A Practical Guide to Advanced Networking

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A PRACTICAL GUIDE TO ADVANCED NETWORKING

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Route Redistribution into OSPF

Next, the steps for route redistribution for OSPF are examined for Router A and Router B in the network shown in Figure 3-5. Both routers have been configured to run OSPF using the following commands:

```
!
router ospf 200
 network 10.0.0.0 0.255.255.255 area 0
!
```

Once the basic configuration for OSPF has been configured, the routers will have the OSPF neighbor adjacency established and the OSPF routes will be exchanged. The result of the **show ip ospf neighbor** and **show ip route ospf** on Router A are shown in the output examples that follow. The results confirm the neighbor adjacency and that the expected network routes are being learned via OSPF:

```
RouterA#sh ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address
Interface
172.16.20.1       1   FULL/BDR        00:00:34    10.1.1.2
FastEthernet0/1
RouterA#sh ip route ospf
     10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
O       10.20.20.0/24 [110/2] via 10.1.1.2, 00:15:38, FastEthernet0/1
```

Router B's connected interface to Router C is not advertised as a network statement in the OSPF configuration. Therefore, its connected network will not be shown in Router A's routing table. This is the same behavior demonstrated for RIP. Just like RIP, connected networks can be redistributed in OSPF by using the **redistribute connected** command. This command is next issued on Router B:

```
RouterB(config)#router ospf 200
RouterB(config-router)#redistribute connected
% Only classful networks will be redistributed
```

However, what we get is the message stating that only classful networks can be redistributed. Because the connected network is 172.16.20.0/30, which is not a classful network, this will not work. Cisco provides a solution to this problem with a slightly different command:

```
RouterB(config-router)#redistribute connected subnets
```

redistribute connected subnets
Allows the classless network to be distributed.

E2
An OSPF external type 2 route.

This command allows the classless network to be distributed. Once the command is issued, we can then verify the result on Router A. The **show ip route** command now shows the network 172.16.20.0 is being advertised by OSPF. Not only that, the network route is flagged as an **E2** or an OSPF external type 2 route, which is different than other OSPF internal routes. By default, any routes that are being redistributed from another routing protocol into OSPF will appear as OSPF E2 routes that are the least preferred among the OSPF route types.

```
RouterA#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
```

```
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS
level-2
       ia - IS-IS inter area, * - candidate default, U - per-user
static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     172.16.0.0/30 is subnetted, 1 subnets
O E2    172.16.20.0 [110/20] via 10.1.1.2, 00:01:59, FastEthernet0/1
     10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
O       10.20.20.0/24 [110/2] via 10.1.1.2, 00:06:49, FastEthernet0/1
C       10.10.10.0/24 is directly connected, FastEthernet0/0
C       10.1.1.0/30 is directly connected, FastEthernet0/1
```

Now, configure a static route on Router B to the LAN C network of 192.168.30.0 and redistribute it into OSPF. This enables Router A to learn the route to 192.168.30.0. To redistribute static routes, issue the command **redistribute static** on Router B:

```
RouterB(config)#ip route 192.168.30.0 255.255.255.0 172.16.20.2
RouterB(config)#router ospf 200
RouterB(config-router)#redistribute static
% Only classful networks will be redistributed
```

The same warning message is shown saying that, "only classful networks will be redistributed." This time, the network 192.168.30.0/24 is a classful network, so the network will be redistributed; otherwise, the command **redistribute static subnets** will need to be used to distribute classless networks similar to what was done for the connected network. As a result of the redistributed static route entered in Router B, Router A now learns of the route to LAN C network via OSPF and the network is shown as an OSPF external type 2 route:

redistribute static subnets
Allows the static network to be distributed.

```
RouterA#sh ip route ospf
O E2 192.168.30.0/24 [110/20] via 10.1.1.2, 00:03:37, FastEthernet0/1
      172.16.0.0/30 is subnetted, 1 subnets
O E2    172.16.20.0 [110/20] via 10.1.1.2, 00:51:59, FastEthernet0/1
    10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
O       10.20.20.0/24 [110/2] via 10.1.1.2, 00:42:28, FastEthernet0/1
```

The other dynamic protocols are distributed into OSPF in similar fashion. For example, if Router C runs EIGRP as its routing protocol, then Router B will need to run EIGRP in order for Router B and Router C to communicate. Both routers have to agree on an EIGRP Autonomous system number. In this example, an EIGRP AS number of 200 is selected. The EIGRP routing configuration for Router C and Router B follow.

Router C's EIGRP configuration:

```
!
router eigrp 200
 network 192.168.30.0 0.
 network 172.16.0.0
no auto-summary
!
```

Router B's EIGRP configuration:

```
!
router eigrp 200
 network 10.0.0.0
 network 172.16.0.0
no auto-summary
!
```

Now, verify that Router B is able to receive an EIGRP route from Router C before proceeding with the route redistribution. This can be done using the **sh ip route** command. The routing table for Router B is shown. It shows a network route of 192.168.30.0/24 learned from Router C's interface 172.16.20.2 via EIGRP:

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

Gateway of last resort is not set

D    192.168.30.0/24 [90/30720] via 172.16.20.2, 00:50:45,
FastEthernet0/1
     172.16.0.0/30 is subnetted, 1 subnets
C       172.16.20.0 is directly connected, FastEthernet0/1
     10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
C       10.20.20.0/24 is directly connected, FastEthernet0/0
O       10.10.10.0/24 [110/2] via 10.1.1.1, 00:53:18, FastEthernet1/0
C       10.1.1.0/30 is directly connected, FastEthernet1/0
```

The next step is to configure Router B to redistribute a learned EIGRP route into OSPF. Recall that the OSPF cost or metric is derived from the bandwidth of the interface. By default, Cisco routers will assign an OSPF cost/metric of 20 to any redistributed routes with exception for redistributed routes from BGP. If the metric does not need to be set, the command to distribute dynamic routing protocols is all the same for OSPF. The command to redistribute EIGRP routes into OSPF is

redistribute eigrp *AS_id* **[metric** *0-16777214***]**. This time, the keyword **subnets** will be used to avoid the warning message of only classful networks will be redistributed:

```
RouterB(config)#router ospf 200
RouterB(config-router)#redistribute eigrp 200 subnets
```

redistribute eigrp *AS_id* **[metric** *0-16777214***]**
The command to redistribute EIGRP routes into RIP.

The command **show ip route ospf** on Router A would confirm the result that the network 192.168.30.0/24 is advertised as an OSPF external type 2 route:

```
RouterA#sh ip route ospf
O E2 192.168.30.0/24 [110/20] via 10.1.1.2, 00:03:37, FastEthernet0/1
     172.16.0.0/30 is subnetted, 1 subnets
O E2    172.16.20.0 [110/20] via 10.1.1.2, 00:51:59, FastEthernet0/1
     10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
O       10.20.20.0/24 [110/2] via 10.1.1.2, 00:42:28, FastEthernet0/1
```

To redistribute RIP into OSPF, the command is **redistribute rip**. For IS-IS, the command is **redistribute isis** *IS-IS_Level*. The configuration example is as follows:

```
RouterB(config)#router ospf 200
RouterB(config-router)#redistribute rip
RouterB(config-router)#redistribute isis level-1-2
```

redistribute rip
The command to redistribute RIP into OSPF.

redistribute isis *IS-IS_Level*
The command to redistribute EIGRP routes into IS-IS.

Route Redistribution into EIGRP

Next, the steps for route redistribution of routers into EIGRP is examined. First, EIGRP is configured for Router A and Router B. Both routers will have the same EIGRP routing configuration, as shown:

```
!
router eigrp 200
 network 10.0.0.0
 no auto-summary
!
```

The EIGRP neighbor adjacency can be verified with the command **show ip eigrp neighbor**, and the EIGRP route is verified with **show ip route eigrp** on Router A. The results confirm that the neighbor adjacency is established and the correct network routes are being exchanged via EIGRP:

```
RouterA#sh ip eigrp neighbors
IP-EIGRP neighbors for process 200
H  Address    Interface  Hold  Uptime     SRTT  RTO  Q      Seq
                                (sec)      (ms)       Cnt    Num
0  10.1.1.2   Fa0/1      11    00:03:39   40    240  0      4

RouterA#show ip route eigrp
     10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
D       10.20.20.0/24 [90/30720] via 10.1.1.2, 00:03:48,
FastEthernet0/1
```

Router B's connected interface to Router C will need to be redistributed, because it is not included as a network statement in the EIGRP configuration. Router A's routing table does not show a connected network for 172.16.20.0/30. This is expected, because it has not yet been redistributed by Router B, as previously discussed in the RIP and OSPF example. The command **redistribute connected** is issued on Router B to redistribute the connected network:

```
RouterB(config)#router eigrp 200
RouterB(config-router)#redistribute connected
```

EX
External EIGRP type.

Once the command **redistribute connected** is issued, the command **sh ip route** can be issued on Router A to verify that the network 172.16.20.0 is being advertised via EIGRP. The network route is also flagged as an **EX** or an external EIGRP type. The external EIGRP route has an administrative distance (AD) value of 170, which is higher than the internal EIGRP route's AD value of 90:

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

Gateway of last resort is not set

     172.16.0.0/30 is subnetted, 1 subnets
D EX    172.16.20.0 [170/30720] via 10.1.1.2, 00:23:14,
FastEthernet0/1
     10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
D       10.20.20.0/24 [90/30720] via 10.1.1.2, 00:37:20,
FastEthernet0/1
C       10.10.10.0/24 is directly connected, FastEthernet0/0
C       10.1.1.0/30 is directly connected, FastEthernet0/1
```

Next, a static route on Router B needs to be configured to the LAN C network of 192.168.30.0. Additionally, the static route must be redistributed into EIGRP. This enables Router A to learn the route as well. To redistribute static routes, the command **redistribute static** is issued on Router B.

```
RouterB(config)#ip route 192.168.30.0 255.255.255.0 172.16.20.2
RouterB(config)#router eigrp 200
RouterB(config-router)#redistribute static
```

As a result, Router A now learns of the route to LAN C network via EIGRP, and the network 192.168.30.0 is displayed as an EIGRP external route, just like the distributed connected route:

```
RouterA#sh ip route eigrp
D EX 192.168.30.0/24 [170/30720] via 10.1.1.2, 00:00:17,
FastEthernet0/1
     172.16.0.0/30 is subnetted, 1 subnets
D EX    172.16.20.0 [170/30720] via 10.1.1.2, 00:33:53,
FastEthernet0/1
     10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
D       10.20.20.0/24 [90/30720] via 10.1.1.2, 00:47:59,
FastEthernet0/1
```

As we have learned, EIGRP uses a composite metric, which consists of bandwidth, delay, reliability, load, and MTU. To redistribute other dynamic routing protocols, the metric value has to be converted into EIGRP's metric values or new EIGRP metric values must be assigned. Routes will not be redistributed properly without these values. Cisco recommends that every redistributed dynamic routing protocol be assigned with EIGRP metrics. As it turns out, even though only the two EIGRP metric values of bandwidth and delay are used by default, Cisco enforces all the metric values be defined. The parameters defining the EIGRP metric assignments are as follows:

- Bandwidth metric is a value between 1–4294967295 in Kbps.
- Delay metric is a value between 0–4294967295 in ten microseconds.
- Reliability metric is a value between 1–255, where 255 is 100 percent reliable.
- Load metric is a value between 0–255, where 255 is a 100 percent load.
- MTU is a maximum transfer unit value between 1-65,535, where 1,500 is a norm.

The following example demonstrates how to redistribute RIPv2 routes into EIGRP. Router C and Router B are both configured to run RIPv2. The RIPv2 routing configurations for Router C and Router B follow:

Router C's RIPv2 configuration:

```
!
router rip
 version 2
 network 172.16.0.0
 network 192.168.30.0
!
```

Router B's RIPv2 configuration:

```
!
router rip
 version 2
 network 10.0.0.0
 network 172.16.0.0
!
```

Now, you must verify that Router B is able to receive a RIP route from Router C before proceeding with the route redistribution. The routing table of Router B is