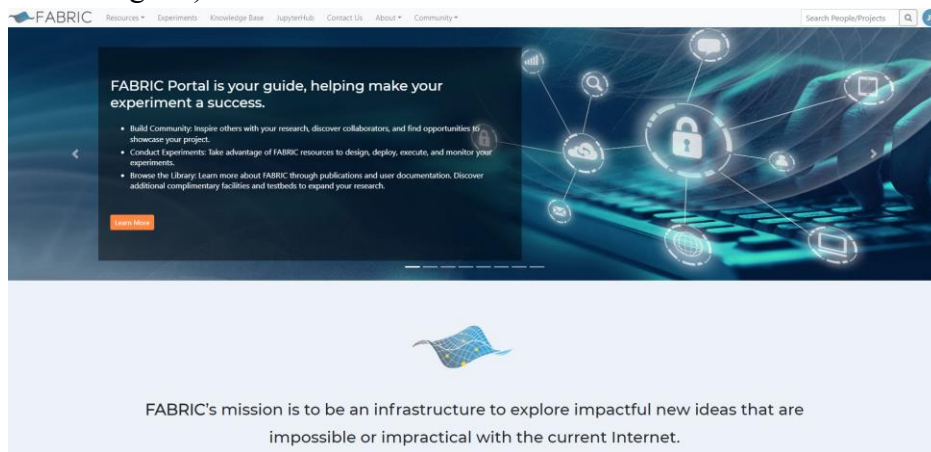# CLab 6
Routing with IPv4

CSCI 4406 – Computer Networks

Joshua Ludolf

- I logged into fabric portal and ran the create slice Jupyter notebook (no issues, took some time though…).

Retry: 1, Time: 41 sec

Slice

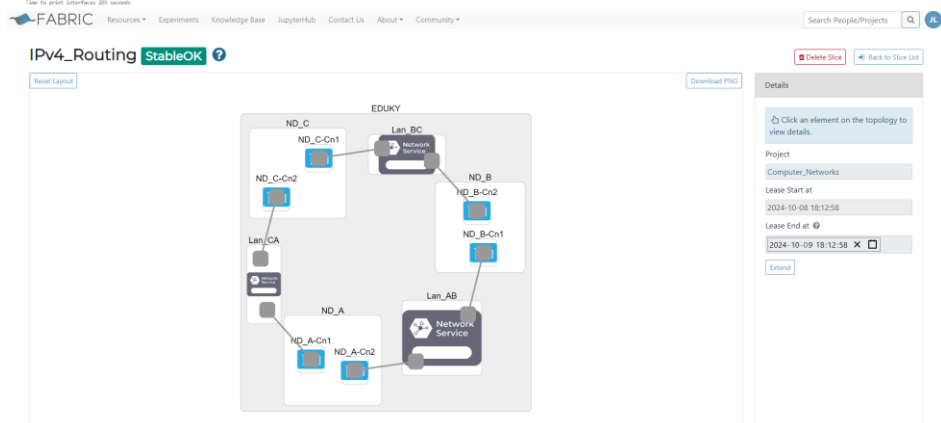| ID	80179030-8161-4289-95b9-28be083a3ef0
Name	IPv4_Routing
Lease Expiration (UTC)	2024-10-10 15:22:46 +0000
Lease Start (UTC)	2024-10-09 15:22:46 +0000
Project ID	a70de2f5-9e12-4b6b-b412-0ae1a2c553b0
State	Configuring

Slivers

ID	Name	Site	Type	State	Error
69026bac-bd31-4e06-807f-d5872d667495	ND_A	EDUKY	node	Ticketed	
b496cabe-86c4-44e9-bdfe-09b2f0257bd4	ND_B	EDUKY	node	Ticketed	
deb1da43-4518-4b7a-a742-2c8bbbd9e7b7	ND_C	EDUKY	node	Ticketed	
59c9f553-cdb2-48d9-8fdb-300d7bd68447	Lan_AB	EDUKY	network	Ticketed	
e0c94b58-2073-4708-ad37-c5075b943e7b	Lan_BC	EDUKY	network	Ticketed	
379e085d-fd28-4bb7-b7cd-6db86af875f6	Lan_CA	EDUKY	network	Ticketed	

- I ran and followed steps in the Routing with IPv4 Jupyter Notebook.

- This was the result of retrieving the IPv4 Slice (no issues).

- I logged into node A (in one terminal) and node C (in another terminal):

```
fabric@spring:CLab 6-16%$ ssh -i /home/fabric/work/fabric_config/slice_key -F /home/fabric/work/fabric_config/ssh_config ubuntu@2610:1e0:1700:206:f816:3eff:fe85:f8c4
Warning: Permanently added 'bastion.fabric-testbed.net' (ED25519) to the list of known hosts.
Warning: Permanently added '2610:1e0:1700:206:f816:3eff:fe85:f8c4' (ED25519) to the list of known hosts.
Welcome to Ubuntu 20.04.6 LTS (GNU/Linux 5.4.0-186-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

  System information as of Tue Oct  8 23:29:49 UTC 2024

  System load:             0.0
  Usage of /:              16.7% of 9.51GB
  Memory usage:            12%
  Swap usage:              0%
  Processes:               159
  Users logged in:         0
  IPv4 address for enp3s0: 10.30.6.227
  IPv6 address for enp3s0: 2610:1e0:1700:206:f816:3eff:fe85:f8c4


Expanded Security Maintenance for Applications is not enabled.

67 updates can be applied immediately.
49 of these updates are standard security updates.
To see these additional updates run: apt list --upgradable

1 additional security update can be applied with ESM Apps.
Learn more about enabling ESM Apps service at https://ubuntu.com/esm

New release '22.04.5 LTS' available.
Run 'do-release-upgrade' to upgrade to it.


Last login: Tue Oct  8 23:15:07 2024 from 2610:1e0:1700:205::51
ubuntu@NDA:~$ 
```

```
fabric@spring:CLab 6-16%$ ssh -i /home/fabric/work/fabric_config/slice_key -F /home/fabric/work/fabric_config/ssh_config ubuntu@2610:1e0:1700:206:f816:3eff:fe74:c5ba
Warning: Permanently added 'bastion.fabric-testbed.net' (ED25519) to the list of known hosts.
Warning: Permanently added '2610:1e0:1700:206:f816:3eff:fe74:c5ba' (ED25519) to the list of known hosts.
Welcome to Ubuntu 20.04.6 LTS (GNU/Linux 5.4.0-186-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

  System information as of Tue Oct  8 23:19:37 UTC 2024

  System load:             0.21
  Usage of /:              16.7% of 9.51GB
  Memory usage:            13%
  Swap usage:              0%
  Processes:               173
  Users logged in:         0
  IPv4 address for enp3s0: 10.30.9.133
  IPv6 address for enp3s0: 2610:1e0:1700:206:f816:3eff:fe74:c5ba


Expanded Security Maintenance for Applications is not enabled.

67 updates can be applied immediately.
49 of these updates are standard security updates.
To see these additional updates run: apt list --upgradable

1 additional security update can be applied with ESM Apps.
Learn more about enabling ESM Apps service at https://ubuntu.com/esm

New release '22.04.5 LTS' available.
Run 'do-release-upgrade' to upgrade to it.


Last login: Tue Oct  8 23:15:06 2024 from 2610:1e0:1700:205::51
ubuntu@NDC:~$ 
```

o I tried pinging from node A to node C (192.168.3.12), however it gave an expected result that was from the Jupyter Notebook (node A only has routes to node B and Node C only has routes to Node B):

```
ubuntu@NDA:~$ ping 192.168.3.12
ping: connect: Network is unreachable
```

o I tried adding route from node A to node C and then tried the same ping command (from previous step), but it doesn't work as the routes are for local machines:

```
ubuntu@NDA:~$ sudo route add 192.168.3.12 dev enp7s0
ubuntu@NDA:~$ ping 192.168.3.12
PING 192.168.3.12 (192.168.3.12) 56(84) bytes of data.
From 192.168.1.10 icmp_seq=1 Destination Host Unreachable
From 192.168.1.10 icmp_seq=2 Destination Host Unreachable
From 192.168.1.10 icmp_seq=3 Destination Host Unreachable
From 192.168.1.10 icmp_seq=4 Destination Host Unreachable
From 192.168.1.10 icmp_seq=5 Destination Host Unreachable
From 192.168.1.10 icmp_seq=6 Destination Host Unreachable
^C
--- 192.168.3.12 ping statistics ---
9 packets transmitted, 0 received, +6 errors, 100% packet loss, time 8197ms
pipe 3
ubuntu@NDA:~$ 
```

o I added the route from node C to node A:

```
ubuntu@NDC:~$ sudo route add 192.168.3.10 dev enp7s0
ubuntu@NDC:~$ 
```

o After that I tried to ping from node A to node C (I got different then the Jupyter notebook, I did everything like it said to do…):

```
ubuntu@NDA:~$ ping 192.168.3.12 -c 1
PING 192.168.3.12 (192.168.3.12) 56(84) bytes of data.
From 192.168.1.10 icmp_seq=1 Destination Host Unreachable

--- 192.168.3.12 ping statistics ---
1 packets transmitted, 0 received, +1 errors, 100% packet loss, time 0ms
```

• From there I moved on to the actual assignment part of the Jupyter notebook (I did additional research on Google and Stack Overflow)

o I figured I would need to port forward Node B after doing some additional research

```
ubuntu@NDB:~$ echo 1 | sudo tee /proc/sys/net/ipv4/ip_forward
1
```

o I added a route on Node A to reach 192.168.2.12 via Node B

```
ubuntu@NDA:~$ sudo ip route add 192.168.2.12 via 192.168.1.11
```

o Then I started to test the connection of Node A to 192.168.2.12

```
ubuntu@NDA:~$ ping 192.168.2.12 -c 1
PING 192.168.2.12 (192.168.2.12) 56(84) bytes of data.

--- 192.168.2.12 ping statistics ---
1 packets transmitted, 0 received, 100% packet loss, time 0ms
```

- Finally, I traceroute from Node A to IP Address 192.168.2.12 (actually had no issues and ran fine!)

```
ubuntu@NDA:~$ traceroute 192.168.2.12
traceroute to 192.168.2.12 (192.168.2.12), 30 hops max, 60 byte packets
 1  192.168.1.11 (192.168.1.11)  0.093 ms  0.080 ms  0.076 ms
 2  * * *
 3  * * *
 4  * * *
 5  * * *
 6  * * *
 7  * * *
 8  * * *
 9  * * *
10  * * *
11  * * *
12  * * *
13  * * *
14  * * *
15  * * *
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
```

  - When I ran traceroute from NodeA to 192.168.2.12, it shows the path packets take to reach their destination. I saw each hop along the way, which was particularly useful for verifying that traffic routes correctly through Node B.

- Summary:

  From this lab, I learned how to configure and verify static routing. This can be achieved by enabling IP forwarding and modifying routing tables on different nodes, additionally, ensured that traffic from Node A could reach a specific IP address via an intermediary node, Node B. Furthermore, I used to traceroute command to confirm the correctness in the flow of the network traffic and verified my routing configuration was successful. This hands-on experience deepened my understanding of the importance of network management and troubleshooting.