Creating a static routing in Mininet:
Implement routing logic in an Openflow controller over Mininet

Assignment 2 report

Computer Science and Engineering

by

GROUP 2

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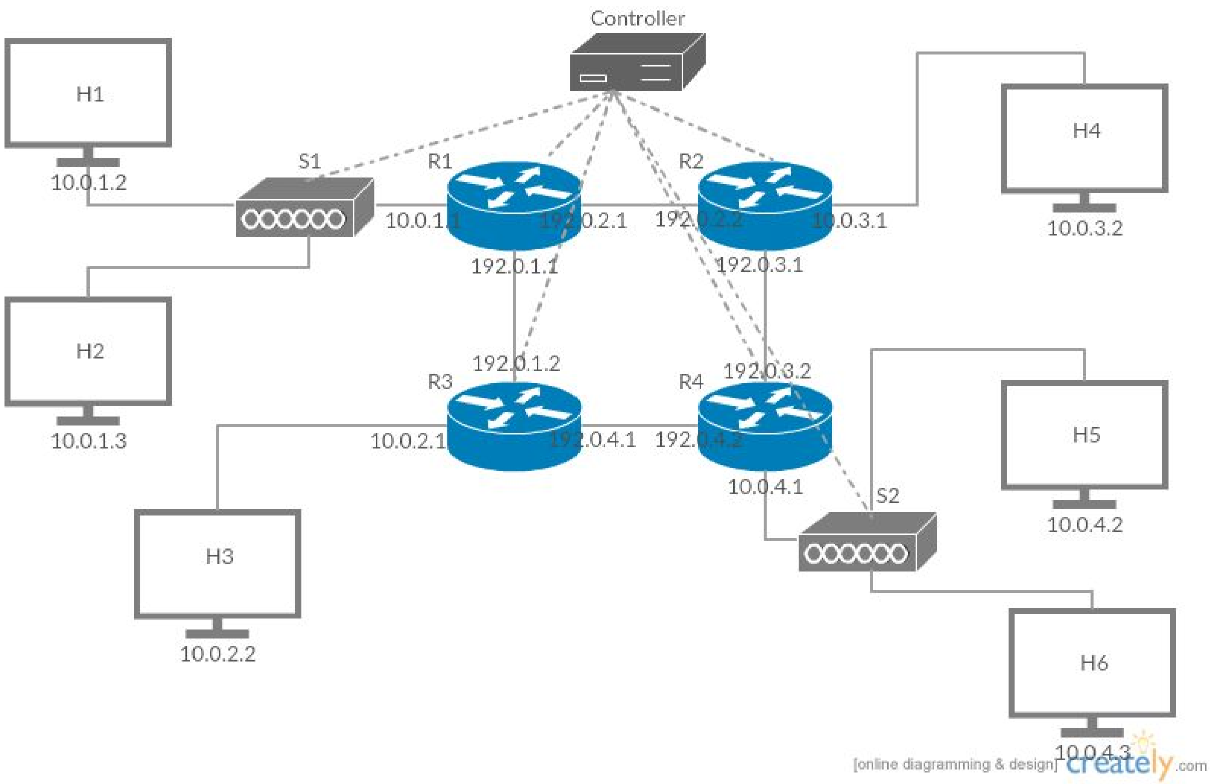
➢Network Topology



➢Routing Tables:

R1:

Destination	Gateway	Netmask	Interface
10.0.1.2	10.0.1.2	255.255.255.255	r1-eth1
10.0.1.3	10.0.1.3	255.255.255.255	r1-eth1

10.0.3.0	192.0.2.2	255.255.255.0	r1-eth3
10.0.2.0	192.0.1.2	255.255.255.0	r1-eth2
10.0.4.0	192.0.1.2	255.255.255.0	r1-eth2
192.0.2.0	192.0.2.2	255.255.255.0	r1-eth3
192.0.1.0	192.0.1.2	255.255.255.0	r1-eth2
192.0.3.0	192.0.2.2	255.255.255.0	r1-eth3
192.0.4.0	192.0.1.2	255.255.255.0	r1-eth2
0.0.0.0	192.0.1.2	0.0.0.0	r1-eth2

R2:

Destination	Gateway	Netmask	Interface
10.0.3.2	10.0.3.2	255.255.255.255	r2-eth1
10.0.1.0	192.0.2.1	255.255.255.0	r2-eth2
10.0.2.0	192.0.3.2	255.255.255.0	r2-eth3
10.0.4.0	192.0.3.2	255.255.255.0	r2-eth2
192.0.1.0	192.0.2.1	255.255.255.0	r2-eth2
192.0.2.0	192.0.2.1	255.255.255.0	r2-eth2
192.0.3.0	192.0.3.2	255.255.255.0	r2-eth3
192.0.4.0	192.0.3.2	255.255.255.0	r2-eth3
0.0.0.0	10.0.3.2	0.0.0.0	r2-eth1

R3:

Destination	Gateway	Netmask	Interface
10.0.2.2	10.0.2.2	255.255.255.255	r3-eth1
10.0.1.0	192.0.1.1	255.255.255.0	r3-eth2
10.0.3.0	192.0.1.1	255.255.255.0	r3-eth2
10.0.4.0	192.0.4.2	255.255.255.0	r3-eth3
192.0.1.0	192.0.1.1	255.255.255.0	r3-eth2
192.0.2.0	192.0.1.1	255.255.255.0	r3-eth2
192.0.3.0	192.0.4.2	255.255.255.0	r3-eth3
192.0.4.0	192.0.4.2	255.255.255.0	r3-eth3
0.0.0.0	10.0.2.2	0.0.0.0	r3-eth1

R4:

Destination	Gateway	Netmask	Interface
10.0.4.2	10.0.4.2	255.255.255.255	r4-eth1
10.0.4.3	10.0.4.3	255.255.255.255	r4-eth1
10.0.1.0	192.0.4.1	255.255.255.0	r4-eth3
10.0.2.0	192.0.4.1	255.255.255.0	r4-eth3
10.0.3.0	192.0.3.1	255.255.255.0	r4-eth2
192.0.1.0	192.0.4.1	255.255.255.0	r4-eth3
192.0.2.0	192.0.3.1	255.255.255.0	r4-eth2
192.0.3.0	192.0.3.1	255.255.255.0	r4-eth2
192.0.4.0	192.0.4.1	255.255.255.0	r4-eth3
0.0.0.0	10.0.4.1	0.0.0.0	r4-eth1

➢H1 to all other hosts:

```
mininet> h1 ping -c 1 h2
PING 10.0.1.3 (10.0.1.3) 56(84) bytes of data.
64 bytes from 10.0.1.3: icmp_seq=1 ttl=63 time=73.0 ms

--- 10.0.1.3 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 73.018/73.018/73.018/0.000 ms
mininet>
mininet> h1 ping -c 1 h3
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=62 time=110 ms

--- 10.0.2.2 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 110.258/110.258/110.258/0.000 ms
mininet>
mininet> h1 ping -c 1 h4
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=62 time=81.8 ms

--- 10.0.3.2 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 81.857/81.857/81.857/0.000 ms
mininet>
mininet> h1 ping -c 1 h5
PING 10.0.4.2 (10.0.4.2) 56(84) bytes of data.
64 bytes from 10.0.4.2: icmp_seq=1 ttl=61 time=160 ms

--- 10.0.4.2 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 160.482/160.482/160.482/0.000 ms
mininet>
mininet> h1 ping -c 1 h6
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=72.1 ms

--- 10.0.4.3 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 72.192/72.192/72.192/0.000 ms
mininet>
```

➢H1 to IP 10.0.5.2

```
mininet> h1 ping -c 1 10.0.5.2
PING 10.0.5.2 (10.0.5.2) 56(84) bytes of data.
From 10.0.1.1 icmp_seq=1 Destination Net Unreachable

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

➢ Traceroute H2 to all other hosts:

```
root@mininet-vm:~/mininet-sdn# traceroute 10.0.1.2
traceroute to 10.0.1.2 (10.0.1.2), 30 hops max, 60 byte packets
 1  10.0.1.1 (10.0.1.1)  142.657 ms  144.476 ms  146.189 ms
 2  10.0.1.2 (10.0.1.2)  281.161 ms  280.899 ms  280.887 ms
root@mininet-vm:~/mininet-sdn#
root@mininet-vm:~/mininet-sdn# traceroute 10.0.2.2
traceroute to 10.0.2.2 (10.0.2.2), 30 hops max, 60 byte packets
 1  10.0.1.1 (10.0.1.1)  143.485 ms  148.059 ms  145.917 ms
 2  192.0.1.2 (192.0.1.2)  253.558 ms  251.719 ms  234.207 ms
 3  10.0.2.2 (10.0.2.2)  284.501 ms  274.311 ms  322.019 ms
root@mininet-vm:~/mininet-sdn#
root@mininet-vm:~/mininet-sdn# traceroute 10.0.3.2
traceroute to 10.0.3.2 (10.0.3.2), 30 hops max, 60 byte packets
 1  10.0.1.1 (10.0.1.1)  203.018 ms  204.712 ms  206.644 ms
 2  192.0.2.2 (192.0.2.2)  264.207 ms  264.175 ms  264.100 ms
 3  10.0.3.2 (10.0.3.2)  359.961 ms  282.750 ms  359.771 ms
root@mininet-vm:~/mininet-sdn#
root@mininet-vm:~/mininet-sdn# traceroute 10.0.4.2
traceroute to 10.0.4.2 (10.0.4.2), 30 hops max, 60 byte packets
 1  10.0.1.1 (10.0.1.1)  179.368 ms  178.518 ms  178.031 ms
 2  192.0.2.2 (192.0.2.2)  277.681 ms  277.245 ms  276.813 ms
 3  192.0.3.2 (192.0.3.2)  359.731 ms  319.338 ms  359.679 ms
 4  10.0.4.2 (10.0.4.2)  435.704 ms  435.606 ms  435.703 ms
root@mininet-vm:~/mininet-sdn#
root@mininet-vm:~/mininet-sdn# traceroute 10.0.4.3
traceroute to 10.0.4.3 (10.0.4.3), 30 hops max, 60 byte packets
 1  10.0.1.1 (10.0.1.1)  202.509 ms  205.206 ms  207.275 ms
 2  192.0.2.2 (192.0.2.2)  291.969 ms  291.480 ms  291.032 ms
 3  192.0.3.2 (192.0.3.2)  378.865 ms  338.359 ms  378.772 ms
 4  10.0.4.3 (10.0.4.3)  427.761 ms  466.578 ms  466.562 ms
root@mininet-vm:~/mininet-sdn#
```

➢ Traceroute H2 to IP 10.0.9.2:

"Node: h2"

```
root@mininet-vm:~/mininet-sdn# traceroute 10.0.9.2
traceroute to 10.0.9.2 (10.0.9.2), 30 hops max, 60 byte packets
 1  10.0.1.1 (10.0.1.1)  151.908 ms  154.187 ms  156.048 ms
 2  10.0.1.1 (10.0.1.1)  158.332 ms !N  197.126 ms !N  197.110 ms !N
```

➢ Traceroute H2 to IP 10.0.4.9:

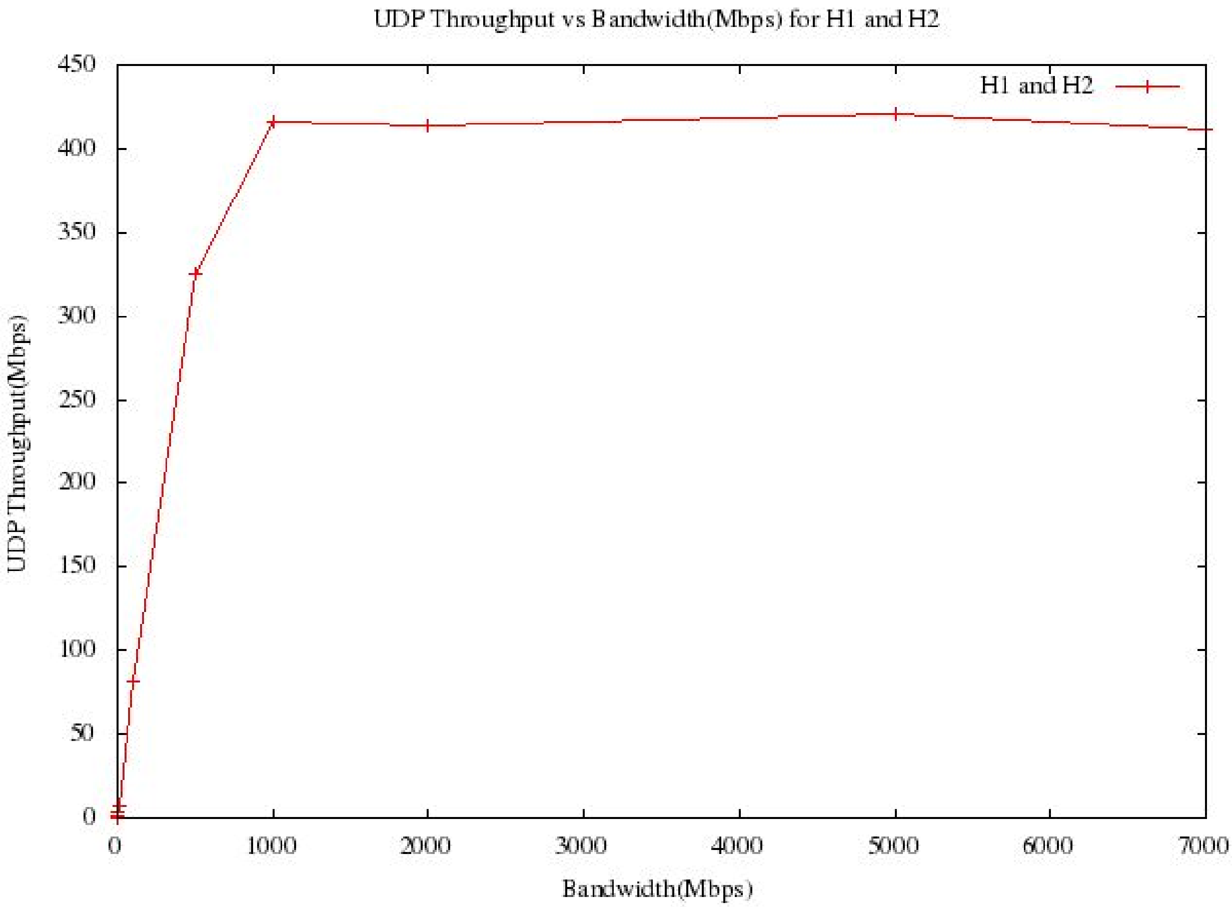
"Node: h2"

```
root@mininet-vm:~/mininet-sdn# traceroute 10.0.4.9
traceroute to 10.0.4.9 (10.0.4.9), 30 hops max, 60 byte packets
 1  10.0.1.1 (10.0.1.1)  183.289 ms  185.602 ms  187.961 ms
 2  192.0.2.2 (192.0.2.2)  280.728 ms  279.979 ms  279.533 ms
 3  192.0.3.2 (192.0.3.2)  390.581 ms  390.563 ms  390.548 ms
 4  192.0.3.2 (192.0.3.2)  390.448 ms !H  373.910 ms !H  390.400 ms !H
```

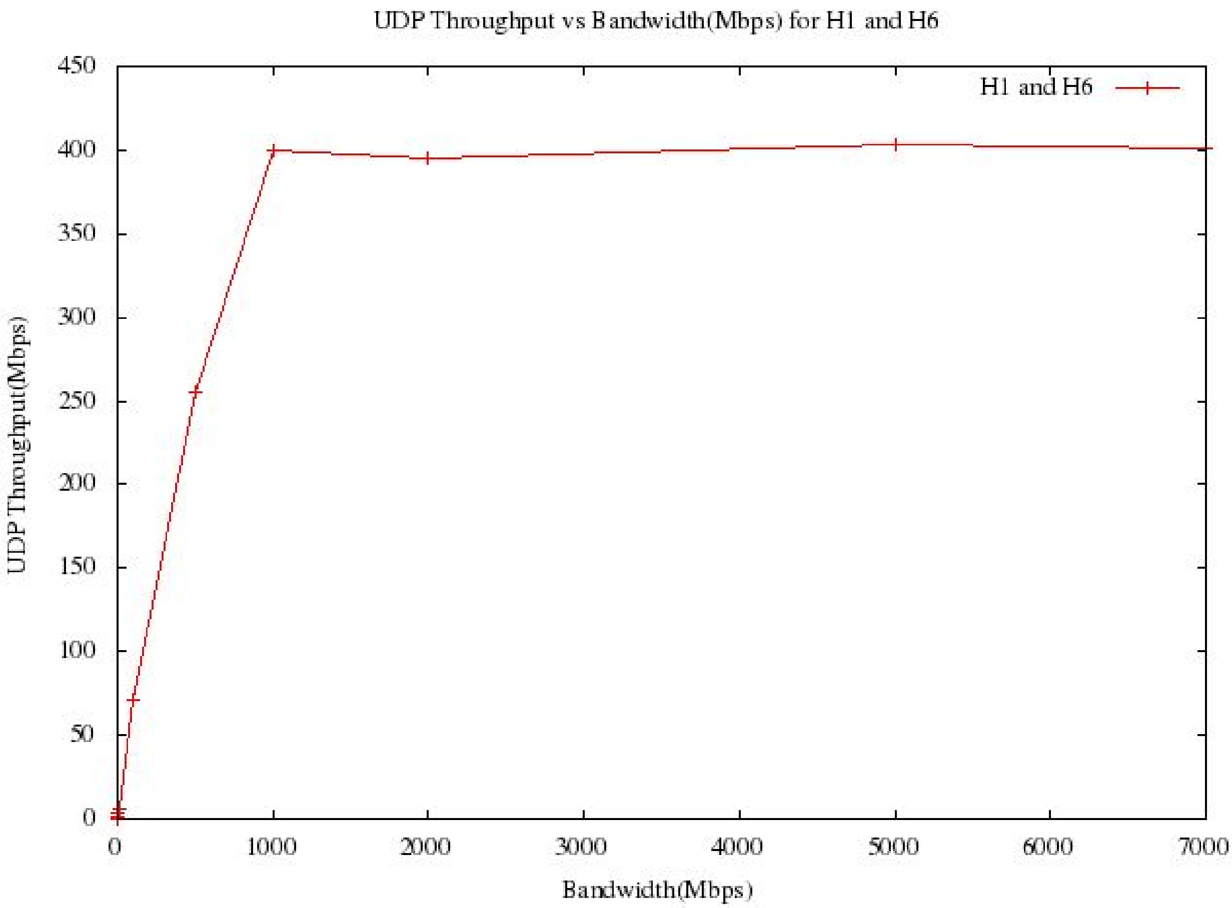
➢ TCP Throughput between H1 and all other hosts:

Host	Throughput (Mbps)
H2	321
H3	317
H4	318
H5	316
H6	315

➢Bandwidth vs UDP Throughput H1 and H2:



➢ Bandwidth vs UDP Throughput H1 and H6:



➢ Observations:

1. The concept of centralized server provides a lot of flexibility in tweaking the network based on the network application requirements. Physically changing this on each and every device would be very infeasible.
2. Network delay is reduced to a great extent by adding open-flow entries in the devices. The time taken for communication between controller and device takes a lot of time.
3. TCP throughput decreases as one moves farther from H1 (i.e. as the number of hops increases). However the change is not too much.
4. UDP throughput increases with bandwidth and then becomes constant (gets saturated).
5. UDP throughput is more for H1 and H2 compared to H1 and H6. Thus it decreases as the number of hops increases.

- Group contribution:

Equal.