ELEC3500 TELECOMMUNICATIONS NETWORKS

Simulation Experiment III

Experiment: Study of TCP Congestion Control Techniques.

Required Reading Materials:

1. Text book, Chapter 3, Section 3.7, pages 297-306.
2. Lecture slides: Lecture_14.pdf.

Objective: In this simulation experiment, the basic TCP (Transmission Control Protocol) congestion control technique will be examined. TCP use the AIMD (Additive-Increase, Multiplicative Decrease) process to throttle TCP connection rates to avoid the congestion on the transmission link. This experiment will examine the AIMD technique under different traffic load conditions. This experiment will also study the effect traffic load on the RTT (Round Trip Time) and the router queue length. The simulation model use a client server architecture.

Procedure:

This laboratory is designed based on the TCP congestion control technique lecture materials. The model simulates the TCP Reno protocol. ***Use the TCP model in the TCPIP folder which is available on Blackboard (DO NOT use the model in the ELEC3500 folder).*** The standard TCP/IP model has been modified to support the experiment. Check the omnetpp.ini file, you will see that several parameters are listed under the heading *"Parameters that needs to be changed for ELEC3500"*. Default simulation parameter values are listed in Table 1.

Table 1: Simulation Parameter Values

Parameter	Variable	Default Value
Client No.	Cwindow.numClients	1
Simulation time	sim-time-limit	200.00s
Advertised window	tcp.advertised window	65535*10 B
Maximum transmission unit	ppp.mtu	4470B
Maximum segment size	tcp.mss	1000B
Router queue size	router.ppp[*].queue.frameCapacity	10 MTU
Client file Size	.Client*.app[*].sendBytes	1000 MiB
Transmission link speed**	router.pppg++	10Mbps

**: this parameter is in .ned file.

It is not necessary to change all parameters. Instructions are given below to change the parameters for two simulation scenarios. Use a simulation time of ***200 sec*** for all simulations.

We will examine the effect of traffic load generated by multiple users on the TCP connection throughput by running the simulation model thrice, each which increasing number of clients. More precisely, simulation 1 consists of one client (client #0); simulation 2 consists of two clients (clients #0 and #1); whereas simulation 3 consists of three clients (clients #0, #1 and #2). Notice that OMNeT++ labels the clients with a starting index of 0. Use the default values for other parameters in the omnet.ini file. Collect each of the simulation simulation plots by right clicking on the vector value, then click on the plot and save it. Include the following plots in your report.

a. Simulation time vs the congestion window size (cwnd) for client #0 in all three simulations.
b. Simulation time vs RTT (measured RTT) for client #0 in all three simulations.
c. Simulation time vs number of duplicated ACKs received (rcvd DupACK) by client #0 in simulation 3.
d. Simulation time vs router queue lengths (queueLength:vector) for clients #0 and #1 in simulation 2.
e. Simulation time vs congestion window size (cwnd) for client #2 in simulation 3.

Report Submission Instruction:

You need to submit a report with a simulation section and a knowledge section.

Simulation Section: This section is marked out of 40 and should be structured as follows.

- ***Introduction:*** Explain in a single paragraph (200 words maximum) the objectives of the laboratory simulation.
- ***Simulation model****:* Briefly describe the simulation model used in the experiment (300 words and 1 figure maximum).
- ***Results****:* Provide all the plots collected.
- ***Analysis:*** Briefly explain how the congestion window size is affected by the traffic load. Also, briefly describe how the RTT (Round Trip Time) is affected by the traffic load.

Knowledge Section: This section is marked out of 60. Answer the following questions.

1. Explain why the client congestion window (cwnd) size varies differently for different load conditions.

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2. Analysing the DupACK plot, do you see any correlation between the congestion window size and the number of DupACKs received by a client? Briefly explain.

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3. Consider the client #0 and client #2 congestion window plots in simulation 3. Are both clients achieving the same average throughput or different? If different, which client has higher average throughput?

[20]

Report Submission Date:

The lab report is due on 8th October 2021 (Friday of Week 10) at 23:59 pm.