Building Topologies and Measuring Different Metrics in NS-3

CSE322 : Computer Networking Sessionals

Assignment on NS-3

Objective

The objective of this assignment is to get students familiar with how to design different simulation environments and measure different performance metrics in NS-3 while varying different parameters.

Specifications

In this assignment, you need to simulate 2 types of network :

- Wireless high-rate (e.g., 802.11) (static)

- Wireless high-rate (e.g., 802.11) (mobile)

A single bottleneck dumbbell topology needs to be built in case of the static wireless network as shown in Figure 1 where the middle connection needs to be a wired one with a lower data rate. The nodes in the left network are senders and the right ones are receivers.

For the mobile network, you can design a topology of your choice but the topology must have at least three different networks.

The parameters that need to be varied in the simulations are:

- Number of nodes: 20, 40, 60, 80, 100.

- Number of flows: 10, 20, 30, 40, and 50 (Not considering the Ack flows)

- Number of packets per second: 100, 200, 300, 400, 500

- Speed of nodes: 5 m/s, 10 m/s, 15 m/s, 20 m/s, 25 m/s (Only in wireless mobile topology)

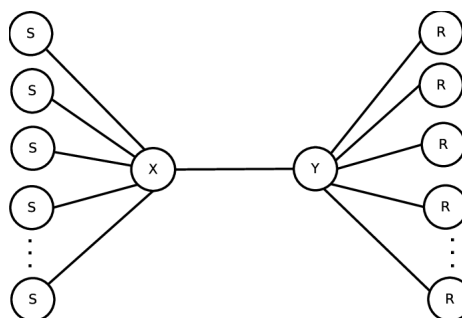- Coverage area : 1/2/4/5 * Tx_range (Only in wireless static topology) .

Figure 1: A single bottleneck dumbbell topology

In all cases, you need to measure the average of the following metrics and plot graphs :

1. Network throughput : The amount of total bits received per second in a network.

2. Packet delivery ratio : # of packets received / # of packets delivered

You do not need to consider the Ack flows while calculating the metrics.

Implementation Guidelines

- Initially, design the topology and the simulation. Packets should be sent to a destination crossing at least two networks (which means each flow should consist of at least three networks). For the wireless mobile network, design the topology in such a way that the possibility of congestion increases when you increase the number of flows.

- Each node must have an application with a flow (except the ones within the bottleneck link). Here, flow means packet exchange between two applications. So, in the case of increasing nodes, you need to increase flows too.

- Consider the packet size to be 1024 bytes. Suppose, packets are not segmented so setting the SegmentSize attribute of TCPSocket should work.

- For the coverage area, you may take the default value of Tx_range to be 5. (Hint : Look for the MaxRange Attribute)

- You may use an additional error model if there is no packet drop in your designed network. However, it should work fine without any error model.

- All varying parameters must be taken as arguments from the command line. Prepare a shell script (.sh file) that runs the simulation file with different command line arguments.

- **The performance metrics need to be calculated with the help of appropriate trace sources**. The metrics need to be calculated for all sender/receiver nodes to get the average results. You may not consider Ack flows for the calculation if there is no trace source to track them.

- The graphs need to be plotted for the average performance metrics of the varying parameters (such as flow VS throughput, speed VS Packet Delivery Ratio etc). You may generate additional log/trace files for the values needed for plotting but you must use GNUPlot (or any other library of NS-3).

- Your shell script should include the commands necessary to generate plots if they are generated from different files.

Resources

- Go to example/wireless directory and look into the existing examples to get an idea on how to design the topology.

- You may use netanim (An animation tool) for visualizing the wireless network and the position and movements.

Mark Distribution

Task	Marks
Design of wireless static topology	10
Design of wireless mobile topology	15
Inputs from command line arguments	5
Varying different parameters	20
Using proper trace sources	15
Calculation of metrics	20
Results of graphs	10
Proper Submission	5
Total	**100**

Submission Guidelines

- You need to submit only .cc, .sh files, and any additional file you created for plotting.

- The two .cc files need to be renamed this way: 1905***_1.cc, 1905***_2.cc. The same goes for the .sh files.

- Create a folder having the same name as your 7-digit student id. Put all your source files inside the folder. Rename the source files so that they have your student id as a prefix.

- Zip the folder and submit it in Moodle.

Please note that usage of any unfair means will be duly punished and will result in a -100% mark.

Submission Deadline : August 7, 2023 11:59 PM