LAB GUIDE

DHCP Fundamentals

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

At the end of this lab you will be able to implement and test the basic Dynamic Host Configuration Protocol (DHCP) functions on Aruba CX switches for IPV4.

Aruba CX switches support DHCP Client, Server and Relay agent functions.

DHCP Client: CX switches can act as a DHCP client, this can be used in scenarios such as Zero Touch Provisioning (ZTP), in this lab setup we will use the functionality to demonstrate Client IP allocation only.

DHCP Server: CX switches can act as DHCP servers, this can be used in various situations where a dedicated DHCP server may not be practical or warranted.

DHCP Relay: When a DHCP server is not available on the same local broadcast segment, the DHCP request is forwarded "relayed" as a unicast request to an off segment DHCP server to attain client assignment.

For further details on DHCP on Aruba CX switches please refer to the latest Aruba documentation located on https://asp.arubanetworks.com/

Lab Overview

This lab set up is as shown in Figure 1. Aruba CX simulator will be used as both DHCP Server and Client. This will allow the reader to observe the behavior and configure DHCP Client, Server and Relay.

Lab Network Layout
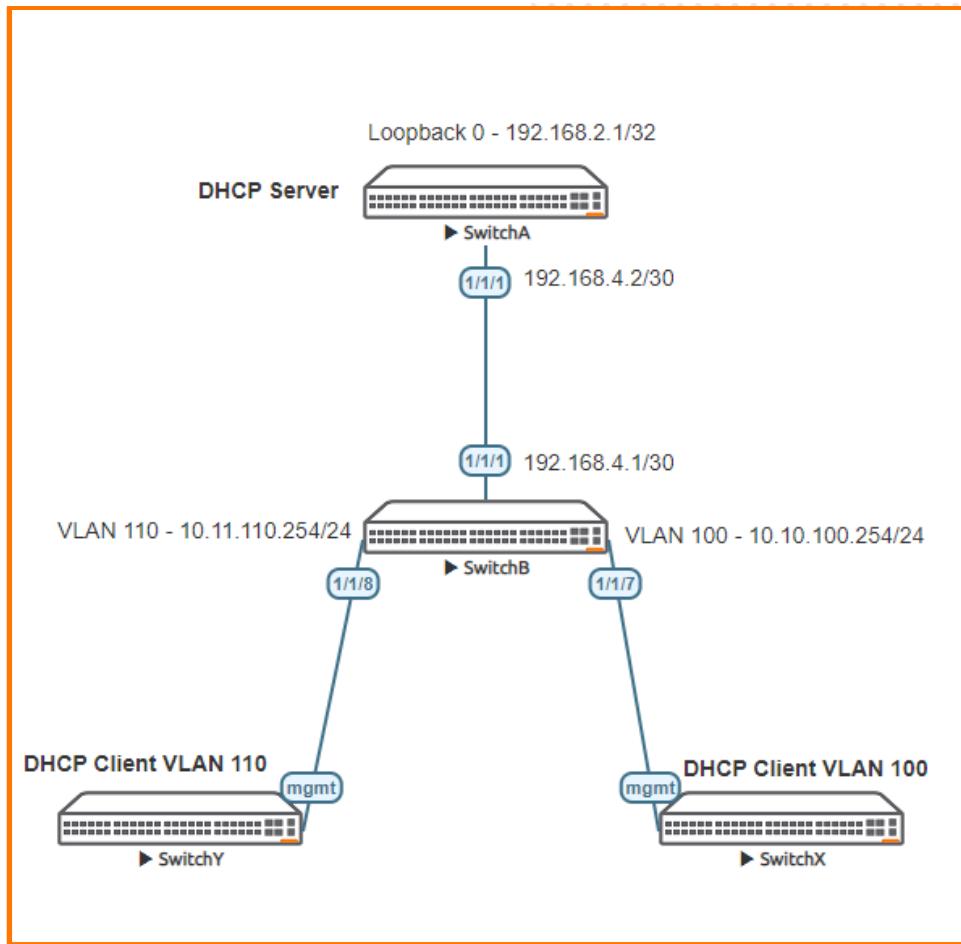
Figure 1. DHCP Lab topology

Lab Tasks

Task 1 - Lab setup

For this lab refer to Figure 1 for topology setup. Open switch A and B consoles and log in with user "admin" and no password. **Note**: Switch X and Y will not require configuration as they will acquire an IP address from the DHCP server, and will be used for testing only.

```
configure
hostname <device host name>
```

- On **Switch A and B** bring up on 1/1/1:

```
int 1/1/1
  no shutdown
```

use "exit" to go back a level

- Validate LLDP neighbors appear as expected on each switch. Here we show Switch A output only.

```
SwitchA#show lldp neighbor-info

LLDP Neighbor Information
show lldp neighbor-info

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

Total Neighbor Entries         : 1
Total Neighbor Entries Deleted : 2
Total Neighbor Entries Dropped : 0
Total Neighbor Entries Aged-Out : 2

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
```

Task 2 - Configure DHCP Server and routing

On Switch A configure

- Basic IP and static routing
- Create DHCP Server to include:
    - Two subnets for VLAN 100 and 110 with a scope for 10 hosts
    - Default Router (DHCP option 3)
    - DNS (DHCP option 6)
    - Lease time for IP address of 30 mins

```
SwitchA#
configure
interface 1/1/1
    no shutdown
    ip address 192.168.4.2/30      < ----- Interface address will be used to identify the DHCP Server
exit
interface loopback 0
    ip address 192.168.2.1/32
exit
ip route 0.0.0.0/0 192.168.4.1   < ----- Set default route to Switch B
dhcp-server vrf default
    pool VL100
        range 10.10.100.1 10.10.100.20 prefix-len 24
        dns-server 8.8.8.8 8.8.4.4
        default-router 10.10.100.254
         lease 00:00:30
        exit
    pool VL110
        range 10.11.110.1 10.11.110.20 prefix-len 24
        dns-server 8.8.8.8 8.8.4.4
        default-router 10.11.110.254
        lease 00:00:30
        exit
    authoritative
    enable
```

- Check DHCP Server is enabled and operational and parameters configured are as expected

```
SwitchA#

show dhcp-server

VRF Name           : default
DHCP Server        : enabled
Operational State  : operational
Authoritative Mode : true

Pool Name          : VL100
Lease Duration     : 00:00:30

DHCP dynamic IP allocation
----------------------------
Start-IP-Address        End-IP-Address          Prefix-Length
-----------------       ---------------         -------------
10.10.100.1             10.10.100.20            24
```

```
DHCP Server options
-------------------
**************************************************
Note:DHCP Server well known option number mapping:
default-router(3), Dns-server(6), Domain-name(15),
Netbios-name-server(44), Netbios-node-type(46)
**************************************************
Option-Number       Option-Type          Option-Value
--------------      ------------         -------------
  3                 ip                   10.10.100.254
  6                 ip                   8.8.8.8 8.8.4.4


DHCP Server static IP allocation
--------------------------------
DHCP Server static host is not configured.


BOOTP Options
---------------
Boot-File-Name            TFTP-Server-Name             TFTP-Server-Address
---------------           -----------------            --------------------
*                         *                            *

Pool Name         : VL110
Lease Duration    : 00:00:30
DHCP dynamic IP allocation
---------------------------
Start-IP-Address          End-IP-Address           Prefix-Length
----------------          --------------           -------------
10.11.110.1               10.11.110.20             24


DHCP Server options
-------------------
**************************************************
Note:DHCP Server well known option number mapping:
default-router(3), Dns-server(6), Domain-name(15),
Netbios-name-server(44), Netbios-node-type(46)
**************************************************
Option-Number       Option-Type          Option-Value
--------------      ------------         -------------
  3                 ip                   10.11.110.254
  6                 ip                   8.8.8.8 8.8.4.4


DHCP Server static IP allocation
--------------------------------
DHCP Server static host is not configured.


BOOTP Options
---------------
Boot-File-Name            TFTP-Server-Name             TFTP-Server-Address
---------------           -----------------            --------------------
*                         *                            *
```

- Check DHCP Server leases, at this stage none should be allocated.

SwitchA#

show dhcp-server leases
No DHCP leases in the database.

Task 3 - Configure VLANs, DHCP Relay and static routing

On Switch B configure

- Basic IP and static routing
- Create VLAN Interfaces with Relay agent helper address
- Assign port 11/7 to VLAN 100 .Keep the port shut at this stage
- Assign port 11/8 to VLAN 110. Keep the port shut at this stage

.

```
SwitchB#
configure
vlan 100,110
exit
interface 1/1/1
    no shutdown
    ip address 192.168.4.1/30
    exit
interface vlan 100
    ip address 10.10.100.254/24
    ip helper-address 192.168.4.2        < -----Relay Agent pointing to the DHCP server, Switch A
    exit
interface vlan 110
    ip address 10.11.110.254/24
    ip helper-address 192.168.4.2
    exit
interface 1/1/7
    no routing
    shutdown
    vlan access 100
    exit
interface 1/1/8
    no routing
    shutdown
    vlan access 110
    exit
ip route 0.0.0.0/0 192.168.4.2           < ----- Set default route to Switch A
```

Note: The Relay Agent `ip helper-address` can be any Layer 3 reachable address on the upstream Aruba CX Switch

- Check reachability between Switch A and B

- From Switch B ping 192.168.4.2 ,next hop interface and 192.168.2.1 loopback 0 on A

```
ping 192.168.4.2
PING 192.168.4.2 (192.168.4.2) 100(128) bytes of data.
108 bytes from 192.168.4.2: icmp_seq=1 ttl=64 time=2.78 ms
108 bytes from 192.168.4.2: icmp_seq=2 ttl=64 time=2.10 ms
108 bytes from 192.168.4.2: icmp_seq=3 ttl=64 time=2.04 ms
108 bytes from 192.168.4.2: icmp_seq=4 ttl=64 time=2.25 ms
108 bytes from 192.168.4.2: icmp_seq=5 ttl=64 time=3.65 ms

--- 192.168.4.2 ping statistics ---

5 packets transmitted, 5 received, 0% packet loss, time 4005ms
rtt min/avg/max/mdev = 2.043/2.567/3.650/0.602 ms
```

```
ping 192.168.2.1
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=64 time=2.43 ms
108 bytes from 192.168.2.1: icmp_seq=2 ttl=64 time=2.10 ms
108 bytes from 192.168.2.1: icmp_seq=3 ttl=64 time=1.88 ms
108 bytes from 192.168.2.1: icmp_seq=4 ttl=64 time=2.38 ms
108 bytes from 192.168.2.1: icmp_seq=5 ttl=64 time=2.28 ms

--- 192.168.2.1 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4004ms
```

Task 4 – Assign DHCP address'

Important: Ensure Switch X and Switch Y are powered up and their "mgmt "ports are connected to Switch B 1/1/7 and /1/18 respectively

- On Switch B open up port 1/1/7 and 1/1/8

```
SwitchB# configure
SwitchB(config)# int 1/1/7-1/1/8
SwitchB(config-if-<1/1/7-1/1/8>)# no shut
SwitchB(config-if-<1/1/7-1/1/8>)#exit
```

Note: It may take a short while for the DHCP allocation process due to resources' of your system

Now log into either Switch X or Y as admin and log in with user "admin" and no password, and observe the mgmt interface.

The management interface "mgmt" is configured for dhcp by default and an IP address from one of the DHCP scopes defined on Switch A should be allocated as shown below.

```
switch login: admin
Password:

Please configure the 'admin' user account password.
Enter new password:
Confirm new password: switch login: admin
Password:

Please configure the 'admin' user account password.
Enter new password:
Confirm new password:
switch# show ip interface mgmt
Invalid input: mgmt
switch#
switch# show interface mgmt
  Address Mode: dhcp
  Admin State: up
  Link State: up
  Mac Address: 50:01:00:01:00:00
  IPv4 address/subnet-mask: 10.11.110.3/24
  Default gateway IPv4: 10.11.110.254
  IPv6 address/prefix:
  IPv6 link local address/prefix: fe80::5201:ff:fe01:0/64
  Default gateway IPv6:
  Primary Nameserver: 8.8.8.8
  Secondary Nameserver: 8.8.4.4
```

Test the connection to Switch A loopback 0 from Switch X or Y, note you will need to use the VRF mgmt in the ping request.

```
Switch# 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=3.56 ms
108 bytes from 192.168.2.1: icmp_seq=2 ttl=63 time=2.70 ms
108 bytes from 192.168.2.1: icmp_seq=3 ttl=63 time=2.87 ms
108 bytes from 192.168.2.1: icmp_seq=4 ttl=63 time=2.63 ms
108 bytes from 192.168.2.1: icmp_seq=5 ttl=63 time=2.49 ms

--- 192.168.2.1 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4004ms
rtt min/avg/max/mdev = 2.496/2.855/3.566/0.378 ms
switch#
```

- Run diagnostic on Switch B for DHCP Relay

It can see valid client and server packets have been logged

```
SwitchB#
SwitchB#Diagnostics
SwitchB#diag-dump dhcp-relay basic
============================================================================
[Start] Feature dhcp-relay Time : Thu Apr  8 21:44:53 2021
============================================================================
----------------------------------------------------------------------------
[Start] Daemon hpe-relay
----------------------------------------------------------------------------
```

```
DHCP Relay : 1
DHCP Relay hop-count-increment : 1
DHCP Relay Option82 : 0
DHCP Relay Option82 validate : 0
DHCP Relay Option82 policy : replace
DHCP Relay Option82 remote-id : mac
DHCP Relay Option82 Source Intf : Disable
System Mac [08:00:09:16:7b:7e]
vsx: Not Present
evpn VLANs: None

evpn MAC clause : unset
Allow l2vpn client : enable
```

Interface vlan100: 1
```
Selected Gateway Intf IP- 10.10.100.254
Intf IP-NODE's IP- 10.10.100.254
Selected Mac [08:00:09:16:7b:7e] & Virtual Mac [00:00:00:00:00:00]

  Client Packet Statistics:
```

Valid	Dropped	O82_Valid	O82_Dropped	vsx_drops
16	0	0	0	0

```
  Server Packet Statistics:

 Valid      Dropped     O82_Valid    O82_D
Server Packet Statistics:
```

Valid	Dropped	O82_Valid	O82_Dropped	Invalid_IP_Drops	To_Dsnoop
10	0	0	0	0	0

```
0
client request dropped packets with extn option 82 = 0
client request valid packets with extn option 82 = 0
server request dropped packets with extn option 82 = 0
server request valid packets with extn option 82 = 0
Port 67 - 192.168.4.2,2
Source VRF:default, table_id:0
```

Interface vlan110: 1
```
Selected Gateway Intf IP- 10.11.110.254
Intf IP-NODE's IP- 10.11.110.254
Selected Mac [08:00:09:16:7b:7e] & Virtual Mac [00:00:00:00:00:00]

  Client Packet Statistics:
```

Valid	Dropped	O82_Valid	O82_Dropped	vsx_drops
11	0	0	0	0

```
  Server Packet Statistics:
```

Valid	Dropped	O82_Valid	O82_Dropped	Invalid_IP_Drops	To_Dsnoop
8	0	0	0	0	0

```
0
client request dropped packets with extn option 82 = 0
client request valid packets with extn option 82 = 0
server request dropped packets with extn option 82 = 0
server request valid packets with extn option 82 = 0
Port 67 - 192.168.4.2,2
Source VRF:default, table_id:0

-------------------------------------------------------------------------
[End] Daemon hpe-relay
-------------------------------------------------------------------------
=========================================================================
[End] Feature dhcp-relay
```

Finally check the DHCP Server on Switch A. You should see something similar to the below .In this case showing two different address's on two different subnets

```
SwitchA# show dhcp-server leases
IP-Address      Client-Id     Expiry-Time          Client-Hostname    VRF-Name     Link-Address
------------    -----------   -----------          ---------------    ---------    -------------
10.10.100.18    *             21:18:11 08/04/2021   *                  default      50:01:00:04:00:00
10.11.110.3     *             21:17:42 08/04/2021   *                  default      50:01:00:01:00:00
```

Task 5 – Optional Packet Trace

Depending on the platform and version used with the Aruba CX simulator it is possible to take a direct packet trace with a GUI on Switch X or Y and observe the DHCP offer received on the client switch as shown below.
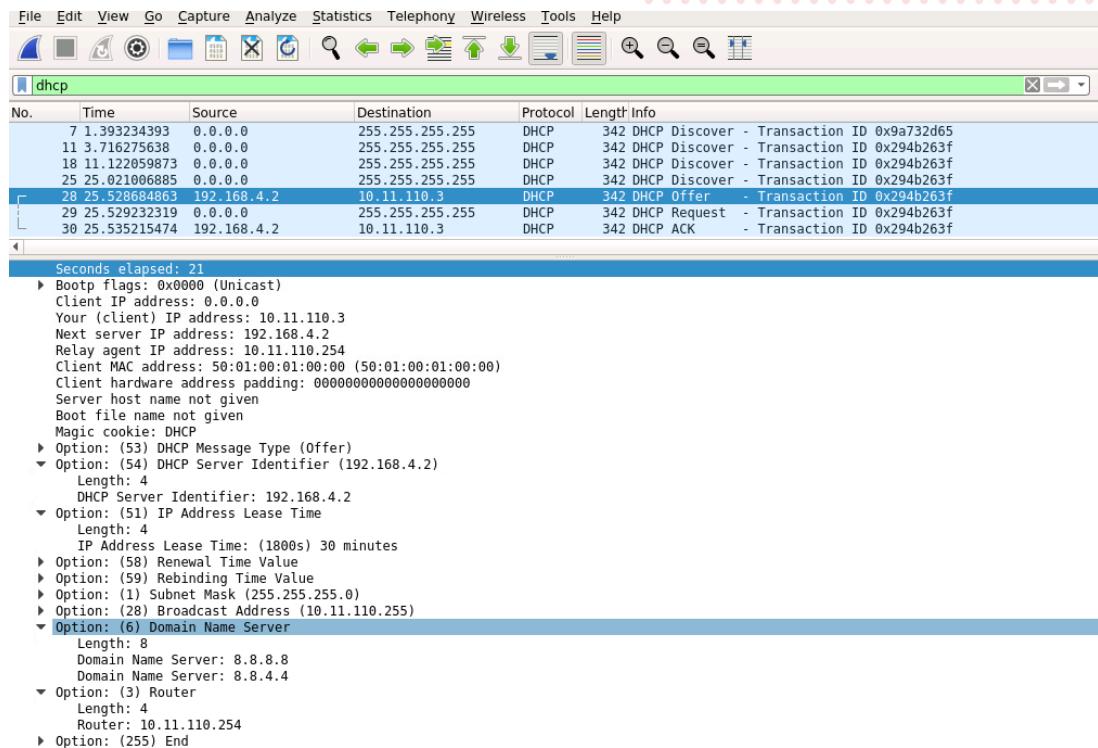
End of lab

Appendix – Complete Configurations

- If you face issues during your lab, you can verify your configs with the configs listed in this section

- If configs are the same, try powering off/powering on the switches to reboot them

Switch A

```
hostname SwitchA
!
ssh server vrf mgmt
vlan 1
interface mgmt
    no shutdown
    ip dhcp
!
interface 1/1/1
    no shutdown
    ip address 192.168.4.2/30
interface loopback 0
    ip address 192.168.2.1/32
ip route 0.0.0.0/0 192.168.4.1
!
https-server vrf mgmt
dhcp-server vrf default
 pool VL100
        range 10.10.100.1 10.10.100.20 prefix-len 24
        dns-server 8.8.8.8 8.8.4.4
        default-router 10.10.100.254
        lease 00:00:30
        exit
    pool VL110
        range 10.11.110.1 10.11.110.20 prefix-len 24
        dns-server 8.8.8.8 8.8.4.4
        default-router 10.11.110.254
        lease 00:00:30
        exit
    authoritative
    enable
```

Switch B

```
hostname SwitchB
!
ssh server vrf mgmt
vlan 1,100,110
interface mgmt
    no shutdown
    ip dhcp
interface 1/1/1
    no shutdown
    ip address 192.168.4.1/30
interface 1/1/7
    no shutdown
    no routing
    vlan access 100
interface 1/1/8
    no shutdown
    no routing
    vlan access 110
interface vlan 100
    ip address 10.10.100.254/24
    ip helper-address 192.168.4.2
interface vlan 110
    ip address 10.11.110.254/24
    ip helper-address 192.168.4.2
ip route 0.0.0.0/0 192.168.4.2
!
https-server vrf mgmt
```

Switch X and Y

```
!
ssh server vrf mgmt
vlan 1
interface mgmt
```

```
     no shutdown
     ip dhcp
!
https-server vrf mgmt
```

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