Data Center Network Topology:

Cumulus Linux NOS on Agema Systems Switches

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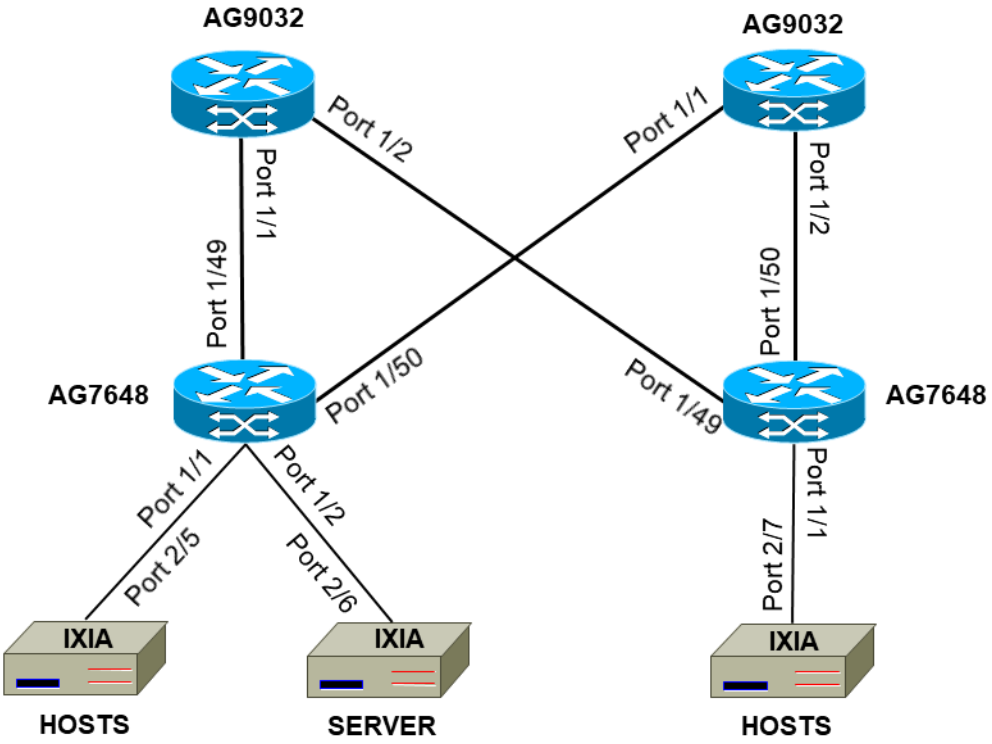
Contents

Background

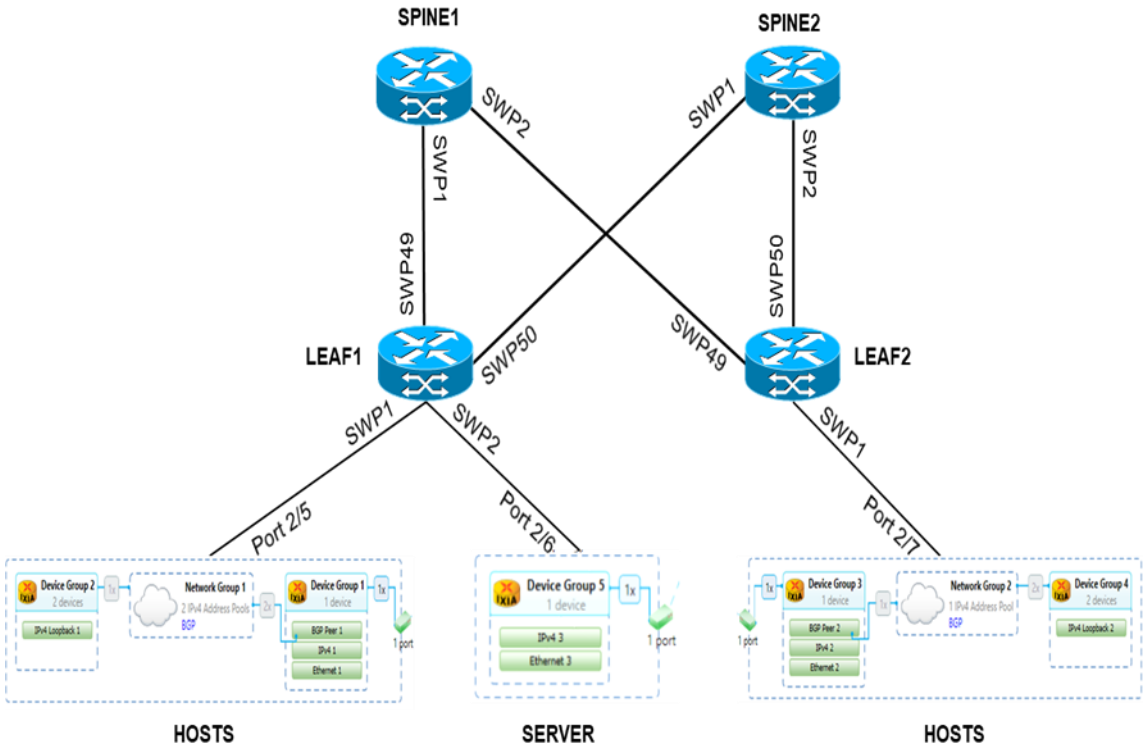
This document serves as a guide in setting up, configuring, and validating a Data Center network topology with two-leaf and two-spine on Agema Systems switches loaded with Cumulus Linux NOS. BGP is configured throughout the topology. Testing covers both functional and scale of up to 800K BGP routes in the RIB table.

Network Topology

Physical Topology



Logical Topology

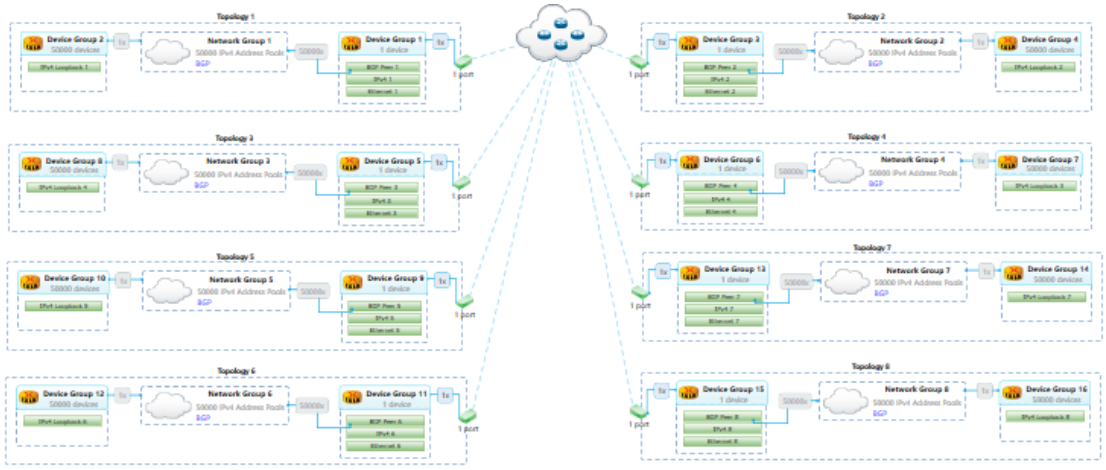


Topology Notes

- **LEAF1** and **LEAF2** represent the access layer switches on the network.
- **SPINE1** and **SPINE2** represent the aggregation layer switches on the network.
- **HOSTS** and **SERVER** represent any number of external network devices connected physically or logically to the access layer switches.

Findings

1. All functional testing checked out correctly. Hosts/Server reachability are established over the Data Center. Refer to **Network Validation and Troubleshooting** section for details.
2. The AG9032 and AG7648 switches can scale to at least 800K BGP route entries in the RIB table. Here's how the Ixia (hosts) look like the when everything is up:



Here is a brief **BGP Summary** outputs from each switch under scale with 800K BGP routes:

LEAF1	LEAF2	SPINE1	SPINE2
roger@AG7648-38-LEAF1:~$ ***sudo net show bgp summary***	*roger@AG7648-50-LEAF2:~$* ***sudo net show bgp summary***	*roger@AG9032-54-SPINE1:~$* ***sudo net show bgp summary***	*roger@AG9032-36-SPINE2:~$* ***sudo net show bgp summary***
show bgp ipv4 unicast summary ========== ======== *BGP router identifier 10.100.1.1, local AS number 65001 vrf-id 0*	*show bgp ipv4 unicast summary* ========== ======== *BGP router identifier 10.100.1.2, local AS number 65002 vrf-id 0*	*show bgp ipv4 unicast summary* ========== ======== *BGP router identifier 10.100.1.201, local AS number 65201 vrf-id 0*	*show bgp ipv4 unicast summary* ========== ======== *BGP router identifier 10.100.1.202, local AS number 65202 vrf-id 0*

BGP table version 32725474 ***RIB entries 800009*, using 116 MiB of memory*** *Peers 6, using 117 KiB of memory*	*BGP table version 36905600* ***RIB entries 800009*, using 116 MiB of memory*** *Peers 6, using 117 KiB of memory*	*BGP table version 39053462* ***RIB entries 800009*, using 116 MiB of memory*** *Peers 2, using 39 KiB of memory*	*BGP table version 41204575* ***RIB entries 800009*, using 116 MiB of memory*** *Peers 2, using 39 KiB of memory*

Refer to **Scalability / Stress Test** section for details.

3. BGP routes get withdrawn and re-added successfully when a port flaps. Refer to **Scalability / Stress Test** section for details.

Initial Switch Setup

1. Log into the **Agema Systems** switches using the default credentials:
   username: ***cumulus***
   password: ***CumulusLinux!***
2. (Optional) Create a new sudo user.
   Example:
   cumulus@cumulus:~$ ***sudo adduser roger***
   Enter new UNIX password: ***cortes***
   Retype new UNIX password: ***cortes***

   Add admin privileges.
   Example:
   cumulus@cumulus:~$ ***sudo adduser roger sudo***

3. Enter **exit** and then login as the new user.

Switch Basic Network Configurations

Here are key configurations for two-leaf / two-spine Data Center setup with two hosts and a server. Each of the switches can be configured using the Network Command Line Utility (NCLU), or by editing the **/etc/network/interfaces** and **/etc/frr/frr.conf** files directly as the sudo user.

NCLU is similar to Cisco CLI although it's on Linux. Usage example:
*roger@AG7648-38-LEAF1:~$ sudo net add host<tab> # hitting tab will auto-complete **hostname***

1. Log into the **LEAF1** switch:
   username: ***roger***
   password: ***cortes***
2. Setup the proper time zone, configure the management port, and update the hostname.
   sudo dpkg-reconfigure tzdata # Make sure to complete setting the time zone
   sudo net add interface eth0 ip address 10.62.2.38/24
   sudo net add interface eth0 ip gateway 10.62.2.254
   sudo net add hostname AG7648-38-LEAF1
   sudo net commit
3. Activate the license.
   sudo cl-license -i
   <copy and paste the license key> then hit "ctl+d"
   sudo reboot or sudo systemctl restart switchd

4. Repeat steps 1 and 3 for **LEAF2**, **SPINE1** and **SPINE2** switches.

Switch Data Center Network Configurations

LEAF1 Configurations

1. Execute the following commands to add the networking configurations on the **LEAF1** switch:

```
# Configure the interfaces
sudo net add loopback lo ip address 10.100.1.1/32
sudo net add interface swp1 ip address 10.101.1.1/24
sudo net add interface swp2 ip address 10.101.2.1/24
sudo net add interface swp49-50 link autoneg on

# Configure BGP
sudo net add bgp autonomous-system 65001
sudo net add bgp bestpath as-path multipath-relax
sudo net add bgp neighbor swp49 remote-as external
sudo net add bgp neighbor swp50 remote-as external
sudo net add bgp timers 5 30
sudo net add bgp neighbor 10.101.1.2 remote-as internal
sudo net add bgp ipv4 unicast neighbor 10.101.1.2 activate
sudo net add bgp neighbor 10.101.1.2 next-hop-self
sudo net add bgp network 10.100.1.1/32
sudo net add bgp network 10.101.2.0/24

# Display the configurations for review before committing
sudo net pending

# Commit the configurations
sudo net commit

# Display the configurations
```

sudo net show configuration

The above configurations using NCLU would produce the following in **/etc/network/interfaces** and **/etc/frr/frr.conf** files:

/etc/network/interfaces

```
source /etc/network/interfaces.d/*.intf

# The loopback network interface
auto lo
iface lo inet loopback
        address 10.100.1.1/32

# The primary network interface
auto eth0
iface eth0
        address 10.62.2.38/24
        gateway 10.62.2.254

auto swp1
iface swp1
        address 10.101.1.1/24

auto swp2
iface swp2
        address 10.101.2.1/24

auto swp49
iface swp49
        link-autoneg on
```

```
auto swp50
iface swp50
        link-autoneg on
```

/etc/frr/frr.conf

```
hostname AG7648-38-LEAF1
username cumulus nopassword
!
service integrated-vtysh-config
!
log syslog informational
!
interface swp1
  ipv6 nd ra-interval 10
  no ipv6 nd suppress-ra
!
interface swp49
  ipv6 nd ra-interval 10
  no ipv6 nd suppress-ra
!
interface swp50
  ipv6 nd ra-interval 10
  no ipv6 nd suppress-ra
!
router bgp 65001
  coalesce-time 1200
  bgp bestpath as-path multipath-relax
  timers bgp 5 30
  neighbor swp49 interface remote-as external
  neighbor swp50 interface remote-as external
  neighbor 10.101.1.2 remote-as internal
```

```
!
address-family ipv4 unicast
  network 10.100.1.1/32
  network 10.101.2.0/24
  neighbor 10.101.1.2 next-hop-self
 exit-address-family
!
```

2. If the **/etc/network/interfaces** or the **/etc/frr/frr.conf** file was edited, execute the following to activate the configurations:

   sudo systemctl restart switchd

LEAF2 Configurations

1. Execute the following commands to add the networking configurations on the **LEAF2** switch:

   # Configure the interfaces

   sudo net add loopback lo ip address 10.100.1.2/32

   sudo net add interface swp49-50 link autoneg on

   # (Optional) Using a VLAN interface instead of the main interface as in LEAF1

   sudo net add vlan 20 ip address 10.102.1.1/24

   sudo net add vlan 20 ip address-virtual 00:00:00:00:10:10 10.102.1.1/24

   sudo net add interface swp1 bridge access 20

   # Configure BGP

   sudo net add bgp autonomous-system 65002

   sudo net add bgp bestpath as-path multipath-relax

   sudo net add bgp neighbor swp49 remote-as external

   sudo net add bgp neighbor swp50 remote-as external

   sudo net add bgp timers 5 30

sudo net add bgp neighbor 10.102.1.2 remote-as internal
sudo net add bgp ipv4 unicast neighbor 10.102.1.2 activate
sudo net add bgp neighbor 10.102.1.2 next-hop-self
sudo net add bgp network 10.100.1.2/32

 # Display the configurations for review before committing
sudo net pending

 # Commit the configurations
sudo net commit

 # Display the configurations
sudo net show configuration

The above configurations using NCLU would produce the following in **/etc/network/interfaces** and **/etc/frr/frr.conf** files:

/etc/network/interfaces

```
source /etc/network/interfaces.d/*.intf

# The loopback network interface
auto lo
iface lo inet loopback
        address 10.100.1.2/32

# The primary network interface
auto eth0
iface eth0
        address 10.62.2.50/24
        gateway 10.62.2.254
```

```
auto swp1
iface swp1
        bridge-access 20

auto swp49
iface swp49
        link-autoneg on

auto swp50
iface swp50
        link-autoneg on

auto bridge
iface bridge
        bridge-ports swp1
        bridge-vids 20
        bridge-vlan-aware yes

auto vlan20
iface vlan20
        address 10.102.1.1/24
        address-virtual 00:00:00:00:20:20 10.102.1.1/24
        vlan-id 20
        vlan-raw-device bridge
```

/etc/frr/frr.conf

```
hostname AG7648-50-LEAF2
username cumulus nopassword
!
service integrated-vtysh-config
!
```

```
log syslog informational
!
interface swp1
 ipv6 nd ra-interval 10
 no ipv6 nd suppress-ra
!
interface swp49
 ipv6 nd ra-interval 10
 no ipv6 nd suppress-ra
!
interface swp50
 ipv6 nd ra-interval 10
 no ipv6 nd suppress-ra
!
router bgp 65002
 coalesce-time 1200
 bgp bestpath as-path multipath-relax
 timers bgp 5 30
 neighbor swp49 interface remote-as external
 neighbor swp50 interface remote-as external
 neighbor 10.102.1.2 remote-as internal
 !
 address-family ipv4 unicast
  network 10.100.1.2/32
  neighbor 10.102.1.2 next-hop-self
 exit-address-family
!
```

2. If the **/etc/network/interfaces** or the **/etc/frr/frr.conf** file was edited, execute the following to activate the configurations:

   sudo systemctl restart switchd

SPINE1 Configurations

1. Execute the following commands to add the networking configurations on the **SPINE1** switch:

```
# Configure the interfaces
sudo net add loopback lo ip address 10.100.1.201/32
sudo net add interface swp1-2 link autoneg on

# Configure BGP
sudo net add bgp autonomous-system 65201
sudo net add bgp bestpath as-path multipath-relax
sudo net add bgp neighbor swp1 remote-as external
sudo net add bgp neighbor swp2 remote-as external
sudo net add bgp network 10.100.1.201/32
sudo net add bgp timers 5 30

# Display the configurations for review before committing
sudo net pending

# Commit the configurations
sudo net commit

# Display the configurations
sudo net show configuration
```

   The above configurations using NCLU would produce the following in **/etc/network/interfaces** and **/etc/frr/frr.conf** files:

/etc/network/interfaces

```
source /etc/network/interfaces.d/*.intf
```

```
# The loopback network interface
auto lo
iface lo inet loopback
        address 10.100.1.201/32

# The primary network interface
auto eth0
iface eth0
        address 10.62.2.54/24
        gateway 10.62.2.254

auto swp1
iface swp1
        link-autoneg on

auto swp2
iface swp2
        link-autoneg on
```

/etc/frr/frr.conf

```
hostname AG9032-54-SPINE1
username cumulus nopassword
!
service integrated-vtysh-config
!
log syslog informational
!
interface swp1
  ipv6 nd ra-interval 10
  no ipv6 nd suppress-ra
!
```

```
interface swp2
 ipv6 nd ra-interval 10
 no ipv6 nd suppress-ra
!
router bgp 65201
 coalesce-time 1150
 bgp bestpath as-path multipath-relax
 timers bgp 5 30
 neighbor swp1 interface remote-as external
 neighbor swp2 interface remote-as external
 !
 address-family ipv4 unicast
  network 10.100.1.201/32
 exit-address-family
!
```

2. If the **/etc/network/interfaces** or the **/etc/frr/frr.conf** file was edited, execute the following to activate the configurations:

   sudo systemctl restart switchd

SPINE2 Configurations

1. Execute the following commands to add the networking configurations on the **SPINE2** switch:

   # Configure the interfaces

   sudo net add loopback lo ip address 10.100.1.202/32

   sudo net add interface swp1-2 link autoneg on

   # Configure BGP

   sudo net add bgp autonomous-system 65202

   sudo net add bgp bestpath as-path multipath-relax

sudo net add bgp neighbor swp1 remote-as external
sudo net add bgp neighbor swp2 remote-as external
sudo net add bgp network 10.100.1.202/32
sudo net add bgp timers 5 30

 # Display the configurations for review before committing
sudo net pending

 # Commit the configurations
sudo net commit

 # Display the configurations
sudo net show configuration

The above configurations using NCLU would produce the following in **/etc/network/interfaces** and **/etc/frr/frr.conf** files:

/etc/network/interfaces

```
source /etc/network/interfaces.d/*.intf

# The loopback network interface
auto lo
iface lo inet loopback
        address 10.100.1.202/32

# The primary network interface
auto eth0
iface eth0
        address 10.62.2.36/24
        gateway 10.62.2.254
```

```
auto swp1
iface swp1
        link-autoneg on

auto swp2
iface swp2
        link-autoneg on
```

/etc/frr/frr.conf

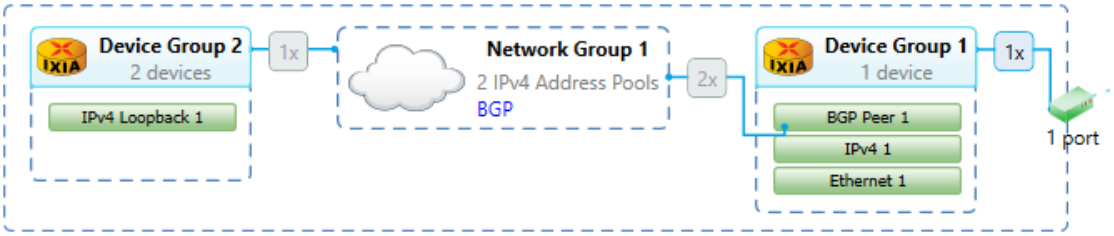
```
hostname AG9032-36-SPINE2
username cumulus nopassword
!
service integrated-vtysh-config
!
log syslog informational
!
interface swp1
  ipv6 nd ra-interval 10
  no ipv6 nd suppress-ra
!
interface swp2
  ipv6 nd ra-interval 10
  no ipv6 nd suppress-ra
!
router bgp 65202
  coalesce-time 1150
  bgp bestpath as-path multipath-relax
  timers bgp 5 30
  neighbor swp1 interface remote-as external
  neighbor swp2 interface remote-as external
  !
```

```
 address-family ipv4 unicast
  network 10.100.1.202/32
 exit-address-family
!
```

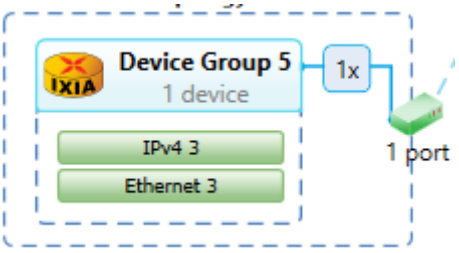
2. If the **/etc/network/interfaces** or the **/etc/frr/frr.conf** file was edited, execute the following to activate the configurations:
   sudo systemctl restart switchd

Ixia Configurations

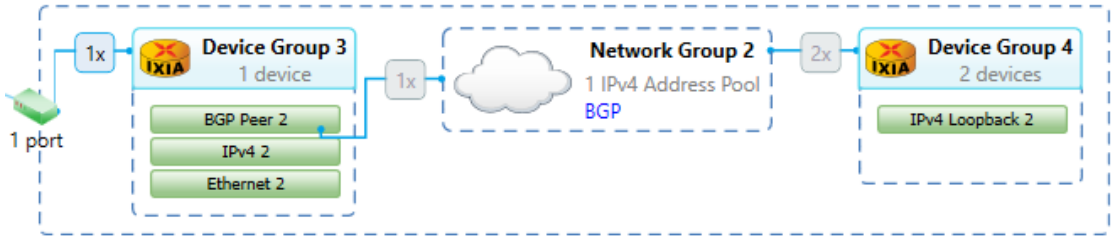
1. Setup **Ixia port 2/5** to emulate the BGP host network connected to **LEAF1** as shown below.



2. Setup **Ixia port 2/6** to emulate the SERVER connected to **LEAF1** as shown below.



3. Setup **Ixia port 2/7** to emulate the BGP host network connected to **LEAF2** as shown below.



4. Start the Ixia.

Network Validation and Troubleshooting

1. Check the license.

roger@AG7648-38-LEAF1:~$ **sudo cl-license**

robert.zhu@deltaww.com|oCcYMCACDhlVe7XDD7pffhmZcLFsAg4O+DkTiqNenWsiCVn8sw

2. Check the system and SW version.

roger@AG7648-38-LEAF1:~$ ***sudo net show system***

Delta AG7648

Cumulus Linux 3.5.0

Build: Cumulus Linux 3.5.0

Chipset: ***Broadcom Trident2 BCM56854***

Port Config: 48 x 10G-SFP+ & 6 x 40G-QSFP+

CPU: (x86_64) Intel Atom C2338 1.74GHz

Uptime: 1 day, 23:00:49.520000

roger@AG9032-54-SPINE1:~$ ***sudo net show system***

Delta AG9032V1

Cumulus Linux 3.5.0

Build: Cumulus Linux 3.5.0

Uptime: 1 day, 23:34:36.830000

roger@AG7648-38-LEAF1:~$ ***sudo net show version***

NCLU_VERSION=1.0

DISTRIB_ID="Cumulus Linux"

DISTRIB_RELEASE=3.5.0

*DISTRIB_DESCRIPTION="**Cumulus Linux 3.5.0**"*

3. Check interfaces status and assigned IP addresses.

roger@AG7648-38-LEAF1:~$ ***sudo net show interface***

Name Master Speed MTU Mode Remote Host Remote Port Summary

----- ------ -------- ------- ----- ------------ ---------- ---------- ---------- ----------

UP lo N/A 65536 Loopback

IP: 127.0.0.1/8, 10.100.1.1/32, ::1/128

UP eth0 1G 1500 Mgmt Agema-LAB-01 0/25

IP: 10.62.2.38/24

UP swp1 10G 1500 Interface/L3

IP: 10.101.1.1/24

UP swp2 10G 1500 Interface/L3

IP: 10.101.2.1/24

.

.

.

UP swp49 40G 1500 NotConfigured AG9032-54-SPINE1 swp1

UP swp50 40G 1500 NotConfigured AG9032-36-SPINE2 swp1

4. Check LLDP neighbors.

roger@AG7648-38-LEAF1:~$ ***sudo net show lldp***

LocalPort Speed Mode RemotePort RemoteHost Summary

---------- ------- ---------- ---------- ---------- ----------

eth0 1G Mgmt 0/25 Agema-LAB-01 IP: 10.62.2.38/24

swp49 40G NotConfigured swp1 AG9032-54-SPINE1

swp50 40G NotConfigured swp1 AG9032-36-SPINE2

5. Check BGP routing.

roger@AG7648-38-LEAF1:~$ ***sudo net show bgp***

show bgp ipv4 unicast

==========

BGP table version is 10467499, ***local router ID is 10.100.1.1***

*Status codes: s suppressed, d damped, h history, * valid, > best, = multipath,*

i internal, r RIB-failure, S Stale, R Removed

Origin codes: i - IGP, e - EGP, ? - incomplete

Network	Next Hop	Metric	LocPrf	Weight	Path
*> 10.100.1.1/32	0.0.0.0	0		32768	i
*= 10.100.1.2/32	swp50			0	65202 65002 i
*>	swp49			0	65201 65002 i
*> 10.100.1.201/32	swp49	0		0	65201 i
*> 10.100.1.202/32	swp50	0		0	65202 i
*> 10.101.2.0/24	0.0.0.0	0		32768	i
*>i100.0.0.1/32	10.101.1.2		0	0	i
*>i100.0.0.2/32	10.101.1.2		0	0	i
*= 200.0.0.1/32	swp50			0	65202 65002 i
*>	swp49			0	65201 65002 i

Displayed 8 routes and 10 total paths

show bgp ipv6 unicast

==========

No BGP prefixes displayed, 0 exist

6. Issue pings to all the other switches, hosts, and server from **LEAF1** to ensure connectivity.

roger@AG7648-38-LEAF1:~$ ***ping 10.100.1.2***

PING 10.100.1.2 (10.100.1.2) 56(84) bytes of data.

64 bytes from 10.100.1.2: icmp_seq=1 ttl=63 time=0.179 ms

64 bytes from 10.100.1.2: icmp_seq=2 ttl=63 time=0.212 ms

^C

--- 10.100.1.2 ping statistics ---

2 packets transmitted, 2 received, 0% packet loss*, time 999ms*

rtt min/avg/max/mdev = 0.179/0.195/0.212/0.021 ms

roger@AG7648-38-LEAF1:~$ ***ping 10.100.1.201***

PING 10.100.1.201 (10.100.1.201) 56(84) bytes of data.

64 bytes from 10.100.1.201: icmp_seq=1 ttl=64 time=0.231 ms

64 bytes from 10.100.1.201: icmp_seq=2 ttl=64 time=0.243 ms

^C

--- 10.100.1.201 ping statistics ---

2 packets transmitted, 2 received, 0% packet loss*, time 999ms*

rtt min/avg/max/mdev = 0.231/0.237/0.243/0.006 ms

roger@AG7648-38-LEAF1:~$ ***ping 10.100.1.202***

PING 10.100.1.202 (10.100.1.202) 56(84) bytes of data.

64 bytes from 10.100.1.202: icmp_seq=1 ttl=64 time=0.225 ms

64 bytes from 10.100.1.202: icmp_seq=2 ttl=64 time=0.224 ms

64 bytes from 10.100.1.202: icmp_seq=3 ttl=64 time=0.233 ms

^C

--- 10.100.1.202 ping statistics ---

3 packets transmitted, 3 received, 0% packet loss*, time 1999ms*

rtt min/avg/max/mdev = 0.224/0.227/0.233/0.012 ms

roger@AG7648-38-LEAF1:~$ ***ping 10.101.2.2***

PING 10.101.2.2 (10.101.2.2) 56(84) bytes of data.

64 bytes from 10.101.2.2: icmp_seq=1 ttl=64 time=0.169 ms

64 bytes from 10.101.2.2: icmp_seq=2 ttl=64 time=0.170 ms

64 bytes from 10.101.2.2: icmp_seq=3 ttl=64 time=0.184 ms

^C

--- 10.101.2.2 ping statistics ---

3 packets transmitted, 3 received, 0% packet loss*, time 1999ms*

rtt min/avg/max/mdev = 0.169/0.174/0.184/0.012 ms

roger@AG7648-38-LEAF1:~$ ***ping 100.0.0.1***

PING 100.0.0.1 (100.0.0.1) 56(84) bytes of data.

64 bytes from 100.0.0.1: icmp_seq=1 ttl=64 time=0.199 ms

64 bytes from 100.0.0.1: icmp_seq=2 ttl=64 time=0.171 ms

64 bytes from 100.0.0.1: icmp_seq=3 ttl=64 time=0.185 ms

^C

--- 100.0.0.1 ping statistics ---

3 packets transmitted, 3 received, 0% packet loss*, time 2002ms*

rtt min/avg/max/mdev = 0.171/0.185/0.199/0.011 ms

roger@AG7648-38-LEAF1:~$ ***ping 200.0.0.1***

PING 200.0.0.1 (200.0.0.1) 56(84) bytes of data.

64 bytes from 200.0.0.1: icmp_seq=1 ttl=62 time=0.207 ms

64 bytes from 200.0.0.1: icmp_seq=2 ttl=62 time=0.204 ms

64 bytes from 200.0.0.1: icmp_seq=3 ttl=62 time=0.204 ms

64 bytes from 200.0.0.1: icmp_seq=4 ttl=62 time=0.214 ms

^C

--- 200.0.0.1 ping statistics ---

4 packets transmitted, 4 received, 0% packet loss*, time 2999ms*

rtt min/avg/max/mdev = 0.204/0.207/0.214/0.011 ms

Scalability / Stress Test

1. Ensure that the LEAFs and SPINEs can accommodate and show 800K BGP routes.

   a. Increase the number of hosts in the Ixia to create 400K BGP routes and then start the Ixia protocols. This will create 800K route entries since there are two paths.

   Note: The Ixia port supports 52K loopback interfaces only. 4 ports per LEAF is required to get 400K BGP routes into each LEAF.

   b. Make 4 connections between Ixia and LEAF1. Setup each port to emulate 50K BGP hosts.
   c. Make 4 connections between Ixia and LEAF2. Setup each port to emulate 50K BGP hosts.
   d. On the LEAFs and SPINEs, add the following configurations:

LEAF1	LEAF2	SPINE1	SPINE2
sudo net add interface swp2 ip address 10.101.2.1/24 *sudo net add interface swp3 ip address 10.101.3.1/24* *sudo net add interface swp4 ip address 10.101.4.1/24* *sudo net add bgp neighbor 10.101.2.2 remote-as internal* *sudo net add bgp ipv4 unicast neighbor 10.101.2.2 activate* *sudo net add bgp neighbor 10.101.2.2 next-hop-self*	*sudo net add interface swp2 ip address 10.102.2.1/24* *sudo net add interface swp3 ip address 10.102.3.1/24* *sudo net add interface swp4 ip address 10.102.4.1/24* *sudo net add bgp neighbor 10.102.2.2 remote-as internal* *sudo net add bgp ipv4 unicast neighbor 10.102.2.2 activate* *sudo net add bgp neighbor 10.102.2.2 next-hop-self*	*sudo net add bgp timers 60 300* *sudo net commit*	*sudo net add bgp timers 60 300* *sudo net commit*

sudo net add bgp neighbor 10.101.3.2 remote-as internal *sudo net add bgp ipv4 unicast neighbor 10.101.3.2 activate* *sudo net add bgp neighbor 10.101.3.2 next-hop-self* *sudo net add bgp neighbor 10.101.4.2 remote-as internal* *sudo net add bgp ipv4 unicast neighbor 10.101.4.2 activate* *sudo net add bgp neighbor 10.101.4.2 next-hop-self* *sudo net add bgp timers 60 300* *sudo net commit*	*sudo net add bgp neighbor 10.102.3.2 remote-as internal* *sudo net add bgp ipv4 unicast neighbor 10.102.3.2 activate* *sudo net add bgp neighbor 10.102.3.2 next-hop-self* *sudo net add bgp neighbor 10.102.4.2 remote-as internal* *sudo net add bgp ipv4 unicast neighbor 10.102.4.2 activate* *sudo net add bgp neighbor 10.102.4.2 next-hop-self* *sudo net add bgp timers 60 300* *sudo net commit*		

e. Start Ixia protocols.

f. Observe that each LEAF and SPINE shows 800K BGP routes and each switch operates normally. Below are sample outputs from the switches.

LEAF1	LEAF2	SPINE1	SPINE2
roger@AG7648-38-LEAF1:~$ ***sudo net show bgp summary*** *show bgp ipv4 unicast summary* ========== ======== *BGP router identifier 10.100.1.1, local AS number 65001 vrf-id 0* *BGP table version 32725474* ***RIB entries 800009, using 116 MiB of memory***	*roger@AG7648-50-LEAF2:~$* ***sudo net show bgp summary*** *show bgp ipv4 unicast summary* ========== ======== *BGP router identifier 10.100.1.2, local AS number 65002 vrf-id 0* *BGP table version 36905600* ***RIB entries 800009, using 116 MiB of memory***	*roger@AG9032-54-SPINE1:~$* ***sudo net show bgp summary*** *show bgp ipv4 unicast summary* ========== ======== *BGP router identifier 10.100.1.201, local AS number 65201 vrf-id 0* *BGP table version 39053462* ***RIB entries 800009, using 116 MiB of memory***	*roger@AG9032-36-SPINE2:~$* ***sudo net show bgp summary*** *show bgp ipv4 unicast summary* ========== ======== *BGP router identifier 10.100.1.202, local AS number 65202 vrf-id 0* *BGP table version 41204575* ***RIB entries 800009, using 116 MiB of memory***

Peers 6, using 117 KiB of memory *Neighbor V* *AS MsgRcvd MsgSent TblVer* *InQ OutQ Up/Down State/PfxRcd* *AG9032-54-SPINE1(swp49) 4* *65201 103836 101758* *0 0 0 23:39:17* *Idle* *AG9032-36-SPINE2(swp50) 4* *65202 123617 121125* *0 0 0 23:38:21* *200003* *10.101.1.2 4* *65001 8383734 36236* *0 0 0 00:03:12* *50000* *10.101.2.2 4* *65001 1550218 18005* *0 0 0 00:03:12* *50000* *10.101.3.2 4* *65001 50485 2046* *0 0 0 00:03:11* *50000* *10.101.4.2 4* *65001 50485 2066* *0 0 0 00:03:17* *50000* *Total number of neighbors 6*	*Peers 6, using 117 KiB of memory* *Neighbor V* *AS MsgRcvd MsgSent TblVer* *InQ OutQ Up/Down State/PfxRcd* *AG9032-54-SPINE1(swp49) 4* *65201 111527 110539* *0 0 0 23:38:26* *1* *AG9032-36-SPINE2(swp50) 4* *65202 118703 113784* *0 0 0 1d00h00m* *200003* *10.102.1.2 4* *65002 3255234 69990* *0 0 0 00:03:36* *50000* *10.102.2.2 4* *65002 1557467 20661* *0 0 0 00:03:36* *50000* *10.102.3.2 4* *65002 50498 1945* *0 0 0 00:03:41* *50000* *10.102.4.2 4* *65002 50489 1807* *0 0 0 00:03:07* *50000* *Total number of neighbors 6*	*Peers 2, using 39 KiB of memory* *Neighbor V* *AS MsgRcvd MsgSent TblVer* *InQ OutQ Up/Down State/PfxRcd* *AG7648-38-LEAF1(swp1) 4* *65001 102298 104448* *0 0 0 23:43:50* *Idle* *AG7648-50-LEAF2(swp2) 4* *65002 111824 112995* *0 0 0 23:42:47* *400004* *Total number of neighbors 2*	*Peers 2, using 39 KiB of memory* *Neighbor V* *AS MsgRcvd MsgSent TblVer* *InQ OutQ Up/Down State/PfxRcd* *AG7648-38-LEAF1(swp1) 4* *65001 731120 733696* *0 0 0 23:38:31* *200002* *AG7648-50-LEAF2(swp2) 4* *65002 837229 842420* *0 0 0 1d00h00m* *200002* *Total number of neighbors 2*

2. Disable port 1/49 of LEAF1 and ensure that only 400K routes remain after a few minutes. Re-enable port 1/49 and observe that the BGP routes get re-established.

 # disable port 1/49

sudo net add interface swp49 link down

sudo net commit

 # wait for 5 minutes and observe that only 400K routes remain

roger@AG7648-38-LEAF1:~$ ***sudo net show bgp summary***

show bgp ipv4 unicast summary

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BGP router identifier 10.100.1.1, local AS number 65001 vrf-id 0

BGP table version 200003

RIB entries 400005*, using 58 MiB of memory*

Peers 6, using 117 KiB of memory

Neighbor	*V*	*AS*	*MsgRcvd*	*MsgSent*	*TblVer*	*InQ*	*OutQ*	*Up/Down*	*State/PfxRcd*
swp49	*4*	*0*	*0*	*0*	*0*	*0*	*0*	*never*	*Idle*
AG9032-36-SPINE2(swp50)	*4*	*65202*	*620*	*2441*	*0*	*0*	*0*	*00:00:59*	*1*
10.101.1.2	*4*	*65001*	*50004*	*5*	*0*	*0*	*0*	*00:00:58*	*50000*
10.101.2.2	*4*	*65001*	*50004*	*5*	*0*	*0*	*0*	*00:00:58*	*50000*
10.101.3.2	*4*	*65001*	*50004*	*5*	*0*	*0*	*0*	*00:00:58*	*50000*
10.101.4.2	*4*	*65001*	*50004*	*5*	*0*	*0*	*0*	*00:00:58*	*50000*

Total number of neighbors 6

 # execute the following to re-enable port 1/49:

sudo net del interface swp49 link down

sudo net commit

 # observe that 800K routes are restored

roger@AG7648-38-LEAF1:~$ ***sudo net show bgp summary***

show bgp ipv4 unicast summary

==========

BGP router identifier 10.100.1.1, local AS number 65001 vrf-id 0

BGP table version 400005

***RIB entries 800009**, using 116 MiB of memory*

Peers 6, using 117 KiB of memory

Neighbor	*V*	*AS*	*MsgRcvd*	*MsgSent*	*TblVer*	*InQ*	*OutQ*	
Up/Down State/PfxRcd								
AG9032-54-SPINE1(swp49)	*4*	*65201*	*524*	*509*	*0*	*0*	*0*	*00:00:26*
200002								
AG9032-36-SPINE2(swp50)	*4*	*65202*	*898*	*2695*	*0*	*0*	*0*	*00:06:21*
1								
10.101.1.2	*4*	*65001*	*50015*	*265*	*0*	*0*	*0*	*00:06:20*
50000								
10.101.2.2	*4*	*65001*	*50015*	*265*	*0*	*0*	*0*	*00:06:20*
50000								
10.101.3.2	*4*	*65001*	*50015*	*265*	*0*	*0*	*0*	*00:06:20*
50000								
10.101.4.2	*4*	*65001*	*50015*	*265*	*0*	*0*	*0*	*00:06:20*
50000								

Total number of neighbors 6