

Networks Lab

Assignment 3

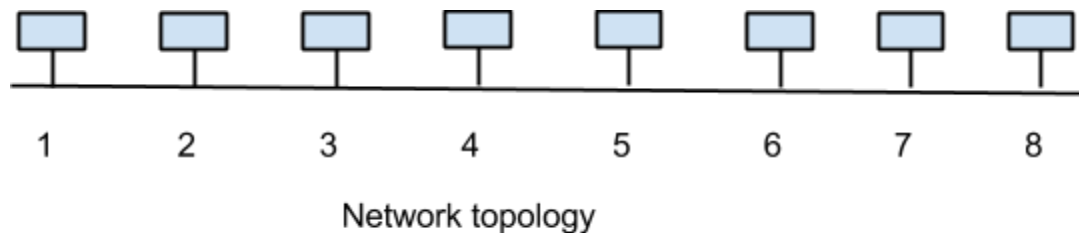
Note:

1. You should have NS-3 installed for this assignment.
2. Refer to www.nsnam.org for all the information about NS-3.
3. Also install tcpdump on your machines.
4. Refer to www.tcpdump.org/ for tcpdump.
5. Assuming your installation directory is ns-allinone-*. We call it the home directory of NS-3.
6. Make suitable assumptions unless specified in the question or discuss with TAs.
7. Do not copy the solutions from others. Cases of plagiarism will be treated seriously.

You are already acquainted with NS-3 basics. In this assignment, you'll build a network topology and study performance parameters over different experiments.

Evaluation of CSMA Protocol Performance:

In this assignment you need to build a network topology of 8 nodes(CSMA) as described by the following figure.



The nodes use CSMA protocol for channel access at the link layer. The CSMA link bandwidth is 1024 Kbps and the one-way link delay is 2 ms. Every node uses IPv4 at the Internet layer. The application layer uses UDP echo application where the echo messages are generated at different data generation rate. There are four different UDP flows in this network as given below.

Flow 1 : Node 1 -> Node 5

Flow 2: Node 2 -> Node 6

Flow 3: Node 7 -> Node 3

Flow 4: Node 8 -> Node 4

In this assignment you need to measure the performance of the CSMA network with respect to following performance metrics:

- 1) **Throughput** : Average amount of data bits successfully transmitted per unit time.

- 2) **Forwarding Delay** : Average end-to-end delay (including the queuing delay and the transmission delay) experienced by the CSMA frames.
- 3) **Jitter** : Jitter is the variation in individual frame delay.

Measure the performance of the CSMA protocols in terms of the above metrics and plot a graph (for every metrics, there should be one graph) with respect to following application layer traffic generation rate.

- 1) 16 Kbps
- 2) 32 Kbps
- 3) 64 Kbps
- 4) 128 Kbps
- 5) 256 Kbps
- 6) 512 Kbps
- 7) 1024 Kbps

Note that, you need to measure the link layer performance or the network performance, not the per node performance. Therefore you should consider all the CSMA frames from all the communication pairs while calculating the performance metrics.

Note:

1. To model link layer dynamics like channel error, external interference etc., network simulators use pseudo-random generators. This pseudo-random generators are governed by a seed value. Please look into the following document to know more about random generators and seed values:

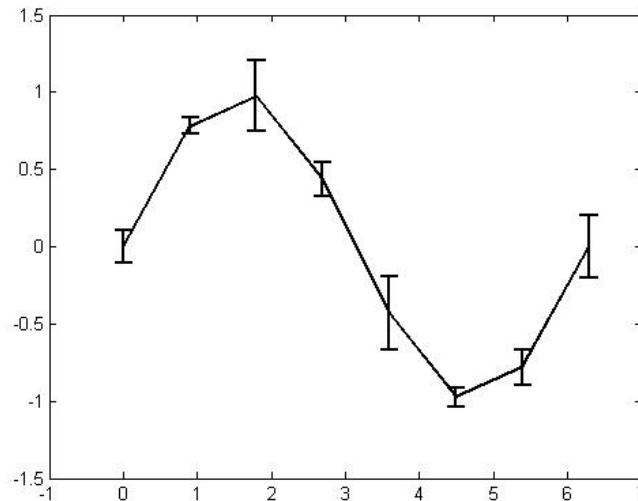
http://www.nsnam.org/doxygen/classns3_1_1_rng_seed_manager.html

In this experiment, you have to use random seed generators to make the simulation more realistic. For this purpose, you have to execute every scenario with 10 different seed values and take the average and the standard deviation of the performance metric. The standard deviation is also called the *confidence interval* that tells you how much the performance results can deviate in different channel conditions. Note that one good choice for the seed value is the system time in milliseconds. So every time you execute the script, the system time will change and give you a different seed value.

In summary, your task will be to do the following:

- a. For a particular data rate, compute performance parameters for 10 different seed values and take the average with standard deviation (confidence interval).
- b. Plot the results for different data rates along with the confidence interval. For plotting, you can use gnuplot or whichever you are comfortable with.

Your graph may look something like this, where x axis be the data rate and the y-axis



be the performance parameter [the example graph is an indicate one, do not look at the numerical values!]. The horizontal curve gives you the plot through the average values, and the vertical lines show you the deviation (or the confidence interval).

2. You need to change the packet size and the time interval between consecutive UDP echo packets to find out the data generation rate. For instance, if packet size is 16 Kb, and time interval is 0.25 sec, then data generation rate is 64 Kbps.

State your observations on the impact of different data rates and different seed values over different statistical performance parameters.

NOTE for Submission:

1. You need to do this experiment in a group of two (same group as previous lab).
2. After the experiment, prepare a report with the results and analysis.
3. Submit the .cc file along with script, parameter values, plots and your analysis of the results.
4. Create a gzipped tarball file (tar.gz) containing the data analysis files and plots and the report. The name of the compressed file should be assign_3_<roll_number_member_1>_<roll_number_member_2>.tar.gz . For example, if the members of a group are 12CS10001 and 12CS10002, then the file name should be assign_3_12CS10001_12CS10002.tar.gz.
5. One of the member of the group should upload the assignment to the Moodle course web page by the submission deadline.
6. Submission deadline: 2 Feb, 2015, 11:59 pm.