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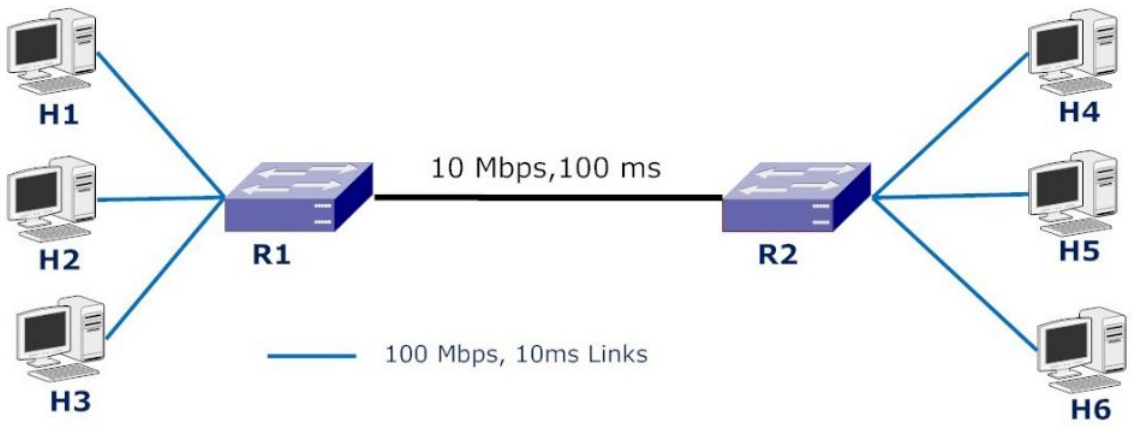
Assignment 4 - Network Simulation Using ns-3

Application

Compare the effect of buffer size on TCP and UDP flows. Select a Dumbbell topology with two routers R1 and R2 connected by a (10 Mbps, 100 ms) link. Each of the routers is connected to 3 hosts, i.e. H1, H2, H3 are connected to R1, and H4, H5, H6 are connected to R2. All the hosts are attached to the routers with (100 Mbps, 10 ms) links. Both the routers (i.e. R1 and R2) use drop-tail queues with equal queue size set according to the bandwidth-delay product. Choose a packet size of 1.5 KB. Start 3 TCP New Reno flows, and after a while start 3 CBR over UDP flows each with 20 Mbps. These flows are randomly distributed across H1, H2 and H3. Increase the rate of one UDP flow up to 100 Mbps and observe its impact on the throughput of the TCP flows and the other UDP flow. Vary the buffer size in the range of 10 packets to 800 packets and repeat the above experiments to find out the impact of buffer size on the fair share of bandwidth and plot the necessary graphs. Make appropriate assumptions wherever necessary.



Solution

Effect of buffer size on TCP and UDP flows

➔ Topology:

```
H1 ---+      +--- H4
      |      |
H2 --- R1 --- R2 --- H5
      |      |
H3 ---+      +--- H6
```

A **Dumbbell topology** with two routers R1 and R2 connected by a **(10 Mbps, 100 ms)** link.

Each of the routers is connected to **3 hosts i.e., H1, H2 and H3** are connected to **R1**, and **H4, H5 and H6** are connected to **R2**. All the hosts are attached to the routers with (100 Mbps, 10ms) links. Both the routers use drop-tail queues with an equal **queue size** set according to the **bandwidth-delay product**. The size comes out to be around **85p** (where p stands for packet) Packet size is **1.5KB**.

➔ Simulation:

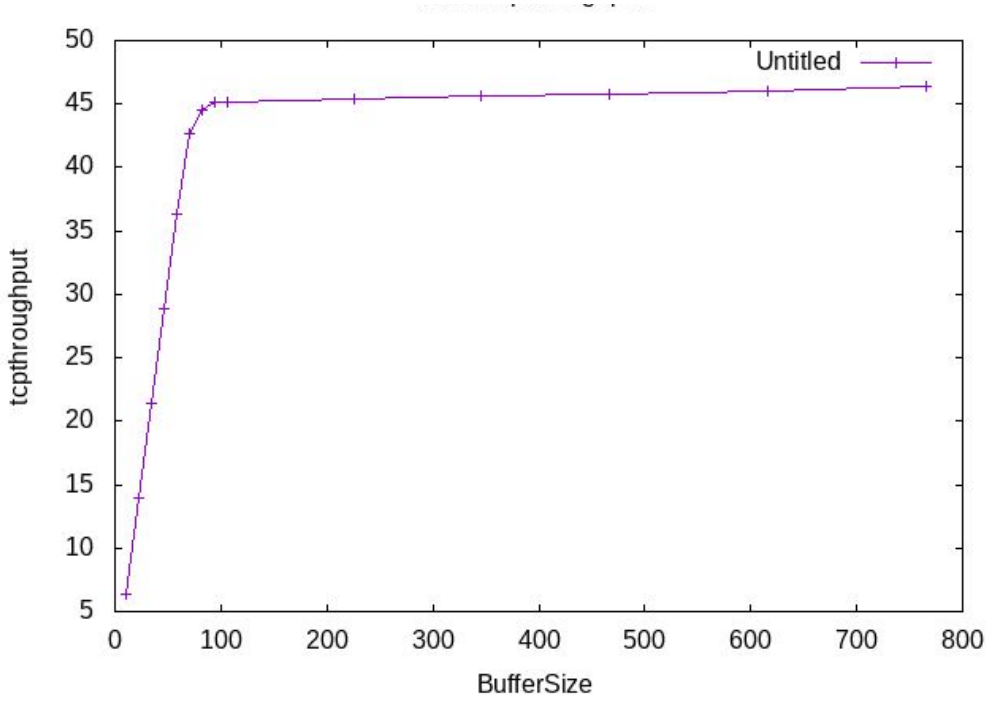
Initially, **3 TCP New Reno** flows are started.
After a while, **3 CBR over UDP flows** (each with **20 Mbps**) are started.
Rate of one UDP flow is increased **up to 100 Mbps** which **impacts the throughput** of the TCP flows and the other UDP flow.
The buffer size is varied in the range of **10 packets to 800 packets** and the above is repeated to find out the **impact of buffer size** on the fair share of bandwidth. The buffer size is increased at the increment of 12 packets up to 100, at an increment of 120 packets up to 400, and then at an increment of 150 packets.

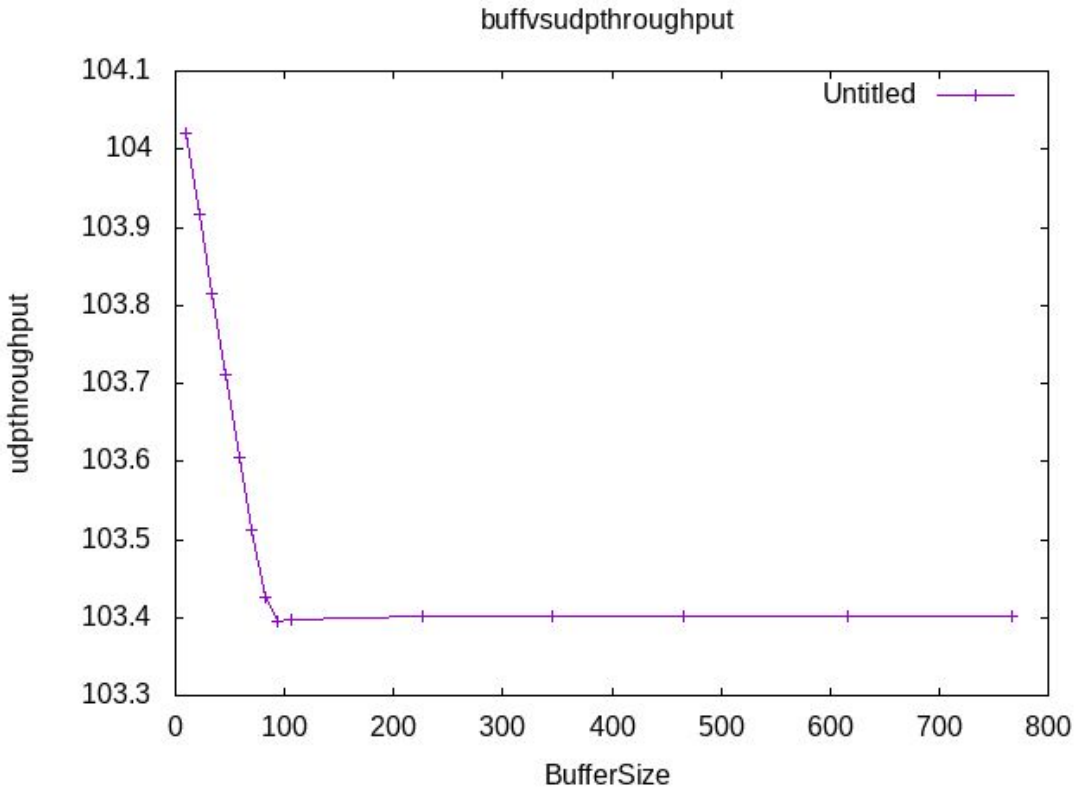
We have written a script named **"assignment_4.cc"** which generates **5 plots** in total. A header file named **"header_file.h"** is also present containing all the required classes along with function definitions. The plots are as follows:-

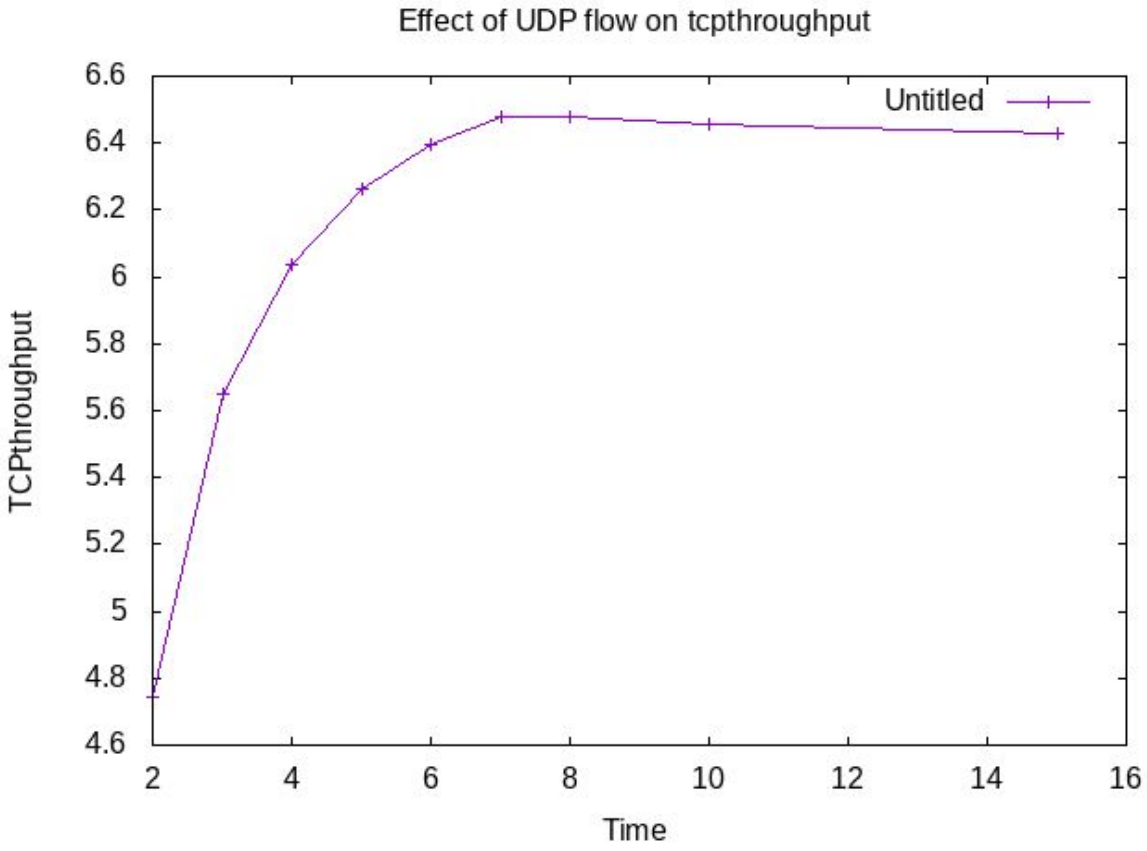
1. Time vs TCP throughput
2. Time vs UDP throughput
3. Buffer Size vs TCP throughput
4. Buffer Size vs UDP throughput
5. Buffer Size vs Fairness Index

NOTE:- All the throughput values are taken in Kbps and Buffer Size in units of packets.

Buffer Size vs TCP throughput




buffvsudpthroughput
Untitled
udpthroughput
BufferSize
104.1
104
103.9
103.8
103.7
103.6
103.5
103.4
103.3
0
100
200
300
400
500
600
700
800


Effect of UDP flow on tcpthroughput
Untitled
TCPthroughput
Time
6.6
6.4
6.2
6
5.8
5.6
5.4
5.2
5
4.8
4.6
2
4
6
8
10
12
14
16

Time vs UDP throughput