

## Steps followed in execution

- 1) Wrote all the python scripts.
- 2) Then `scp -r scripts mininet@192.168.56.101:~` from ubuntu terminal.
- 3) Then created a topology with scripts with this command  
`sudo mn --custom ~/scripts/ass1.py --topo mytopo --link tc`
- 4) `iperf h2 h1` for TCP throughput.
- 5) `iperfudp bw h1 h2` for UDP throughput.

# Part-1

## 1)TCP Throughput

Results: ['958 Kbits/sec', '1.53 Mbits/sec']

## 2)UDP Throughput

Bandwidth	Throughput
64 Kbps	64 Kbps
128 Kbps	128 Kbps
256 Kbps	256 Kbps
512 Kbps	512 Kbps
1024 Kbps	975 Kbps
2048 Kbps	973 Kbps
4096 Kbps	973 Kbps

## Part-2A

1)TCP Throughput(BW=512 Kbps and delay=1ms)

Results: ['479 Kbits/sec', '950 Kbits/sec']

2)UDP Throughput (BW=512 Kbps and delay=1ms)

Bandwidth	Throughput
64 Kbps	64 Kbps
128 Kbps	128 Kbps
256 Kbps	256 Kbps
512 Kbps	489 Kbps
1024 Kbps	487 Kbps
2048 Kbps	487 Kbps
4096 Kbps	487 Kbps

## Part-2B

1)TCP Throughput(BW=512 Kbps and delay=10ms)

Results: ['479 Kbits/sec', '911 Kbits/sec']

2)UDP Throughput (BW=512 Kbps and delay=10ms)

Bandwidth	Throughput
64 Kbps	64 Kbps
128 Kbps	128 Kbps
256 Kbps	256 Kbps
512 Kbps	489 Kbps
1024 Kbps	487 Kbps
2048 Kbps	487 Kbps
4096 Kbps	487 Kbps

## Part-2C

1)TCP Throughput(BW=512 Kbps and delay=100ms)

Results: ['479 Kbits/sec', '882 Kbits/sec']

2)UDP Throughput (BW=512 Kbps and delay=10ms)

Bandwidth	Throughput
64 Kbps	64 Kbps
128 Kbps	128 Kbps
256 Kbps	256 Kbps
512 Kbps	489 Kbps
1024 Kbps	487 Kbps
2048 Kbps	487 Kbps
4096 Kbps	487 Kbps

## Part-2D

1)TCP Throughput(BW=1 Mbps and delay=1ms)

Results: ['958 Kbits/sec', '1.53 Mbits/sec']

2)UDP Throughput (BW=1 Mbps and delay=1ms)

Bandwidth	Throughput
64 Kbps	64 Kbps
128 Kbps	128 Kbps
256 Kbps	256 Kbps
512 Kbps	512 Kbps
1024 Kbps	975 Kbps
2048 Kbps	974 Kbps
4096 Kbps	973 Kbps

## Part-2E

1)TCP Throughput(BW=1 Mbps and delay=10ms)

Results: ['958 Kbits/sec', '1.51 Mbits/sec']

2)UDP Throughput (BW=1 Mbps and delay=10ms)

Bandwidth	Throughput
64 Kbps	64 Kbps
128 Kbps	128 Kbps
256 Kbps	256 Kbps
512 Kbps	512 Kbps
1024 Kbps	975 Kbps
2048 Kbps	974 Kbps
4096 Kbps	973 Kbps

## Part-2F

1)TCP Throughput(BW=1 Mbps and delay=100ms)

Results: ['948 Kbits/sec', '1.68 Mbits/sec']

2)UDP Throughput (BW=1 Mbps and delay=100ms)

Bandwidth	Throughput
64 Kbps	64 Kbps
128 Kbps	128 Kbps
256 Kbps	256 Kbps
512 Kbps	512 Kbps
1024 Kbps	975 Kbps
2048 Kbps	974 Kbps
4096 Kbps	973 Kbps



## Part-2G

1)TCP Throughput(BW=2 Mbps and delay=1ms)

Results: ['1.91 Mbits/sec', '2.69 Mbits/sec']

2)UDP Throughput (BW=2 Mbps and delay=1ms)

Bandwidth	Throughput
64 Kbps	64 Kbps
128 Kbps	128 Kbps
256 Kbps	256 Kbps
512 Kbps	512 Kbps
1024 Kbps	1.02 Mbps
2048 Kbps	1.95 Mbps
4096 Kbps	1.95 Mbps

## Part-2H

1)TCP Throughput(BW=2 Mbps and delay=10ms)

Results: ['1.91 Mbits/sec', '2.68 Mbits/sec']

2)UDP Throughput (BW=2 Mbps and delay=10ms)

Bandwidth	Throughput
64 Kbps	64 Kbps
128 Kbps	128 Kbps
256 Kbps	256 Kbps
512 Kbps	512 Kbps
1024 Kbps	1.02 Mbps
2048 Kbps	1.95 Mbps
4096 Kbps	1.95 Mbps

## Part-2I

1)TCP Throughput(BW=2 Mbps and delay=100ms)

Results: ['1.86 Mbits/sec', '2.82 Mbits/sec']

2)UDP Throughput (BW=2 Mbps and delay=100ms)

Bandwidth	Throughput
64 Kbps	64 Kbps
128 Kbps	128 Kbps
256 Kbps	256 Kbps
512 Kbps	512 Kbps
1024 Kbps	1.02 Mbps
2048 Kbps	1.95 Mbps
4096 Kbps	1.95 Mbps

**1) What is the effect of S1-S2 link bandwidth on TCP and UDP throughput ?**

As s1-s2 bandwidth increases both tcp and udp throughput increases because the allowed speed at each junction is feasibly increasing . For udp throughput, saturation value also increases.

**2) What is the effect of S1-S2 link delay on TCP and UDP throughput ?**

As s1-s2 link delay increases, there is no difference in UDP throughput because in delay and out delay are same.

However tcp throughput decreases by a very small amount.

## Part-3A

### 1)TCP Throughput(loss=1%)

Results: ['945 Kbits/sec', '1.04 Mbits/sec']

### 2)UDP Throughput (loss=1%)

Bandwidth	Throughput
64 Kbps	64 Kbps
128 Kbps	123 Kbps
256 Kbps	249 Kbps
512 Kbps	489 Kbps
1024 Kbps	959 Kbps
2048 Kbps	941 Kbps
4096 Kbps	951 kbps

## Part-3B

### 1)TCP Throughput(loss=3%)

Results: ['1.03 Mbits/sec', '1.22 Mbits/sec']

### 2)UDP Throughput (loss=3%)

Bandwidth	Throughput
64 Kbps	61.8 Kbps
128 Kbps	127 Kbps
256 Kbps	240 Kbps
512 Kbps	486 Kbps
1024 Kbps	931 Kbps
2048 Kbps	936 Kbps
4096 Kbps	934 kbps

## Part-3C

### 1)TCP Throughput(loss=5%)

Results: ['957 Kbits/sec', '977 Kbits/sec']

### 2)UDP Throughput (loss=5%)

Bandwidth	Throughput
64 Kbps	57.4 Kbps
128 Kbps	119 Kbps
256 Kbps	231 Kbps
512 Kbps	482 Kbps
1024 Kbps	908 Kbps
2048 Kbps	912 Kbps
4096 Kbps	906 kbps

## Part-3D

### 1)TCP Throughput(loss=10%)

Results: ['524 Kbits/sec', '991 Kbits/sec']

### 2)UDP Throughput (loss=10%)

Bandwidth	Throughput
64 Kbps	53.0 Kbps
128 Kbps	111 Kbps
256 Kbps	226 Kbps
512 Kbps	447 Kbps
1024 Kbps	867 Kbps
2048 Kbps	852 Kbps
4096 Kbps	861 kbps



## Part-3E

### 1)TCP Throughput(loss=15%)

Results: ['93.1 Kbits/sec', '174 Kbits/sec']

### 2)UDP Throughput (loss=15%)

Bandwidth	Throughput
64 Kbps	57.4 Kbps
128 Kbps	101 Kbps
256 Kbps	210 Kbps
512 Kbps	409 Kbps
1024 Kbps	804 Kbps
2048 Kbps	802 Kbps
4096 Kbps	802 kbps

## Part-3

**What is your observation regarding the impact of loss rate on the TCP and UDP throughput performance?**

As s1-s2 loss increases udp throughput decreases because data is begin lost, while tcp throughput, initially increases by a small amount and then, decreases drastically because initially at the junction the data saving time decreases, increasing the throughput speed, but then the data is lost very much, which decreases the throughput speed.