LAB GUIDE

a Hewlett Packard Enterprise company

Deploying OSPFv3 Areas

!!IMPORTANT!!

THIS GUIDE ASSUMES THAT THE AOS-CX OVA HAS BEEN INSTALLED AND WORKS IN GNS3 OR EVE-NG. PLEASE REFER TO GNS3/EVE-NG INITIAL SETUP LABS IF REQUIRED.

AT THIS TIME, EVE-NG DOES NOT SUPPORT EXPORTING/IMPORTING AOS-CX STARTUP-CONFIG. THE LAB USER SHOULD COPY/PASTE THE AOS-CX NODE CONFIGURATION FROM THE LAB GUIDE AS DESCRIBED IN THE LAB GUIDE IF REQUIRED.

TABLE OF CONTENTS

Lab Objective 1
Lab Overview 2
Lab Network Layout 3
Lab Tasks 4
Task 1 Lab Set-up 4
Task 2–Configure loopback 0 interfaces on Switch A-E 4
Task 2 - Configure Loopback interfaces on Switch A-E ..... **Error! Bookmark not defined.**
Task 3 - Configure OSPFv3 Area 0 and Area 1 for Switches A, B, C D 4
Task 3.1 Configure OSPFv3 routing 5
Task 3.2 Validate connectivity -Check ospf neighbor adjacencies are formed 6
Task 3.3 Review Routing tables on switches 8
Task 3.4 Review OSPFv3 Path and link Costs 10
Task 4 Create different OSPFv3 Autonomous Systems (AS) and redistribute routes 13
Task 4.1 Configure ospfv3 routing between Switch C & Switch E 13
Task 4.1 Validate ospf neighbors and routes 14
Task 4.2 Create an ASBR with route redistribute commands 16
Task 4.3 Validate neighbors and route redistribution on Switch B & Switch E 16
Task 5 Stub Area 19
Task 6 NSSA – Not So Stubby Area 22
Appendix – Complete Configurations 25

Lab Objective

This lab is identical to the OSPFv2 basic areas lab but leverages the OSPFv3 routing protocol.

The OSPF (Open Shortest Path Protocol) is one of the most popular routing protocols for IP Networks. It uses a link state routing (LSR) algorithm which is performed by every switch router mode in the network. OSPF leverages areas and it is these area concepts that form the basis of the LAB which introduces the ‘Backbone area’, ‘Regular Areas’ including Stub areas and

not so stubby areas.

This lab should be considered as a basic OSPFv3 lab as an introduction to the configuration and operation of OSPF on Aruba CX switches.

At the end of this workshop you will be able to understand and configure ospfv3 areas, understand basic ospf metric calculations of routes, simple route redistributions and the use of stub areas and NSSAs (Not so stubby areas) with OSPFv3

Lab Overview

The lab comprises of two Autonomous systems presented as AS1 and AS2. AS1 comprises of two areas , Area 0 & 1 with AS2 redistributing into AS1 .

OSPv3 requires the router-d to be configured with IPV4 addressing and forms part of the configuration guide.

The CLI output presented in this lab guide was produced using the CX simulator software release of 10.07.

AS – Autonomous Systems

The two AS systems in this lab are discreet/separate routing systems each running its own LSR (Link State Routing) algorithm for each router node to build a topology map of all available data paths in the network. The data is saved on each router in database which is also referred to as a Link-State Database (LSDB).

Routing information Is not shared between Autonomous Systems unless explicitly configured with route redistribution for each AS. This activity is covered in the lab between Switch C and Switch E where switch C is configured as an ASBR and redistributes route between AS1 and AS2. .(An ASBR is an Autonomous System Boundary Router)

Area0 backbone –

OSPF area 0 or backbone area is typically designed as a high-speed transit area for router traffic and is at the core of an OSPF network. All other areas are connected to it and inter area traffic must traverse the backbone area. (If a single area only is deployed there Is no requirement to have an area 0)

The lab has two Area backbones or Area 0 networks, One for AS1 & 1 for AS2

OSPF areas (Not Area 0-)

OSPF areas that are not the backbone are numbered other than 0 and are often referred to as ‘Regular Areas’ if they are not configured as a ‘Stub Area’ or ‘Not So Stubby Area ‘ (NSSA)..

In this lab, AS1 has Area 0 and Area 1 connecting to it via Switch B which performs the function of an ABR (Area Border Router).

The initial build of the for AS1 involves Area 0 and Area 1 as a regular area. Switch B and Switch C in Area 1 are re-configured from a regular OSPF area to a ‘Stub’ area and then as a NSSA in subsequent lab tasks.

- A ‘Stub’ area is an area where there are no routers or areas beyond it and it does not advertise external routes (external link advertisements LSA Type 5).
- A NSSA accepts external routes (in the form of external link advertisements LSA Type 7) and is useful to import external routes from one AS to another whilst still keeping some benefits of a stub area.

Lab Network Layout

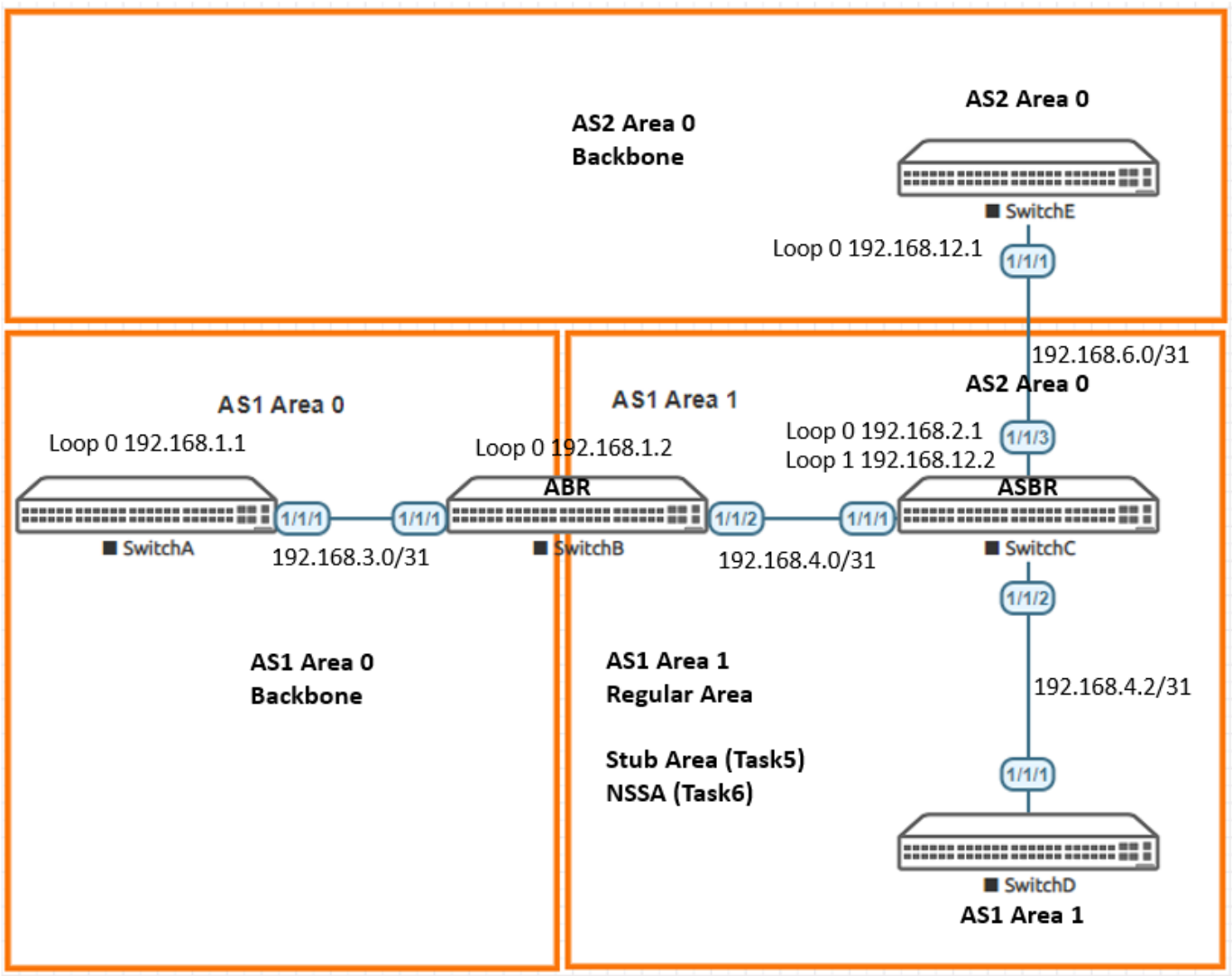

Figure 1 OSPF Area and IP addressing

Lab Tasks

Task 1 Lab Set-up

For this lab refer to Figure 1 for topology and IP address details.

- Start all the devices, including host and client
- Open each switch console and log in with user “admin” and no password
- Change all hostnames as shown in the topology:

```
hostname …
```

- On all devices, bring up required ports:

```
int 1/1/1-1/1/3
  no shutdown
```

- Validate LLDP neighbors appear as expected on each switch

```
show lldp neighbor
```

Task 2–Configure loopback 0 interfaces on Switch A-E

Configure loopback addressing on loopback 0 on each switch with a /32 ip subnet mask

Loopback0 ip addressing

Switch A ip address 192.168.1.1
Switch B ip address 192.168.1.2
Switch C ip address 192.168.2.1
Switch D ip address 192.168.2.2
Switch E ip address 192.168.12.1

Example SwitchB

```
SwitchB# conf t

SwitchB(config)# interface loopback 0
SwitchB(config-loopback-if)# ip address 192.168.1.2/32
```

End of Task2

Task 3 - Configure OSPFv3 Area 0 and Area 1 for Switches A, B, C D

The following tasks will be completed in task3 to configure OSPF on switches A,B, C.& D

On each switch A, B,C, D

- Configure a OSPFv3 routing process with appropriate areas and assign a router-id which will be ‘loopback0’
- Configure appropriate switch interfaces with OSPF enabled and ensure connectivity is established
- Ensure neighbor adjacencies are formed between each switch rtr
- Review inter-area and intra-area routes in the ospf routing table
- Review the OSPF Cost of specific routes (Switch A)

-
-

Task 3.1 Configure OSPFv3 routing

Configure OSPF routing on Switch A, B, C & D and assign a router-id with loopback 0
Configure IP ospf interfaces
All entries from the configuration editor cli 'conf t'

SwitchA area 0

```
router ospfv3 1
    router-id 192.168.1.1
    area 0.0.0.0

interface 1/1/1
    ipv6 address fd00:192:168:3::0/127
    ipv6 ospfv3 1 area 0.0.0.0
    ipv6 ospfv3 network point-to-point


interface loopback 0
     ipv6 ospfv3 1 area 0
```

SwitchB area 0 Area 1 – ABR router

```
router ospfv3 1
     router-id 192.168.1.2
     area 0.0.0.0
     area 0.0.0.1
interface 1/1/1
     ipv6 address fd00:192:168:3::1/127
    ipv6 ospfv3 1 area 0.0.0.0
    ipv6 ospfv3 network point-to-point


interface 1/1/2
    ipv6 address fd00:192:168:4::0/127
    ipv6 ospfv3 1 area 0.0.0.1
    ipv6 ospfv3 network point-to-point


interface loopback 0
        ipv6 ospfv3 1 area 0
```

SwitchC

```
router ospfv3 1
    router-id 192.168.2.1
    area 0.0.0.1

interface 1/1/1
   ipv6 address fd00:192:168:4::1/127
    ipv6 ospfv3 1 area 0.0.0.1
    ipv6 ospfv3 network point-to-point


interface 1/1/2
   ipv6 address fd00:192:168:4::2/127
    ipv6 ospfv3 1 area 0.0.0.1
    ipv6 ospfv3 network point-to-point

interface loopback 0
    ipv6 ospfv3 1 area 0.0.0.1
```

SwitchD

```
router ospfv3 1
    router-id 192.168.2.2
    area 0.0.0.1

interface 1/1/1
      ipv6 address fd00:192:168:4::3/127
    ipv6 ospfv3 1 area 0.0.0.1
    ipv6 ospfv3 network point-to-point


interface loopback 0
    ipv6 ospfv3 1 area 0.0.0.1
```

Task 3.2 Validate connectivity -Check ospf neighbor adjacencies are formed

On switches A-D confirm ospfv3 neighbor adjacencies are formed

On switches A-D

```
sh ipv6 ospfv3 neighbors
```

Switch A - example output

```
SwitchA# sh ipv6 ospfv3 neighbors
VRF : default                          Process : 1
=================================================

Total Number of Neighbors: 1

Neighbor ID      Priority  State             Interface
-------------------------------------------------------
192.168.1.2      n/a       FULL              1/1/1
  Neighbor address fe80::800:921:1e7:84da
```

Switch B – example output

```
SwitchB#  sh ipv6 ospfv3 neighbors
OSPFv3 Process ID 1 VRF default
================================

Total Number of Neighbors: 2

Neighbor ID      Priority  State             Interface
---------------------------------------------------------
192.168.1.1      n/a       FULL              1/1/1
  Neighbor address fe80::800:901:4ee:1182

192.168.2.1      n/a       FULL              1/1/2
  Neighbor address fe80::800:901:414:362d
```

Repeat for Switch C & D.

SwitchC will have ospfv3 neighbor adjacencies with Switch B &D

SwitchE will be configured in subsequent tasks.

Task 3.3 Review Routing tables on switches

Review ospf routing table output on sample switches in area 0 and Area 1 and note the intra-area and inter area routes presented.

On selected switches use the command:-

```
sh ipv6 ospfv3 route
```

Sample output

Switch A

```
SwitchA# sh ipv6 ospfv3 route
Codes: i - Intra-area route, I - Inter-area route
       E1 - External type-1, E2 - External type-2

OSPFv3 Process ID 1 VRF default, Routing Table
-----------------------------------------------

Total Number of OSPFv3 Routes : 3

fd00:192:168:3::/127 (i) area:0.0.0.0
     directly attached to interface 1/1/1, cost 100 distance 110
fd00:192:168:4::/127 (I)
     via fe80::800:921:1e7:84da interface 1/1/1, cost 200 distance 110
fd00:192:168:4::2/127 (I)
     via fe80::800:921:1e7:84da interface 1/1/1, cost 300 distance 110
```

Note the intra-area and inter area-routes from Switch A

Intra-area routes refer to updates (routing) that are passed between ospf routers within the same area and do not need to traverse the backbone (Area 0).

Inter-area routes refer to updates that are passed between areas and required to traverse Area 0

External routes refer to updates passed from another routing protocol into the OSPF domain using an Autonomous System Border Router. An example of external routes will be configured in subsequent steps

Switch B

Switch B is an Area Border Router with area 0 & 1 configured. .

Output extracted from ‘sh ipv6 ospfv3 route’

```
OSPFv3 Process ID 1 VRF default, Routing Table
----------------------------------------------

Total Number of OSPFv3 Routes : 3

fd00:192:168:3::/127 (i) area:0.0.0.0
     directly attached to interface 1/1/1, cost 100 distance 110
fd00:192:168:4::/127 (i) area:0.0.0.1
     directly attached to interface 1/1/2, cost 100 distance 110
fd00:192:168:4::2/127 (i) area:0.0.0.1
     via fe80::800:901:414:362d interface 1/1/2, cost 200 distance 110

SwitchB#
```

As Switch B has interfaces in area 0 & area 1 configured, all routes are learnt as intra-area routes.

Task 3.4 Review OSPFv3 Path and link Costs

On **Switch A** routing output, via the 'sh ipv6 ospfv3 route' cli command, note the OSPF costs between Switch A and Switch D. Use the point-to-point network interface of fd00:192:168:4::2/127 between SwitchC & Switch D as a reference.

fd00:192:168:4::2/127 (l)

via fe80::800:921:1e7:84da interface 1/1/1, cost 300 distance 110

Route to fd00:192:168:4::2/127 will be presented as a cost of '300' from the output in Switch A's route table. OSPF

The OSPF routing metric uses following formula to calculate the cost:-

Cost = Reference bandwidth / Interface bandwidth in bps.

Reference bandwidth was defined as arbitrary value in OSPF documentation (RFC 2338). Vendors need to use their own reference bandwidth. Aruba uses the 100 Mbs value as a reference bandwidth (100000000 bps).

Switch A Interface Speed for interface 1/1/1

Run 'sh interface brief' or 'sh interface 1/1/1' from the CLI to find the default interface speed.

Example shown with 'sh interface brief' command.

```
SwitchA# sh interface brief
-------------------------------------------------------------------------------------------------------
-----
Port      Native  Mode   Type          Enabled Status  Reason               Speed   Description
          VLAN                                                              (Mb/s)
-------------------------------------------------------------------------------------------------------
-----
1/1/1     --      routed --            yes     up                           1000    --
```

Using the bandwidth formula we have 100,000/1000 (Reference bandwidth in mbps/interface bandwidth in mbps) = a link cost of 100

As we have standard default settings and common link costs across our lab network, we can ascertain that the route fd00:192:168:4::2/127 has traversed x 3 links (including the cost of the link of origin) to reach Switch A from Switch D.

In a 'live' network, interface speeds will vary and may not be consistent which will impact the overall bandwidth cost of any given route.

Cost calculation using a reference speed of 100 Mbps

Interface Speed	Link Cost
25 Gbit/s	1
10 Gbit/s	1
5 Gbit/s	2
1 Gbit/s	10
1000 Mbit/s	100

Note: For VLAN interfaces, the default interface speed is taken as 1 Gbit/s

Confirm the ipv6 ospfv3 default link cost on switch A interface 1/1/1

```
SwitchA# sh ipv6 ospfv3 interface 1/1/1
Interface 1/1/1 is Up, Line Protocol is Up
-----------------------------------------
VRF                 : default                       Process             : 1
IPv6 address        : fe80::800:901:4ee:1182        Area                : 0.0.0.0
Status              : Up                            Network Type        : Point-to-point
Hello Interval      : 10                            Dead Interval       : 40
Transit Delay       : 1                             Retransmit Interval : 5
BFD                 : Disabled                      Link Speed          : 1000 Mbps
Cost Configured     : NA                            Cost Calculated     : 100
State/Type          : Point-to-point                Router Priority     : n/a
DR                  : No                            BDR                 : No
Link LSAs           : 2                             Checksum Sum        : 76041
```

The default reference speed can be changed in the respective ospfv3 process configuration using the reference-bandwidth command.

```
SwitchA(config)# router ospfv3 1
SwitchA(config-ospfv3-1)# reference-bandwidth
  <1-4000000>  Set reference bandwidth in Mbps. (Default: 100000Mbps)
```

The default interface costs can be changed for each interface (or interface VLAN) by using the **ipv6 ospfv3 cost** command:-

```
SwitchA(config)# interface 1/1/1
```

```
SwitchA(config-if)# ipv6 ospfv3 cost
  <1-65535>  Set cost.
```

The **no ipv6 ospfv3 cost** command resets the cost value back to the default

End of Task 3

Task 4 Create different OSPFv3 Autonomous Systems (AS) and redistribute routes

Importing routes and redistributing into OSPF is supported by creating an ASBR, an Autonomous System Boundary Router.

In this task you will create:-

- a separate OSPFv3 routing process: on Switch C – (process 2) in area 0
- A routing ospfv3 process in Switch E in area 0
- Route redistribute ospfv3 routes (from ospfv3 process 2) into ospfv3 process 1 on switch C
- Route redistribute ospfv3 routes (from ospfv3 process 1) into ospfv3 process 2 on switch C
- Review ospfv3 redistributed route metrics

-

Task 4.1 Configure ospfv3 routing between Switch C & Switch E

Switch C

From the configuration context, create an additional loopback address for the router-id for ospf process 2

```
interface loopback 1
    ip address 192.168.12.2/32
```

Create an additional router ospfv3 process

```
router ospfv3 2
    router-id 192.168.12.2
    area 0.0.0.0
```

add interface loopback 1 in to ospfv3 process 2

```
interface loopback 1
ipv6 ospfv3 2 area 0.0.0.0
```

Configure OSPF on interface 1/1/3 to Switch E

```
interface 1/1/3
    ipv6 address fd:00:192:168:6::0/127
    ipv6 ospfv3 2 area 0.0.0.0
    ipv6 ospfv3 network point-to-point
```

Switch E

From the configuration context, create the ospfv3 routing process

```
router ospfv3 1
    router-id 192.168.12.1
    area 0.0.0.0
```

add interface loopback 0 in to ospf process 1

```
interface loopback 0
ipv6 ospfv3 1 area 0.0.0.0
```

Configure interface 1/1/1

```
interface 1/1/1
    ipv6 address fd00:192:168:6::1/127
    ipv6 ospfv3 1 area 0.0.0.0
    ipv6 ospfv3 network point-to-point
```

Task 4.1 Validate ospf neighbors and routes

Validate neighbor adjacency has been formed between Switch C and Switch D

```
show ipv6 ospfv3 neighbors -
```

Sample output Switch E

```
SwitchE# sh ipv6 ospfv3 neighbors
VRF : default                          Process : 1
=================================================
Total Number of Neighbors: 1

Neighbor ID      Priority  State            Interface
-------------------------------------------------------
192.168.12.2     n/a       FULL             1/1/1
  Neighbor address fe80::800:901:c14:362d
```

Review ospfv3 routing table and note which routes are available on each route process

On Switches B, C,& D

```
sh ipv6 ospfv3 routes
```

Switch C sample output

Note that Switch C now has output for 2 ospfv3 process IDs

```
SwitchC# sh ipv6 ospfv3 route
Codes: i - Intra-area route, I - Inter-area route
       E1 - External type-1, E2 - External type-2

OSPFv3 Process ID 1 VRF default, Routing Table
-----------------------------------------------

Total Number of OSPFv3 Routes : 3

fd00:192:168:3::/127 (I)
     via fe80::800:921:2e7:84da interface 1/1/1, cost 200 distance 110
fd00:192:168:4::/127 (i) area:0.0.0.1
     directly attached to interface 1/1/1, cost 100 distance 110
fd00:192:168:4::2/127 (i) area:0.0.0.1
     directly attached to interface 1/1/2, cost 100 distance 110

OSPFv3 Process ID 2 VRF default, Routing Table
-----------------------------------------------

Total Number of OSPFv3 Routes : 2

fd:0:192:168:6::/127 (i) area:0.0.0.0
     directly attached to interface 1/1/3, cost 100 distance 110
fd00:192:168:6::/127 (i) area:0.0.0.0
     via fe80::800:901:463:8e7b interface 1/1/3, cost 200 distance 110
```

- On switch B , the ospfv3 route table will not include routes learnt from Switch C ospf process ID 2 as these routes are learnt within a different Autonomous System.

- On Switch E ,the ospf route table will not include routes learnt from Switch C ospfv3 process id 1 as they are again routes learnt within a different Autonomous System. Until we decide to redistribute some, or selected routes between router AS systems , all routes learnt within an AS will remain within that AS.

Task 4.2 Create an ASBR with route redistribute commands

To include routes from different AS (Autonomous Systems) so they propagate within our routed lab network we need to redistribute routes on Switch C and by doing so,we make Switch C an ASBR; an Autonomous System Boundary Router

This is a 2 step process which involves the router that 'borders each AS boundary', in our example our ASBR router is Switch C:-

1. Redistribute routes from ospfv3 process 2 into ospfv3 process 1
2. Redistribute routes from ospfv3 process 1 into ospfv3 process 2

On Switch C

- First, we route redistribute ospfv3 routes (from ospfv3 process 2) into ospfv3 process 1 on switch C

Within the '`router ospfv3 1`' context add the following commands#

```
redistribute ospfv3 2
```

- Ospfv3 learned routes from ospfv3 process 2 will be redistributed into ospfv3 process 1

Seconds step , we repeat the process for ospfv3 process 2, we route redistribute ospfv3 routes (from ospfv3 process 1) into ospfv3 process 2 on switch C

Within the '`router ospfv3 2`' context add the following commands

```
redistribute ospfv3 1
```

Task 4.3 Validate neighbors and route redistribution on Switch B & Switch E

On either switch C or E, run the 'sh ipv6 ospfv3 neighbors' command.

Sample switch C

Sample Output Switch E – note the process id split on neighbors

```
SwitchC# sh ipv6 ospfv3 neighbors
VRF : default                           Process : 1
==================================================

Total Number of Neighbors: 2

Neighbor ID      Priority  State             Interface
--------------------------------------------------------
192.168.1.2      n/a       FULL              1/1/1
  Neighbor address fe80::800:921:2e7:84da

192.168.2.2      n/a       FULL              1/1/2
  Neighbor address fe80::800:901:4c6:3d6f

VRF : default                           Process : 2
==================================================

Total Number of Neighbors: 1

Neighbor ID      Priority  State             Interface
--------------------------------------------------------
192.168.12.1     n/a       FULL              1/1/3
  Neighbor address fe80::800:901:463:8e7b
```

On switch B and D run the ‘`sh ipv6 ospfv3 route`’ command and note the output

Switch B output

```
SwitchB# sh ipv6 ospfv3 route
Codes: i - Intra-area route, I - Inter-area route
       E1 - External type-1, E2 - External type-2
```

```
OSPFv3 Process ID 1 VRF default, Routing Table
----------------------------------------------

Total Number of OSPFv3 Routes : 5

fd:0:192:168:6::/127 (E2)
     via fe80::800:901:414:362d interface 1/1/2, cost 100 distance 110
fd00:192:168:3::/127 (i) area:0.0.0.0
     directly attached to interface 1/1/1, cost 100 distance 110
fd00:192:168:4::/127 (i) area:0.0.0.1
     directly attached to interface 1/1/2, cost 100 distance 110
fd00:192:168:4::2/127 (i) area:0.0.0.1
     via fe80::800:901:414:362d interface 1/1/2, cost 200 distance 110
fd00:192:168:6::/127 (E2)
     via fe80::800:901:414:362d interface 1/1/2, cost 200 distance 110
```

Switch E output

```
SwitchE# sh ipv6 ospfv3 route
Codes: i - Intra-area route, I - Inter-area route
       E1 - External type-1, E2 - External type-2

OSPFv3 Process ID 1 VRF default, Routing Table
----------------------------------------------

Total Number of OSPFv3 Routes : 4

fd:0:192:168:6::/127 (i) area:0.0.0.0
     directly attached to interface 1/1/1, cost 100 distance 110
fd00:192:168:3::/127 (E2)
     via fe80::800:901:c14:362d interface 1/1/1, cost 200 distance 110
fd00:192:168:4::/127 (E2)
     via fe80::800:901:c14:362d interface 1/1/1, cost 100 distance 110
fd00:192:168:4::2/127 (E2)
     via fe80::800:901:c14:362d interface 1/1/1, cost 100 distance 110
```

SwitchE(config)#

The redistributed routes (from another AS) are tagged as a Type 5 LSA routes and are identified as an external router with the E prefix.

E1 routes is the cost of the external metric and the additional internal cost within OSPF to reach that network.

- E1 route(s) includes the internal cost to the ASBR which is added to the external cost of the route

The cost of E2 routes is always the external metric value of the route and the internal cost to/from the ASBR is ignored.

- E2 route(s) do not include the internal cost of the ASBR . They will always have the same external cost.

End of Task 4

Task 5 Stub Area

This task will create a stub area between Switch B and Switch C for area 1. Switch B still operates as an ABR but the neighbor relationship in area 1 is changed to 'Stub' for switch C.

Switch D and Switch E are not required for this task

'shutdown' interface 1/1/2 & 1/1/3 on Switch C

.

.**Switch B**

On switch B , the area 0.0.0.1 needs to be amended to include 'stub'

From within 'router ospfv3 1' config context

```
area 0.0.0.1 stub
```

.**Switch C**

On switch C , the area 0.0.0.1 needs to be amended to include 'stub'

From within 'router ospfv3 router ospfv3 1 ' config context

```
area 0.0.0.1 stub
```

Check neighbor adjacency has formed with Switch B

```
SwitchC# sh ipv6 ospfv3 neighbors
```

```
VRF : default                          Process : 1
=====================================================

Total Number of Neighbors: 1

Neighbor ID      Priority  State             Interface
-----------------------------------------------------
192.168.1.2      n/a       FULL              1/1/1
  Neighbor address fe80::800:921:2e7:84da
```

Display switch C ospf routing table

```
sh ipv6 ospfv3 route
```

You should note a significant change in the ospf route table on switch C. Switch B, as the ABR , now injects a default route to its neighbor Switch C , as it is configured as a stub area .

Sample output Switch C

SwitchC# **sh ipv6 ospfv3 route**

Codes: i - Intra-area route, I - Inter-area route

E1 - External type-1, E2 - External type-2

OSPFv3 Process ID 1 VRF default, Routing Table

Total Number of OSPFv3 Routes : 3

::/0 (I)

via fe80::800:921:2e7:84da interface 1/1/1, cost 101 distance 110

fd00:192:168:3::/127 (I)

via fe80::800:921:2e7:84da interface 1/1/1, cost 200 distance 110

fd00:192:168:4::/127 (i) area:0.0.0.1

directly attached to interface 1/1/1, cost 100 distance 110

OSPFv3 Process ID 2 VRF default, Routing Table

Total Number of OSPFv3 Routes : 0

There is a default route advertised from Switch B as the ABR for area 1 ‘Stub’

As Switch C has a single ingress and egress point, the route table can be reduced further by eliminating ‘Inter Area routes’.

On Switch B within the ‘router ospf 1’ context

Enter

SwitchB(config)# router ospfv3 1

SwitchB(config-ospf-1)# **area 0.0.0.1 stub no-summ**

Display Switch C ospf routing table

SwitchC# **sh ipv6 ospfv3 routes**

Codes: i - Intra-area route, I - Inter-area route

E1 - External type-1, E2 - External type-2

OSPFv3 Process ID 1 VRF default, Routing Table

Total Number of OSPFv3 Routes : 2

::/0 (I)

via fe80::800:921:2e7:84da interface 1/1/1, cost 101 distance 110

fd00:192:168:4::/127 (i) area:0.0.0.1

directly attached to interface 1/1/1, cost 100 distance 110

OSPFv3 Process ID 2 VRF default, Routing Table

Total Number of OSPFv3 Routes : 0

Inter area routes are no longer present in the route table. The ‘no-summary’ disables the summary of LSAs on each router that is connect to the ABR in that area.

Stub areas

.

- Typically have a single ingress egress point to connecting to the ABR
- External networks redistributed from other protocols into ospf are not allowed to be advertised into a stub area. The ABR, in this case switch B, stops LSA types 4 & 5.
- Routing is based on the stub router receiving a default route from the ABR (0.0.0.0)
- All OSPF routers inside a stub area must be configured as a stub router .
- Routers (stub areas) are required to connect to an ABR

For hub and spoke connectivity in large OSPF networks, the Stub area is used extensively as they reduce the amount the of LSAs advertised and processed and thereby reduce the overall size of the routing table and assist in keeping the overall routing protocol convergence times down.

..

End of Task 5

Task 6 NSSA – Not So Stubby Area

A NSSA, Not So Stubby Area, is very similar to a standard stub area but has one major difference. It is less restrictive than a stub area which cannot import external routes. NSSA can import external routes into OSPF from either another OSPF process or another routing protocol.

In this task, area 1 between Switch B and Switch C is configured as a NSSA area and the routes learnt for ospf process 2 (for area 0 between Switch C and Switch E) are redistributed into NSSA area 1..

On Switch B remove the stub area configuration and add the NSSA configuration

From the router ospf 1 config context

```
no area 0.0.0.1 stub
area 0.0.0.1 nssa no-summary
```

on Switch C - 'No shut' interface 1/1/3

```
interface 1/1/3
    no shutdown
```

On Switch C remove the stub area configuration and add the NSSA configuration

From the router ospf 1 config context

```
no area 0.0.0.1 stub
```

```
area 0.0.0.1 nssa
```

Check that Switch B & C have an ospf neighbor adjacency

```
sh ipv6 ospfv3 neighbor
```

On Switch C , the redistribute commands into process ospf 1 and process opsf2 should still be present.

```
router ospfv3 1
    router-id 192.168.2.1
    redistribute ospfv3 2
    area 0.0.0.1 nssa
router ospfv3 2
    router-id 192.168.12.2
    redistribute ospfv3 1
    area 0.0.0.0
```

On Switch C , display the ipv6 ospfv3 route table

```
SwitchC# sh ipv6 ospfv3 route
Codes: i - Intra-area route, I - Inter-area route
       E1 - External type-1, E2 - External type-2

OSPFv3 Process ID 1 VRF default, Routing Table
-----------------------------------------------

Total Number of OSPFv3 Routes : 2

::/0              (I)
     via fe80::800:921:2e7:84da interface 1/1/1, cost 101 distance 110
fd00:192:168:4::/127 (i) area:0.0.0.1
     directly attached to interface 1/1/1, cost 100 distance 110

OSPFv3 Process ID 2 VRF default, Routing Table
-----------------------------------------------

Total Number of OSPFv3 Routes : 1
```

```
fd:0:192:168:6::/127 (i) area:0.0.0.0
     directly attached to interface 1/1/3, cost 100 distance 110
```

The default advertised route from the Switch B ABR is the same when the switches were configured for 'Stub'. Switch C is re-advertising routes between ospfv3 processes 1 & 2.

On Switch B , display the ipv6 ospfv3 route table

```
SwitchB# sh ipv6 ospfv3 route
Codes: i - Intra-area route, I - Inter-area route
       E1 - External type-1, E2 - External type-2

OSPFv3 Process ID 1 VRF default, Routing Table
-----------------------------------------------

Total Number of OSPFv3 Routes : 3

fd:0:192:168:6::/127 (E2)
     via fd00:192:168:4::1 interface 1/1/2, cost 100 distance 110
fd00:192:168:3::/127 (i) area:0.0.0.0
     directly attached to interface 1/1/1, cost 100 distance 110
fd00:192:168:4::/127 (i) area:0.0.0.1
     directly attached to interface 1/1/2, cost 100 distance 110
```

As we have re-configured switch B, from a standard stube area, as an ABR with the NSSA ospfv3 area parameter, and we have switch switch C peering as a NSSA router to switch B, we can now re-distribute external routes from Switch C into area 1.

Route **`fd:0:192:168:6::/127`** (the transit link between Switch C and Switch E ins AS 2) is now in the switch B routing table.

- **End of lab task5 and lab tasks**

Appendix – Complete Configurations

Switch A

```
interface 1/1/1
    no shutdown
    ipv6 address fd00:192:168:3::/127
    ipv6 ospfv3 1 area 0.0.0.0
    ipv6 ospfv3 network point-to-point
interface 1/1/2
    no shutdown
interface 1/1/3
    no shutdown
interface loopback 0
    ip address 192.168.1.1/32
    ipv6 ospfv3 1 area 0.0.0.0
router ospfv3 1
    router-id 192.168.1.1
    area 0.0.0.0
```

Switch B

```
interface 1/1/1
    no shutdown
    ipv6 address fd00:192:168:3::1/127
    ipv6 ospfv3 1 area 0.0.0.0
    ipv6 ospfv3 network point-to-point
interface 1/1/2
    no shutdown
```

```
    ipv6 address fd00:192:168:4::0/127
    ipv6 ospfv3 1 area 0.0.0.1
    ipv6 ospfv3 network point-to-point
interface 1/1/3
    no shutdown
interface loopback 0
    ip address 192.168.1.2/32
    ipv6 ospfv3 1 area 0.0.0.0
!
router ospfv3 1
   router-id 192.168.1.2
   area 0.0.0.0
   area 0.0.0.1                          Tasks 2-4 full ospf area 1
  area 0.0.0.1 stub                      Task 5 'Stub area' with or without 'no-summary'
  area 0.0.0.1 nssa no-summary           Task 6 'NSSA' with no-summary
```

Switch C

```
 interface 1/1/1
    no shutdown
    ipv6 address fd00:192:168:4::1/127
  ipv6 ospfv3 1 area 0.0.0.1
    ipv6 ospfv3 network point-to-point
interface 1/1/2
    ipv6 address fd00:192:168:4::2/127
    ipv6 ospfv3 1 area 0.0.0.1
    ipv6 ospfv3 network point-to-point
interface 1/1/3
    no shutdown
    ipv6 address fd:0:192:168:6::/127
    ipv6 ospfv3 2 area 0.0.0.0
    ipv6 ospfv3 network point-to-point
interface loopback 0
    ip address 192.168.2.1/32
    ipv6 ospfv3 1 area 0.0.0.1
interface loopback 1
```

```
    ip address 192.168.12.2/32
    ipv6 ospfv3 2 area 0.0.0.0
!
router ospfv3 1
    router-id 192.168.2.1
    redistribute ospf 2
    area 0.0.0.1                        Tasks 2-4 full ospf area 1
    area 0.0.0.1 stub                   Task 5 'Stub area' with or without 'no-summary'
    area 0.0.0.1 nssa no-summary        Task 6 'NSSA' with no-summary

router ospfv3 2
    router-id 192.168.12.2
    redistribute ospf 1
    area 0.0.0.0
```

Switch D

```
interface 1/1/1
    no shutdown
    ipv6 address fd00:192:168:4::3/127
    ipv6 ospfv3 1 area 0.0.0.1
    ipv6 ospfv3 network point-to-point
interface 1/1/2
    no shutdown
interface 1/1/3
    no shutdown
interface loopback 0
    ip address 192.168.2.2/32
    ipv6 ospfv3 1 area 0.0.0.1
!
router ospfv3 1
    router-id 192.168.2.2
    area 0.0.0.1
```

Switch E

```
interface 1/1/1
    no shutdown
```

```
    ipv6 address fd00:192:168:6::1/127
    ipv6 ospfv3 1 area 0.0.0.0
    ipv6 ospfv3 network point-to-point
interface 1/1/2
    no shutdown
interface 1/1/3
    no shutdown
interface loopback 0
    ip address 192.168.12.1/32
    ipv6 ospfv3 1 area 0.0.0.0
!
router ospfv3 1
    router-id 192.168.12.1
    area 0.0.0.0
```

END OF DOCUMENT

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