Understanding Redistribution of OSPF Routes into BGP

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Related Information

Introduction

This Tech Note explains the behavior of Open Shortest Path First (OSPF) to Border Gateway Protocol (BGP) redistribution on Cisco routers. The behavior of OSPF to BGP redistribution is outlined in RFC 1403.

There are several types of OSPF routes:

- **Intra-Area** - In a multiarea OSPF network, routes, originated within an area, are known by the routers in the same area as Intra-Area routes. These routes are flagged as O in the `show ip route` command output.

- **Inter-Area** - When a route crosses an OSPF Area Border Router (ABR), the route is known as an OSPF Inter-Area route. These routes are flagged as O IA in the `show ip route` command output.

Both Intra and Inter-Area routes are also called OSPF Internal routes, as they are generated by OSPF itself, when an interface is covered with the `network` command.

- **External Type-2 or External Type-1** - Routes which were redistributed into OSPF, such as Connected, Static, or other Routing Protocol, are known as External Type-2 or External Type-1. These routes are flagged as O E2 or O E1 in the `show ip route` command output.

- **NSSA external type 2 or NSSA external type 1** - When an area is configured as a Not-So-Stub Area (NSSA), and routes are redistributed into OSPF, the routes are known as NSSA external type 2 or NSSA external type 1. These routes are flagged as O N2 or O N1 in the `show ip route` command output.

Describing the differences between External and NSSA type 2 or 1 is beyond the scope of this document. Refer to the OSPF Design Guide for more information.

The default behavior is not to redistribute any routes from OSPF into BGP. Redistribution must be configured. You can use the `route-map` command to filter routes during OSPF to BGP redistribution. When
Redistributing, specific keywords like **internal**, **external** and **nssa-external** are required to redistribute respective routes.

**Prerequisites**

**Requirements**

An understanding of OSPF route types is required before using this document.

**Components Used**

This document is not restricted to specific software and hardware versions.

The information presented in this document was created from devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If you are working in a live network, ensure that you understand the potential impact of any command before using it.

**Conventions**

For more information on document conventions, see the Cisco Technical Tips Conventions.

**Network Setup**

There are four cases of redistributing OSPF routes into BGP discussed below. The network diagram applies to the first three cases. The diagram and setup for the fourth case can be found in the Redistribution of OSPF NSSA–External Routes into BGP section.

**Redistribution of Only OSPF Internal (Intra– and Inter–Area) Routes into BGP**
If you configure the redistribution of OSPF into BGP without keywords, only OSPF intra-area and inter-area routes are redistributed into BGP, by default. You can use the internal keyword along with the redistribute command under router bgp to redistribute OSPF intra- and inter-area routes.

This configuration is a new configuration of Router B that redistributes only the intra-area route (131.108.2.0/24) and inter-area route (131.108.1.0/24) into BGP and only OSPF Internal (intra-area and inter-area) routes are redistributed into BGP:

```
hostname RTB
!
interface Ethernet0/0
 ip address 2.2.2.3 255.255.255.0
!
interface Serial1/0
 ip address 3.3.3.1 255.0.0.0
!
routing ospf 1
 network 2.0.0.0 0.255.255.255 area 1
!
routing bgp 100
 redistribute ospf 1

! -- This redistributes only OSPF intra- and inter-area routes into BGP.

neighbor 3.3.3.2 remote-as 200
!
end
```

```
RTB# show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       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

2.0.0.0/24 is subnetted, 1 subnets
 C 2.2.2.0 is directly connected, Ethernet0/0
 C 3.0.0.0/8 is directly connected, Serial1/0
 O E2 200.1.1.0/24 [110/20] via 2.2.2.2, 00:16:17, Ethernet0/0
 O E1 200.2.2.0/24 [110/104] via 2.2.2.2, 00:00:41, Ethernet0/0
131.108.0.0/24 is subnetted, 2 subnets
 O 131.108.2.0 [110/74] via 2.2.2.2, 00:16:17, Ethernet0/0
 O IA 131.108.1.0 [110/84] via 2.2.2.2, 00:16:17, Ethernet0/0
RTB#
```

```
RTB# show ip bgp
BGP table version is 10, local router ID is 192.168.1.7
Status codes: s suppressed, d damped, h history, * valid, > best, i = internal,
               r RIB-failure, S Stale
Origin codes: i = IGP, e = EGP, ? = incomplete

Network     Next Hop         Metric LocPrf Weight Path
*> 2.2.2.0/24  0.0.0.0         0      32768 ?
*> 131.108.1.0/24 2.2.2.2       84     32768 ?
```

Router B redistributes only OSPF Internal routes:
Router C learning these routes from BGP:

RTC# show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
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

2.0.0.0/24 is subnetted, 1 subnets
B 2.2.2.0 [20/0] via 3.3.3.1, 00:11:19
C 3.0.0.0/8 is directly connected, Serial0/0
131.108.0.0/24 is subnetted, 2 subnets
B 131.108.2.0 [20/74] via 3.3.3.1, 00:03:56
B 131.108.1.0 [20/84] via 3.3.3.1, 00:03:28

RTC#

Redistribution of Only OSPF External (Type 1 and 2) Routes into BGP

Use the `external` keyword along with the `redistribute` command under `router bgp` to redistribute OSPF external routes into BGP. With the `external` keyword, you have three choices:

- redistribute both external type−1 and type−2 (Default)
- redistribute type−1
- redistribute type−2

Enter the commands in the configuration mode as described here:

```
RTB(config-router)# router bgp 100
RTB(config-router)# redistribute ospf 1 match external 1 external 2
```

In this configuration of Router B, we redistribute only OSPF External routes, but both type−1 and type−2:

```
hostname RTB
!
interface Ethernet0/0
  ip address 2.2.2.1 255.0.0.0
!
interface Serial1/0
  ip address 3.3.3.1 255.0.0.0
!
router ospf 1
  network 2.0.0.0 0.255.255.255 area 1
!
router bgp 100
  redistribute ospf 1 match external 1 external 2

!--- This redistributes ONLY OSPF External routes, !--- but both type-1 and type-2.
```
neighbor 3.3.3.3 remote-as 200
!
end

Note: The configuration shows match external 1 external 2 and the command entered was redistribute ospf 1 match external. This is normal because OSPF automatically appends “external 1 external 2” in the configuration. It matches both OSPF external 1 and external 2 routes and it redistributes both routes into BGP.

Router B redistributes only OSPF External routes:

    RTB# show ip bgp
    BGP table version is 21, local router ID is 192.168.1.7
    Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
    r RIB-failure, S Stale
    Origin codes: i - IGP, e - EGP, ? - incomplete

    +---------------+--------+-----+--------+------------+--+
    | Network       | Next Hop | Metric| LocPrf | Weight    | Path |
    +---------------+--------+-----+--------+------------+--+
    | *> 200.1.1.0  | 2.2.2.2 | 20   | 32768  | ?          |     |
    | *> 200.2.2.0  | 2.2.2.2 | 104  | 32768  | ?          |     |
    +---------------+--------+-----+--------+------------+--+

Router C learns about these two OSPF external routes from BGP:

    RTC# 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, * − candidate default
    U − per-user static route, o − ODR
    Gateway of last resort is not set
    B    200.1.1.0/24 [20/20] via 3.3.3.1, 00:01:43
    B    200.2.2.0/24 [20/0] via 3.3.3.1, 00:01:43
    C    3.0.0.0/8 is directly connected, Serial0/0

Redistribution of Only OSPF External Type 1 or Type 2 Routes into BGP

Enter this command under router bgp 100 on Router B to redistribute only OSPF external 1 routes:

    router bgp 100
    redistribute ospf 1 match external 1

The Router B BGP table shows that it is only redistributing external 1 routes into BGP and all other OSPF routes are not redistributed into BGP:

    RTB# show ip bgp
    BGP table version is 24, local router ID is 192.168.1.7
    Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
    r RIB-failure, S Stale
    Origin codes: i - IGP, e - EGP, ? - incomplete

    Network | Next Hop | Metric | LocPrf | Weight | Path |
    +--------+--------+-------+--------+--------+--+
    | *> 200.2.2.0 | 2.2.2.2 | 104   | 32768  | ?      |     |
    +--------+--------+-------+--------+--------+--+

In the same way, enter this command under router bgp 100 on Router B to redistribute only OSPF external 2
Redistribution of OSPF Internal and External Routes into BGP

In this case, all OSPF routes are redistributed into BGP by using both the `internal` and `external` keywords, as shown in this Router B configuration:

```
RTB
hostname RTB
!
interface Ethernet0/0
 ip address 2.2.2.1 255.0.0.0
!
interface Serial1/0
 ip address 3.3.3.1 255.0.0.0
!
routing ospf 1
 network 2.0.0.0 0.255.255.255 area 1
!
routing bgp 100
 redistribute ospf 1 match internal external 1 external 2

!--- This redistributes all OSPF routes into BGP.

neighbor 3.3.3.3 remote-as 200
!
end
```

Again, `external` is replaced with `external 1 external 2` in the configuration. This is normal unless you specify which specific external routes you want to redistribute into BGP. After performing the configuration change, Router B redistributes all OSPF routes and Router C starts to learn all routes from BGP:

```
RTB# show ip bgp
BGP table version is 30, local router ID is 192.168.1.7
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal, r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>* &gt; 2.2.2.0/24</td>
<td>0.0.0.0</td>
<td>0</td>
<td>32768</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>* &gt; 131.108.1.0/24</td>
<td>2.2.2.2</td>
<td>84</td>
<td>32768</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>* &gt; 131.108.2.0/24</td>
<td>2.2.2.2</td>
<td>74</td>
<td>32768</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>* &gt; 200.1.1.0</td>
<td>2.2.2.2</td>
<td>20</td>
<td>32768</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>* &gt; 200.2.2.0</td>
<td>2.2.2.2</td>
<td>104</td>
<td>32768</td>
<td>?</td>
<td></td>
</tr>
</tbody>
</table>

RTC# show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
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
```
Redistribution of OSPF NSSA–External Routes into BGP

This is a special case in which only Not–So–Stubby Area (NSSA) routes are redistributed into BGP. This case is very similar to the case described in the Redistribution of only OSPF External (Type 1 and 2) Routes into BGP section. The only difference is that BGP is now matching NSSA–external routes instead of just external routes. The routing table of Router B shows these OSPF NSSA–external routes:

```
   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

   200.1.1.0/24 [110/20] via 2.2.2.1, 00:22:53, Ethernet0
   200.2.2.0/24 [110/20] via 2.2.2.2, 00:22:53, Ethernet0
   131.108.1.0/24 [110/20] via 2.2.2.2, 00:22:53, Ethernet0
   131.108.2.0/24 [110/20] via 2.2.2.2, 00:22:53, Ethernet0
   2.0.0.0/8 is directly connected, Ethernet0
   3.0.0.0/8 is directly connected, Serial1
```

This network diagram is used for this case:
The network diagram shows that Router B receives both OSPF N1 and N2 routes. The default behavior is to redistribute both N1 and N2 routes if only the `nssa-external` keyword is used. This configuration of Router B allows us to redistribute OSPF N1 (200.1.1.0/24) and OSPF N2 (200.2.2.0/24) routes into BGP:

```
hostname RTB
!
interface Ethernet0/0
   ip address 2.2.2.1 255.0.0.0
!
interface Serial1/0
   ip address 3.3.3.1 255.0.0.0
!
router ospf 1
   network 2.0.0.0 0.255.255.255 area 1 nssa
!
router bgp 100
   redistribute ospf 1 match nssa-external 1 nssa-external 2

!--- This redistributes only OSPF NSSA-external routes
!--- Type-1 and Type-2 into BGP.
!
neighbor 3.3.3.3 remote-as 200
!
end
```

**Note:** Like the OSPF external configuration, the above configuration displays `match nssa-external 1 nssa-external 2` and the command entered was `redistribute ospf 1 match nssa-external`. This is normal because OSPF automatically appends "nssa-external 1 nssa-external 2" in the configuration. It matches both OSPF N1 and OSPF N2 routes and redistributes both routes into BGP.

After the configuration change on Router B, Router B redistributes OSPF NSSA-external routes, and Router C starts learning OSPF NSSA-external routes from BGP:

```
RTB# show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
   D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
   N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
   E1 - OSPF external type 1, E2 - OSPF external type 2
   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

2.0.0.0/24 is subnetted, 1 subnets
 C   200.1.1.1 is directly connected, Ethernet0/0
 C   200.1.1.2 is directly connected, Serial1/0
O N2  200.1.1.24 [110/94] via 2.2.2.1, 00:11:12, Ethernet0/0
O N1  200.2.2.24 [110/20] via 2.2.2.2, 00:12:23, Ethernet0/0
131.108.0.0/24 is subnetted, 2 subnets
 O   131.108.1.0 [110/74] via 2.2.2.2, 00:12:23, Ethernet0/0
 O IA  131.108.2.0 [110/84] via 2.2.2.2, 00:12:11, Ethernet0/0
RTB#
```

```
RTB# show ip bgp
BGP table version is 21, local router ID is 3.3.3.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i − IGP, e − EGP, ? − incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>*&gt; 200.1.1.0</td>
<td>2.2.2.2</td>
<td>94</td>
<td></td>
<td>32768</td>
<td>?</td>
</tr>
<tr>
<td>*&gt; 200.2.2.0</td>
<td>2.2.2.1</td>
<td>20</td>
<td></td>
<td>32768</td>
<td>?</td>
</tr>
</tbody>
</table>

RTC# show ip route
Codes: C − connected, S − static, R − RIP, M − mobile, B − BGP
D − EIGRP, EX − EIGRP external, O − OSPF, IA − OSPF inter area
N1 − OSPF NSSA external type 1, N2 − OSPF NSSA external type 2
E1 − OSPF external type 1, E2 − OSPF external type 2
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     3.0.0.0/8 is directly connected, Serial0/0
B     200.1.1.0/24 [20/94] via 3.3.3.1, 00:02:06
B     200.2.2.0/24 [20/20] via 3.3.3.1, 00:02:06

In the same way as with OSPF External routes, to redistribute only OSPF N1 routes, enter the following command under router BGP 100 on Router B:

```
router bgp 100
redistribute ospf 1 match nssa-external 1
```

!−−− This redistributes only OSPF N1 routes into BGP.

To redistribute only OSPF N2 routes, enter the following command under router BGP 100 on Router B:

```
router bgp 100
redistribute ospf 1 match nssa-external 2
```

!−−− This redistributes only OSPF N2 routes into BGP.

Note: Route−Maps can also be used to redistribute OSPF Type 1/2 into BGP. Refer to Redistribute OSPF E2 Routes in BGP for more information.

**Modify the Redistribution Option in OSPF**

It is important to understand how the successive configuration change may alter your configuration. A new command with the match option does not overwrite the previous one but is added to it. Starting with no redistribution, this example configuration command sequence shows its impact on redistribution:

```
R4# conf t
R4(config)# router bgp 100
R4(config-router)# redistribute ospf 1 match internal
R4(config-router)# ^Z
```

!−−− Initially, we redistribute internal OSPF routes into BGP 100.

```
R4# sh run | i redistribute ospf
redistribute ospf 1 match internal
```
Unable to Redistribute iBGP Learnt Routes into an IGP such as EIGRP, OSPF

Route Redistribution is used to propagate routes learned with the use of one protocol, into another routing protocol. When BGP is redistributed into an IGP, only eBGP learned routes get redistributed. The iBGP learned routes known on the router are not introduced into the IGP in order to prevent routing loops from being formed.

By default, iBGP redistribution into IGP is disabled. Issue the `bgp redistribute-internal` command in order
to enable redistribution of iBGP routes into IGP. Precautions need to be taken to redistribute specific routes using route maps into IGP.

A sample configuration for redistributing iBGP routes into OSPF is shown here:

```
router bgp 65345
bgp redistribute-internal
!
router ospf 100
redistribute bgp 65345 subnets
```

**Note:** The redistribution of internal Border Gateway Protocol (iBGP) routes into an Interior Gateway Protocol can cause routing loops within the Autonomous System (AS). This is not recommended. Route filters need to be set in order to control the information, which is imported into the IGP.

### Redistribute OSPF Default Routes in to BGP

In order to redistribute default routes in to BGP, use the `network` statement and `default-information originate`. In our example, the OSPF default routes are redistributed in to BGP. This is done with the creation of a route-map and the distribution of the default network, which is permitted by the standard ACL.

```
!
route-map map_default_only permit 10
  match ip address acl_default_only
!
ip access-list standard acl_default_only
  permit 0.0.0.0
!
router bgp 64601
  network 0.0.0.0
  redistribute ospf 1 route-map map_default_only
    default-information originate
  !--- distributes the default route in bgp
!
```

After the configuration, clear the bgp sessions with the `clear ip bgp *` command.

### Related Information

- OSPF Support Page
- BGP Support Page
- Technical Support & Documentation – Cisco Systems