P538 Computer Networks

Homework 1

January 28, 2018

Due: February 3, 2018 (Online)

Instructions: You may discuss the questions with your classmates, but not your answers. Please explain all answers and show all work.

1) [15 pts] Suppose users share a 20 Mbps link. Also suppose each user transmits continuously at 2 Mbps when transmitting, but each user transmits only 20 percent of the time.
   a. When circuit switching is used, how many users can be supported?
   b. For the remainder of this problem, suppose packet switching is used. Under what conditions will there be essentially no queuing delay before the link.
   c. Suppose now there are 15 users. Find the fraction of the time that the queue grows.

2) [10 pts] How long does it take a packet of length 1,000 bytes to propagate over a link of distance 2,500 km, propagation speed $2.5 *10^8$ m/s, and a transmission rate 2 Mbps. More generally, how long does it take a packet of length L to propagate over a link of distance d, propagation speed s, and transmission rate R bps? Does this delay depend on packet length? Does this delay depend on transmission rate?

3) [15pts] Suppose two hosts, A and B, are separated by 20,000 kilometers and are connected by a direct link of R = 2Mbps. Suppose the propagation speed over the link is $2.5 * 10^8$ m/sec.
   a. Calculate the bandwidth-delay product, $R*d_{prop}$
   b. Consider sending a file of 800,000 bits from Host A to Host B. Suppose the file is sent continuously as one large message. What is the maximum number of bits that will be in the link at any given time?
   c. What is the width (in meters of a bit in the link?

4) [10 pts] Calculate the time that it takes to transmit 30000 bits of data across a 100Mbps Ethernet with store-and-forward switch in the path. Assume that each link introduces a propagation delay of 25 ms. Also assume the maximum segment size of 1500 bytes for an Ethernet frame.