LAB GUIDE
DCN 2-Tier L3 Fabric with iBGP

a Hewlett Packard Enterprise company

!!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.

WRITE MEM SAVED CONFIGS DON'T IMPORT CORRECTLY, READER SHOULD COPY/PASTE LAB CONFIGS FROM APPENDIX INTO LAB IF REQUIRED.

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Lab Objective

At the end of this workshop, you will be able to implement the basic configurations on a standard switch topology to implement a 2- Tier Data Center switch fabric layer 3 leveraging OSPF and iBGP technologies with VSX configurations at the edge of the network. The Key technologies leveraged are OSPF and iBGP as interconnecting the Core and edge switches at L3 with VSX configured on edge switches.

Lab Overview

The lab comprises of a 2 core switches interconnected at layer3 between edge and core switch nodes. OSPF is used as an underlay with iBGP configured as an overlay technology in preparation of supporting VXLAN and EVPN (VXLAN and EVPN are not part of this lab).

The iBGP configuration leverages route reflectors on each core switch to avoid mesh connectivity issues between each switch node. OSPF is used as an underlay IGP interconnecting layer routes between switches.

VSX is used at the edge of the network between each edge switch nodes. The core switches are interconnected at layer 3, VSX is not configured on this switch pair but could be of benefit if additional edge switch pairs were connected at layer 2 to the core.

Edge switch pairs interconnect at both layer 2 and layer 3. At layer 2 via the VSX ISL link and at layer 3 on VLAN 4001.

This DCN lab is one of a series, other labs in this series are:-

- DCN 2-Tier L3 fabric with OSPF — August 2021
- DCN 2 -Tier L3 fabric with IBGP — August 2021
- DCN 2-Tier L3 fabric with OSPF — August 2021
- DCN 2-Tier L3 fabric with OSPF – MultVRF — September 2021
- DCN 2-Tier L3 fabric with iBGP – MultVRF — September 2021
- DCN 2-Tier L3 fabric with eBGP – MultVRF — September 2021
- DCN 2-Tier L3 fabric with OSPF VXLAN/EVPN Overlay — September 2021
- DCN 2-Tier L3 fabric with iBGP with VXLAN/EVPN Overlay — October 2021
- DCN 2-Tier L3 fabric with eBGP with VXLAN/EVPN Overlay — October 2021
- NetEdit in the DC: EBGP EVPN Multi-AS VXLAN Fabric provisioning — October 2021
- NetEdit in the DC: iBGP EVPN Multi-AS VXLAN Fabric provisioning — October 2021

The above reflects anticipated dates for lab completion and subsequent posting on the CX Simulator community page.

AOS-CX Switch Simulator Community page

This lab was created using the CX simulator version 10.08

Lab Network Layout

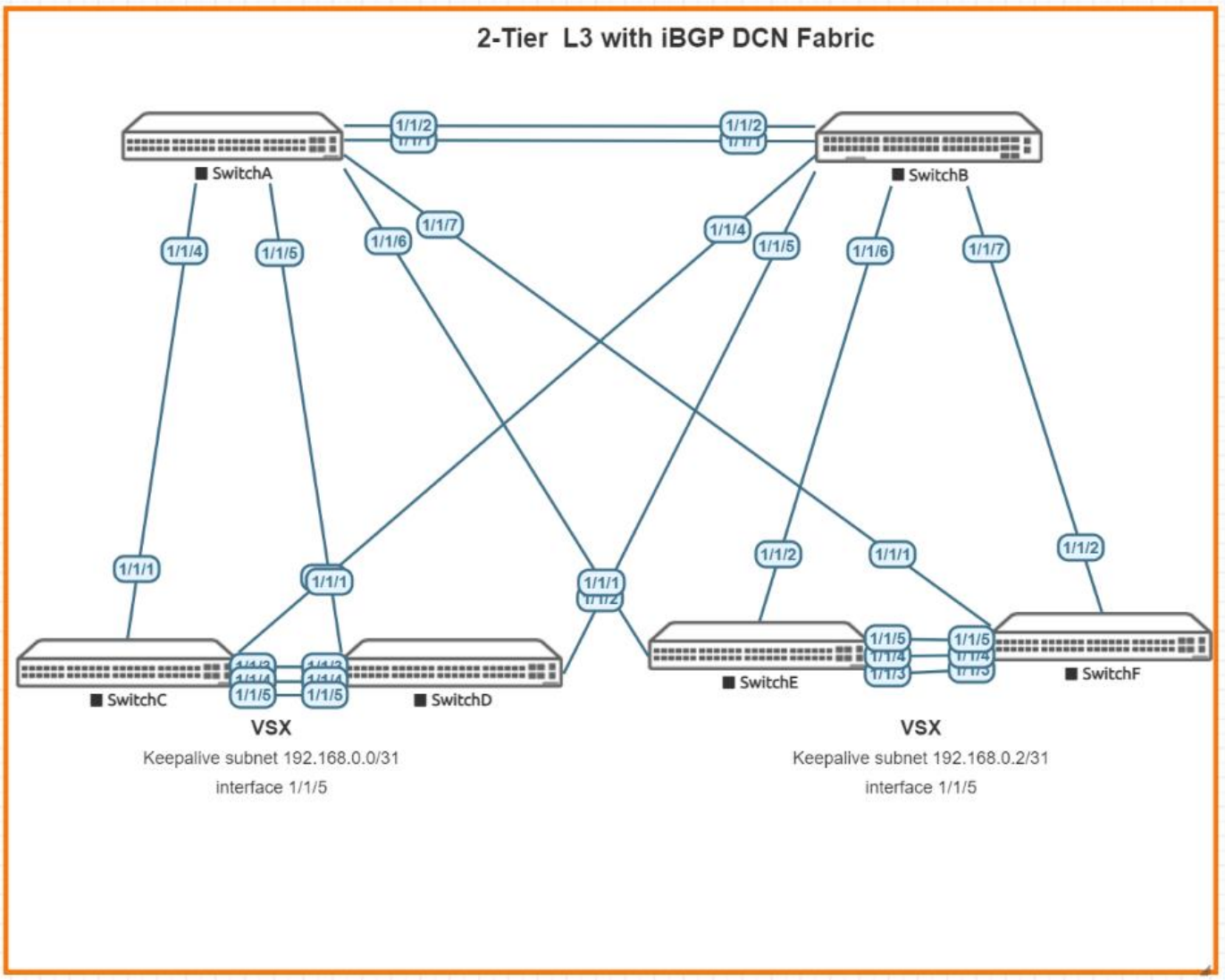

Figure 1. Lab topology physical interconnection

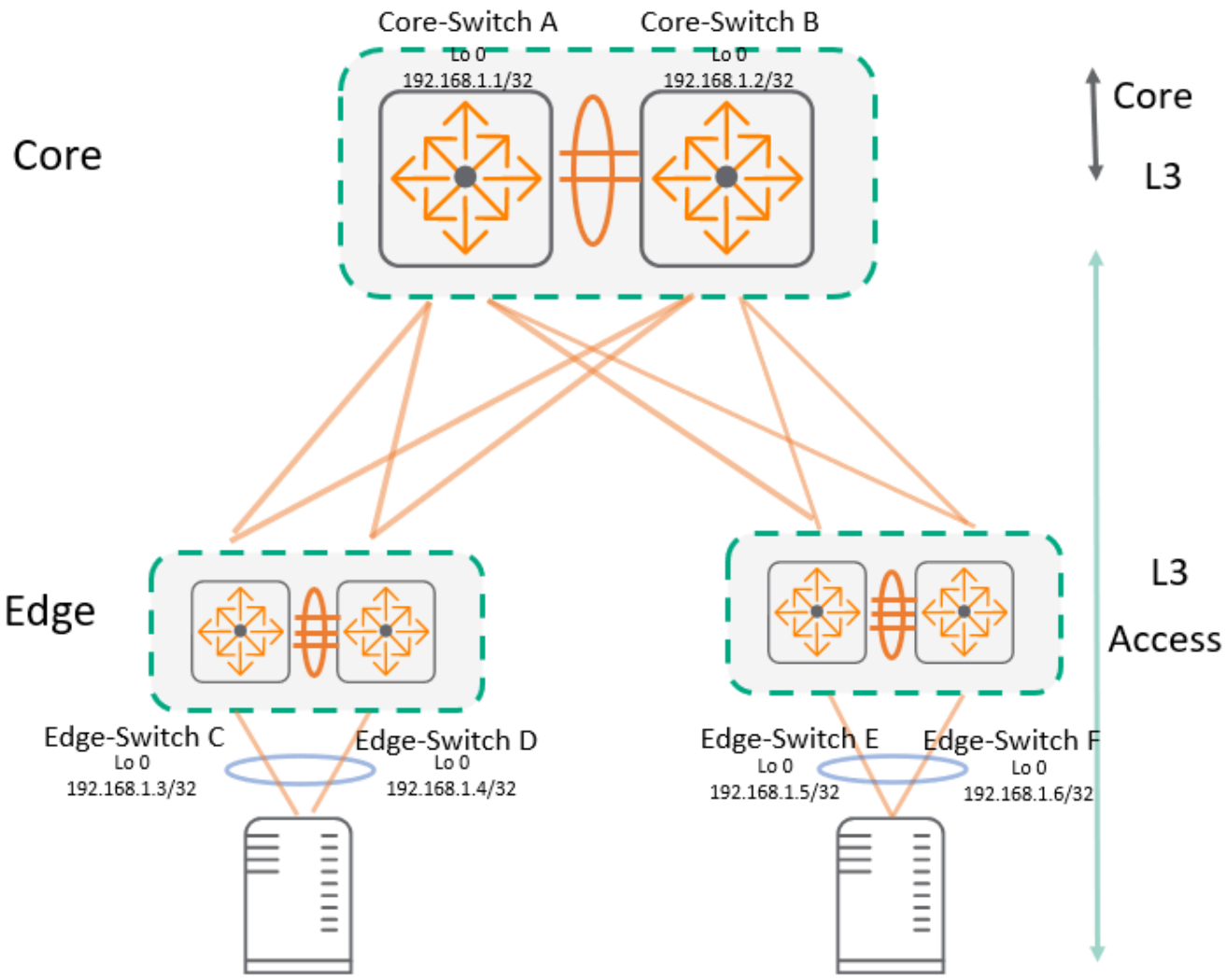

Figure 2 -Logical connectivity model

**Server connectivity is not part of the lab – provided for illustration only.*

IP addressing

Point to Point links L3 & Transit VLANs

Switch -1	Subnet	Switch-2	Switch -1-ip	Switch-2-ip
Switch A int 1/1/1-1/1/2 L3 lag	192.168.3.0/31	Switch B int 1/1/1-1/1/2 L3 lag	.0	.1
Switch A int 1/1/4	192.168.3.2/31	Switch C int 1/1/1	.2	.3
Switch A int 1/1/5	192.168.3.4/31	Switch D int 1/1/1	.4	.5
Switch A int 1/1/6	192.168.3.6/31	Switch E int 1/1/1	.6	.7
Switch A int 1/1/7	192.168.3.8/31	Switch F int 1/1/1	.8	.9
Switch B int 1/1/4	192.168.3.10/31	Switch C int 1/1/2	.10	.11
Switch B int 11/5	192.168.3.12/31	Switch D int 1/1/2	.12	.13
Switch B int 1/1/6	192.168.3.14/31	Switch E int 1/1/2	.14	.15
Switch B int 1/1/7	192.168.3.16/31	Switch F int 1/1/2	.16	.17
Switch-C transit VLAN 4001	192.168.3.18/31	Switch-D transit VLAN 4001	.18	.19
Switch-E transit VLAN 4001	192.168.3.20/31	Switch-F transit VLAN 4001	.20	.21

IP addressing VSX pairs

Switch -pair	VSX Primary	VSX Secondary	System-mac	Keepalive subnet	Switch ip	Switch ip
Switch C-Switch D	Switch C	Switch D	02:00:00:00:01:01	192.168.0.0/31	Switch C .2	Switch D .3
Switch E-Switch F	Switch E	Switch F	02:00:00:00:02:01	192.168.0.2/31	Switch E .4	Switch F .5

IP addressing loopbacks

Switch	Loopback /Transit VLAN	address	Description
Switch A	Loopback 0	192.168.1.1/32	OSPF/BGP underlay
Switch B	Loopback 0	192.168.1.2/32	
Switch C	Loopback 0	192.168.1.3/32	
Switch D	Loopback 0	192.168.1.4/32	
Switch E	Loopback 0	192.168.1.5/32	
Switch F	Loopback 0	192.168.1.6/32	

Lab Tasks

Task 1 - Lab setup

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

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

```
hostname …
```

- :

```
int 1/1/1-1/1/7
  no shutdown
```

Validate LLDP neighbors appear as expected. Connectivity should reflect the topology diagram in *fig1*.

```
show lldp neighbor
```

Example Switch A

```
SwitchA# sh lldp ne

LLDP Neighbor Information
=========================

Total Neighbor Entries          : 6
Total Neighbor Entries Deleted  : 0
Total Neighbor Entries Dropped  : 0
Total Neighbor Entries Aged-Out : 0

LOCAL-PORT  CHASSIS-ID         PORT-ID                   PORT-DESC
     TTL      SYS-NAME
-------------------------------------------------------------------------------
-----------------------
1/1/1       08:00:09:16:7b:7e  1/1/1                     1/1/1
     120      SwitchB
1/1/2       08:00:09:16:7b:7e  1/1/2                     1/1/2
     120      SwitchB
1/1/4       08:00:09:b6:77:ac  1/1/1                     1/1/1
     120      SwitchC
1/1/5       08:00:09:9b:4c:6b  1/1/1                     1/1/1
     120      SwitchD
1/1/6       08:00:09:b6:81:f1  1/1/1                     1/1/1
     120      SwitchE
1/1/7       08:00:09:76:73:f6  1/1/1                     1/1/1
     120      SwitchF
```

- Typically, the MTU size would be set to a value of 9198 bytes for active center networking interfaces however jumbo frames are not supported on the CX simulator and this configuration will not be applied.

Task 2 Configure Switch A & B L3 lag

In this section , the L3 interfaces between the core and the L3 lag between Switch A & B.

On Switch A, configure the following from the config context:-

```
interface lag 10
    no shut
    description L3-lag-switchA-B
    ip address 192.168.3.0/31

interface 1/1/1-1/1/2
    lag 10
```

On Switch B, configure the following from the config context:-

```
interface lag 10
    no shut
    description L3-lag-switchA-B
    ip address 192.168.3.1/31
    lacp mode active

interface 1/1/1-1/1/2
    lag 10
```

On either switch , confirm the lag link is up and receiving/transmitting traffic:-

```
SwitchA# sh interface lag 10

Aggregate lag10 is up
 Admin state is up
 Description : L3-lag-switchA-B
 MAC Address                  : 08:00:09:ee:11:82
 Aggregated-interfaces        : 1/1/1 1/1/2
 Aggregation-key              : 10
 IPv4 address                   192.168.3.0/31
 Speed                        : 2000 Mb/s
 L3 Counters: Rx Disabled, Tx Disabled
 qos trust none

 Statistic                          RX                  TX                  Total
 ---------------- -------------------- -------------------- --------------------
 Packets                           142                  148                    0
   Unicast                           0                    0                    0
   Multicast                         0                    0                    0
   Broadcast                         0                    0                    0
 Bytes                           19602                20150                    0
 Jumbos                            0                    0                    0
 Dropped                           0                    0                    0
 Pause Frames                      0                    0                    0
 L3 Packets                        0                    0                    0
 L3 Bytes                          0                    0                    0
 Errors                            0                    0                    0
   CRC/FCS                         0                  n/a                    0
   Collision                     n/a                    0                    0
   Runts                           0                  n/a                    0
   Giants                          0
```

Task 3 – Configure VSX between edge Switch pairs

Note: Switch CX simulator software levels need to be the same for VSX to deploy correctly.

This task will be repeated for each switch pair , C/D & E/F, and will involve the following:-
.
Creation of a LAG on each switch

VSX configuration on each switch – discrimination between Primary and Secondary nodes

VSX Keep-Alive configuration.

Keep-Alive subnets used:-

- Switch C/D use subnet 192.168.0.0/31
- Switch E/F use subnet 192.168.0.2/31

It is an option, and highly desirable, to run VSX

Switch C & D

On switch C configure the lag 256 as the ISL link

```
interface lag 256
    description ISL to SwitchB
    no routing
    vlan trunk native 1
    vlan trunk allowed all
    lacp mode active
    no shut
```

Apply the lag 128 on interfaces 1/1/1 and 1/1/2

```
SwitchC(config)# interface 1/1/3-1/1/4
SwitchC(config-if-<1/1/3-1/1/4>)# lag 256
```

Configure the VSX configuration on Switch C

```
vsx
    system-mac 02:00:00:00:01:01
    inter-switch-link lag 256
    role primary
    keepalive peer 192.168.0.1 source 192.168.0.0
    no split-recovery
    vsx-sync vsx-global
```

Configure the keepalive link to Switch D on interface 1//1/5

```
interface 1/1/5
    description Keepalive interface to SwitchD
    ip address 192.168.0.0/31
```

Repeat the configuration on Switch D , note the changes of VSX role from primary to secondary, keepalive source and destination addressing, and using an ip keepalive address on interface 1/1/5 of 192.168.0.1/31. Configuration example :-

On switch D configure the lag 256 as the ISL link

```
interface lag 256
    description ISL
    no routing
    no shut
    vlan trunk native 1
    vlan trunk allowed all
    lacp mode active
```

Apply the lag 128 on interfaces 1/1/3 and 1/1/4

```
SwitchD(config)# interface 1/1/3-1/1/4
SwitchD(config-if-<1/1/3-1/1/4>)# lag 256
SwitchD(config-if-<1/1/3-1/1/4>)# exit
```

Configure the VSX configuration on Switch D

```
    vsx
    system-mac 02:00:00:00:01:01
    inter-switch-link lag 256
    role secondary
    keepalive peer 192.168.0.0 source 192.168.0.1
    no split-recovery
```

Configure the keepalive link to Switch C on interface 1/1/5

```
SwitchD(config)# interface 1/1/5
    description Keepalive interface to SwitchC
    ip address 192.168.0.1/31
```

Run the following commands validate the VSX configuration and status

```
SwitchC# sh interface lag 256 brief
--------------------------------------------------------------------------------------------------------
------
Port      Native  Mode   Type          Enabled Status  Reason               Speed   Description
          VLAN                                                              (Mb/s)
--------------------------------------------------------------------------------------------------------
------
lag256    1       trunk  --            yes     up      --                   2000    ISL to SwitchD
SwitchC#
```

```
SwitchA# sh vsx status
VSX Operational State
---------------------
  ISL channel             : In-Sync
  ISL mgmt channel        : operational
  Config Sync Status      : In-Sync
  NAE                     : peer_reachable
  HTTPS Server            : peer_reachable

Attribute           Local                Peer
------------        --------             --------
ISL link            lag256               lag256
ISL version         2                    2
System MAC          02:00:00:00:01:00    02:00:00:00:01:00
Platform            X86-64               X86-64
Software Version    Virtual.10.08.0001BO Virtual.10.08.0001BO
Device Role         primary              secondary

SwitchC# sh vsx status
VSX Operational State
---------------------
  ISL channel             : In-Sync
  ISL mgmt channel        : operational
  Config Sync Status      : In-Sync
  NAE                     : peer_reachable
  HTTPS Server            : peer_reachable

Attribute           Local                Peer
------------        --------             --------
ISL link            lag256               lag256
ISL version         2                    2
System MAC          02:00:00:00:01:01    02:00:00:00:01:01
Platform            X86-64               X86-64
Software Version    Virtual.10.08.0001BO Virtual.10.08.0001BO
Device Role         primary              secondary


SwitchC# sh vsx brief
ISL State                              : In-Sync
Device State                           : Peer-Established
Keepalive State                        : Keepalive-Established
Device Role                            : Primary
Number of Multi-chassis LAG interfaces : 0
SwitchC#
```

Configure Switch E & F as a VSX pair

- Switch E will be the VSX Primary

- Use interfaces 1/1/3-1/1/4 for the lag 256
- Use system mac address of `02:00:00:00:02:01`

- Use subnet 192.168.0.2/31 for keepalive on interface 1/1/5

VSX example Switch E

```
interface lag 256
    description ISL
    no routing
    vlan trunk native 1
    vlan trunk allowed all
    lacp mode active
    no shut

interface 1/1/3
    no shutdown
    lag 256
interface 1/1/4
    no shutdown
    lag 256

vsx
    system-mac 02:00:00:00:02:01
    inter-switch-link lag 256
    role primary
    keepalive peer 192.168.0.3 source 192.168.0.2
    no split-recovery
    vsx-sync vsx-global


interface 1/1/5
    no shutdown
    description keepalive to Switch F
    ip address 192.168.0.2/31
```

SwitchF

```
interface lag 256
    no shutdown
    description ISL to Switch E
    no routing
    vlan trunk native 1
    vlan trunk allowed all
    lacp mode active
interface 1/1/3-1/1/4
    no shutdown
    lag 256
```

```
vsx
    system-mac 02:00:00:00:02:01
    inter-switch-link lag 256
    role secondary
    keepalive peer 192.168.0.2 source 192.168.0.3
    no split-recovery

interface 1/1/5
    no shutdown
    description keepalive to Switch E
    ip address 192.168.0.3/31
```

Run the following commands to validate output (On either switch E or F)

```
sh interface lag 256 brief
sh vsx status
sh vsx brief
```

For more information relating to VSX and general best practices in a live environment , refer to the vsx best practice document.

VSX Configuration Best Practices

Task 4 – Underlay OSPF configuration and configure point to point links and OSPF

In this task, the allocate point to point links between core and edge will be configure and OSPF configured.

Task 4.1 Configure loopback 0 on all switches

First, loopback addressing is to be configured on all Switches as per the following table.

IP addressing loopbacks

Switch	Loopback /Transit VLAN	address	Description
Switch A	Loopback 0	192.168.1.1/32	OSPF/BGP underlay
Switch B	Loopback 0	192.168.1.2/32	
Switch C	Loopback 0	192.168.1.3/32	
Switch D	Loopback 0	192.168.1.4/32	
Switch E	Loopback 0	192.168.1.5/32	
Switch F	Loopback 0	192.168.1.6/32	

The loopback will provide router ids for the ospf and iBGP route processes

On Switch A configure

```
interface loopback 0
    ip address 192.168.1.1/32
    exit
```

- **Repeat for the remaining switches using the appropriate ip addressing.**

Task 4.2 Configure route process and ip addressing

This is a 2 step process on each switch

1. Configure OSPF
2. Configure point to point interfaces and enable ospf per interface

The following ip addressing schema will be used:-

Switch -1	Subnet	Switch-2	Switch -1-ip	Switch-2-ip
Switch A int 1/1/1-1/1/2 L3 lag	192.168.3.0/31	Switch B int 1/1/1-1/1/2 L3 lag	.0	.1
Switch A int 1/1/4	192.168.3.2/31	Switch C int 1/1/1	.2	.3
Switch A int 1/1/5	192.168.3.4/31	Switch D int 1/1/1	.4	.5
Switch A int 1/1/6	192.168.3.6/31	Switch E int 1/1/1	.6	.7
Switch A int 1/1/7	192.168.3.8/31	Switch F int 1/1/1	.8	.9
Switch B int 1/1/4	192.168.3.10/31	Switch C int 1/1/2	.10	.11
Switch B int 1/1/5	192.168.3.12/31	Switch D int 1/1/2	.12	.13
Switch B int 1/1/6	192.168.3.14/31	Switch E int 1/1/2	.14	.15
Switch B int 1/1/7	192.168.3.16/31	Switch F int 1/1/2	.16	.17
Switch-C transit VLAN 4001	192.168.3.18/31	Switch-D transit VLAN 4001	.18	.19
Switch-E transit VLAN 4001	192.168.3.20/31	Switch-F transit VLAN 4001	.20	.21

Switch A OSPF configuration with ip addressing

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

interface lag 10
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/4
    description p2p-to-switch C
    ip address 192.168.3.2/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/5
    description p2p-to-switch D
    ip address 192.168.3.4/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/6
    description p2p-to-switch E
    ip address 192.168.3.6/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/7
```

```
    description p2p-to-switch F
    ip address 192.168.3.8/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface loopback 0
    ip address 192.168.1.1/32
    ip ospf 1 area 0.0.0.0
```

Switch B OSPF configuration with ip addressing

```
router ospf 1
    router-id 192.168.1.2
    area 0

interface lag 10
    ip ospf 1 area 0
    ip ospf network point-to-point

interface 1/1/4
    description p2p-to-switch c
    ip address 192.168.3.10/31
    ip ospf 1 area 0
    ip ospf network point-to-point
interface 1/1/5
    description p2p-to-switch D
    ip address 192.168.3.12/31
    ip ospf 1 area 0
    ip ospf network point-to-point
interface 1/1/6
    description p2p-to-switch E
    ip address 192.168.3.14/31
    ip ospf 1 area 0
    ip ospf network point-to-point
interface 1/1/7
    description p2p-to-switch F
    ip address 192.168.3.16/31
    ip ospf 1 area 0
    ip ospf network point-to-point
interface loopback 0
    ip address 192.168.1.2/32
    ip ospf 1 area 0
```

Switch C OSPF configuration with ip addressing

```
vlan 4001
    name transit-vlan-SwitchD
```

```
router ospf 1
    router-id 192.168.1.3
    area 0.0.0.0
interface vlan 4001
    description transit vlan to Switch D
    ip address 192.168.3.18/31
    ip ospf 1 area 0.0.0.0
    ip ospf cost 1
    ip ospf network point-to-point

interface 1/1/1
    description p2p-to Switch A
    ip address 192.168.3.3/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/2
    description p2p-to Switch B
    ip address 192.168.3.11/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface loopback 0
    ip ospf 1 area 0.0.0.0
```

Switch D OSPF configuration with ip addressing

```
router ospf 1
    router-id 192.168.1.4
    area 0
vlan 4001
    name transit-vlan-SwitchC
interface vlan 4001
    description transit vlan to Switch C
    ip address 192.168.3.19/31
    ip ospf 1 area 0.0.0.0
    ip ospf cost 1
    ip ospf network point-to-point
interface 1/1/1
    description p2p-to Switch A
    ip address 192.168.3.5/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/2
    description p2p-to Switch B
    ip address 192.168.3.13/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface loopback 0
```

```
    ip ospf 1 area 0.0.0.0
```

Switch E OSPF configuration with ip addressing

```
router ospf 1
    router-id 192.168.1.5
    area 0
vlan 4001
    name transit-vlan-Switch F
interface vlan 4001
    description transit vlan to Switch F
    ip address 192.168.3.20/31
    ip ospf 1 area 0.0.0.0
    ip ospf cost 1
    ip ospf network point-to-point
interface 1/1/1
    description p2p-to Switch A
    ip address 192.168.3.7/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/2
    description p2p-to Switch B
    ip address 192.168.3.15/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface loopback 0
    ip ospf 1 area 0.0.0.0
```

Switch F OSPF configuration with ip addressing

```
router ospf 1
    router-id 192.168.1.6
    area 0
vlan 4001
    name transit-vlan-Switch E
interface vlan 4001
    description transit vlan to Switch E
    ip address 192.168.3.21/31
    ip ospf 1 area 0.0.0.0
    ip ospf cost 1
    ip ospf network point-to-point
interface 1/1/1
    description p2p-to Switch A
    ip address 192.168.3.9/31
```

```
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/2
    description p2p-to Switch B
    ip address 192.168.3.17/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface loopback 0
    ip ospf 1 area 0.0.0.0
```

Task 4.3 Validate the ospf routing network

From each Switch, check that the ospf database has x 6 advertising routers with a Link State ID of the advertising router loopback address.

Sample output Switch A

```
SwitchA# sh ip ospf lsdb
OSPF Router with ID (192.168.1.1) (Process ID 1 VRF default)
================================================================

Router Link State Advertisements (Area 0.0.0.0)
-----------------------------------------------

LSID            ADV Router      Age       Seq#       Checksum       Link Count
-------------------------------------------------------------------------------
192.168.1.1     192.168.1.1     636       0x80000006 0x00009dc8    11
192.168.1.2     192.168.1.2     755       0x8000000f 0x000038e1    11
192.168.1.3     192.168.1.3     826       0x80000008 0x0000cd3c     7
192.168.1.4     192.168.1.4     442       0x8000000c 0x0000ed0d     7
192.168.1.5     192.168.1.5     875       0x80000007 0x0000747a     7
192.168.1.6     192.168.1.6     637       0x8000000b 0x0000944b     7
```

The output should be identical on each Switch.

Check the number of ospf neighbors. Core switches will have x 5 neighbors, edge switches will have x 3 neighbors.

Sample output Switch A

```
SwitchA# sh ip ospf neighbors
VRF : default                              Process : 1
=================================================

Total Number of Neighbors : 5

Neighbor ID      Priority  State             Nbr Address         Interface
-------------------------------------------------------------------------
192.168.1.3      n/a       FULL              192.168.3.3         1/1/4

192.168.1.4      n/a       FULL              192.168.3.5         1/1/5

192.168.1.5      n/a       FULL              192.168.3.7         1/1/6

192.168.1.6      n/a       FULL              192.168.3.9         1/1/7

192.168.1.2      n/a       FULL              192.168.3.1         lag10

SwitchC# sh ip ospf neighbors
VRF : default                              Process : 1
=================================================

Total Number of Neighbors : 3

Neighbor ID      Priority  State             Nbr Address         Interface
-------------------------------------------------------------------------
192.168.1.1      n/a       FULL              192.168.3.2         1/1/1

192.168.1.2      n/a       FULL              192.168.3.10        1/1/2
192.168.1.4      n/a       FULL              192.168.3.19        vlan4001
```

Task 5 – iBGP configuration

This task adds an overly using iBGP in preparation for leveraging EVPN extensions. BGP is required if VXLAN and EVPN extensions are desired to run as an overlay across the network. Two options are available, eBGP and iBGP. This lab leverages iBGP. (EVPN configuration is not part of this lab)

This lab exercise provides an example on configuring iBGP with various options presented as way of illustrating BGP capabilities, options and flexibility. The configurations provided should not be considered as best practice but only as a way of illustrating configuration options.

iBGP requires a direct peering mechanism to all iBGP speakers. This results in a mesh network which is cumbersome and impractical for a 2-tier topology and generally these sentiments apply to most real world deployments.

Mesh peering with iBGP for the campus and can be avoided using confederations and in this lab example, using route reflectors in the core of the network to provide and simulate direct peering between edge switch pairs across the core fabric.

Review of iBGP commands used in the core end edge networks.

`bgp log-neighbor-changes`

Enables logging of BGP neighbor session state changes.

`bgp deterministic-med`

Enables comparison of the Multi-Exit Discriminator (MED) attribute when selecting routes advertised by different peers in the same autonomous system.

`bgp always-compare-med`

Enables comparison of the Multi Exit Discriminator (MED) for paths from neighbors in different autonomous systems.

`bgp bestpath as-path multipath-relax`

Configures Border Gateway Protocol (BGP) to treat two BGP routes as equal cost even if their AS-paths differ, as long as their AS-path lengths and other relevant attributes are the same. This allows routes with different AS-paths to be programmed into the forwarding table as equal cost multipath routes.

`neighbor edge peer-group`

This command configures the router as a BGP route reflector and the specified peer as its client.

In this example a peer group is configured called ‘edge’ . Later within the cli configuration neighbors are aligned to the ‘edge’ peer group.

`neighbor edge remote-as 65001`

identifying edge switch neighbor members remote-as

`neighbor edge fall-over`

Enables BGP fast peering session deactivation. When neighbor fall-over is configured, the BGP process monitors the RIB and if the route to peer is not present in the routing table, it immediately deactivates the peer session without waiting for the hold down timer.

`neighbor edge update-source loopback 0`

This command specifies the source address to reach the neighbor.
An iBGP connection can occur as long as there is a TCP/IP path between the routers. If multiple paths exist

between the iBGP routers, using a loopback interface as the neighbor address can add stability to the network.

```
neighbor 192.168.0.5 peer-group edge
```

Assigning neighbor 192.168.0.5 to peer group 'edge'

```
 address-family ipv4 unicast
```

```
neighbor edge route-reflector-client
```

This command configures the router as a BGP route reflector and the specified peer as its client.

```
 neighbor 192.168.1.2 activate
 neighbor 192.168.1.3 activate
 neighbor 192.168.1.4 activate
 neighbor 192.168.1.5 activate
 neighbor 192.168.1.6 activate
```

This command enables the address-family capability and exchange of information specific to an address family with a BGP neighbor. Without it, neighbor peers will not be formed

```
 redistribute connected
```

redistribute connected interfaces

Apply the following configurations to the appropriate switches:-

Switch A

```
router bgp 65001
    bgp router-id 192.168.1.1
    bgp log-neighbor-changes
    bgp deterministic-med
    bgp always-compare-med
    bgp bestpath as-path multipath-relax
    neighbor edge peer-group
    neighbor edge remote-as 65001
    neighbor edge description edge RR clients
    neighbor edge fall-over
    neighbor edge update-source loopback 0
    neighbor 192.168.1.2 remote-as 65001
    neighbor 192.168.1.2 update-source loopback 0
    neighbor 192.168.1.3 peer-group edge
    neighbor 192.168.1.4 peer-group edge
    neighbor 192.168.1.5 peer-group edge
    neighbor 192.168.1.6 peer-group edge
    address-family ipv4 unicast
   neighbor edge route-reflector-client
        neighbor 192.168.1.2 activate
        neighbor 192.168.1.3 activate
        neighbor 192.168.1.4 activate
```

```
        neighbor 192.168.1.5 activate
        neighbor 192.168.1.6 activate
        redistribute connected
    exit-address-family
```

Switch B

```
router bgp 65001
    bgp router-id 192.168.1.2
    bgp log-neighbor-changes
    bgp deterministic-med
    bgp always-compare-med
    bgp bestpath as-path multipath-relax
    neighbor edge peer-group
    neighbor edge remote-as 65001
    neighbor edge description edge RR clients
    neighbor edge fall-over
    neighbor edge update-source loopback 0
    neighbor 192.168.1.1 remote-as 65001
    neighbor 192.168.1.1 update-source loopback 0
    neighbor 192.168.1.3 peer-group edge
    neighbor 192.168.1.4 peer-group edge
    neighbor 192.168.1.5 peer-group edge
    neighbor 192.168.1.6 peer-group edge
    address-family ipv4 unicast
        neighbor edge route-reflector-client
        neighbor 192.168.1.1 activate
        neighbor 192.168.1.3 activate
        neighbor 192.168.1.4 activate
        neighbor 192.168.1.5 activate
        neighbor 192.168.1.6 activate
        redistribute connected
    exit-address-family
```

Switch C

```
router bgp 65001
    bgp router-id 192.168.1.3
    bgp log-neighbor-changes
    bgp deterministic-med
    bgp always-compare-med
    bgp bestpath as-path multipath-relax
    neighbor 192.168.1.1 remote-as 65001
    neighbor 192.168.1.1 update-source loopback 0
    neighbor 192.168.1.2 remote-as 65001
    neighbor 192.168.1.2 update-source loopback 0
   neighbor 192.168.1.4 remote-as 65001
   neighbor 192.168.1.4 update-source loopback 0
    address-family ipv4 unicast
```

```
        neighbor 192.168.1.1 activate
        neighbor 192.168.1.2 activate
        neighbor 192.168.1.4 activate
        redistribute connected
    exit-address-family
```

Switch D

```
router bgp 65001
    bgp router-id 192.168.1.4
    bgp log-neighbor-changes
    bgp deterministic-med
    bgp always-compare-med
    bgp bestpath as-path multipath-relax
    neighbor 192.168.1.1 remote-as 65001
    neighbor 192.168.1.1 update-source loopback 0
    neighbor 192.168.1.2 remote-as 65001
    neighbor 192.168.1.2 update-source loopback 0
    neighbor 192.168.1.3 remote-as 65001
    neighbor 192.168.1.3 update-source loopback 0
    address-family ipv4 unicast
        neighbor 192.168.1.1 activate
        neighbor 192.168.1.2 activate
        neighbor 192.168.1.3 activate
       redistribute connected
    exit-address-family
```

Switch E

```
router bgp 65001
    bgp router-id 192.168.1.5
    bgp log-neighbor-changes
    bgp deterministic-med
    bgp always-compare-med
    bgp bestpath as-path multipath-relax
    neighbor 192.168.1.1 remote-as 65001
    neighbor 192.168.1.1 update-source loopback 0
    neighbor 192.168.1.2 remote-as 65001
    neighbor 192.168.1.2 update-source loopback 0
   neighbor 192.168.1.6 remote-as 65001
   neighbor 192.168.1.6 update-source loopback 0
    address-family ipv4 unicast
        neighbor 192.168.1.1 activate
        neighbor 192.168.1.2 activate
        neighbor 192.168.1.6 activate
        redistribute connected
    exit-address-family
```

Switch F

```
router bgp 65001
    bgp router-id 192.168.1.6
    bgp log-neighbor-changes
    bgp deterministic-med
    bgp always-compare-med
    bgp bestpath as-path multipath-relax
    neighbor 192.168.1.1 remote-as 65001
    neighbor 192.168.1.1 update-source loopback 0
    neighbor 192.168.1.2 remote-as 65001
    neighbor 192.168.1.2 update-source loopback 0
    neighbor 192.168.1.5 remote-as 65001
    neighbor 192.168.1.5 update-source loopback 0
    address-family ipv4 unicast
        redistribute connected
       neighbor 192.168.1.1 activate
        neighbor 192.168.1.2 activate
        neighbor 192.168.1.5 activate
    exit-address-family
```

run the `sh ip rib` command to review the preferred routes in the routing table:-

Task 5.1 validate iBGP

Neighbor adjacencies

Switch A & B will have 5 neighbor adjacencies . One neighbor adjacency to each edge switch and a neighbor adjacency to the adjacent core switch.

Edge switches will have 3 neighbor adjacencies. 1 to the adjacent edge switch node via VLAN 4001 and a neighbor adjacency to each of the the core switches.

Switch A example

```
SwitchA# sh bgp ipv4 unicast summary
VRF : default
BGP Summary
-----------
 Local AS               : 65001        BGP Router Identifier  : 192.168.1.1
 Peers                  : 5            Log Neighbor Changes   : Yes
 Cfg. Hold Time         : 180          Cfg. Keep Alive        : 60
 Confederation Id       : 0

 Neighbor        Remote-AS MsgRcvd MsgSent   Up/Down Time State        AdminStatus
 192.168.1.2     65001       45      52      00h:21m:17s  Established   Up          Switch B
 192.168.1.3     65001       32      44      00h:21m:01s  Established   Up          Switch C
```

```
 192.168.1.4     65001       33      43      00h:20m:43s  Established   Up          Switch D
 192.168.1.5     65001       32      46      00h:20m:28s  Established   Up          Switch E
 192.168.1.6     65001       33      46      00h:20m:13s  Established   Up          Switch F
```

Switch C example

```
SwitchC# sh bgp ipv4 unicast summ
VRF : default
BGP Summary
-----------
 Local AS               : 65001        BGP Router Identifier  : 192.168.1.3
 Peers                  : 3            Log Neighbor Changes   : Yes
 Cfg. Hold Time         : 180          Cfg. Keep Alive        : 60
 Confederation Id       : 0

 Neighbor        Remote-AS MsgRcvd MsgSent   Up/Down Time State        AdminStatus
 192.168.1.1     65001       72      71      00h:49m:34s  Established   Up
 192.168.1.2     65001       71      69      00h:49m:40s  Established   Up
 192.168.1.4     65001       63      67      00h:49m:20s  Established   Up
```

Show the rib routing table

Example Switch C

```
SwitchC# sh ip rib

Displaying ipv4 routes in RIB

Origin Codes: R - RIP, O - OSPFv2, B - BGP
              C - connected, S - static, L - local
Type Codes:   E - External BGP, I - Internal BGP
              IA - OSPF inter area, ia - OSPF intra area
              E1 - OSPF external type 1, E2 - OSPF external type 2
              EV - BGP EVPN, V - BGP VPN
* indicates selected for forwarding

VRF: default

Prefix               Nexthop          Interface     VRF(egress)   Origin/   Distance/    Age
                                                                   Type      Metric
-------------------------------------------------------------------------------------------
*192.168.0.0/31      -                1/1/5         -             C         [0/0]        -
 192.168.0.0/31      192.168.1.4      -             -             B/I       [200/0]
03h:01m:21s
*192.168.0.0/32      -                1/1/5         -             L         [0/0]        -
*192.168.0.2/31      192.168.1.5      -             -             B/I       [200/0]
```

```
03h:01m:25s
*192.168.1.1/32      192.168.3.2       1/1/1          -            O/ia      [110/100]
03h:01m:32s
*192.168.1.2/32      192.168.3.10      1/1/2          -            O/ia      [110/100]
03h:01m:33s
*192.168.1.3/32      -                 loopback0      -            L         [0/0]         -
*192.168.1.4/32      192.168.3.19      vlan4001       -            O/ia      [110/1]
03h:01m:27s
*192.168.1.5/32      192.168.3.2       1/1/1          -            O/ia      [110/200]
03h:01m:32s
*192.168.1.5/32      192.168.3.10      1/1/2          -            O/ia      [110/200]
03h:01m:32s
*192.168.1.6/32      192.168.3.2       1/1/1          -            O/ia      [110/200]
03h:01m:32s
*192.168.1.6/32      192.168.3.10      1/1/2          -            O/ia      [110/200]
03h:01m:32s
 *192.168.3.0/31      192.168.3.2       1/1/1          -            O/ia      [110/150]
03h:02m:50s
*192.168.3.0/31      192.168.3.10      1/1/2          -            O/ia      [110/150]
03h:02m:50s
 192.168.3.0/31      192.168.1.1       -              -            B/I       [200/0]
03h:02m:43s
 192.168.3.0/31      192.168.1.2       -              -            B/I       [200/0]
03h:02m:43s
 192.168.3.2/31      -                 1/1/1          -            O/ia      [110/100]
03h:02m:51s
 192.168.3.2/31      192.168.1.1       -              -            B/I       [200/0]
03h:02m:43s
*192.168.3.2/31      -                 1/1/1          -            C         [0/0]         -
*192.168.3.3/32      -                 1/1/1          -            L         [0/0]         -
 192.168.3.4/31      192.168.1.4       -              -            B/I       [200/0]
03h:02m:39s
*192.168.3.4/31      192.168.3.19      vlan4001       -            O/ia      [110/101]
03h:02m:45s
*192.168.3.6/31      192.168.3.2       1/1/1          -            O/ia      [110/200]
03h:02m:50s
 192.168.3.6/31      192.168.1.1       -              -            B/I       [200/0]
03h:02m:43s
 192.168.3.8/31      192.168.1.1       -              -            B/I       [200/0]
03h:02m:43s
*192.168.3.8/31      192.168.3.2       1/1/1          -            O/ia      [110/200]
03h:02m:50s
 192.168.3.10/31     -                 1/1/2          -            O/ia      [110/100]
03h:02m:51s
*192.168.3.10/31     -                 1/1/2          -            C         [0/0]         -
 192.168.3.10/31     192.168.1.2       -              -            B/I       [200/0]
03h:02m:43s
```

```
*192.168.3.11/32     -               1/1/2          -          L        [0/0]          -
 192.168.3.12/31     192.168.1.4     -              -          B/I      [200/0]
03h:02m:39s
*192.168.3.12/31     192.168.3.19    vlan4001       -          O/ia     [110/101]
03h:02m:45s
*192.168.3.14/31     192.168.3.10    1/1/2          -          O/ia     [110/200]
03h:02m:51s
 192.168.3.14/31     192.168.1.2     -              -          B/I      [200/0]
03h:02m:43s
*192.168.3.16/31     192.168.3.10    1/1/2          -          O/ia     [110/200]
03h:02m:51s
 192.168.3.16/31     192.168.1.2     -              -          B/I      [200/0]
03h:02m:43s
*192.168.3.18/31     -               vlan4001       -          C        [0/0]          -
 192.168.3.18/31     192.168.1.4     -              -          B/I      [200/0]
03h:02m:39s
 192.168.3.18/31     -               vlan4001       -          O/ia     [110/1]
03h:02m:50s
*192.168.3.18/32     -               vlan4001       -          L        [0/0]          -
 192.168.3.20/31     192.168.1.5     -              -          B/I      [200/0]
03h:02m:43s
*192.168.3.20/31     192.168.3.2     1/1/1          -          O/ia     [110/201]
03h:02m:50s
*192.168.3.20/31     192.168.3.10    1/1/2          -          O/ia     [110/201]
03h:02m:50s

Total Route Count : 43
```

Al preferred routes are selected via ospf (other than local /remote keepalive subnets)

Ping the following switch host loopbacks from any switch , example from Switch C (loopback 192.168.1.3), to validate connectivity:-

192.168.1.1 Switch A

192.168.1.2 Switch B

192.168.1.4 Switch D

192.168.1.5 Switch E

192.168.1.6 Switch E

END of LAB tasks

Appendix – Complete Configurations

Switch A

```
hostname SwitchA
led locator on
!
!
ssh server vrf mgmt
vlan 1
interface mgmt
    no shutdown
    ip dhcp
interface lag 10
    no shutdown
    description L3-lag-switchA-B
    ip address 192.168.3.0/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/1
    no shutdown
    lag 10
interface 1/1/2
    no shutdown
    lag 10
interface 1/1/3
    no shutdown
interface 1/1/4
    no shutdown
    description p2p-to-switch C
    ip address 192.168.3.2/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/5
    no shutdown
```

```
    description p2p-to-switch D
    ip address 192.168.3.4/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/6
    no shutdown
    description p2p-to-switch E
    ip address 192.168.3.6/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/7
    no shutdown
    description p2p-to-switch F
    ip address 192.168.3.8/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface loopback 0
    ip address 192.168.1.1/32
    ip ospf 1 area 0.0.0.0
!
!
router ospf 1
    router-id 192.168.1.1
    area 0.0.0.0
router bgp 65001
    bgp router-id 192.168.1.1
    bgp log-neighbor-changes
    bgp deterministic-med
    bgp always-compare-med
    bgp bestpath as-path multipath-relax
    neighbor edge peer-group
    neighbor edge remote-as 65001
    neighbor edge description edge RR clients
    neighbor edge fall-over
    neighbor edge update-source loopback 0
    neighbor 192.168.1.2 remote-as 65001
```

```
    neighbor 192.168.1.2 update-source loopback 0
    neighbor 192.168.1.3 peer-group edge
    neighbor 192.168.1.4 peer-group edge
    neighbor 192.168.1.5 peer-group edge
    neighbor 192.168.1.6 peer-group edge
    address-family ipv4 unicast
        neighbor edge route-reflector-client
        neighbor 192.168.1.2 activate
        neighbor 192.168.1.3 activate
        neighbor 192.168.1.4 activate
        neighbor 192.168.1.5 activate
        neighbor 192.168.1.6 activate
       redistribute connected
    exit-address-family
!
```

Switch B

```
hostname SwitchB
led locator on
!
!
ssh server vrf mgmt
vlan 1
interface mgmt
    no shutdown
    ip dhcp
interface lag 10
    no shutdown
    description L3-lag-switchA-B
    ip address 192.168.3.1/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/1
    no shutdown
    lag 10
interface 1/1/2
```

```
    no shutdown
    lag 10
interface 1/1/3
    no shutdown
interface 1/1/4
    no shutdown
    description p2p-to-switch c
    ip address 192.168.3.10/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/5
    no shutdown
    description p2p-to-switch D
    ip address 192.168.3.12/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/6
    no shutdown
    description p2p-to-switch E
        ip address 192.168.3.14/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/7
    no shutdown
    description p2p-to-switch F
    ip address 192.168.3.16/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface loopback 0
    ip address 192.168.1.2/32
    ip ospf 1 area 0.0.0.0
!
!
router ospf 1
    router-id 192.168.1.2
    area 0.0.0.0
```

```
router bgp 65001
    bgp router-id 192.168.1.2
    bgp log-neighbor-changes
    bgp deterministic-med
    bgp always-compare-med
    bgp bestpath as-path multipath-relax
    neighbor edge peer-group
    neighbor edge remote-as 65001
    neighbor edge description edge RR clients
    neighbor edge fall-over
    neighbor edge update-source loopback 0
    neighbor 192.168.1.1 remote-as 65001
    neighbor 192.168.1.1 update-source loopback 0
    neighbor 192.168.1.3 peer-group edge
    neighbor 192.168.1.4 peer-group edge
    neighbor 192.168.1.5 peer-group edge
    neighbor 192.168.1.6 peer-group edge
    redistribute connected
exit-address-family
!
```

Switch C

```
!
hostname SwitchC
user admin group administrators password ciphertext
AQBapd8enlxYi8P09dotYV/R2O4lEy+76CDCxtQNQXnV6zZ6YgAAAJkbAy1X/dwVzWOegcBs4rqZmyyhx3vWj2wiO0/+Kxv
U24AUaOcy55STr6BhToxWZWDSnyfJ5Yom320DHo01yDtdfijPEmDcDS10h2R2
1/lwoxfEGoXW+FIZ383fDlqF2JiZ
led locator on
ntp server pool.ntp.org minpoll 4 maxpoll 4 iburst
ntp enable
!
!
!
!
!
```

```
!
ssh server vrf mgmt
vlan 1
vlan 4001
    name transit-vlan-SwitchD
interface mgmt
    no shutdown
    ip dhcp
interface lag 256
    no shutdown
    description ISL to SwitchD
    no routing
    vlan trunk native 1
    vlan trunk allowed all
    lacp mode active
interface 1/1/1
    no shutdown
    description p2p-to Switch A
    ip address 192.168.3.3/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/2
    no shutdown
    description p2p-to Switch B
    ip address 192.168.3.11/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/3
    no shutdown
    lag 256
interface 1/1/4
    no shutdown
    lag 256
interface 1/1/5
    no shutdown
    description keepalive interface switchD
```

```
    ip address 192.168.0.0/31
interface 1/1/6
    no shutdown
interface 1/1/7
    no shutdown
interface loopback 0
    ip address 192.168.1.3/32
    ip ospf 1 area 0.0.0.0
interface vlan 4001
    description transit vlan to Switch D
    ip address 192.168.3.18/31
    ip ospf 1 area 0.0.0.0
    ip ospf cost 1
    ip ospf network point-to-point
vsx
    system-mac 02:00:00:00:01:01
    inter-switch-link lag 256
    role primary
    keepalive peer 192.168.0.1 source 192.168.0.0
    no split-recovery
    vsx-sync vsx-global
!
!
router ospf 1
    router-id 192.168.1.3
    area 0.0.0.0
router bgp 65001
    bgp router-id 192.168.1.3
    bgp log-neighbor-changes
    bgp deterministic-med
    bgp always-compare-med
    bgp bestpath as-path multipath-relax
    neighbor 192.168.1.1 remote-as 65001
    neighbor 192.168.1.1 update-source loopback 0
    neighbor 192.168.1.2 remote-as 65001
    neighbor 192.168.1.2 update-source loopback 0
```

```
    neighbor 192.168.1.4 remote-as 65001
    neighbor 192.168.1.4 update-source loopback 0
    address-family ipv4 unicast
        neighbor 192.168.1.1 activate
        neighbor 192.168.1.2 activate
        neighbor 192.168.1.4 activate
        redistribute connected
    exit-address-family
!
```

Switch D

```
hostname SwitchD
user admin group administrators password ciphertext AQBapYPTZ9Y/6IMJbHMMSo5tl6mQq9C8
+U+BEMVGX4Y+1kceYgAAAICB31OZ9TsHdnSFRLAxPC3oxNHBeNLSh3M/zmhqd8VPRCMlSxHCOTOazqZbnrkA
QTTecIlldnHSK/hMk50Hy1Bqd/cb2vJsZviFjPQe1p0IpkFllwDwzZPXJPhjyQJrTf9K
led locator on
ntp server pool.ntp.org minpoll 4 maxpoll 4 iburst
ntp enable
!
!
!
!
!
!
ssh server vrf mgmt
vlan 1
vlan 4001
    name transit-vlan-SwitchC
interface mgmt
    no shutdown
    ip dhcp
interface lag 256
    no shutdown
    description ISL
    no routing
    vlan trunk native 1
    vlan trunk allowed all
```

```
    lacp mode active
interface 1/1/1
    no shutdown
    description p2p-to Switch A
    ip address 192.168.3.5/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/2
    no shutdown
    description p2p-to Switch B
    ip address 192.168.3.13/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/3
    no shutdown
    lag 256
interface 1/1/4
    no shutdown
    lag 256
interface 1/1/5
    no shutdown
    description keepalive interface to SwitchC
    ip address 192.168.0.1/31
interface 1/1/6
    no shutdown
interface 1/1/7
    no shutdown
interface loopback 0
    ip address 192.168.1.4/32
    ip ospf 1 area 0.0.0.0
interface vlan 4001
    description transit vlan to switch C
    ip address 192.168.3.19/31
    ip ospf 1 area 0.0.0.0
    ip ospf cost 1
    ip ospf network point-to-point
```

```
vsx
    system-mac 02:00:00:00:01:01
    inter-switch-link lag 256
    role secondary
    keepalive peer 192.168.0.0 source 192.168.0.1
    no split-recovery
    vsx-sync vsx-global
!
!
router ospf 1
    router-id 192.168.1.4
    area 0.0.0.0
router bgp 65001
    bgp router-id 192.168.1.4
    bgp log-neighbor-changes
    bgp deterministic-med
    bgp always-compare-med
    bgp bestpath as-path multipath-relax
    neighbor 192.168.1.1 remote-as 65001
    neighbor 192.168.1.1 update-source loopback 0
    neighbor 192.168.1.2 remote-as 65001
    neighbor 192.168.1.2 update-source loopback 0
    neighbor 192.168.1.3 remote-as 65001
    neighbor 192.168.1.3 update-source loopback 0
    address-family ipv4 unicast
        neighbor 192.168.1.1 activate
        neighbor 192.168.1.2 activate
        neighbor 192.168.1.3 activate
        redistribute connected
    exit-address-family
!
```

Switch E

```
hostname SwitchE
user admin group administrators password ciphertext
AQBape2KXO9Ae1XTrV2XqS4ix5JGb/shE9wYpW8cHHL/JVHRYgAAACmywuf9eTzfmcYKpvS3rHYFhlIBnikElJX/z8NOlAn
```

```
N5gj40DwXgJuCuFOml1eu4drZJkyTg7ovCT7d2zX2quWpmphLsqt5JyPYLdp7
EYGHKIfj/hnH1+nbvWYhzfoX7I7u
led locator on
ntp server pool.ntp.org minpoll 4 maxpoll 4 iburst
ntp enable
!
!
!
!
!
!
ssh server vrf mgmt
vlan 1
vlan 4001
    name transit-vlan-Switch F
interface mgmt
    no shutdown
    ip dhcp
interface lag 256
    no shutdown
    description ISL
    no routing
    vlan trunk native 1
    vlan trunk allowed all
    lacp mode active
interface 1/1/1
    no shutdown
    description p2p-to switch A
    ip address 192.168.3.7/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/2
    no shutdown
    description p2p-to switch B
    ip address 192.168.3.15/31
    ip ospf 1 area 0.0.0.0
```

```
    ip ospf network point-to-point
interface 1/1/3
    no shutdown
    lag 256
interface 1/1/4
    no shutdown
    lag 256
interface 1/1/5
    no shutdown
    description keepalive to switch F
    ip address 192.168.0.2/31
interface 1/1/6
    no shutdown
interface 1/1/7
    no shutdown
interface loopback 0
    ip address 192.168.1.5/32
    ip ospf 1 area 0.0.0.0
interface vlan 4001
    ip address 192.168.3.20/31
    ip ospf 1 area 0.0.0.0
    ip ospf cost 1
    ip ospf network point-to-point
vsx
    system-mac 02:00:00:00:02:01
    inter-switch-link lag 256
    role primary
    keepalive peer 192.168.0.3 source 192.168.0.2
    no split-recovery
    vsx-sync vsx-global
!
!
!
!
!
router ospf 1
```

```
    router-id 192.168.1.5
    area 0.0.0.0
router bgp 65001
    bgp router-id 192.168.1.5
    bgp log-neighbor-changes
    bgp deterministic-med
    bgp always-compare-med
    bgp always-compare-med
    bgp bestpath as-path multipath-relax
    neighbor 192.168.1.1 remote-as 65001
    neighbor 192.168.1.1 update-source loopback 0
    neighbor 192.168.1.2 remote-as 65001
    neighbor 192.168.1.2 update-source loopback 0
    neighbor 192.168.1.6 remote-as 65001
    neighbor 192.168.1.6 update-source loopback 0
    address-family ipv4 unicast
        neighbor 192.168.1.1 activate
        neighbor 192.168.1.2 activate
        neighbor 192.168.1.6 activate
        redistribute connected
    exit-address-family
!
!
```

Switch F

```
hostname SwitchF
user admin group administrators password ciphertext AQBape4Mg79PdATqRbfi5V4C5ls4ylJp
V3VmrwwpX7SIfyDoYgAAAHDXgcZF05gx/in1wByaJCLUYl08geKi3ibKu65O/wO/R4iXpRpzMy/5U3BRljz+
WvpyEdgOFhROZBtUKJnCOJUXimwnvYT0DBZYRIJOcJPfNsrlMZeuDnykbLcwSTrf8k4y
led locator on
ntp server pool.ntp.org minpoll 4 maxpoll 4 iburst
ntp enable
!
!
ssh server vrf mgmt
vlan 1
vlan 4001
```

```
    name transit-vlan-Switch E
interface mgmt
    no shutdown
    ip dhcp
interface lag 256
    no shutdown
    description ISL to Switch E
    no routing
    vlan trunk native 1
    vlan trunk allowed all
    lacp mode active
interface 1/1/1
    no shutdown
    description p2p-to-switch A
    ip address 192.168.3.9/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/2
    no shutdown
    description p2p-to Switch B
    ip address 192.168.3.17/31
    ip ospf 1 area 0.0.0.0
    ip ospf network point-to-point
interface 1/1/3
    no shutdown
    lag 256
interface 1/1/4
    no shutdown
    lag 256
interface 1/1/5
    no shutdown
    description keepalive to Switch E
    ip address 192.168.0.3/31
interface 1/1/6
    no shutdown
interface 1/1/7
```

```
    no shutdown
interface loopback 0
    ip address 192.168.1.6/32
    ip ospf 1 area 0.0.0.0
interface vlan 4001
    description transit vlan to Switch E
    ip address 192.168.3.21/31
    ip ospf 1 area 0.0.0.0
    ip ospf cost 1
    ip ospf network point-to-point
vsx
    system-mac 02:00:00:00:02:01
    inter-switch-link lag 256
    role secondary
    keepalive peer 192.168.0.2 source 192.168.0.3
    no split-recovery
    vsx-sync vsx-global
!
!
router ospf 1
    router-id 192.168.1.6
    area 0.0.0.0
router bgp 65001
    bgp router-id 192.168.1.6
    bgp log-neighbor-changes
    bgp deterministic-med
    bgp always-compare-med
    bgp bestpath as-path multipath-relax
    neighbor 192.168.1.1 remote-as 65001
    neighbor 192.168.1.1 update-source loopback 0
    neighbor 192.168.1.2 remote-as 65001
    neighbor 192.168.1.2 update-source loopback 0
    neighbor 192.168.1.5 remote-as 65001
    neighbor 192.168.1.5 update-source loopback 0
    address-family ipv4 unicast
        neighbor 192.168.1.1 activate
```

```
        neighbor 192.168.1.2 activate
        neighbor 192.168.1.5 activate
        redistribute connected
    exit-address-family
!
```

END OF DOCUMENT

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