

## CSEE 4119: Computer Networks

### Homework 1

Due: 02/05/2018, 5:00 pm

**packet collision -- several stations send packet at the same time in the same network**

1. (10 points) Is bandwidth in the cable Internet access dedicated or shared among homes in a neighborhood? Are packet collisions possible in a downstream cable channel? Explain your answer.
2. (20 points) Suppose users share a 2 Mbps link. Also suppose each user transmits continuously at 1 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. Why will there be essentially no queuing delay before the link if two or fewer users transmit at the same time? Why will there be a queuing delay if three users transmit at the same time?
  - c. Suppose now there are four users. Find the probability that at any given time, more than two users transmit simultaneously. Find the fraction of time during which the queue grows.
3. (20 points) Consider a packet of length  $L$  which begins at end system  $A$  and travels over three links to a destination end system  $B$ . These three links are connected by two packet switches. Suppose links are identical and let  $d$ ,  $s$ , and  $R$  denote the length, propagation speed, and the transmission rate of each link.
  - a. Assuming no queuing delays and processing delays, in terms of  $d$ ,  $s$ ,  $R$ , and  $L$ , what is the total end-to-end delay for the packet?
  - b. Suppose the packet switch does not store-and-forward packets but instead immediately transmits each bit it receives before waiting for the entire packet to arrive. What is the end-to-end delay in this case?
4. (20 points)
  - a. Suppose  $N$  packets arrive simultaneously to a link at which no packets are currently being transmitted or queued. Each packet is of length  $L$  and the link has transmission rate  $R$ . What is the average queuing delay for these  $N$  packets?
  - b. Now suppose that  $N$  such packets arrive to the link every  $LN/R$  seconds. What is the average queuing delay of a packet?
5. (30 points) Perform a Traceroute between you and a destination on the same continent. On MAC terminal you can use the command  
`traceroute www.targethost.com`  
and in the Windows command prompt you can use  
`tracert www.targethost.com`
  - a. Include a screenshot of the traceroute output. Find the average round-trip delay. Find the number of routers in the path. Try to identify the number of ISP networks that the

Traceroute packets pass through from source to destination (Routers with similar names and/or similar IP addresses should be considered as part of the same ISP).

b. Perform the same experiment with a destination on a different continent.