IT 304: Computer Networks

Lab # 2: Queueing delay in computer networks*

For the Week of August 05, 2013

Guidelines:

- **Pre-lab preparation:** Read the relevant portions of the textbook on queuing delay. Practice NS2 to be able to create the given simulation scenario. Go through the NS manual to see how the various parameters of a queue can be monitored.
- For a detailed class hierarchy both in OTcl and C++ refer to the NS2 manual available online at the NS web site.

1. **Aim:** The purpose of this lab is to understand the variation of queue length (and hence the queuing delay) with respect to the traffic intensity for different distributions.
2. **Queuing delay:** As discussed in the class queuing delay is the most variable one among all the delay components. Queuing delay depends on the traffic intensity ρ and the nature of traffic. The traffic intensity is defined as the ratio of (average) arrival rate to the (average) service rate. In general for the queue to be stable, (i.e., queue length and delay be finite) $\rho < 1$.

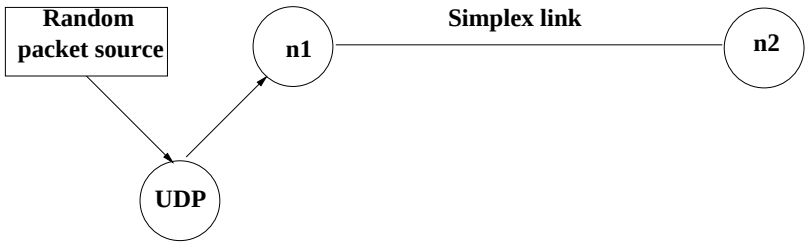

Figure 1: The figure above shows the network scenario considered as part of this lab.

3. **Exercises:** As part of this we try to plot the average queue length versus the traffic intensity ρ by varying ρ from 0 to 1. Follow the detailed instructions given below to create the network scenario and compute the average queue length for a given ρ. Generate the above mentioned plot for at least two random distributions and observe the shape of the plot in each case. Also, compute the queue length for a value of ρ such that $\rho > 1$.
   (a) Create the network scenario given in Fig. 1. Ensure that the queue limit of the queue between n1 and n2 is set to a high value to avoid packet losses. Ensure that the link

bandwidth is large to reduce the rounding errors introduced due to the rounding of packet sizes to an integer number of bytes.

(b) Generate interarrival times of packets and packetsizes according to a random distribution. Possible choices for distribution are exponential, uniform, Pareto, etc. An instance of random variable class "Exponential" can be created as follows:

`set exp [new RandomVariable/Exponential]`. The variable `avg_` is used to set the mean arrival rate.

(c) Write a procedure(s) in OTcl that simulates (a) a random source that feeds to the UDP source (and thereby into the queue of the link between n1 and n2 in Fig. 1) at a rate equal to λ packets/second and (b) a random link service that sends a random number of packets/bytes/bits from the queue of the link between n1 and n2 at a rate $\mu = \frac{\lambda}{\rho}$ packets/second.

(d) Write a procedure to compute the average queue length (which is nothing but the instantaneous queue size at any observation instant divided by the total simulation time). Instantaneous queue size can be obtained from the variable `pkts_(or size_)` of the queue monitoring object in terms of packets (or bytes). (Note: Ensure that the simulation is run sufficiently long to get a good estimate of the average queue length).