Georgia Institute of Technology

ECE 4607 - Wireless Networks

NS2 Simulation Project - Spring 2015

Due date. The report is due on **April 24thth, 2015**. Upload an archive (zip or tar.gz) on t-square. Your archive should contain your report in PDF, the tcl file and your trace files. Only submit one report per group.

1 Simulation component (7 points)

The goal of this section is to conduct simulations to compare the performance of various flavors of TCP.

First, construct a network with 7 nodes and two TCP flows as shown in Fig. 1 below.

- All links are duplex links with FIFO queue (DropTail). The 2-tuple (a, b) labeled beside each link species the (bandwidth in Mbps, propagation delay in ms) of the link. For example, link R1-R2 has bandwidth of 20 Mbps and propagation delay of 40 ms. The queue limit at both ends of each link is 50 packets.
- Both flows are TCP flows carrying FTP traffic (backlogged traffic with infinite data to send). Make S1 and S2 as the sources, and D1 and D2 as the destinations. Use different variants of TCP including Tahoe, Reno, NewReno and Sack. The packet size is 1500 bytes.
- Set the receiver window of each TCP flow to be large enough such that the end-to-end TCP throughput is not limited by the flow control window size.

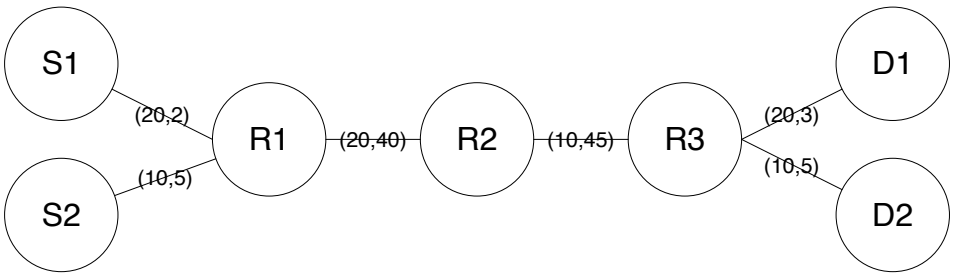

Figure 1: Network topology

For each TCP variant, run the simulation for 100 seconds, and obtain the following results:

- **(1.5 points)** Find the total number of TCP segments received at the destination and the end-to-end TCP throughput of each flow.
- **(2 points)** Plot the instantaneous throughput (averaged over 100 ms) and congestion window (at the sources) against time in one figure. Obtain a figure for each flow. For clarity of presentation, you may plot only for a chosen time span with representative results.
- **(2 points)** Attach a loss module to the link R1-R2 to simulate random packet losses. Vary the packet loss rate from 0% to 1%, with 0.1% step. Repeat the simulation by 20 times with a different seed to get the average throughput under a given packet loss rate.

- **(1.5 points)** Discuss the results you obtained previously, including any reason affecting the performance of the two flows in terms of throughput without packet loss and with packet losses.

2 Experimental component (3 points)

For this question, you will have to install the tcptrace program and use it to analyze a real trace of network traffic. You can download the tcptrace program from `http://www.tcptrace.org/index.html`. The manual for tcptrace can be found in the same page. Download the `tcp_trace.pcap` from Piazza. This file is the trace of a real file download on a machine on the ECE network (local host) from a remote server (remote host). The download uses a bidirectional TCP connection. The trace has been obtained using the tcpdump utility at an intermediate router between the two end hosts. Your task is to run the tcptrace program on the trace file and obtain the following information:

1. IP addresses of the local and remote end-hosts. **(0.3 points)**
2. Port numbers of the local and remote end-hosts. **(0.3 points)**
3. Maximum segment size used in either direction. **(0.3 points)**
4. Total bytes and unique bytes sent by the remote end-host. **(0.3 points)**
5. Number of unique data packets sent by the remote end-host. **(0.3 points)**
6. Average downlink throughput. (The value reported by tcptrace may not be correct. Calculate the value by yourself.) **(0.3 points)**
7. Average RTT in either direction. **(0.3 points)**
8. Minimum end-to-end RTT. (Study how tcptrace measures RTT.) **(0.3 points)**
9. TCP flavors used by both end-hosts. How do you identify the flavors? **(0.3 points)**
10. Maximum congestion control window size used by the remote end-host. **(0.3 points)**