

This is a guide to the Lab 1 implementation:

First, install all necessary files for Container lab:

```
curl -sL https://containerlab.dev/setup | sudo -E bash -s "all"
```

Then create a “clab” file with format: clab.(NAME).yaml

Here’s a snippet of what this file looks like:

```
student@csc15840-vm1-loc1: X + v
# topology documentation: http://containerlab.dev/lab-examples/srl-ceos/
name: Lab1

topology:
  nodes:
    R1:
      kind: arista_ceos
      image: ceos:4.32.0F
      startup-config: /home/student/Documents/CSCI5840_Advanced_Network_Automation/Lab1_Network_Infrastructure_Implementation/r1.cfg
    R2:
      kind: arista_ceos
      image: ceos:4.32.0F
      startup-config: /home/student/Documents/CSCI5840_Advanced_Network_Automation/Lab1_Network_Infrastructure_Implementation/r2.cfg
    R3:
      kind: arista_ceos
      image: ceos:4.32.0F
      startup-config: /home/student/Documents/CSCI5840_Advanced_Network_Automation/Lab1_Network_Infrastructure_Implementation/r3.cfg
    R4:
      kind: arista_ceos
      image: ceos:4.32.0F
      startup-config: /home/student/Documents/CSCI5840_Advanced_Network_Automation/Lab1_Network_Infrastructure_Implementation/r4.cfg
    R5:
      kind: arista_ceos
      image: ceos:4.32.0F
      startup-config: /home/student/Documents/CSCI5840_Advanced_Network_Automation/Lab1_Network_Infrastructure_Implementation/r5.cfg
    S1:
      kind: arista_ceos
      image: ceos:4.32.0F
      startup-config: /home/student/Documents/CSCI5840_Advanced_Network_Automation/Lab1_Network_Infrastructure_Implementation/s1.cfg
    S2:
      kind: arista_ceos
      image: ceos:4.32.0F
      startup-config: /home/student/Documents/CSCI5840_Advanced_Network_Automation/Lab1_Network_Infrastructure_Implementation/s2.cfg
    S3:
      kind: arista_ceos
      image: ceos:4.32.0F
      startup-config: /home/student/Documents/CSCI5840_Advanced_Network_Automation/Lab1_Network_Infrastructure_Implementation/s3.cfg
    S4:
      kind: arista_ceos
      image: ceos:4.32.0F
      startup-config: /home/student/Documents/CSCI5840_Advanced_Network_Automation/Lab1_Network_Infrastructure_Implementation/s4.cfg
    Web_Server:
      kind: linux
      image: myubuntu
    H1:
      kind: linux
      image: myubuntu
    H2:
      kind: linux
      image: myubuntu
    H3:
      kind: linux
      image: myubuntu
    H4:
      kind: linux
      image: myubuntu

  links:
    - endpoints: ["R1:eth1", "S1:eth1"]
    - endpoints: ["R1:eth2", "S3:eth1"]
    - endpoints: ["R2:eth1", "S2:eth1"]
    - endpoints: ["R2:eth2", "S4:eth1"]
    - endpoints: ["R3:eth1", "R4:eth1"]
    - endpoints: ["R3:eth2", "R5:eth1"]
    - endpoints: ["R3:eth3", "S3:eth2"]
    - endpoints: ["R4:eth2", "R5:eth2"]
    - endpoints: ["R4:eth3", "S4:eth2"]
    - endpoints: ["S1:eth2", "S2:eth2"]
```

To get the images, we have to import them using docker, in my case we are using Arista cEOS for the routers and switches, and Ubuntu for the server and hosts.

Arista cEOS download:

```
Sudo docker import cEOS64-lab-4.32.0F.tar.xz ceos:4.32.0F
```

Ubuntu download:

Here I created a Dockerfile to create the docker image as I want:

```
FROM ubuntu:20.04
RUN apt-get update && \
    apt-get install -y iputils-ping net-tools isc-dhcp-client
```

Then run the command to import into docker:

```
Sudo docker build -t myUbuntu
```

Now we have the images ready to run as seen from the .yaml file before.

Next run the containerlab with this command:

```
sudo containerlab destroy -t clab.TEST.yaml
```

It will output this line of text when it is successfully ran:

```

student@csc15840-vm1-1och1722:~/Documents/CSC15840_Advanced_Network_Automation/Lab1_Network_Infrastructure_Implementation$ sudo containerlab deploy -t clab.Lab1.yml
INFO[0000] Containerlab v0.57.0 started
INFO[0000] Parsing & checking topology file: clab.Lab1.yml
INFO[0000] Creating lab directory: /home/student/Documents/CSC15840_Advanced_Network_Automation/Lab1_Network_Infrastructure_Implementation/clab-Lab1
INFO[0000] Creating container: "H1"
INFO[0000] Creating container: "R1"
INFO[0000] Creating container: "R3"
INFO[0000] Creating container: "H3"
INFO[0000] Creating container: "S2"
INFO[0000] Creating container: "Web_Server"
INFO[0000] Creating container: "R4"
INFO[0000] Creating container: "S1"
INFO[0001] Creating container: "H2"
INFO[0001] Creating container: "S4"
INFO[0001] Created link: H3:eth1 <--> S2:eth3
INFO[0001] Running postdeploy actions for Arista cEOS 'S2' node
INFO[0002] Running postdeploy actions for Arista cEOS 'R4' node
INFO[0002] Created link: R3:eth1 <--> R4:eth1
INFO[0002] Created link: R1:eth1 <--> S1:eth1
INFO[0002] Running postdeploy actions for Arista cEOS 'R1' node
INFO[0002] Running postdeploy actions for Arista cEOS 'R3' node
INFO[0002] Created link: S1:eth2 <--> S2:eth2
INFO[0002] Created link: H1:eth1 <--> S1:eth3
INFO[0003] Running postdeploy actions for Arista cEOS 'S1' node
INFO[0003] Creating container: "H4"
INFO[0003] Created link: H2:eth1 <--> S1:eth4
INFO[0003] Creating container: "R5"
INFO[0003] Created link: R4:eth3 <--> S4:eth2
INFO[0004] Running postdeploy actions for Arista cEOS 'S4' node
INFO[0004] Created link: R3:eth2 <--> R5:eth1
INFO[0004] Created link: R4:eth2 <--> R5:eth2
INFO[0004] Created link: R5:eth3 <--> Web_Server:eth1
INFO[0004] Running postdeploy actions for Arista cEOS 'R5' node
INFO[0004] Created link: H4:eth1 <--> S2:eth4
INFO[0004] Creating container: "R2"
INFO[0006] Created link: R2:eth1 <--> S2:eth1
INFO[0006] Created link: R2:eth2 <--> S4:eth1
INFO[0006] Running postdeploy actions for Arista cEOS 'R2' node
INFO[0115] Creating container: "S3"
INFO[0116] Created link: R1:eth2 <--> S3:eth1
INFO[0116] Created link: R3:eth3 <--> S3:eth2
INFO[0116] Created link: S3:eth3 <--> S4:eth3
INFO[0116] Created link: S3:eth4 <--> host:CR_e1-1
INFO[0116] Running postdeploy actions for Arista cEOS 'S3' node
INFO[0185] Adding containerlab host entries to /etc/hosts file
INFO[0185] Adding ssh config for containerlab nodes

```

#	Name	Container ID	Image	Kind	State	IPv4 Address	IPv6 Address
1	clab-Lab1-H1	5c0d11713f32	myubuntu	linux	running	172.20.20.11/24	2001:172:20:20::b/64
2	clab-Lab1-H2	13c8b583cb64	myubuntu	linux	running	172.20.20.17/24	2001:172:20:20::11/64
3	clab-Lab1-H3	ef0817cd52e0	myubuntu	linux	running	172.20.20.10/24	2001:172:20:20::a/64
4	clab-Lab1-H4	c01fd06a3958	myubuntu	linux	running	172.20.20.19/24	2001:172:20:20::13/64
5	clab-Lab1-R1	b94b1a8f4fd4	ceos:4.32.0F	arista_ceos	running	172.20.20.15/24	2001:172:20:20::f/64
6	clab-Lab1-R2	aa80919bbab2	ceos:4.32.0F	arista_ceos	running	172.20.20.21/24	2001:172:20:20::15/64
7	clab-Lab1-R3	9f17e6b9a344	ceos:4.32.0F	arista_ceos	running	172.20.20.14/24	2001:172:20:20::e/64
8	clab-Lab1-R4	8145794674db	ceos:4.32.0F	arista_ceos	running	172.20.20.12/24	2001:172:20:20::c/64
9	clab-Lab1-R5	48c3a6508be2	ceos:4.32.0F	arista_ceos	running	172.20.20.20/24	2001:172:20:20::14/64
10	clab-Lab1-S1	2a930c29842f	ceos:4.32.0F	arista_ceos	running	172.20.20.13/24	2001:172:20:20::d/64
11	clab-Lab1-S2	959f9a124d27	ceos:4.32.0F	arista_ceos	running	172.20.20.7/24	2001:172:20:20::7/64
12	clab-Lab1-S3	4e1e5287bfff0	ceos:4.32.0F	arista_ceos	running	172.20.20.22/24	2001:172:20:20::16/64
13	clab-Lab1-S4	10e76f403ba3	ceos:4.32.0F	arista_ceos	running	172.20.20.18/24	2001:172:20:20::12/64
14	clab-Lab1-Web_Server	ba16b87ca59f	myubuntu	linux	running	172.20.20.16/24	2001:172:20:20::10/64

Now to ssh to the Arista devices for example, R1, type this command:

Ssh admin@172.20.20.15

Username: admin Password: admin

To ssh to the Ubuntu instances, type this in with the respective container ID

Docker exec -it <container ID> bash

Now comes the configuration. Simply log into to the devices as shown above and add these configurations:

Web_Server configuration:

Route add default gw <gateway IP> eth1

Host configuration:

Route add default gw <gateway IP> eth1

Dhclient eth1

Dhclient -6 eth1

Router and Switch configurations:

```
R1:
interface Ethernet1
    no switchport
!
interface Ethernet1.10
    encapsulation dot1q vlan 10
    ip address 21.0.0.2/24
!
interface Ethernet1.20
    encapsulation dot1q vlan 20
    ip address 22.0.0.2/24
!
interface Ethernet1.30
    encapsulation dot1q vlan 30
    ipv6 address 2300::2/64
!
interface Ethernet2
    no switchport
!
interface Ethernet2.40
    encapsulation dot1q vlan 40
    ip address 10.40.0.20/29
!
interface Ethernet2.100
    encapsulation dot1q vlan 100
    ip address 10.100.0.6/24
!
interface Loopback0
    ip address 10.40.1.1/32
!
interface Management0
    ip address 172.20.20.15/24
    ipv6 address 2001:172:20:20::f/64
```

```
!  
interface Vlan100  
!  
ip routing  
!  
router ospf 40  
    router-id 10.40.1.1  
    network 10.40.0.16/29 area 0.0.0.0  
    network 21.0.0.0/24 area 0.0.0.0  
    network 22.0.0.0/24 area 0.0.0.0  
    max-lsa 12000  
!  
router rip  
    network 21.0.0.0/24  
    network 22.0.0.0/24  
    no shutdown  
!  
R2:  
dhcp server  
    subnet 21.0.0.0/24  
        range 21.0.0.4 21.0.0.254  
        name VLAN10  
        default-gateway 21.0.0.1  
    !  
    subnet 22.0.0.0/24  
        range 22.0.0.4 22.0.0.254  
        name VLAN20  
        default-gateway 22.0.0.1  
    !  
    subnet 2100::/64  
        range 2100::4 2100::ffff:ffff:fffe  
        name VLAN10  
    !  
    subnet 2200::/64  
        range 2200::4 2200::ffff:ffff:fffe  
        name VLAN 20  
    !  
    subnet 2300::/64  
        range 2300::4 2300::ffff:ffff:fffe  
        name VLAN30  
    !  
vlan 10  
    name vlan10  
!  
vlan 20
```

```
    name vlan20
!
vlan 30
    name vlan30
!
interface Ethernet1
    no switchport
!
interface Ethernet1.10
    encapsulation dot1q vlan 10
    ip address 21.0.0.1/24
    dhcp server ipv4
    dhcp server ipv6
    ipv6 address 2100::1/64
!
interface Ethernet1.20
    encapsulation dot1q vlan 20
    ip address 22.0.0.1/24
    dhcp server ipv4
    dhcp server ipv6
    ipv6 address 2200::1/64
!
interface Ethernet1.30
    encapsulation dot1q vlan 30
    dhcp server ipv6
    ipv6 address 2300::1/64
!
interface Ethernet2
    no switchport
!
interface Ethernet2.40
    encapsulation dot1q vlan 40
    ip address 10.40.0.19/29
!
interface Ethernet2.100
    encapsulation dot1q vlan 100
    ip address 10.100.0.7/24
!
interface Loopback0
    ip address 10.40.2.1/32
!
interface Vlan10
    dhcp server ipv4
    dhcp server ipv6
!
```

```
interface Vlan20
    dhcp server ipv4
    dhcp server ipv6
!
interface Vlan30
    dhcp server ipv4
    dhcp server ipv6
!
ip routing
!
router ospf 40
    router-id 10.40.2.1
    network 10.40.0.16/29 area 0.0.0.0
    network 21.0.0.0/24 area 0.0.0.0
    network 22.0.0.0/24 area 0.0.0.0
    max-lsa 12000
!
router rip
    network 21.0.0.0/24
    network 22.0.0.0/24
    shutdown
!
R3:
interface Ethernet1
    no switchport
    ip address 10.40.0.9/30
!
interface Ethernet2
    no switchport
    ip address 10.40.0.1/30
!
interface Ethernet3
    no switchport
!
interface Ethernet3.40
    encapsulation dot1q vlan 40
    ip address 10.40.0.18/29
!
interface Ethernet3.100
    encapsulation dot1q vlan 100
    ip address 10.100.0.8/24
!
interface Loopback0
    ip address 10.40.3.1/32
!
```

```
interface Management0
  ip address 172.20.20.14/24
  ipv6 address 2001:172:20:20::e/64
!
ip routing
!
router bgp 65001
  router-id 10.40.3.1
  neighbor 10.40.0.2 remote-as 65005
  neighbor 10.40.0.10 remote-as 65001
  network 10.40.0.16/29
  network 10.40.3.1/32
  redistribute ospf
!
router ospf 40
  router-id 10.40.3.1
  redistribute bgp
  network 10.40.0.16/29 area 0.0.0.0
  max-lsa 12000
!
R4:
interface Ethernet1
  no switchport
  ip address 10.40.0.10/30
!
interface Ethernet2
  no switchport
  ip address 10.40.0.6/30
!
interface Ethernet3
  no switchport
!
interface Ethernet3.40
  encapsulation dot1q vlan 40
  ip address 10.40.0.17/29
!
interface Ethernet3.100
  encapsulation dot1q vlan 100
  ip address 10.100.0.9/24
!
interface Loopback0
  ip address 10.40.4.1/32
!
interface Management0
  ip address 172.20.20.12/24
```



```
    ipv6 address 2001:172:20:20::c/64
!
ip routing
!
router bgp 65001
    router-id 10.40.4.1
    neighbor 10.40.0.5 remote-as 65005
    neighbor 10.40.0.9 remote-as 65001
    network 10.40.0.16/29
    network 10.40.4.1/32
    redistribute ospf
!
router ospf 40
    router-id 10.40.4.1
    redistribute bgp
    network 10.40.0.16/29 area 0.0.0.0
    max-lsa 12000
!
R5:
interface Ethernet1
    no switchport
    ip address 10.40.0.2/30
!
interface Ethernet2
    no switchport
    ip address 10.40.0.5/30
!
interface Ethernet3
    no switchport
    ip address 1.1.1.1/30
!
interface Loopback0
    ip address 10.40.5.1/32
!
interface Management0
    ip address 172.20.20.20/24
    ipv6 address 2001:172:20:20::14/64
!
ip routing
!
router bgp 65005
    router-id 10.40.5.1
    maximum-paths 2
    neighbor 10.40.0.1 remote-as 65001
    neighbor 10.40.0.6 remote-as 65001
```

```
    network 1.1.1.0/30
    network 10.40.0.16/29
    network 10.40.5.1/32
!
S1:
vlan 10
    name HOST_10
!
vlan 20
    name HOST_20
!
vlan 30
    name HOST_30
!
vlan 200
    name MGMT
!
vlan 240
    name PROD
!
interface Ethernet1
    switchport mode trunk
!
interface Ethernet2
    switchport mode trunk
!
interface Ethernet3
    switchport access vlan 10
!
interface Ethernet4
    switchport access vlan 20
!
no ip routing
!
S2:
vlan 10
    name HOST_10
!
vlan 20
    name HOST_20
!
vlan 30
    name HOST_30
!
vlan 200
```

```

    name MGMT
!
vlan 240
    name PROD
!
interface Ethernet1
    switchport mode trunk
!
interface Ethernet2
    switchport mode trunk
!
interface Ethernet3
    switchport access vlan 10
!
interface Ethernet4
    switchport access vlan 30
!
interface Vlan40
!
S3:
vlan 40,100
    name PROD
!
interface Ethernet1
    switchport mode trunk
!
interface Ethernet2
    switchport mode trunk
!
interface Ethernet3
    switchport mode trunk
!
interface Ethernet4
    switchport access vlan 100
!
interface Management0
    ip address 172.20.20.22/24
    ipv6 address 2001:172:20:20::16/64
!
interface Vlan100
    ip address 10.100.0.3/24
!
no ip routing
!
S4:

```

```
vlan 40
  name PROD
!
vlan 100
  name MGMT
!
interface Ethernet1
  switchport mode trunk
!
interface Ethernet2
  switchport mode trunk
!
interface Ethernet3
  switchport mode trunk
!
interface Management0
  ip address 172.20.20.18/24
  ipv6 address 2001:172:20:20::12/64
!
interface Vlan100
  ip address 10.100.0.4/24
!
no ip routing
!
```

Once these configurations are installed, feel free to log into the hosts and test connectivity!