

Homework 2

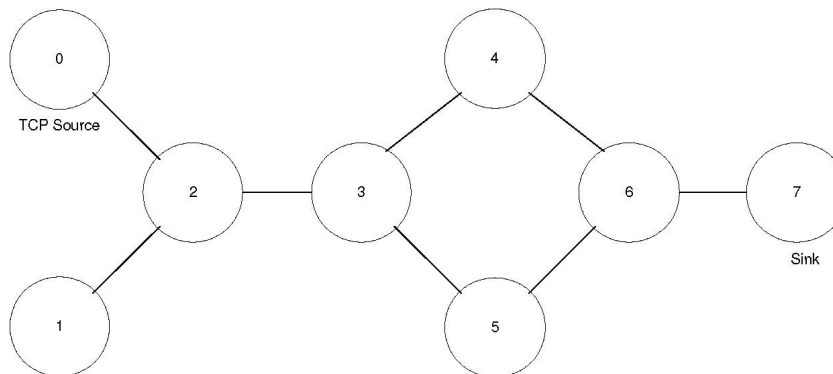
Please email your answers/report in **PDF format** to Mr. Jafari “mjafari@ce.sharif.edu” and CC me at “kharrazi@sharif.edu”. The HW file name should be “**Your Lastname-693-HW-2**”. It should be used as the subject of your email, too. In order for us not to miss your homework please follow the formatting. This homework is due by **Aban 14th, 11:59 PM**. You are also supposed to have a face-to-face delivery, the time of which will be announced later.

In this assignment, we’ll use the network simulator (NS-2) to understand the working of transport layer protocols TCP and UDP. In the first part, you are expected to learn and understand NS-2. Then, you are expected to modify the script, generate some results, and draw conclusions about these two protocols. In the second part you will check the fairness of tcp connections and get familiar with the ns error models. You can also download NS code from the NS webpage and install it on your own computer.

Part I

In this part of the assignment, the goal is to become familiar with network traces and be able to write simple scripts to process such data. Please follow the below steps: (55 Points)

1. Write a simulation script which generates the following topology:



With the following characteristics:

- Establish a TCP connection between node 0 and node 7 (use TCP Tahoe).
- Set the maximum window size of the TCP flow to 32 packets.
- Establish a UDP connection between node 1 and node 7 and a second between node 5 and node 7.
- Set the packet size to 512 bytes.

- Both the UDP and TCP sources start at 0.0 seconds and run for the whole duration of the simulation.
2. Run the simulation for 30 seconds.
 3. The script file posted on the course webpage measures the throughput (the ratio of the total number of packets received to the total number of packets sent) of UDP flow. Modify it to also measure the throughput of TCP flow and goodput of TCP flow. Or you can write your own script and use it as a parser. NOTE: goodput of the TCP flow is the average number of TCP bytes received per unit time. The parser script can be run by typing: `awk f parser.awk out.tr` The script should be able to measure:
 - UDP throughput
 - TCP throughput
 - TCP goodput
 4. Run the parser script and store the results in a log file.
 5. Change the version of TCP to TCP Reno and repeat steps 2-4.
 6. Change the version of TCP to TCP Vegas and repeat steps 2-4.
 7. Plot graphs of (using the data from the 3 log files)
 - UDP throughput vs UDP packet rate
 - TCP throughput vs UDP packet rate
 - TCP goodput vs UDP packet rate
 8. The bandwidth of all the links should be set at 5Mbps and also the delay on all the links should be set at 5ms. Write a script and find the utilization of the following link.
 - The link between node 2 and node 3.
 - The link between node 3 and node 4.
 - The link between node 3 and node 5.

Observations to be made:

- Comment on the difference in the average bandwidths available to the different versions of TCP. Explain the difference in terms of congestion control mechanisms of these versions. Which version would you like to adopt for your network?
- Comment on the bandwidth share of TCP and UDP. Do you think that UDP traffic is suppressing the bandwidth share of TCP traffic? If yes, can you suggest a way to stop that?

Part II ¹

We will be using ns-2 to study the throughput of a single hop IEEE 802.11 network. There are several factors that affect the throughput, 1) number of nodes, 2) the back-off mechanism for contention resolution, 3) use of ACK and 4) packet size and use of RTS/CTS, etc. The purpose of this assignment is to evaluate the impact of some of these factors. Construct a simulation scenario with m nodes in a single hop network. A constant bit rate (CBR) source on top of UDP transport is used as traffic source. Adjust the rate of the CBR source such that the loss rate is controlled below 5% (Don't parametrize your simulation environment in such a way that the loss rate is more than 5%). Choose any routing protocol as you wish. Throughput is defined as the ratio of the total number of application layer bits received to the total number of application layer bits sent. Measure the throughput and single-hop delay with respect to the following parameters (while fixing the other parameters). (45 Points)

¹Parts of this assignment are obtained from other courses. Acknowledgments are available on the course website.

1. Vary the number of sender/receiver pairs (with all sources transmitting at the same rate).
2. Enable or disable RTS/CTS.
3. Vary the size of application packets..

Note that some of the simulations may require minor modification of source codes. Repeat each experiment 5 times with a different random seed and compute the average to get the final results. [hint: locate the mac-802.11 related codes in the ns-2 source tree first and then start with a single pair of sender and receiver scenario.] Summarize your findings and comment on whether the use of routing protocols would have an impact on the results and how.

What to turn in:

- All of the TCL scripts used for your simulations.
- The parsing scripts for calculating the required parameters.
- The required graphs (plotted using xgraph, or excel). Handmade graphs will not be accepted.
- Detailed observations and conclusions.
- A report file with clear instructions to run your simulations and parse the trace files. You should clearly specify the functionality and purpose of each file. NOTE: Please DO NOT send the trace files. All files should be contained in a directory which is zipped into a single file and must follow the naming conventions as specified earlier (Lastname-693-HW-2.zip).