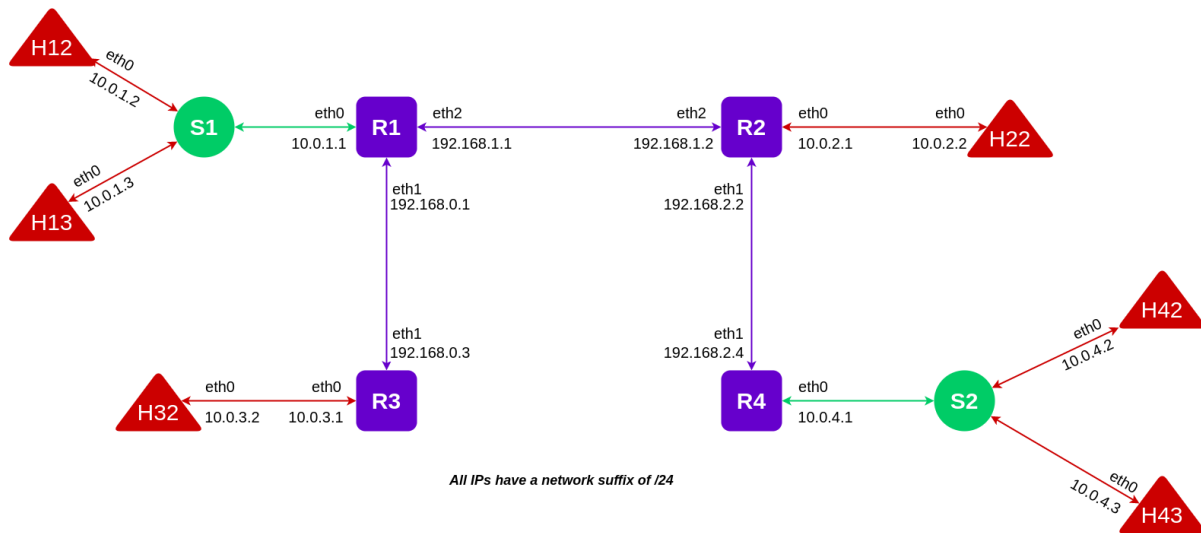# NC864 SDN - Assignment 2

By: **Shathin R Rao [MT2020067]**

Repository: **github.com/Shathin/nc864-sdn**

Target Network

Target Network consisting of 6 hosts, 2 switches and 4 routers.

The above diagram shows the target networks with the additional neccessary assumptions made based on the target network shown in the problem statement.

Following are the different subnets and hosts in those networks -

- $10.0.1.0/24 \rightarrow R1 - eth0$, $H12$, $H13$ and $S1$.

- $10.0.2.0/24 \rightarrow R2 - eth0$ and $H22$

- $10.0.3.0/24 \rightarrow R3 - eth0$ and $H32$

- $10.0.4.0/24 \rightarrow R4 - eth0$, $H42$, $H43$ and $S2$.

- $192.168.0.0/24 \rightarrow R1 - eth1$ and $R3 - eth1$

- $192.168.1.0/24 \rightarrow R1 - eth2$ and $R2 - eth2$

- $192.168.2.0/24 \rightarrow R2 - eth1$ and $R4 - eth1$

Scripts

Two scripts are available for execution `assignment2_routing1.py` and `assignment2_routing2.py` .

```
sudo python3 script.py
```

Both the scripts create the same target network but differ in the connectivity provided for the hosts in the network.

`assignment2_routing1.py`

This scripts creates the target network and allows all hosts $H12$. $H13$. $H22$, $H32$, $H42$ and $H43$ to be able to ping each other.

`assignment2_routing2.py`

This script creates the target network and allows hosts $H12$. $H13$. $H22$, $H32$, $H42$ and $H43$ to be able to ping each other with the exception of $H12$ being able to ping $H22$ (and vice-versa).

> 📌 Be sure to clean up before executing the script for another time. Run `sudo mn -c` command to perform the cleanup.

Results

`assignment2_routing1.py`

Executing the topology file `assignment2_routing1.py`

```
*** Testing connectivity before setting up routing rules
*** Ping: testing ping reachability
h12 -> h13 X X X X r1 X X X
h13 -> h12 X X X X r1 X X X
h22 -> X X X X X X r2 X X
h32 -> X X X X X X X r3 X
h42 -> X X X X h43 X X X r4
h43 -> X X X X h42 X X X r4
r1 -> h12 h13 X X X X X X X
r2 -> X X h22 X X X X X X
r3 -> X X X h32 X X X X X
r4 -> X X X X h42 h43 X X X
*** Results: 82% dropped (16/90 received)

*** Setup routing rules

*** Testing connectivity after setting up routing rules
*** Ping: testing ping reachability
h12 -> h13 h22 h32 h42 h43 r1 r2 r3 r4
h13 -> h12 h22 h32 h42 h43 r1 r2 r3 r4
h22 -> h12 h13 h32 h42 h43 r1 r2 r3 r4
h32 -> h12 h13 h22 h42 h43 r1 r2 r3 r4
h42 -> h12 h13 h22 h32 h43 r1 r2 r3 r4
h43 -> h12 h13 h22 h32 h42 r1 r2 r3 r4
r1 -> h12 h13 h22 h32 X X r2 r3 X
r2 -> h12 h13 h22 X h42 h43 r1 X r4
r3 -> h12 h13 X h32 X X r1 X X
r4 -> X X h22 X h42 h43 X r2 X
*** Results: 16% dropped (75/90 received)
```

Connectivity test before and after adding routing rules

```
mininet> h12 ping -c2 h43
PING 10.0.4.3 (10.0.4.3) 56(84) bytes of data.
64 bytes from 10.0.4.3: icmp_seq=1 ttl=61 time=0.386 ms
64 bytes from 10.0.4.3: icmp_seq=2 ttl=61 time=0.256 ms

--- 10.0.4.3 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1011ms
rtt min/avg/max/mdev = 0.256/0.321/0.386/0.065 ms
mininet>
mininet>
mininet> h12 traceroute h43
traceroute to 10.0.4.3 (10.0.4.3), 64 hops max
  1   10.0.1.1   2.119ms   1.148ms   0.476ms
  2   192.168.1.2   2.689ms   1.336ms   0.015ms
  3   *  *  *
  4   10.0.4.3   3.368ms   0.568ms   0.498ms
```

Connectivity (ping and traceroute) between $H12$ to $H43$

```
mininet> h32 ping -c2 h22
PING 10.0.2.2 (10.0.2.2) 56(84) bytes of data.
64 bytes from 10.0.2.2: icmp_seq=1 ttl=61 time=0.180 ms
64 bytes from 10.0.2.2: icmp_seq=2 ttl=61 time=0.167 ms

--- 10.0.2.2 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1020ms
rtt min/avg/max/mdev = 0.167/0.173/0.180/0.006 ms
mininet>
mininet>
mininet> h32 traceroute h22
traceroute to 10.0.2.2 (10.0.2.2), 64 hops max
  1   10.0.3.1  0.013ms  0.008ms  0.006ms
  2   192.168.0.1  0.007ms  0.011ms  0.009ms
  3   *  *  *
  4   10.0.2.2  0.013ms  0.011ms  0.010ms
```

Connectivity (`ping` and `traceroute`) between $H32$ to $H22$

```
mininet> h22 ping -c2 h32
PING 10.0.3.2 (10.0.3.2) 56(84) bytes of data.
64 bytes from 10.0.3.2: icmp_seq=1 ttl=61 time=0.248 ms
64 bytes from 10.0.3.2: icmp_seq=2 ttl=61 time=0.167 ms

--- 10.0.3.2 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1017ms
rtt min/avg/max/mdev = 0.167/0.207/0.248/0.040 ms
mininet>
mininet>
mininet> h22 traceroute h32
traceroute to 10.0.3.2 (10.0.3.2), 64 hops max
  1   10.0.2.1  0.003ms  0.002ms  0.002ms
  2   192.168.1.1  0.002ms  0.001ms  0.002ms
  3   *  *  *
  4   10.0.3.2  0.017ms  0.301ms  0.016ms
```

Connectivity (`ping` and `traceroute`) between $H22$ to $H32$

`assignment2_routing2.py`

```
ryuu@shathin-ubuntu:~/.../assignment-2$ sudo python3 assignment2_routing2.py && sudo mn -c

*** Creating topology
*** *** Adding routers
*** *** Adding network under Router r1
*** *** Adding network under Router r2
*** *** Adding network under Router r3
*** *** Adding network under Router r4
*** *** Connecting routers
*** Topology creation complete
*** Creating network
*** Adding controller
*** Adding hosts:
h12 h13 h22 h32 h42 h43 r1 r2 r3 r4
*** Adding switches:
s1 s4
*** Adding links:
(h22, r2) (h32, r3) (r1, r2) (r1, r3) (r2, r4) (s1, h12) (s1, h13) (s1, r1) (s4, h42) (s4, h43) (s4, r4)
*** Configuring hosts
h12 h13 h22 h32 h42 h43 r1 r2 r3 r4
*** Starting controller
c0
*** Starting 2 switches
s1 s4 ...
```

Executing the topology file `assignment2_routing2.py`

```
*** Testing connectivity before setting up routing rules
*** Ping: testing ping reachability
h12 -> X X X X X r1 X X X
h13 -> h12 X X X X r1 X X X
h22 -> X X X X X X r2 X X
h32 -> X X X X X X X r3 X
h42 -> X X X X h43 X X X r4
h43 -> X X X X h42 X X X r4
r1 -> h12 h13 X X X X X X X
r2 -> X X h22 X X X X X X
r3 -> X X X h32 X X X X X
r4 -> X X X X h42 h43 X X X
*** Results: 83% dropped (15/90 received)

*** Setup routing rules

*** Testing connectivity after setting up routing rules
*** Ping: testing ping reachability
h12 -> h13 h22 h32 h42 h43 r1 r2 r3 r4
h13 -> h12 h22 h32 h42 h43 r1 r2 r3 r4
h22 -> h12 h13 h32 h42 h43 r1 r2 r3 r4
h32 -> h12 h13 h22 h42 h43 r1 r2 r3 r4
h42 -> h12 h13 h22 h32 h43 r1 r2 r3 r4
h43 -> h12 h13 h22 h32 h42 r1 r2 r3 r4
r1 -> h12 h13 h22 h32 X X r2 r3 X
r2 -> h12 h13 h22 X h42 h43 r1 X r4
r3 -> h12 h13 X h32 X X r1 X X
r4 -> X X h22 X h42 h43 X r2 X
*** Results: 16% dropped (75/90 received)

*** Adding new routing rule to make h22 not pingable from h12
*** Testing connectivity after updating routing rules *** Ping: testing ping reachability
h12 -> h13 X h32 h42 h43 r1 r2 r3 r4
h13 -> h12 h22 h32 h42 h43 r1 r2 r3 r4
h22 -> X h13 h32 h42 h43 r1 r2 r3 r4
h32 -> h12 h13 h22 h42 h43 r1 r2 r3 r4
h42 -> h12 h13 h22 h32 h43 r1 r2 r3 r4
h43 -> h12 h13 h22 h32 h42 r1 r2 r3 r4
r1 -> h12 h13 h22 h32 X X r2 r3 X
r2 -> h12 h13 h22 X h42 h43 r1 X r4
r3 -> h12 h13 X h32 X X r1 X X
r4 -> X X h22 X h42 h43 X r2 X
*** Results: 18% dropped (73/90 received)
```

Connectivity test before and after adding routing rules and updating the routing rules

```
ryuu@shathin-ubuntu:~/.../assignment-2$ diff assignment2_routing1.py assignment2_routing2.py
122a123,130
> info("\n*** Adding new routing rule to make h22 not pingable from h12")
> # * h12 <-x-> h22
> net["r2"].cmd("iptables -A FORWARD -s 10.0.1.2 -d 10.0.2.2 -j REJECT") # * iptables method
> # net["r2"].cmd("ip rule add prohibit from 10.0.1.2 to 10.0.2.2") # * ip rule method
>
> info("\n*** Testing connectivity after updating routing rules ")
> net.pingAll(timeout=pingTimeout)
>
```

Result of executing the `diff` command on the two topology files `assignment2_routing1.py` and `assignment2_routing2.py`