LAB GUIDE

RIPng

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.

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

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Lab Objective

This lab will provide hands on experience with IPv6 addressing and RIPng routing.

RIPng is an alternative routing protocol to OSPFv3/BGP, it is suitable for smaller networks and does not require an IPv4 router-ID unlike OSPFv3/BGP.

In this lab, you will:

- Provide IPv6 connectivity between the 2 hosts across the IPv6 network
- Implement RIPng with Equal Cost Multi Pathing (ECMP) to correctly provide network connectivity to the Loopbacks on Switch2 and Switch3 from the hosts

Lab Overview

This lab as shown in Figure 1 has the following different types of IPv6 addresses: loopback, link local, unique local, documentation addressing.

Refer to https://www.ripe.net/manage-ips-and-asns/ipv6/ipv6-address-types for an explanation of the different address types.

2001:db8:beef:X::/64 on Switch1 and Switch4 are considered part of the “Documentation” 2001:db8::/32 range.

User/device LAN subnets are standardized to subnets with /64 mask.

2001:db8:beef:X::/128 on Switch2 and Switch3 are considered part of the “Documentation” 2001:db8::/32 range and are “Loopbacks” as they have /128 subnet mask.

fd00:1:X::/127 between Switches are part of the “Unique Local” fc00::/7 range, as a best practice /64 are reserved for inter switch links but /127 are actually used, e.g. fd00:1:13::/64 is reserved for Switch1 to Switch3 link, but fd00:1:13::/127 is used as only 2 IPs are required on that link.

Lab Network Layout

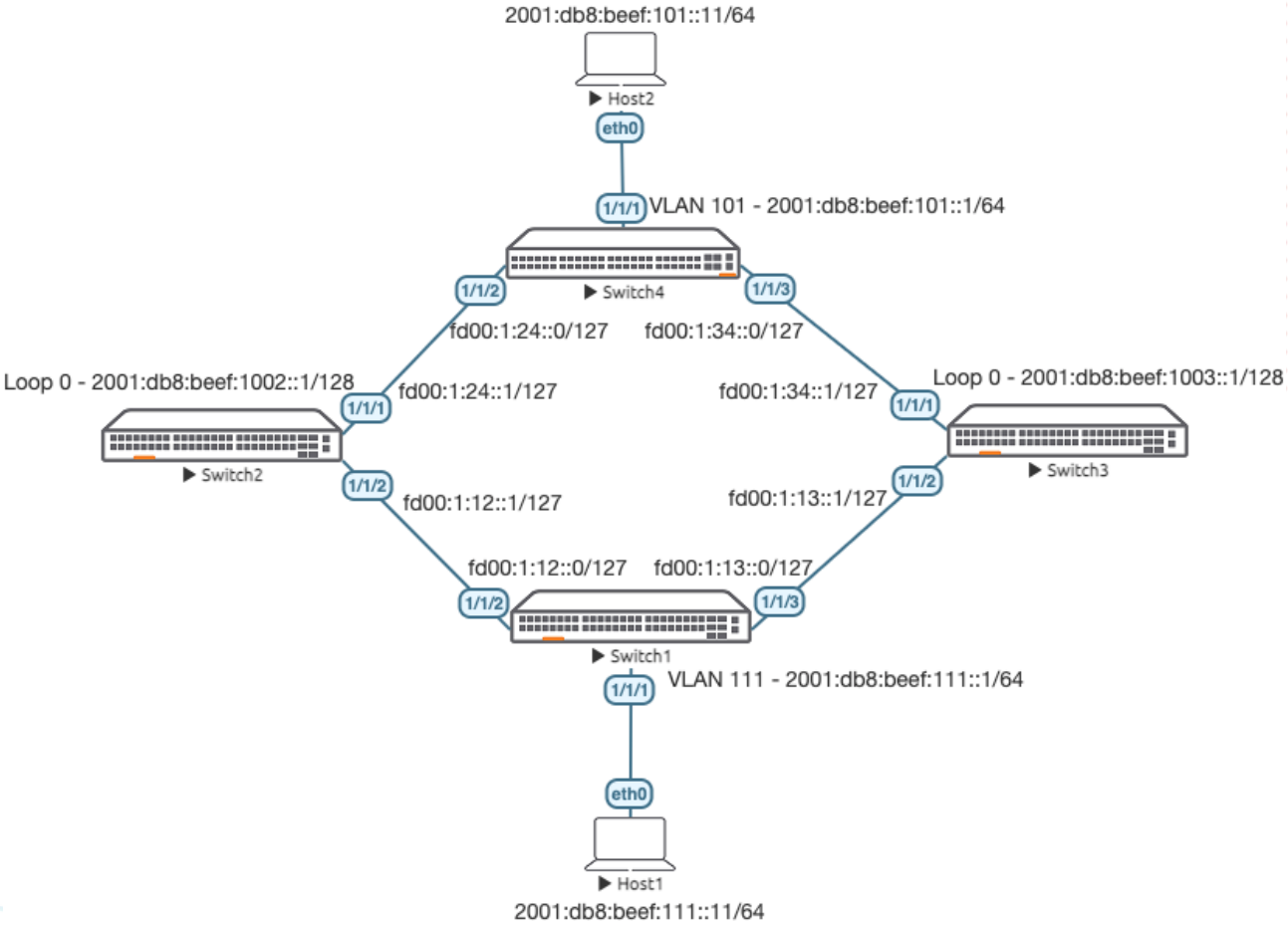

Figure 1. Lab topology and addresses

Lab Tasks

Task 1 – Lab setup

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

- Start all the devices, including hosts
- Open each switch console and log in with user “admin” and hit enter, so that no password is applied
- Set your desired password
- Change all hostnames as shown in the topology:

```
configure
hostname …
```

- On all devices, bring up required ports:

```
int 1/1/1-1/1/6
  no shutdown
use “exit” to go back a level
```

- Validate LLDP neighbors appear as expected on each switch

```
show lldp neighbor
```

Switch1

```
Switch1(config)# sh lld nei

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

Total Neighbor Entries          : 2
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
-------------------------------------------------------------------------------------------
------------
1/1/2       08:00:09:8a:14:fa  1/1/1            1/1/2                     120      Switch2
1/1/3       08:00:09:12:8e:9e  1/1/2            1/1/2                     120      Switch3
```

Task 2 – Configure IPv6 address and Interfaces

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

Switch1

```
Switch1(config)# int 1/1/2
Switch1(config-if)# ipv6 address fd00:1:12::0/127
! Manual IPv6 addresses are required for RIPng, link-local address cannot be used

Switch1(config-if)# int 1/1/3
Switch1(config-if)# ipv6 add fd00:1:13::0/127

Switch1(config)# vlan 111
Switch1(config-vlan-111)# int vlan 111
Switch1(config-if-vlan)# ipv6 address 2001:db8:beef:111::1/64
! User/device LAN subnets are standardized to /64 mask
Switch1(config-if-vlan)# no ipv6 nd suppress-ra dnssl
Switch1(config-if-vlan)# no ipv6 nd suppress-ra rdnss
! IPv6 Router Advertisements (RAs) are suppressed by default
! disable RA suppression so that IPv6 hosts are able to receive default gateway info


Switch1(config)# int 1/1/1
Switch1(config-if)# no routing
Switch1(config-if)# vlan access 111
```

Switch2

```
Switch2(config)# int 1/1/2
Switch2(config-if)# ipv6 add fd00:1:12::1/127
Switch2(config-if)# int 1/1/1
Switch2(config-if)# ipv6 add fd00:1:24::1/127
```

```
! Loopbacks are added on Switch2 and Switch3 only to populate the routing table
! and to have an IP for hosts to ping to
Switch2(config-if)# int lo 0
Switch2(config-loopback-if)# ipv6 add 2001:db8:beef:1002::1/128
```

Switch3

```
Switch3(config)# int 1/1/2
Switch3(config-if)# ipv6 address fd00:1:13::1/127
Switch3(config-if)# int 1/1/1
Switch3(config-if)# ipv6 address fd00:1:34::1/127

Switch3(config-if)# int lo 0
Switch3(config-loopback-if)# ipv6 address 2001:db8:beef:1003::1/128
```

Switch4

```
Switch4(config)# int 1/1/2
Switch4(config-if)# ipv6 add fd00:1:24::0/127
Switch4(config-if)# int 1/1/3
Switch4(config-if)# ipv6 add fd00:1:34::0/127


Switch4(config-if)# vlan 101
Switch4(config-vlan-101)# int vlan 101
Switch4(config-if-vlan)# ipv6 address 2001:db8:beef:101::1/64
Switch4(config-if-vlan)# no ipv6 nd suppress-ra dnssl
Switch4(config-if-vlan)# no ipv6 nd suppress-ra rdnss

Switch4(config-if-vlan)# int 1/1/1
Switch4(config-if)# no routing
Switch4(config-if)# vlan access 101
```

Task 3 – Enable RIPng

- Enable RIPng globally and on required interfaces

Switch1

```
Switch1(config)# router ripng 1
Switch1(config-ripng-1)# int 1/1/2-1/1/3
Switch1(config-if-<1/1/2-1/1/3>)# ipv6 ripng 1
```

Switch2

```
Switch2(config)# router ripng 1
Switch2(config-ripng-1)# int 1/1/1-1/1/2
Switch2(config-if-<1/1/1-1/1/2>)# ipv6 ripng 1

Switch2(config-if-ripng)# int lo 0
Switch2(config-loopback-if)# ipv6 ripng 1
```

Switch3

```
Switch3(config)# router ripng 1
Switch3(config-ripng-1)# int 1/1/1-1/1/2
Switch3(config-if-<1/1/1-1/1/2>)# ipv6 ripng 1

Switch3(config-if-ripng)# int lo 0
Switch3(config-loopback-if)# ipv6 ripng 1
```

Switch4

```
Switch4(config)# router ripng 1
Switch4(config-ripng-1)# int 1/1/2-1/1/3
Switch4(config-if-<1/1/2-1/1/3>)# ipv6 ripng 1

Switch4(config-if-ripng)# int vlan 101
Switch4(config-if-vlan)# ipv6 ripng 1
```

Task 4 – Verify RIPng and learnt routes

- On each switch, you should be able to verify directly connected IPv6 neighbors

```
Switch1(config)# sh ipv6 nei
IPv6 Address                                MAC               Port        Physical Port
State
-------------------------------------------------------------------------------------------
fe80::800:901:88a:14fa                      08:00:09:8a:14:fa  1/1/2       1/1/2
reachable
fe80::800:901:812:8e9e                      08:00:09:12:8e:9e  1/1/3       1/1/3
reachable
fd00:1:13::1                                08:00:09:12:8e:9e  1/1/3       1/1/3
reachable
Total Number Of IPv6 Neighbors Entries Listed- 3.
-------------------------------------------------------------------------------------------
```

- On each switch, you should be able to verify directly connected RIPng neighbors with link-local address

```
Switch1(config)# sh ipv6 ripng nei
VRF : default                          Process-ID : 1
-----------------------------------------------------
Total Number of Neighbors: 2
-------------------------------------------------------------------------
Peer-Address      Type    Last Heard Time    Rcvd-Bad-Pkts    Rcvd-Bad-Routes
-------------------------------------------------------------------------
fe80::800:901:812:8e9e
                  RIPng   23s                0                0
fe80::800:901:88a:14fa
                  RIPng   19s                0                0
```

- On each switch, you should be able to verify RIPng learnt routes
- On Switch1/Switch4, you should be able to see ECMP routes to remote /64 LAN subnet

```
Switch1(config)# sh ipv6 route

Displaying ipv6 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
-------------------------------------------------------------------------------------------------
2001:db8:beef:101::/64  fe80::800:901:88a:14fa    1/1/2     -           R         [120/3]      00h:00m:50s
                        fe80::800:901:812:8e9e    1/1/3     -                     [120/3]      00h:00m:50s
2001:db8:beef:111::/64  -                         vlan111   -           C         [0/0]        -
2001:db8:beef:111::1/128  -                       vlan111   -           L         [0/0]        -
2001:db8:beef:1002::1/128  fe80::800:901:88a:14fa  1/1/2     -           R         [120/2]      00h:02m:25s
2001:db8:beef:1003::1/128  fe80::800:901:812:8e9e  1/1/3     -           R         [120/2]      00h:11m:27s
fd00:1:12::/127         -                         1/1/2     -           C         [0/0]        -
fd00:1:12::/128         -                         1/1/2     -           L         [0/0]        -
```

```
fd00:1:13::/127         -                       1/1/3     -         C         [0/0]        -
fd00:1:13::/128         -                       1/1/3     -         L         [0/0]        -
fd00:1:24::/127         fe80::800:901:88a:14fa  1/1/2     -         R         [120/2]      00h:04m:35s
fd00:1:34::/127         fe80::800:901:812:8e9e  1/1/3     -         R         [120/2]      00h:03m:22s

Total Route Count : 11
```

Task 5 – Configure Hosts

- Configure Host1 with your desired IP and auto default gateway (static IPv6 default gateway does not work in VPCS)

```
VPCS> ip 2001:db8:beef:111::11/64 auto
PC1 : 2001:db8:beef:111::11/64
```

- Verify Host1 has your desired IP and router info from RA

```
VPCS> sh ipv6

NAME              : VPCS[1]
LINK-LOCAL SCOPE  : fe80::250:79ff:fe66:6805/64
GLOBAL SCOPE      : 2001:db8:beef:111::11/64
DNS               :
ROUTER LINK-LAYER : 08:00:09:16:7b:7e
MAC               : 00:50:79:66:68:05
LPORT             : 20000
RHOST:PORT        : 127.0.0.1:30000
MTU:              : 1500
```

- Configure Host2 with your desired IP and auto default gateway (static IPv6 default gateway does not work in VPCS)

```
VPCS> ip 2001:db8:beef:101::11/64 auto
PC1 : 2001:db8:beef:101::11/64
```

- Verify Host2 has your desired IP and router info from RA

```
VPCS> sh ipv6

NAME              : VPCS[1]
LINK-LOCAL SCOPE  : fe80::250:79ff:fe66:6807/64
GLOBAL SCOPE      : 2001:db8:beef:101::11/64
DNS               :
ROUTER LINK-LAYER : 08:00:09:ee:11:82
MAC               : 00:50:79:66:68:07
LPORT             : 20000
RHOST:PORT        : 127.0.0.1:30000
MTU:              : 1500
```

Task 6 – Final Validation

- Ensure unicast connectivity works between hosts and towards loopbacks

```
From Host1

VPCS> ping 2001:db8:beef:101::11
2001:db8:beef:101::11 icmp6_seq=1 ttl=58 time=4.189 ms
2001:db8:beef:101::11 icmp6_seq=2 ttl=58 time=2.907 ms
2001:db8:beef:101::11 icmp6_seq=3 ttl=58 time=3.364 ms
2001:db8:beef:101::11 icmp6_seq=4 ttl=58 time=2.996 ms
2001:db8:beef:101::11 icmp6_seq=5 ttl=58 time=3.478 ms
```

```
VPCS> ping 2001:db8:beef:1002::1
2001:db8:beef:1002::1 icmp6_seq=1 ttl=63 time=2.096 ms
2001:db8:beef:1002::1 icmp6_seq=2 ttl=63 time=1.919 ms
2001:db8:beef:1002::1 icmp6_seq=3 ttl=63 time=2.509 ms
2001:db8:beef:1002::1 icmp6_seq=4 ttl=63 time=2.508 ms
2001:db8:beef:1002::1 icmp6_seq=5 ttl=63 time=1.906 ms

VPCS> ping 2001:db8:beef:1003::1
2001:db8:beef:1003::1 icmp6_seq=1 ttl=63 time=2.007 ms
2001:db8:beef:1003::1 icmp6_seq=2 ttl=63 time=1.917 ms
2001:db8:beef:1003::1 icmp6_seq=3 ttl=63 time=3.231 ms
2001:db8:beef:1003::1 icmp6_seq=4 ttl=63 time=2.153 ms
2001:db8:beef:1003::1 icmp6_seq=5 ttl=63 time=2.002 ms

VPCS> trace 2001:db8:beef:101::11
trace to 2001:db8:beef:101::11, 64 hops max
 1 2001:db8:beef:111::1   1.611 ms  0.655 ms  0.641 ms
 2 fd00:1:12::1   1.852 ms  1.219 ms  1.254 ms
 3 fd00:1:24::   2.717 ms  1.523 ms  1.782 ms
 4 2001:db8:beef:101::11   2.131 ms  1.627 ms  1.669 ms

VPCS> trace 2001:db8:beef:1002::1
trace to 2001:db8:beef:1002::1, 64 hops max
 1 2001:db8:beef:111::1   1.410 ms  0.659 ms  2.478 ms
 2 2001:db8:beef:1002::1   1.928 ms  1.318 ms  1.011 ms

VPCS> trace 2001:db8:beef:1003::1
trace to 2001:db8:beef:1003::1, 64 hops max
 1 2001:db8:beef:111::1   1.419 ms  0.719 ms  1.564 ms
 2 2001:db8:beef:1003::1   2.093 ms  1.369 ms  1.280 ms
```

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

Switch1

```
Switch1# sh run
Current configuration:
!
!Version ArubaOS-CX Virtual.10.07.0004
!export-password: default
hostname Switch1
user admin group administrators password ciphertext
AQBapUB9klSiOMYTrhnlY3ldXHF+fRhLWGckREGQKLLTdQp8YgAAAE3mYKu2t4NdO5a26WbHyKPXilzQc5aJZBgV9O5Dcda
WhRgHJy3He3rF1p7Q/y561qkjaX5LGO7LtIkRsFSIjHz
3LEfV/FRQNy9DUO+mjGshngJ+P+IXWdS3XpEqbYF32HVA
led locator on
ntp server pool.ntp.org minpoll 4 maxpoll 4 iburst
ntp enable
!
!
!
!
!
ssh server vrf mgmt
vlan 1,111
interface mgmt
    no shutdown
    ip dhcp
interface 1/1/1
    no shutdown
    no routing
    vlan access 111
interface 1/1/2
    no shutdown
    ipv6 address fd00:1:12::/127
    ipv6 ripng 1
        exit
interface 1/1/3
    no shutdown
    ipv6 address fd00:1:13::/127
    ipv6 ripng 1
        exit
interface 1/1/4
    no shutdown
interface 1/1/5
    no shutdown
interface 1/1/6
    no shutdown
interface vlan 111
    ipv6 address 2001:db8:beef:111::1/64
    no ipv6 nd suppress-ra dnssl
    no ipv6 nd suppress-ra rdnss
    ipv6 ripng 1
        exit
!
!
!
!
!
router ripng 1
https-server vrf mgmt
```

Switch2

```
Switch2# sh run
Current configuration:
!
!Version ArubaOS-CX Virtual.10.07.0004
!export-password: default
hostname Switch2
user admin group administrators password ciphertext
AQBapeB1tmk7oXfbJVdM3y9LIE6t6LFCdp2YywE0GwZOE0d+YgAAADfY5ty7BHAX6oWBnvjwtTi3Y8aQa3v0TxqdDG1KwH+
EJDaA0ixFFBhxGyxzvbjiVR5mOMVsfLc4PaqRGo6wO36
y/RdrKCx582DxDEi4xocj+mfY0ZPBDKUuFQYim8pHiDSd
led locator on
ntp server pool.ntp.org minpoll 4 maxpoll 4 iburst
ntp enable
!
!
!
!
!
!
ssh server vrf mgmt
vlan 1
interface mgmt
    no shutdown
    ip dhcp
interface 1/1/1
    no shutdown
    ipv6 address fd00:1:24::1/127
    ipv6 ripng 1
        exit
interface 1/1/2
    no shutdown
    ipv6 address fd00:1:12::1/127
    ipv6 ripng 1
        exit
interface 1/1/3
    no shutdown
interface 1/1/4
    no shutdown
interface 1/1/5
    no shutdown
interface 1/1/6
    no shutdown
interface loopback 0
    ipv6 address 2001:db8:beef:1002::1/128
    ipv6 ripng 1
        exit
!
!
!
!
!
router ripng 1
https-server vrf mgmt
```

Switch3

```
Switch3# sh run
Switch3# sh run
Current configuration:
!
!Version ArubaOS-CX Virtual.10.07.0004
!export-password: default
hostname Switch3
user admin group administrators password ciphertext
AQBapcOO4iC0F9Pka7oGO2jOoISzeWlxP+TEkS6jnad0+4K6YgAAAGyB22dhXChU9wLJ/uP1GyzOfSzqWvvBe8ID9qQWPYf
i7+HGVF5JybItCwTEnXZ/f8e5cuaBId/SSMSVyFzum6K
4SVS3jIFt73k7DDCI5SUyRP54rDey9+0PscxmW6u/C+ex
led locator on
ntp server pool.ntp.org minpoll 4 maxpoll 4 iburst
ntp enable
!
!
!
!
!
!
ssh server vrf mgmt
vlan 1
interface mgmt
    no shutdown
    ip dhcp
interface 1/1/1
    no shutdown
    ipv6 address fd00:1:34::1/127
    ipv6 ripng 1
        exit
interface 1/1/2
    no shutdown
    ipv6 address fd00:1:13::1/127
    ipv6 ripng 1
        exit
interface 1/1/3
    no shutdown
interface 1/1/4
    no shutdown
interface 1/1/5
    no shutdown
interface 1/1/6
    no shutdown
interface loopback 0
    ipv6 address 2001:db8:beef:1003::1/128
    ipv6 ripng 1
        exit
!
!
!
!
!
router ripng 1
https-server vrf mgmt
```

Switch4

```
Switch4# sh run
Current configuration:
!
!Version ArubaOS-CX Virtual.10.07.0004
!export-password: default
hostname Switch4
user admin group administrators password ciphertext
AQBapZ+xM6rKjhbd5t56J7ImuXLPmASaViQCbrBlMUJUpbGXYgAAAD3aNiEsSZGFTkI4+CnL9jcrNAHs8yP6h+U6gCqeORA
YkthvjFiO/vBhFW/cBZWJZ37j7CD1uuUY0wNrcuU4vP/
aB5QC0w5mkTe15X7nCwxqGRe37kUrEhUnw8ImHbdTHhPH
led locator on
ntp server pool.ntp.org minpoll 4 maxpoll 4 iburst
ntp enable
!
!
!
!
!
!
ssh server vrf mgmt
vlan 1,101
interface mgmt
    no shutdown
    ip dhcp
interface 1/1/1
    no shutdown
    no routing
    vlan access 101
interface 1/1/2
    no shutdown
    ipv6 address fd00:1:24::/127
    ipv6 ripng 1
        exit
interface 1/1/3
    no shutdown
    ipv6 address fd00:1:34::/127
    ipv6 ripng 1
        exit
interface 1/1/4
    no shutdown
interface 1/1/5
    no shutdown
interface 1/1/6
    no shutdown
interface vlan 101
    ipv6 address 2001:db8:beef:101::1/64
    no ipv6 nd suppress-ra dnssl
    no ipv6 nd suppress-ra rdnss
    ipv6 ripng 1
        exit
!
!
!
!
!
router ripng 1
https-server vrf mgmt
```

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