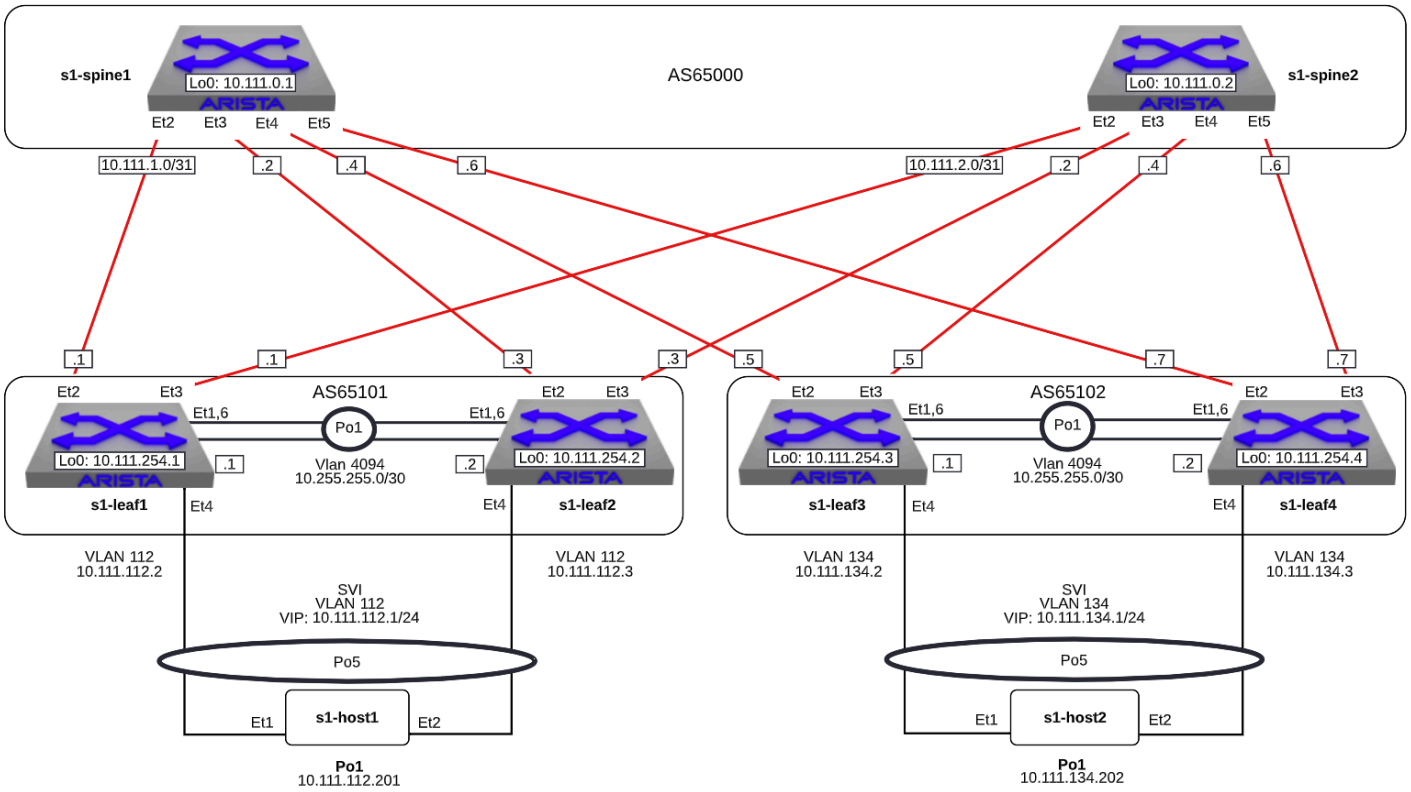
Layer 3 Leaf-Spine



(_images/nested_l3ls_topo_1.png)

Note

The manually-entered commands below that are part of this lab are equivalent to `L3LS_s1-leaf4_complete`.

1. Log into the **LabAccess** jumpserver:

   a. Type `l3ls` at the prompt. The script will configure the datacenter with the exception of **s1-leaf4**.

   Note

   Did you know the "l3ls" script is composed of Python code that uses the CloudVision Portal REST API to automate the provisioning of CVP Configlets. The configlets that are configured via the REST API are `L3LS_s1-spine1`, `L3LS_s1-spine2`, `L3LS_s1-leaf1`, `L3LS_s1-leaf2`, `L3LS_s1-leaf3`, `L3LS_s1-leaf4`.

2. Configure SVI and VARP Virtual IP on the **s1-leaf4** switch using the following criteria

   a. Create the vARP MAC Address in Global Configuration mode

   Note

   Arista EOS utilizes the Industry-Standard CLI. When entering configuration commands, be sure to first type `configure` to enter configuration mode.

```
ip virtual-router mac-address 00:1c:73:00:00:34
```

b. Create the VLAN, SVI and the Virtual Router Address

```
vlan 134
   name Host_Network_134
!
interface vlan 134
   ip address 10.111.134.3/24
   ip virtual-router address 10.111.134.1
```

c. Validate the configuration with the following:

```
s1-leaf4#show ip interface brief
                                                                                Address
Interface         IP Address            Status       Protocol           MTU    Owner
----------------- --------------------- ------------ -------------- ---------- -------
Management0       192.168.0.15/24       up           up                 1500
Vlan134           10.111.134.3/24       up           up                 1500
Vlan4094          10.255.255.2/30       up           up                 1500

s1-leaf4#show ip virtual-router
IP virtual router is configured with MAC address: 001c.7300.0034
IP virtual router address subnet routes not enabled
MAC address advertisement interval: 30 seconds

Protocol: U - Up, D - Down, T - Testing, UN - Unknown
          NP - Not Present, LLD - Lower Layer Down

Interface       Vrf           Virtual IP Address       Protocol       State
--------------- ------------- ------------------------ -------------- ------
Vl134           default       10.111.134.1             U              active
```

3. Configure BGP on the **s1-leaf4** switch using the following criteria

a. Based on the diagram, configure L3 interfaces to **s1-spine1/s1-spine2** and interface Loopback0

```
interface Ethernet2
   description L3 Uplink - s1-spine1
   no switchport
   ip address 10.111.1.7/31
!
interface Ethernet3
   description L3 Uplink - s1-spine2
   no switchport
   ip address 10.111.2.7/31
!
interface Loopback0
   description Management and Router-id
   ip address 10.111.254.4/32
```

b. Validate the configuration with the following:

```
s1-leaf4#show ip interface brief
                                                                                Address
Interface         IP Address            Status       Protocol            MTU    Owner
----------------- --------------------- ------------ -------------- ----------- -------
Ethernet2         10.111.1.7/31         up           up                 1500
Ethernet3         10.111.2.7/31         up           up                 1500
Loopback0         10.111.254.4/32       up           up                65535
Management0       192.168.0.15/24       up           up                 1500
Vlan134           10.111.134.3/24       up           up                 1500
Vlan4094          10.255.255.2/30       up           up                 1500
```

c. Based on the diagram, turn on BGP and configure the neighbor relationships on **s1-leaf4**. eBGP to **s1-spine1/s1-spine2** and iBGP to **s1-leaf3**.

Note

We are using a peer group to configure the neighbor attributes for the spines. This allows us to apply all bgp attributes within a group to each neighbor that is a member in a scalable method.

```
router bgp 65102
   router-id 10.111.254.4
   neighbor SPINE peer group
   neighbor SPINE remote-as 65100
   neighbor SPINE send-community standard extended
   neighbor 10.111.1.6 peer group SPINE
   neighbor 10.111.2.6 peer group SPINE
   neighbor 10.255.255.1 remote-as 65102
   neighbor 10.255.255.1 next-hop-self
```

Note

Since `neighbor 10.255.255.1 remote-as 65102` specifies an iBGP peering relationship (because the ASN is the same as this switch `65102`), the receiving switch may not have a route to networks more than 1 hop away, hence the switches should each advertise that they are the next hop via the `neighbor 10.255.255.1 next-hop-self` statement. While this scenario is only 2 iBGP peers, in a network fabric with several iBGP peers, a switch inside an AS (and not on an edge) may not have a route to a switch in any external AS.

d. Validate the configuration and neighbor establishment

```
s1-leaf4(config-router-bgp)#show active
router bgp 65102
   router-id 10.111.254.4
   neighbor SPINE peer group
   neighbor SPINE remote-as 65100
   neighbor SPINE send-community standard extended
   neighbor 10.111.1.6 peer group SPINE
   neighbor 10.111.2.6 peer group SPINE
   neighbor 10.255.255.1 remote-as 65102
   neighbor 10.255.255.1 next-hop-self
s1-leaf4(config-router-bgp)#show ip bgp summary
BGP summary information for VRF default
Router identifier 10.111.254.4, local AS number 65102
Neighbor Status Codes: m - Under maintenance
Neighbor     V AS           MsgRcvd   MsgSent  InQ OutQ  Up/Down State   PfxRcd PfxAcc
10.111.1.6   4 65100             10         8    0    0 00:01:02 Estab   5      5
10.111.2.6   4 65100              9         9    0    0 00:01:02 Estab   5      5
10.255.255.1 4 65102              9         8    0    0 00:01:00 Estab   9      9
```

4. Configure networks on **s1-leaf4** to advertise to **s1-spine1/s1-spine2**

   a. Add the following networks to BGP announcements on **s1-leaf4**:

```
router bgp 65102
   network 10.111.134.0/24
   network 10.111.254.4/32
```

   b. Verify that these networks are being advertised to the other Spines and Leafs

```
s1-leaf1#show ip route

   VRF: default
   Codes: C - connected, S - static, K - kernel,
          O - OSPF, IA - OSPF inter area, E1 - OSPF external type 1,
          E2 - OSPF external type 2, N1 - OSPF NSSA external type 1,
          N2 - OSPF NSSA external type2, B - Other BGP Routes,
          B I - iBGP, B E - eBGP, R - RIP, I L1 - IS-IS level 1,
          I L2 - IS-IS level 2, O3 - OSPFv3, A B - BGP Aggregate,
          A O - OSPF Summary, NG - Nexthop Group Static Route,
          V - VXLAN Control Service, M - Martian,
          DH - DHCP client installed default route,
          DP - Dynamic Policy Route, L - VRF Leaked,
          G  - gRIBI, RC - Route Cache Route

   Gateway of last resort is not set

   B E      10.111.0.1/32 [200/0] via 10.111.1.0, Ethernet2
   B E      10.111.0.2/32 [200/0] via 10.111.2.0, Ethernet3
   C        10.111.1.0/31 is directly connected, Ethernet2
   B E      10.111.1.0/24 [200/0] via 10.111.1.0, Ethernet2
   C        10.111.2.0/31 is directly connected, Ethernet3
   B E      10.111.2.0/24 [200/0] via 10.111.2.0, Ethernet3
   C        10.111.112.0/24 is directly connected, Vlan112
   B E      10.111.134.0/24 [200/0] via 10.111.1.0, Ethernet2
   C        10.111.254.1/32 is directly connected, Loopback0
   B I      10.111.254.2/32 [200/0] via 10.255.255.2, Vlan4094
   B E      10.111.254.3/32 [200/0] via 10.111.1.0, Ethernet2
   B E      10.111.254.4/32 [200/0] via 10.111.1.0, Ethernet2
   C        10.255.255.0/30 is directly connected, Vlan4094
   C        192.168.0.0/24 is directly connected, Management0

   s1-leaf1#show ip bgp
   BGP routing table information for VRF default
   Router identifier 10.111.254.1, local AS number 65101
   Route status codes: s - suppressed, * - valid, > - active, E - ECMP head, e - ECMP
                       S - Stale, c - Contributing to ECMP, b - backup, L - labeled-unica
                       % - Pending BGP convergence
   Origin codes: i - IGP, e - EGP, ? - incomplete
   RPKI Origin Validation codes: V - valid, I - invalid, U - unknown
   AS Path Attributes: Or-ID - Originator ID, C-LST - Cluster List, LL Nexthop - Link L

            Network                Next Hop              Metric  AIGP       LocPref Wei
   * >      10.111.0.1/32          10.111.1.0            0       -          100     0
   *        10.111.0.1/32          10.255.255.2          0       -          100     0
   * >      10.111.0.2/32          10.111.2.0            0       -          100     0
   *        10.111.0.2/32          10.255.255.2          0       -          100     0
   * >      10.111.1.0/24          10.111.1.0            0       -          100     0
   *        10.111.1.0/24          10.255.255.2          0       -          100     0
   * >      10.111.2.0/24          10.111.2.0            0       -          100     0
   *        10.111.2.0/24          10.255.255.2          0       -          100     0
```

```
* >      10.111.112.0/24        -                   -       -          -       0
*        10.111.112.0/24        10.255.255.2        0       -          100     0
* >      10.111.134.0/24        10.111.1.0          0       -          100     0
*        10.111.134.0/24        10.111.2.0          0       -          100     0
*        10.111.134.0/24        10.255.255.2        0       -          100     0
* >      10.111.254.1/32        -                   -       -          -       0
* >      10.111.254.2/32        10.255.255.2        0       -          100     0
* >      10.111.254.3/32        10.111.1.0          0       -          100     0
*        10.111.254.3/32        10.111.2.0          0       -          100     0
*        10.111.254.3/32        10.255.255.2        0       -          100     0
* >      10.111.254.4/32        10.111.1.0          0       -          100     0
*        10.111.254.4/32        10.111.2.0          0       -          100     0
*        10.111.254.4/32        10.255.255.2        0       -          100     0

s1-leaf1#show ip route bgp

VRF: default
Codes: C - connected, S - static, K - kernel,
       O - OSPF, IA - OSPF inter area, E1 - OSPF external type 1,
       E2 - OSPF external type 2, N1 - OSPF NSSA external type 1,
       N2 - OSPF NSSA external type2, B - Other BGP Routes,
       B I - iBGP, B E - eBGP, R - RIP, I L1 - IS-IS level 1,
       I L2 - IS-IS level 2, O3 - OSPFv3, A B - BGP Aggregate,
       A O - OSPF Summary, NG - Nexthop Group Static Route,
       V - VXLAN Control Service, M - Martian,
       DH - DHCP client installed default route,
       DP - Dynamic Policy Route, L - VRF Leaked,
       G  - gRIBI, RC - Route Cache Route

B E      10.111.0.1/32 [200/0] via 10.111.1.0, Ethernet2
B E      10.111.0.2/32 [200/0] via 10.111.2.0, Ethernet3
B E      10.111.1.0/24 [200/0] via 10.111.1.0, Ethernet2
B E      10.111.2.0/24 [200/0] via 10.111.2.0, Ethernet3
B E      10.111.134.0/24 [200/0] via 10.111.1.0, Ethernet2
B I      10.111.254.2/32 [200/0] via 10.255.255.2, Vlan4094
B E      10.111.254.3/32 [200/0] via 10.111.1.0, Ethernet2
B E      10.111.254.4/32 [200/0] via 10.111.1.0, Ethernet2
```

c. Add in multiple paths by enabling ECMP, on **s1-leaf4**, jump into BGP configuration mode and add:

```
router bgp 65102
   maximum-paths 2
```

d. Check the BGP and IP route tables on **s1-leaf4** as well as each of the **Spines** and **Leafs**

```
s1-spine1#show ip route

   VRF: default
   Codes: C - connected, S - static, K - kernel,
          O - OSPF, IA - OSPF inter area, E1 - OSPF external type 1,
          E2 - OSPF external type 2, N1 - OSPF NSSA external type 1,
          N2 - OSPF NSSA external type2, B - Other BGP Routes,
          B I - iBGP, B E - eBGP, R - RIP, I L1 - IS-IS level 1,
          I L2 - IS-IS level 2, O3 - OSPFv3, A B - BGP Aggregate,
          A O - OSPF Summary, NG - Nexthop Group Static Route,
          V - VXLAN Control Service, M - Martian,
          DH - DHCP client installed default route,
          DP - Dynamic Policy Route, L - VRF Leaked,
          G  - gRIBI, RC - Route Cache Route

   Gateway of last resort is not set

   C        10.111.0.1/32 is directly connected, Loopback0
   C        10.111.1.0/31 is directly connected, Ethernet2
   C        10.111.1.2/31 is directly connected, Ethernet3
   C        10.111.1.4/31 is directly connected, Ethernet4
   C        10.111.1.6/31 is directly connected, Ethernet5
   S        10.111.1.0/24 is directly connected, Null0
   B E      10.111.112.0/24 [200/0] via 10.111.1.1, Ethernet2
                                    via 10.111.1.3, Ethernet3
   B E      10.111.134.0/24 [200/0] via 10.111.1.5, Ethernet4
                                    via 10.111.1.7, Ethernet5
   B E      10.111.254.1/32 [200/0] via 10.111.1.1, Ethernet2
                                    via 10.111.1.3, Ethernet3
   B E      10.111.254.2/32 [200/0] via 10.111.1.1, Ethernet2
                                    via 10.111.1.3, Ethernet3
   B E      10.111.254.3/32 [200/0] via 10.111.1.5, Ethernet4
                                    via 10.111.1.7, Ethernet5
   B E      10.111.254.4/32 [200/0] via 10.111.1.5, Ethernet4
                                    via 10.111.1.7, Ethernet5
   C        192.168.0.0/24 is directly connected, Management0

   s1-spine1#show ip bgp
   BGP routing table information for VRF default
   Router identifier 10.111.0.1, local AS number 65100
   Route status codes: s - suppressed, * - valid, > - active, E - ECMP head, e - ECMP
                       S - Stale, c - Contributing to ECMP, b - backup, L - labeled-unica
                       % - Pending BGP convergence
   Origin codes: i - IGP, e - EGP, ? - incomplete
   RPKI Origin Validation codes: V - valid, I - invalid, U - unknown
   AS Path Attributes: Or-ID - Originator ID, C-LST - Cluster List, LL Nexthop - Link L

            Network                Next Hop              Metric  AIGP       LocPref Wei
   * >      10.111.0.1/32          -                     -       -          -       0
   * >      10.111.1.0/24          -                     -       -          -       0
   * >Ec    10.111.112.0/24        10.111.1.1            0       -          100     0
   *  ec    10.111.112.0/24        10.111.1.3            0       -          100     0
```

```
* >Ec    10.111.134.0/24        10.111.1.5            0       -          100     0
*  ec    10.111.134.0/24        10.111.1.7            0       -          100     0
* >Ec    10.111.254.1/32        10.111.1.1            0       -          100     0
*  ec    10.111.254.1/32        10.111.1.3            0       -          100     0
* >Ec    10.111.254.2/32        10.111.1.3            0       -          100     0
*  ec    10.111.254.2/32        10.111.1.1            0       -          100     0
* >Ec    10.111.254.3/32        10.111.1.5            0       -          100     0
*  ec    10.111.254.3/32        10.111.1.7            0       -          100     0
* >Ec    10.111.254.4/32        10.111.1.7            0       -          100     0
*  ec    10.111.254.4/32        10.111.1.5            0       -          100     0

s1-spine1#sh ip route bgp

VRF: default
Codes: C - connected, S - static, K - kernel,
       O - OSPF, IA - OSPF inter area, E1 - OSPF external type 1,
       E2 - OSPF external type 2, N1 - OSPF NSSA external type 1,
       N2 - OSPF NSSA external type2, B - Other BGP Routes,
       B I - iBGP, B E - eBGP, R - RIP, I L1 - IS-IS level 1,
       I L2 - IS-IS level 2, O3 - OSPFv3, A B - BGP Aggregate,
       A O - OSPF Summary, NG - Nexthop Group Static Route,
       V - VXLAN Control Service, M - Martian,
       DH - DHCP client installed default route,
       DP - Dynamic Policy Route, L - VRF Leaked,
       G  - gRIBI, RC - Route Cache Route

B E      10.111.112.0/24 [200/0] via 10.111.1.1, Ethernet2
                                 via 10.111.1.3, Ethernet3
B E      10.111.134.0/24 [200/0] via 10.111.1.5, Ethernet4
                                 via 10.111.1.7, Ethernet5
B E      10.111.254.1/32 [200/0] via 10.111.1.1, Ethernet2
                                 via 10.111.1.3, Ethernet3
B E      10.111.254.2/32 [200/0] via 10.111.1.1, Ethernet2
                                 via 10.111.1.3, Ethernet3
B E      10.111.254.3/32 [200/0] via 10.111.1.5, Ethernet4
                                 via 10.111.1.7, Ethernet5
B E      10.111.254.4/32 [200/0] via 10.111.1.5, Ethernet4
                                 via 10.111.1.7, Ethernet5
```

Note

ECMP is now working - notice the new status code in the *show ip bgp* output on s1-leaf4

5. Validate connectivity from **s1-host1** to **s1-host2**. From **s1-host1** execute:

```
ping 10.111.134.202
traceroute 10.111.134.202
```

   a. Verify **s1-leaf4**'s IP address is in the traceroute path, either interface 10.111.1.7 via **s1-spine1** or interface 10.111.2.7 via **s1-spine2**. If traffic is hashing via **s1-leaf3**'s 10.111.1.5 or 10.111.2.5 interfaces perform the optional `shutdown` steps below on **s1-leaf3**

```
router bgp 65102
   neighbor 10.111.1.4 shutdown
   neighbor 10.111.2.4 shutdown
```

b. Rerun traceroute/verification from **s1-host1** to **s1-host2** then revert the `shutdown` changes on **s1-leaf3**

```
router bgp 65102
   no neighbor 10.111.1.4 shutdown
   no neighbor 10.111.2.4 shutdown
```

6. Other BGP features to play with if you have time:

a. Route Redistribution: For fun, do a `watch 1 diff show ip route | begin Gateway` on **s1-leaf1** & **s1-leaf2** and let those run while you execute the command `redistribute connected` below on **s1-leaf3**. You will see new routes being injected into the route tables of **s1-leaf1** & **s1-leaf2**.

```
router bgp 65102
   redistribute connected
```

b. Route Maps and Prefix-Lists: Below is an example of some basic Prefix-Lists and Route-Maps that can be used for BGP filtering. Note that this is just an example and will not impact route advertisement in the lab.

```
<Example>

ip prefix-list BOGON-Prefixes seq 10 permit 10.0.0.0/8
ip prefix-list BOGON-Prefixes seq 20 permit 172.16.0.0/12
ip prefix-list BOGON-Prefixes seq 30 permit 192.168.0.0/16
!
route-map BOGONS permit 10
   match ip address prefix-list BOGON-Prefixes
!
route-map BOGONS deny 20
!
route-map InboundSP1 deny 10
   sub-route-map BOGONS
!
route-map InboundSP1 permit 20
   set local-preference 200
!
router bgp 65102
   neighbor UpstreamSP1 route-map InboundSP1 in
```

c. BFD: BFD is a low-overhead, protocol-independent mechanism which adjacent systems can use instead for faster detection of faults in the path between them. BFD is a simple mechanism which detects the liveness of a connection between adjacent systems, allowing it to quickly detect failure of any element in the connection. Note that BFD is not running on the other devices so the BFD neighbor will not come up.

```
router bgp 65102
   neighbor <neighbor_ip> bfd
```

7. Troubleshooting BGP:

```
show ip bgp summary
show ip bgp
show ip bgp neighbor <neighbor_ip>
show run section bgp
show log
```

LAB COMPLETE!

Back to top