COL 334/672 Assignment 3

Deadline: 11:55 P.M 3 November 2022

In this assignment, we will use NS-3 network simulator to analyse different congestion control protocols, creating custom network topology and analysing the effect of various parameters on the congestion window. Please make sure to use version 3.29 of NS-3.

TASK I)

In the first task, we will understand how the congestion window varies with respect to time in different congestion control algorithms. A network topology has been shown in the figure below. Your task is to build the shown topology in NS-3 (with exactly the same values of parameters specified) and observe the questions asked.
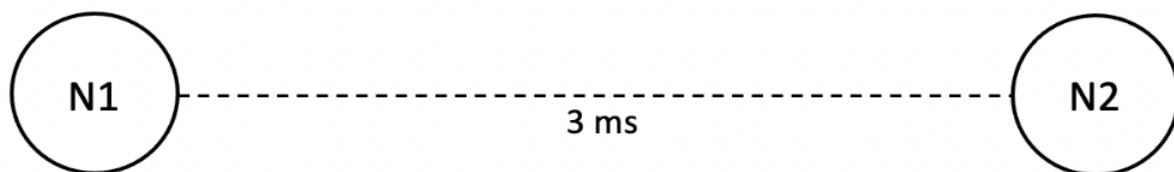

Figure 1

1) Two nodes N1 and N2 should be connected by **point-to-point link**.
2) Create Tcp Source at N1 and Tcp Sink at N2.
3) The application data rate should be set to **2 Mbps**.
4) The propagation delay between two nodes is **3ms**.
5) The channel data rate between N1 and N2 is **5 Mbps**.
6) Packet size should be **2000 bytes.**
7) At N2 use RateErrorModel as the error model with error rate as **0.00001**

After you have created the topology. Your task is to run the simulation for 25 seconds. (i.e start at t = 1 sec and end at t = 25 sec) and you should fill the following table for the given congestion control protocols:

Protocol Name	Max. window size	No. of Packets drop
NewReno		
Vegas		
Veno		
WestWood		

After you have filled the table, answer the following questions in your report:

1) Include the above table with filled values.
2) Draw the graphs of Congestion window size vs time (**for all the four protocols**) along with a short description of each.
3) Compare the graphs with each other. Your comparison should consist of why those trends in graphs were observed (referring to the working mechanism of the protocols / algorithms used by them in different phases).
4) Bbr is a new congestion control algorithm developed at google. Read and describe what makes it different from the above mentioned protocols.

Please Note: Your report should clearly mention the steps for everything you do. Ex: You should describe the code you updated to count the number of dropped packets, the existing ns-3 files that you used and so on.
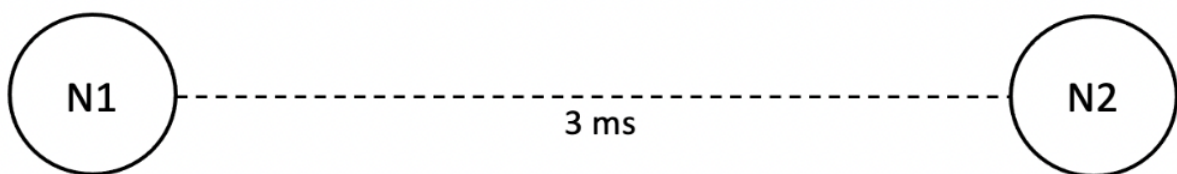
TASK II:

Figure 2

Build a topology of two nodes N1 and N2, connected by a point to point link as shown in figure 2, N1 will be a TCP source and N2 a TCP sink, the channel delay is 3ms. At N2 use **RateErrorModel** with error rate as **0.00001**. Your Task is to analyse the effect of application data rate and channel data rate on the congestion window size at sender N1. Use TCP **NewReno** as the congestion window protocol. Run the connection from t=1 sec to t= 40sec, keep packet size as **3000 bytes.**

Plot the congestion window size vs time graph for the following different scenarios

a) Keeping application data rate as **5Mbps**, vary channel data rates (**3Mbps, 5Mbps, 10Mbps, 15Mbps, 30Mbps**) between N1 and N2.
b) Keeping channel data rate as **4Mbps**, vary application data rates (**1Mbps, 2Mbps, 4Mbps, 8Mbps, 12Mbps**) between N1 and N2.

Note: You need to plot 5 graphs for part 'a' and 5 graphs for part 'b'.

Answer following questions with your observation

● How does application data rate affect congestion window size.
● How does channel data rate affect congestion window size.
● What relation do you observe between channel data rate and application data rate?
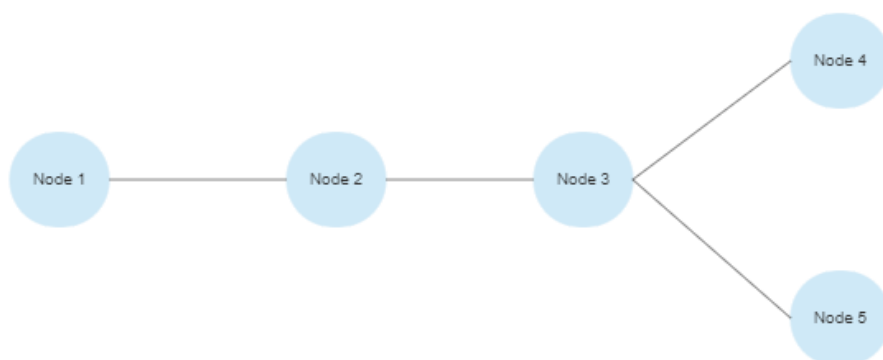
TASK III:

Figure 3

Create the following topology with 5 nodes as shown in figure 3, create a TCP connection between Node1 to Node 4, Node1 as TCP source and Node4 as TCP sink, create a UDP connection between Node5 and Node2, Node5 as UDP source and Node2 as UDP sink.(All links are P2P)

Keep data rate of all links at **500Kbps**, and link delay at **2ms**.

Keep packet size as **1040 bytes,** number of packets as **100000** while creating udp and tcp app

Use **TCP Vegas** as congestion control protocol

Run the following scenarios:

Start TCP connection at **t=1s** and end at **t=100s**, with application rate of 250Kbps

Start UDP connection at **t=20s** with application rate of **250Kbps** such that it clogs half the capacity of N2-N3 link capacity, run it till **t=100s**.

Change UDP connection application rate to **500Kbps** at **t= 30s** such that it clogs the whole capacity of N2-N3 link capacity.

1) Plot Congestion window size vs time graph for TCP connection
2) Indicate the points, where you observe the effect in the congestion window size of TCP connection, when UDP connection is started and when we change the data rate of UDP connection.
3) Also generate the pcap file for submission.

What to Submit

1. For each part, write your answers, observations, plots in a single report file.

2. Submission folder should be a single .zip or .tar.gz file containing a report file and code for each question. Follow the directory structure as given below.
   EntryNumber_ Report.pdf

   Note: [only submit files that you have created or edited, and not other ns3 files]

3. The plots can be generated either using the .cc files or any other tool you wish to choose. But make sure, that plot is generated just using commands and not by copy pasting data values manually in excel or something like that during the demo. (**Tip** : Save the output values in a separate file and write a script to process that file and generate plots).

4. For each code file/package/libraries you submitted in the assignment, clearly describe their purpose in the report (1 to 2 sentences are enough for each).