LAB GUIDE

a Hewlett Packard Enterprise company

Campus 2-Tier with Routed Access – iBGP

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.

https://www.eve-ng.net/index.php/documentation/howtos/howto-add-aruba-cx-switch/

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Lab Objective

This is the first of a series of IPv6 labs for 2-tier campus networks. In this lab, you will configure iBGP routed access, DHCPv4 relay and server and achieve DHCPv4 server redundancy.

Lab Overview

In this lab you will configure IPv4 addresses, OSPF, iBGP, DHCPv4 relay and server and validate the configuration by testing an IPv4 client.

Lab Network Layout

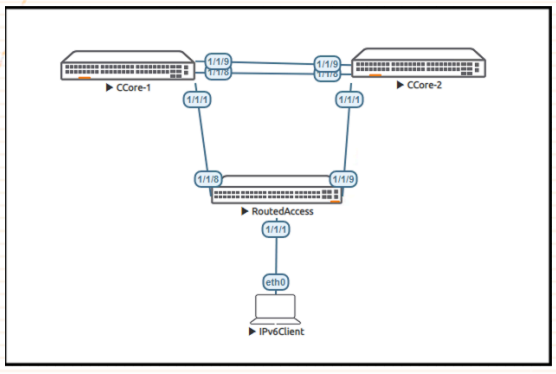

Figure 1. Lab topology and addresses

Notes:

- The client will be simulated with the management port of another AOS-CX switch, for its simplicity in testing DHCPv4

Table 1. IPv6 Addresses

Device	Interface	IPv4 address	Subnet Mask
Collapsed Core 1	1/1/1	192.168.4.0	/31
	1/1/8	192.168.5.0	/31
	1/1/9	192.168.6.0	/31
	Loopback 0	192.168.2.1	/32
Collapsed Core 2	1/1/1	192.168.4.4	/31
	1/1/8	192.168.5.1	/31
	1/1/9	192.168.6.1	/31
	Loopback 0	192.168.2.2	/32
Routed Access	Vlan 10	192.168.10.1	/31
	1/1/8	192.168.4.1	/31
	1/1/9	192.168.4.5	/31
	Loopback 0	192.168.2.3	
IPv6 Client	Mgmt. (DHCP)		

Recommended AOS-CX Switch Simulator Version: 10:07:0010

Login to each switch with username: admin and no password. You will be prompted to assign a new password.

Lab Task 1 - Lab setup

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

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

```
configure
hostname …
```

- On all devices, bring up required ports:

```
int 1/1/1,1/1/8-1/1/9
  no shutdown
use “exit” to go back a level
```

- Validate LLDP neighbors appear as expected on each switch

```
show lldp neighbor

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

    Total Neighbor Entries          : 3
    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:b3:78:ac  1/1/9                     1/1/9
 120      RAccess
1/1/8       08:00:09:e2:dd:0f  1/1/8                     1/1/8
 120      ColCore-1
1/1/9       08:00:09:e2:dd:0f  1/1/9                     1/1/9
 120      ColCore-1
```

Lab Task 2 – Configure IP Interfaces

- Configure interfaces, IPs and required VLANs on the 4 switches

RAccess

```
RAccess(config)# int lo 0
RAccess(config-loopback-if)# ip add 192.168.2.3/32
RAccess(config-loopback-if)# ip ospf 1 area 0
OSPF process does not exist.
Do you want to create (y/n)? y
OSPF Area is not configured.
Do you want to create (y/n)? y

RAccess(config-loopback-if)# router ospf 1
RAccess(config-ospf-1)# router-id 192.168.2.3
RAccess(config-ospf-1)# int 1/1/8
RAccess(config-if)# ip add 192.168.4.1/31
RAccess(config-if)# ip ospf 1 area 0
RAccess(config-if)# ip ospf network point-to-point
RAccess(config-if)# int 1/1/9
RAccess(config-if)# ip add 192.168.4.5/31
RAccess(config-if)# ip ospf 1 area 0
RAccess(config-if)# ip ospf network point-to-point
```

ColCore-1

```
ColCore-1(config)# int lo 0
ColCore-1(config-loopback-if)# ip add 192.168.2.1/32
ColCore-1(config-loopback-if)# ip ospf 1 area 0
OSPF process does not exist.
Do you want to create (y/n)? y
OSPF Area is not configured.
Do you want to create (y/n)? y

ColCore-1(config-loopback-if)# router ospf 1
ColCore-1(config-ospf-1)# router-id 192.168.2.1
ColCore-1(config-ospf-1)# int 1/1/1
ColCore-1(config-if)# ip add 192.168.4.0/31
ColCore-1(config-if)# ip ospf 1 area 0
ColCore-1(config-if)# ip ospf network point-to-point
ColCore-1(config-if)# int 1/1/8
ColCore-1(config-if)# ip add 192.168.5.0/31
ColCore-1(config-if)# ip ospf 1 area 0
ColCore-1(config-if)# ip ospf network point-to-point
ColCore-1(config-if)# int 1/1/9
ColCore-1(config-if)# ip add 192.168.6.0/31
ColCore-1(config-if)# ip ospf 1 area 0
ColCore-1(config-if)# ip ospf network point-to-point
```

ColCore-2

```
ColCore-2(config)# int lo 0
ColCore-2(config-loopback-if)# ip add 192.168.2.2/32
ColCore-2(config-loopback-if)# ip ospf 1 area 0
OSPF process does not exist.
Do you want to create (y/n)? y
OSPF Area is not configured.
Do you want to create (y/n)? y

ColCore-2(config-loopback-if)# router ospf 1
ColCore-2(config-ospf-1)# router-id 192.168.2.2
ColCore-2(config-ospf-1)# int 1/1/1
ColCore-2(config-if)# ip add 192.168.4.4/31
ColCore-2(config-if)# ip ospf 1 area 0
ColCore-2(config-if)# ip ospf network point-to-point
ColCore-2(config-if)# int 1/1/8
ColCore-2(config-if)# ip add 192.168.5.1/31
ColCore-2(config-if)# ip ospf 1 area 0
ColCore-2(config-if)# ip ospf network point-to-point
ColCore-2(config-if)# int 1/1/9
ColCore-2(config-if)# ip add 192.168.6.1/31
ColCore-2(config-if)# ip ospf 1 area 0
ColCore-2(config-if)# ip ospf network point-to-point
```

- Verify OSPF neighbors appear as expected between the switches

```
ColCore-2# show ip ospf neighbors
VRF : default                          Process : 1
================================================

Total Number of Neighbors : 2

Neighbor ID      Priority  State             Nbr Address       Interface
-------------------------------------------------------------------------
192.168.2.3      n/a       FULL              192.168.4.5        1/1/1

192.168.2.1      n/a       FULL              192.168.5.0        1/1/8
```

- Verify OSPF routes are learnt as expected, you should see ECMP routes towards Lo0 of the other leaf, this is supposed to allow VXLAN traffic to be load shared across the ECMP routes (this works with real hardware, however AOS-CX VMs do not currently support ECMP)

```
ColCore-2# show ip route ospf

Displaying ipv4 routes selected for forwarding

Origin Codes: C - connected, S - static, L - local
              R - RIP, B - BGP, O - OSPF
Type Codes:   E - External BGP, I - Internal BGP, V - VPN, EV - EVPN
              IA - OSPF internal area, E1 - OSPF external type 1
              E2 - OSPF external type 2

VRF: default

Prefix              Nexthop          Interface     VRF(egress)       Origin/   Distance/
    Age
                                                                     Type      Metric
-------------------------------------------------------------------------------------------
-----------------
192.168.2.1/32      192.168.5.0      1/1/8         -                 O         [110/100]
    00h:27m:25s
192.168.2.3/32      192.168.4.5      1/1/1         -                 O         [110/100]
    00h:04m:21s
192.168.4.0/31      192.168.5.0      1/1/8         -                 O         [110/200]
    00h:27m:25s
```

```
192.168.10.0/24     192.168.4.5      1/1/1          -                 O          [110/200]
    00h:04m:21s

Total Route Count : 4
```

Lab Task 3 – Configure BGP Interfaces

- On spine switches, configure EVPN Route Reflectors (RR) towards the leaf switches (RR clients) using leaf loopback IPs as neighbors

ColCore-1

```
router bgp 65001
    bgp router-id 192.168.2.1
    neighbor 192.168.2.2 remote-as 65001
    neighbor 192.168.2.2 update-source loopback 0
    neighbor 192.168.2.3 remote-as 65001
    neighbor 192.168.2.3 update-source loopback 0
    address-family ipv4 unicast
        neighbor 192.168.2.2 activate
        neighbor 192.168.2.2 default-originate
        neighbor 192.168.2.3 activate
        neighbor 192.168.2.3 default-originate
    exit-address-family
```

ColCore-2

```
router bgp 65001
    bgp router-id 192.168.2.2
    neighbor 192.168.2.1 remote-as 65001
    neighbor 192.168.2.1 update-source loopback 0
    neighbor 192.168.2.3 remote-as 65001
    neighbor 192.168.2.3 update-source loopback 0
    address-family ipv4 unicast
        neighbor 192.168.2.1 activate
        neighbor 192.168.2.1 default-originate
        neighbor 192.168.2.3 activate
        neighbor 192.168.2.3 default-originate
    exit-address-family
```

RAccess

```
router bgp 65001
    bgp router-id 192.168.2.3
    neighbor 192.168.2.1 remote-as 65001
    neighbor 192.168.2.1 update-source loopback 0
    neighbor 192.168.2.2 remote-as 65001
    neighbor 192.168.2.2 update-source loopback 0
    address-family ipv4 unicast
        neighbor 192.168.2.1 activate
        neighbor 192.168.2.1 default-originate
        neighbor 192.168.2.2 activate
        neighbor 192.168.2.2 default-originate
    exit-address-family
```

- Validate BGP neighbors are up on each switch

```
ColCore-2# show bgp ipv4 unicast
Status codes: s suppressed, d damped, h history, * valid, > best, = multipath,
              i internal, e external S Stale, R Removed, a additional-paths
Origin codes: i - IGP, e - EGP, ? - incomplete

VRF : default
Local Router-ID 192.168.2.2
```

```
    Network            Nexthop         Metric     LocPrf     Weight Path
*>i 0.0.0.0/0          192.168.2.1     0          100        0      i
*=i 0.0.0.0/0          192.168.2.3     0          100        0      i
Total number of entries 2
```

Lab Task 4 – Configure DHCP

DHCP Server on Collapsed Core 1

```
 configure
   dhcp-server vrf default
    pool VLAN10
        range 192.168.10.100 192.168.10.110
        exit
    authoritative
    enable
end
write memory
```

DHCP Server on Collapsed Core 2

```
 configure
   dhcp-server vrf default
       pool VLAN10
           range 192.168.10.130 192.168.10.140
           exit
       authoritative
       enable
end
write memory
```

DHCP Relay on Routed Access Switch

Configure DHCP Relay

```
configure
  interface vlan 10
    ip address 192.168.10.1/24
    ip helper-address 192.168.2.1
    ip ospf 1 area 0.0.0.0    exit
dhcp-relay
end
write memory
```

Important: notice that the DHCPv4 range on both servers is different, taking a portion of range for each server. This tactic provides redundancy without conflicts.

Lab Task 5 – Validate

Client

```
show interface mgmt
```

```
  Address Mode: dhcp
  Admin State: up
  Link State: up
  Mac Address: 50:02:00:04:00:00
  IPv4 address/subnet-mask: 192.168.10.108/24
  Default gateway IPv4: 192.168.10.1
  IPv6 address/prefix:
  IPv6 link local address/prefix: fe80::5202:ff:fe04:0/64
  Default gateway IPv6:
  Primary Nameserver:
  Secondary Nameserver:
  Tertiary Nameserver:
```

```
ping 192.168.2.1 vrf mgmt
```

```
PING 192.168.2.1 (192.168.2.1) 100(128) bytes of data.
```

```
108 bytes from 192.168.2.1: icmp_seq=1 ttl=63 time=2.49 ms
108 bytes from 192.168.2.1: icmp_seq=2 ttl=63 time=2.21 ms
108 bytes from 192.168.2.1: icmp_seq=3 ttl=63 time=2.39 ms
108 bytes from 192.168.2.1: icmp_seq=4 ttl=63 time=2.16 ms
108 bytes from 192.168.2.1: icmp_seq=5 ttl=63 time=2.58 ms

--- 192.168.2.1 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4005ms
rtt min/avg/max/mdev = 2.162/2.366/2.579/0.158 ms
5 packets transmitted, 5 received, 0% packet loss, time 4005ms
rtt min/avg/max/mdev = 2.214/4.523/12.874/4.179 ms
```

On each Collapsed Core Server

Run `show dhcp-server leases`

and verify which one provided the address to the client.

Test DHCP server redundancy

- Shutdown port 1/1/8 on the DHCPv4 relay switch
- On the client shutdown the management interface and turn it back on to get a new IPv4 address
    - Check the DHCPv4 leases on the core switches
- Repeat after re-enabling port 1/1/8 and disabling port 1/1/9 on the DHCPv4gg relay switch

End of Lab

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