Contents

Introduction

This document describes the concepts used for the selection of forwarding address for an External LSA (Link State Advertisement) by an ASBR (Autonomous System Boundary Router) in OSPF (Open Shortest Path First) domain.

Prerequisites

Requirements

Readers of this document should have knowledge of these topics:

- Basic IP routing.
- OSPF routing protocol concepts and terms.

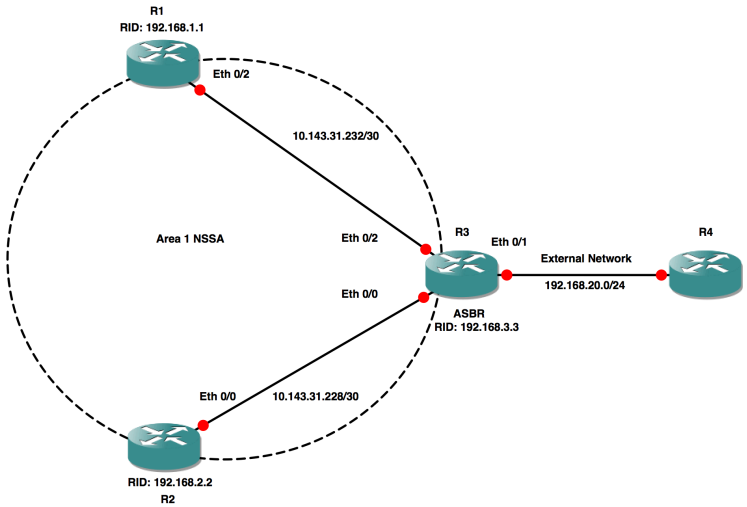
Components Used

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

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, make sure that you understand the potential impact of any command.

Verify

Following image would be used as a sample topology for rest of the document.



R3 is redistributing network 192.168.20.0/24 into OSPF NSSA (Not-So-Stubby Area) using route-map. You can use any method of redistributing route into

OSPF domain.

Relevant configurtion of R3:

OSPF neighborship between different routers:

If you look at the metric of the external route "192.168.20.0" on R1 and R2, you will find that it is seen with a metric of 30 on R1 and with a metric 40 on R2. There is difference even though they are connected to R3 in an identical fashion.

```
R1#sh ip route 192.168.20.0
Routing entry for 192.168.20.0/24
  Known via "ospf 1", distance 110, metric 30, type NSSA extern 1
  Last update from 10.143.31.234 on Ethernet0/2, 00:00:31 ago
  Routing Descriptor Blocks:
  * 10.143.31.234, from 192.168.3.3, 00:00:31 ago, via Ethernet0/2
      Route metric is 30, traffic share count is 1


R2#sh ip route 192.168.20.0
Routing entry for 192.168.20.0/24
  Known via "ospf 1", distance 110, metric 40, type NSSA extern 1
  Last update from 10.143.31.230 on Ethernet0/0, 00:00:26 ago
  Routing Descriptor Blocks:
  * 10.143.31.230, from 192.168.3.3, 00:00:26 ago, via Ethernet0/0
      Route metric is 40, traffic share count is 1
```

LSA information for this prefix on R1 and R2:

```
R1#sh ip ospf database nssa-external

            OSPF Router with ID (192.168.1.1) (Process ID 1)

        Type-7 AS External Link States (Area 1)

  Routing Bit Set on this LSA in topology Base with MTID 0
  LS age: 334
  Options: (No TOS-capability, Type 7/5 translation, DC, Upward)
  LS Type: AS External Link
  Link State ID: 192.168.20.0 (External Network Number )
  Advertising Router: 192.168.3.3
  LS Seq Number: 80000003
  Checksum: 0xA0E3
  Length: 36
  Network Mask: /24
    Metric Type: 1 (Comparable directly to link state metric)
    MTID: 0
    Metric: 20
    Forward Address: 10.143.31.234
    External Route Tag: 0

R2#sh ip ospf database nssa-external

            OSPF Router with ID (192.168.2.2) (Process ID 1)

        Type-7 AS External Link States (Area 1)

  Routing Bit Set on this LSA in topology Base with MTID 0
  LS age: 352
  Options: (No TOS-capability, Type 7/5 translation, DC, Upward)
```

```
  LS Type: AS External Link
  Link State ID: 192.168.20.0 (External Network Number )
  Advertising Router: 192.168.3.3
  LS Seq Number: 80000003
  Checksum: 0xA0E3
  Length: 36
  Network Mask: /24
    Metric Type: 1 (Comparable directly to link state metric)
    MTID: 0
    Metric: 20
    Forward Address: 10.143.31.234
    External Route Tag: 0
```

You can see forwarding address of Type-7 LSA is same on both R1 and R2. Also this forwarding address belongs to interface between R3 and R1. This forwarding address is directly connected for R1 but for R2 it is reachable via R3. This means forwarding address is one extra hop away for R2.

In case if R3 chooses IP address of link between R3 and R2 as forwarding address then similar situation will be seen on R1.

Forwarding address is selected on ASBR using the following rules:

1. If there is a loopback configured in the area then IP address of loopback is selected as forwarding address.
2. If first condition is not met then IP address of first interface on the OSPF interface list is selected as forwarding address. You can see OSPF interface list by using "show ip ospf interface brief" command. The interface on top will be the last interface which was attached to OSPF.

```
R3#sh ip ospf interface brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Et0/2        1     1               10.143.31.234/30   10    P2P   1/1
Et0/0        1     1               10.143.31.230/30   10    P2P   1/1
```

Et0/2 shows on top of "show ip ospf interface brief" and this is the reason why its IP address was chosen as the forwarding address.

Changing the configuration of Et0/0 to default configuration will make it detach from OSPF. Adding the configuration again will attach it back to OSPF. After this Et0/0 will be listed on top of "show ip ospf interface brief" output.

```
R3#sh ip ospf interface brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Et0/2        1     1               10.143.31.234/30   10    P2P   1/1
Et0/0        1     1               10.143.31.230/30   10    P2P   1/1R3#sh ip ospf interface
brief
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Et0/0        1     1               10.143.31.230/30   10    P2P   1/1
Et0/2        1     1               10.143.31.234/30   10    P2P   1/1
```

This change would result in recalculation of forwarding address to that of IP address configured on Et0/0.

```
R1#sh ip ospf database nssa-external
```

```
            OSPF Router with ID (192.168.1.1) (Process ID 1)

        Type-7 AS External Link States (Area 1)

  Routing Bit Set on this LSA in topology Base with MTID 0
  LS age: 284
  Options: (No TOS-capability, Type 7/5 translation, DC, Upward)
  LS Type: AS External Link
  Link State ID: 192.168.20.0 (External Network Number )
  Advertising Router: 192.168.3.3
  LS Seq Number: 80000004
  Checksum: 0x6621
  Length: 36
  Network Mask: /24
    Metric Type: 1 (Comparable directly to link state metric)
    MTID: 0
    Metric: 20
    Forward Address: 10.143.31.230
    External Route Tag: 0

R2#sh ip ospf database nssa-external

            OSPF Router with ID (192.168.2.2) (Process ID 1)

        Type-7 AS External Link States (Area 1)

  Routing Bit Set on this LSA in topology Base with MTID 0
  LS age: 303
  Options: (No TOS-capability, Type 7/5 translation, DC, Upward)
  LS Type: AS External Link
  Link State ID: 192.168.20.0 (External Network Number )
  Advertising Router: 192.168.3.3
  LS Seq Number: 80000004
  Checksum: 0x6621
  Length: 36
  Network Mask: /24
    Metric Type: 1 (Comparable directly to link state metric)
    MTID: 0
    Metric: 20
    Forward Address: 10.143.31.230
    External Route Tag: 0
```

The output of "show ip route" will now show that metric to reach external route on R1 is 40 and on R2 is 30. This is reverse of the earlier outputs.

```
R1#sh ip route 192.168.20.0
Routing entry for 192.168.20.0/24
  Known via "ospf 1", distance 110, metric 40, type NSSA extern 1
  Last update from 10.143.31.234 on Ethernet0/2, 00:06:14 ago
  Routing Descriptor Blocks:
  * 10.143.31.234, from 192.168.3.3, 00:06:14 ago, via Ethernet0/2
      Route metric is 40, traffic share count is 1

R2#sh ip route 192.168.20.0
Routing entry for 192.168.20.0/24
  Known via "ospf 1", distance 110, metric 30, type NSSA extern 1
  Last update from 10.143.31.230 on Ethernet0/0, 00:06:29 ago
  Routing Descriptor Blocks:
  * 10.143.31.230, from 192.168.3.3, 00:06:29 ago, via Ethernet0/0
      Route metric is 30, traffic share count is 1
```

This change can be unpredictable and would result in network convergence so it is advisable to

have a loopback IP address as forwarding address.

```
R1#sh ip route 192.168.20.0
Routing entry for 192.168.20.0/24
  Known via "ospf 1", distance 110, metric 40, type NSSA extern 1
  Last update from 10.143.31.234 on Ethernet0/2, 00:06:14 ago
  Routing Descriptor Blocks:
  * 10.143.31.234, from 192.168.3.3, 00:06:14 ago, via Ethernet0/2
      Route metric is 40, traffic share count is 1

R2#sh ip route 192.168.20.0
Routing entry for 192.168.20.0/24
  Known via "ospf 1", distance 110, metric 30, type NSSA extern 1
  Last update from 10.143.31.230 on Ethernet0/0, 00:06:29 ago
  Routing Descriptor Blocks:
  * 10.143.31.230, from 192.168.3.3, 00:06:29 ago, via Ethernet0/0
      Route metric is 30, traffic share count is 1
```

This also results in equal metric on both R1 and R2:

```
R1#sh ip ospf database nssa-external

            OSPF Router with ID (192.168.1.1) (Process ID 1)

        Type-7 AS External Link States (Area 1)

  Routing Bit Set on this LSA in topology Base with MTID 0
  LS age: 1
  Options: (No TOS-capability, Type 7/5 translation, DC, Upward)
  LS Type: AS External Link
  Link State ID: 192.168.20.0 (External Network Number )
  Advertising Router: 192.168.3.3
  LS Seq Number: 80000005
  Checksum: 0x872F
  Length: 36
  Network Mask: /24
    Metric Type: 1 (Comparable directly to link state metric)
    MTID: 0
    Metric: 20
    Forward Address: 192.168.3.3
    External Route Tag: 0

R1#sh ip route 192.168.20.0
Routing entry for 192.168.20.0/24
  Known via "ospf 1", distance 110, metric 31, type NSSA extern 1
  Last update from 10.143.31.234 on Ethernet0/2, 00:01:27 ago
  Routing Descriptor Blocks:
  * 10.143.31.234, from 192.168.3.3, 00:01:27 ago, via Ethernet0/2
      Route metric is 31, traffic share count is 1



R2#sh ip ospf database nssa-external

            OSPF Router with ID (192.168.2.2) (Process ID 1)

        Type-7 AS External Link States (Area 1)

  Routing Bit Set on this LSA in topology Base with MTID 0
  LS age: 6
  Options: (No TOS-capability, Type 7/5 translation, DC, Upward)
  LS Type: AS External Link
  Link State ID: 192.168.20.0 (External Network Number )
  Advertising Router: 192.168.3.3
```

```
  LS Seq Number: 80000005
  Checksum: 0x872F
  Length: 36
  Network Mask: /24
    Metric Type: 1 (Comparable directly to link state metric)
    MTID: 0
    Metric: 20
    Forward Address: 192.168.3.3
    External Route Tag: 0

R2#sh ip route 192.168.20.0
Routing entry for 192.168.20.0/24
  Known via "ospf 1", distance 110, metric 31, type NSSA extern 1
  Last update from 10.143.31.230 on Ethernet0/0, 00:01:57 ago
  Routing Descriptor Blocks:
  * 10.143.31.230, from 192.168.3.3, 00:01:57 ago, via Ethernet0/0
      Route metric is 31, traffic share count is 1
```

Note: Refer Common Routing Problem with OSPF Forwarding Address for more information about non-zero forwarding address of external LSA.