CS-349 Networks Lab

Assignment - 4: Network Simulator Assignment

Submission deadline: 11:55 PM on Tuesday 17 April, 2018 (Hard Deadline)

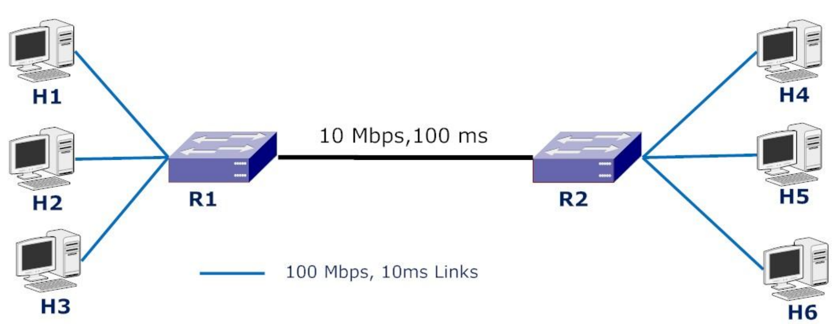
In this assignment you need to simulate the given application using NS-3. Use NS3 ***flow monitor module*** to collect and store the performance data from simulation. Do not use PCAP + Wireshark for the trace collection. No marks will be awarded, if your application uses PCAP file for trace collection. Check the application assigned to each group in the table given below.

Application No.	Group Numbers
1	**1, 7, 13, 19, 25, 31, 37, 43**
2	**2, 8, 14, 20, 26, 32, 38, 44**
3	**3, 9. 15, 21, 27, 33, 39, 45**
4	**4, 10, 16, 22, 28, 34, 40, 46**
5	**5, 11, 17, 23, 29, 35, 41**
6	**6, 12, 18, 24, 30, 36, 42**

NOTE: Submit your code together with graphs (preferably in a report format) in a zipped folder (max size 1 MB) on Moodle by 11:55 PM on Tuesday 17 April, 2018 (hard deadline). Assignment will be evaluated through Viva-voce on Wednesday 18 April, 2018; during your lab session (evaluation schedule and TA assignment will be notified later). Late submission will be penalized by taking necessary actions.

Application #1:

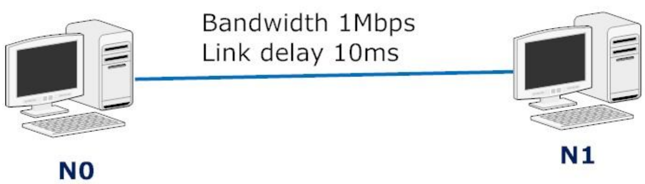
Compare the effect of buffer size on TCP and UDP flows. Select a Dumbbell topology with two routers R1 and R2 connected by a (10 Mbps,100 ms) link. Each of the routers is connected to 3 hosts i.e., H1, H2 and H3 are connected to R1 and, H4, H5 and H6 are connected to R2. All the hosts are attached to the routers with (100 Mbps, 10ms) links. Both the routers (i.e., R1 and R2) use drop-tail queues with equal queue size set according to bandwidth-delay product. Choose a packet size of 1.5KB. Start 4 TCP New Reno flows and after a while start 2 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.



Application #2:

Create a topology of two nodes N0 and N1 connected by a link of bandwidth 1Mbps and link delay 10ms. Use a drop-tail queue at the link. The queue size set according to bandwidth-delay product. Create a TCP agent (type of the agent specified below) and FTP traffic at N0 destined for N1. Create 5 CBR traffic agents of rate 300 Kbps each at N0 destined for N1. Make appropriate assumptions wherever necessary. The timing of the flows are as follows:

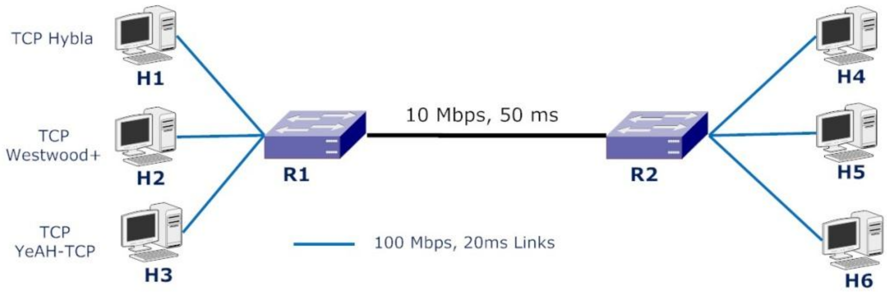
- FTP starts at 0 sec and continues till the end of simulation
- CBR1 starts at 200 ms and continues till end
- CBR2 starts at 400 ms and continues till end
- CBR3 starts at 600 ms and stops at 1200 ms
- CBR4 starts at 800 ms and stops at 1400 ms
- CBR5 starts at 1000 ms and stops at 1600 ms
- Simulation runs for 1800 ms



1. Plot graph(s) of TCP congestion window w.r.t. time for following 5 TCP congestion control algorithm implementations and describe the TCP congestion control algorithms behavior.
   Case 1: use TCP New Reno
   Case 2: use TCP Hybla
   Case 3: use TCP Westwood
   Case 4: use TCP Scalable
   Case 5: use TCP Vegas
2. Draw a graph showing cumulative TCP packets dropped w.r.t. time comparing above 5 TCP congestion control algorithm implementations.
3. Draw a graph showing cumulative bytes transferred w.r.t. time comparing above 5 TCP congestion control algorithm implementations.

Application #3:

Analyze and compare TCP Hybla, TCP Westwood+, and TCP YeAH-TCP performance. Select a Dumbbell topology with two routers R1 and R2 connected by a (10 Mbps, 50 ms) wired link. Each of the routers is connected to 3 hosts i.e., H1 to H3 (i.e. senders) are connected to R1 and H4 to H6 (i.e. receivers) are connected to R2. The hosts are attached with (100 Mbps, 20ms) links. Both the routers use drop-tail queues with queue size set according to bandwidth-delay product. Senders (i.e. H1, H2 and H3) are attached with TCP Hybla, TCP Westwood+, and TCP YeAH-TCP agents, respectively. Choose a packet size of 1.3KB and perform the following task. Make appropriate assumptions wherever necessary.

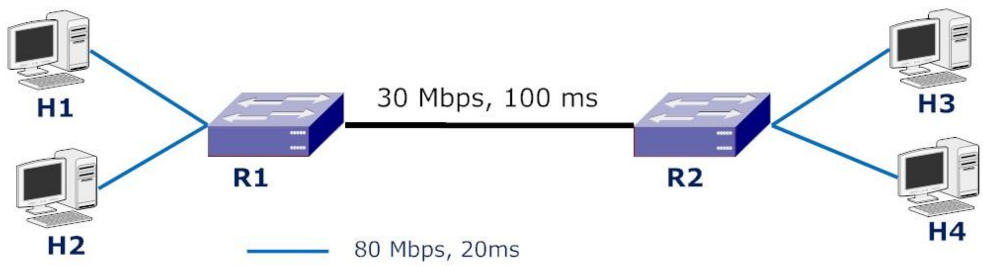


1. Start only one flow and analyze the throughput over sufficiently long duration. Mention how you select the duration. Plot of evolution of congestion window w.r.t. time. Perform this experiment with all the flows attached to all the three sending agents.
2. In next experiment, start 2 other flows sharing the bottleneck while the first one is in progress and measure the throughput (in Kbps) of each flow. Plot the throughput and evolution of the TCP congestion window for each of the flow at a steady-state. Report is the maximum throughput observed for each of the flows?
3. Measure the congestion loss and Goodput over the duration of the experiment for each of the flows.

Application #4:

The objective is to compare the effect of CBR traffic over UDP agent and FTP traffic over TCP agent. Consider a TCP agent from TCP HighSpeed, TCP Vegas and TCP Scalable for the FTP traffic. Consider a Dumbbell topology with two routers R1 and R2 connected by a wired link (30 Mbps, 100 ms) and use drop-tail queues with queue size set according to bandwidth-delay product of the link. Each of the routers is connected to 2 hosts i.e., H1 and H2 are connected to R1 and H3 and H4 are connected to R2. The hosts are attached to the routers with (80 Mbps, 20ms) links. The CBR traffic over UDP agent and FTP traffic over TCP agent are attached to H1 and H2, respectively. Choose appropriate packet size for your experiments and perform the following:

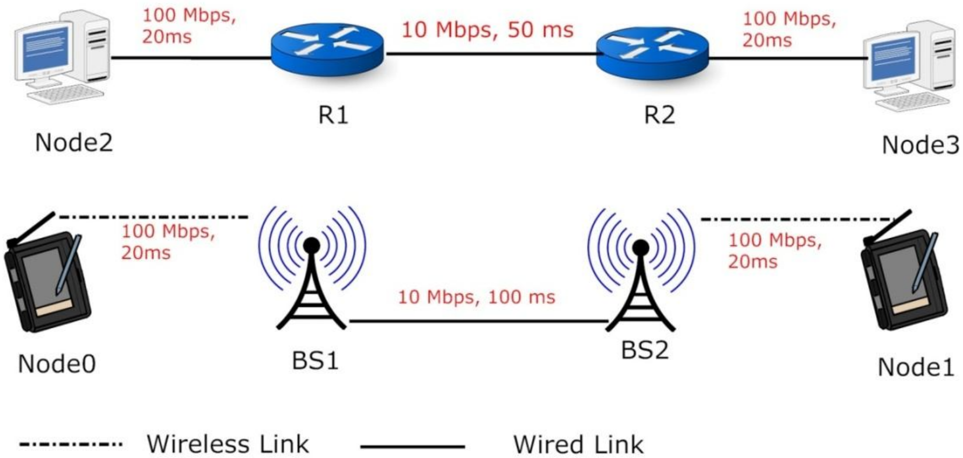
1. Compare the delay (in ms) and throughput (in Kbps) of CBR and FTP traffic streams, when only one of them is present in the network. Plot the graphs for the delay (in ms) and throughput (in Kbps) observed with different packet sizes.
2. Start both the flows at the same time and at different time. Also, compare the delay (in ms) and throughput (in Kbps) of CBR and FTP traffic streams. Plot the graphs for the delay (in ms) and throughput (in Kbps) observed with different packet sizes.



Make appropriate assumptions wherever necessary.

Application #5:

Compare the performance of TCP over wired and wireless networks. Consider a topology as described below. Network consists of two TCP sources Node0 and Node2 and corresponding to two TCP destinations Node1 and Node3 respectively. Node2 and Node3 come in wired domain with two routers R1 and R2 (connected by a {10 Mbps, 50 ms} wired link) in between them. Both the routers use drop-tail queues with queue size set according to bandwidth - delay product. Node0 comes in domain of Base Station 1 (BS1) and Node1 comes in domain of Base Station 2 (BS2). BS1 and BS2 are connected by a (10 Mbps, 100 ms) wired link. The hosts i.e., Node0, Node1, Node2, Node3 are attached with (100 Mbps, 20ms) links to routers or base stations (as shown in below figure). The source (Node2 and Node)) use three TCP agents (i.e., TCP Westwood, TCP Veno and TCP Vegas) to generate three different TCP flows. Study and plot the fairness index (Jain's fairness index) and throughput change when the TCP packet size is varied; all the other parameter values are kept constant. You should use the following TCP packet size values (in Bytes): 40, 44, 48, 52, 60, 552, 576, 628, 1420 and 1500 for your experiments. The throughput (in Kbps) and fairness index must be calculated at steady-state. Make appropriate assumptions wherever necessary.



Application #6:

Using network simulator, ns, study the characteristics of IEE 802.11. For the purpose of experiment, use the topology as follows. There are 3 (three) nodes in the network located in a straight line at locations 250*I, i=0, 1, 2. Node 0 and Node 2 both have TCP traffic to Node 1 (started randomly within 1 to 5 seconds of starting the simulation). Consider TCP Westwood+ or TCP Hybla for the TCP agents at Node 0 and Node 2, respectively. You have to run the simulations and measure the following from the trace output (the averages are taken over all the nodes). Do not use PCAP file for collecting the trace. Use flow monitor module in NS3 for trace collection. *No marks will be given, if you consider PCAP trace with Wireshark.*

1. Average bandwidth spent in transmitting RTS, CTS, and ACK.
2. Average bandwidth spent in transmitting TCP segments and TCP acks.
3. Average bandwidth wasted due to collisions.
4. TCP throughput (number of acknowledged bytes per unit time) at each node

You have to run the simulations for 50 seconds each with different RTS threshold (i.e., 0, 256, 512 and 1000 bytes) and TCP segment size of 1000 bytes. You can use scripts for trace file analysis and to plot the results. Make appropriate assumptions wherever necessary.