.

```
R1# tclsh
```

```
foreach address {
172.16.100.1
172.16.23.2
172.16.23.3
172.16.3.1
192.168.8.1
192.168.9.1
192.168.10.1
192.168.11.1
192.168.20.1
192.168.25.1
192.168.30.1
192.168.35.1
192.168.40.1
} { ping $address }
```

All pings should be successful. Troubleshoot if necessary.

## Step 5: Summarize OSPF areas at the ABR.

Review the R2 routing table. Notice the inter-area routes (O IA) for the R3 loopbacks in area 20.

Where can you summarize in OSPF?

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- a. These four routes can be summarized into a single inter-area route using the **area area range network mask** command on the ABR, R3.

```
R3(config)# router ospf 1
R3(config-router)# area 20 range 192.168.8.0 255.255.252.0
```

- b. On R2, verify the summarization with the **show ip route ospf** command on R2.

```
R2#show ip route ospf
```

<Output omitted>

```

      172.16.0.0/16 is variably subnetted, 10 subnets, 2 masks
O       172.16.3.0/24 [110/1563] via 172.16.23.3, 00:37:42, Serial0/0/1
O IA    192.168.8.0/22 [110/1563] via 172.16.23.3, 00:01:26, Serial0/0/1
O       192.168.20.0/24 [110/1563] via 172.16.23.3, 00:37:42, Serial0/0/1
O       192.168.25.0/24 [110/1563] via 172.16.23.3, 00:37:42, Serial0/0/1
O       192.168.30.0/24 [110/1563] via 172.16.23.3, 00:37:42, Serial0/0/1
O       192.168.35.0/24 [110/1563] via 172.16.23.3, 00:37:42, Serial0/0/1
O       192.168.40.0/24 [110/1563] via 172.16.23.3, 00:37:42, Serial0/0/1
R2#
```

Compare and contrast OSPF and EIGRP in terms of where summarization takes place.

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## Step 6: Configure mutual redistribution between OSPF and EIGRP.

Notice that R2 is the only router with knowledge of all routes (EIGRP and OSPF) in the topology at this point, because it is involved with both routing protocols. Next you will redistribute the EIGRP routes into OSPF and the OSPF routes into EIGRP.

- a. To redistribute the EIGRP routes into OSPF, on R2 issue the **redistribute eigrp 1 subnets** command. The **subnets** command is necessary because, by default, OSPF only redistributes classful networks and supernets.

```
R2(config)# router ospf 1
R2(config-router)# redistribute eigrp 1 subnets
R2(config-router)# exit
```

A default seed metric is not required for OSPF. Redistributed routes are assigned a metric of 20 by default.

- b. To redistribute the OSPF routes into EIGRP, on R2 issue the **redistribute ospf 1 metric 10000 100 255 1 1500** command. Unlike OSPF, EIGRP must specify the metric associated to the redistributed routes. The command tells EIGRP to redistribute OSPF process 1 with these metrics: bandwidth of 10000, delay of 100, reliability of 255/255, load of 1/255, and a MTU of 1500. EIGRP requires a seed metric.

```
R2(config)# router eigrp 1
R2(config-router)# redistribute ospf 1 metric 10000 100 255 1 1500
R2(config-router)# exit
```

- c. Issue the **show ip protocols** command on the redistributing router, R2. Compare your output with the following output.

```
R2# show ip protocols
```

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<Output omitted>

Routing Protocol is "eigrp 1"

<Output omitted>

Redistributing: ospf 1

<Output omitted>

Routing Protocol is "ospf 1"

<Output omitted>

Redistributing External Routes from,  
eigrp 1, includes subnets in redistribution

<Output omitted>

R2#

- d. Display the routing table on R1 to verify the redistributed routes. Redistributed OSPF routes display on R1 as D EX, which means that they are external EIGRP routes.

R1# **show ip route**

<Output omitted>

Gateway of last resort is not set

<Output omitted>

D EX 172.16.3.0/24 [170/40537600] via 172.16.12.2, 00:04:41, Serial0/0/0

<Output omitted>

D EX 192.168.8.0/22 [170/40537600] via 172.16.12.2, 00:04:41, Serial0/0/0

D EX 192.168.20.0/24 [170/40537600] via 172.16.12.2, 00:04:41, Serial0/0/0

D EX 192.168.25.0/24 [170/40537600] via 172.16.12.2, 00:04:41, Serial0/0/0

D EX 192.168.30.0/24 [170/40537600] via 172.16.12.2, 00:04:41, Serial0/0/0

D EX 192.168.35.0/24 [170/40537600] via 172.16.12.2, 00:04:41, Serial0/0/0

D EX 192.168.40.0/24 [170/40537600] via 172.16.12.2, 00:04:41, Serial0/0/0

<Output omitted>

R1#

- e. Display the routing table on R3 to see the redistributed routes. Redistributed EIGRP routes are tagged in the R3 routing table as O E2, which means that they are OSPF external type 2. Type 2 is the default OSPF external type.

R3# **show ip route**

<Output omitted>

O E2 172.16.1.0/24 [110/20] via 172.16.23.2, 00:08:18, Serial0/0/1

O E2 172.16.2.0/24 [110/20] via 172.16.23.2, 00:08:18, Serial0/0/1

<Output omitted>

O E2 172.16.12.0/24 [110/20] via 172.16.23.2, 00:08:18, Serial0/0/1

<Output omitted>

O E2 192.168.48.0/23 [110/20] via 172.16.23.2, 00:08:18, Serial0/0/1

O E2 192.168.50.0/24 [110/20] via 172.16.23.2, 00:08:18, Serial0/0/1

O E2 192.168.51.0/24 [110/20] via 172.16.23.2, 00:08:18, Serial0/0/1

O E2 192.168.70.0/24 [110/20] via 172.16.23.2, 00:08:18, Serial0/0/1

R3#

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- f. Verify full connectivity with the following Tcl script:

```
R1# tclsh

foreach address {
172.16.1.1
192.168.48.1
192.168.49.1
192.168.50.1
192.168.51.1
192.168.70.1
172.16.12.1
172.16.12.2
172.16.2.1
172.16.100.1
172.16.23.2
172.16.23.3
172.16.3.1
192.168.8.1
192.168.9.1
192.168.10.1
192.168.11.1
192.168.20.1
192.168.25.1
192.168.30.1
192.168.35.1
192.168.40.1
} { ping $address }
```

All pings should now be successful. Troubleshoot as necessary.

## Step 7: Summarize external routes into OSPF at the ASBR.

You cannot summarize routes redistributed into OSPF using the **area range** command. This command is effective only on routes internal to the specified area. Instead, use the OSPF **summary-address network mask** command.

- a. Before you make any changes, display the R3 the OSPF routes in the routing table and list only those routes that have a E2 type metric.

```
R3# show ip route ospf | include E2
<Output omitted>
O E2 192.168.48.0/23 [110/20] via 172.16.23.2, 00:16:22, Serial0/0/1
O E2 192.168.50.0/24 [110/20] via 172.16.23.2, 00:16:22, Serial0/0/1
O E2 192.168.51.0/24 [110/20] via 172.16.23.2, 00:16:22, Serial0/0/1
O E2 192.168.70.0/24 [110/20] via 172.16.23.2, 00:16:22, Serial0/0/1
R3#
```

Notice the external routes for the R1 loopback interfaces 48, 50 and 51. Loopbacks 48 and 49 were previously summarized in EIGRP, they will be included when redistributing the EIGRP into OSPF.

Which mask should you use to summarize all loopbacks 48, 50, and 51 to one prefix?

- b. You can summarize this all into one supernet on R2 using the following commands.

```
R2(config)# router ospf 1
R2(config-router)# summary-address 192.168.48.0 255.255.252.0
```

- c. Verify this action in the R3 routing table.

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```
R3# show ip route ospf | include E2
<Output omitted>
O E2 192.168.48.0/22 [110/20] via 172.16.23.2, 00:00:07, Serial0/0/1
O E2 192.168.70.0/24 [110/20] via 172.16.23.2, 00:21:44, Serial0/0/1
R3#
```

What would happen if loopback 50 on R1 were to become unreachable by R2?

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Would data destined for 192.168.50.0/24 from R3 still be sent to R2?

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Would data destined for 192.168.50.0/24 from R2 continue to be sent to R1?

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- d. If you are unsure of the outcome, shut down the interface on R1. Issue the ICMP **tracert** command to 192.168.50.1 from R3 and then from R2. Remember to issue the **no shutdown** command when you are finished checking.

Is this a desirable outcome? Explain.

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