

# CSC358 Tutorial 1

## Question 1: Concept Review

- (a) What's the difference between circuit switching and packet switching?
- (b) What are the types of delays when a packet travels from a source host to a destination host?
- (c) What are in the edge and core of the Internet?
- (d) Why do we say the Internet is a network of networks? What are the roles of access networks, ISP, IXP, and CDN?
- (e) What's the point of the layered protocol stack?

## Question 2: Circuit Switching vs Packet Switching

Suppose a number of users share a 3 Mbps link. Also suppose each user requires 150 kbps when transmitting, but each user transmits only 10 percent of the time. Answer the following questions.

- (a) When circuit switching is used, how many users can be supported?
- (b) For the remainder of this question, suppose packet switching is used. Find the probability that a given user is transmitting at any given point in time.
- (c) Suppose there are 120 users. Find the probability that at any given time, exactly  $n$  users are transmitting simultaneously.
- (d) Find the probability that there are 21 or more users transmitting simultaneously.
- (e) How do you interpret the meaning of this probability?

## Question 3: Propagation Delay and Transmission Delay

Consider two hosts, A and B, connected by a single link of rate  $R$  bps. Suppose that the two hosts are separated by  $m$  meters, and suppose the propagation speed along the link is  $s$  meters/sec. Host A is to send a packet of size  $L$  bits to Host B.

- (a) What is the propagation delay,  $d_{prop}$ ?
- (b) What is the transmission delay of a packet,  $d_{trans}$ ?
- (c) Ignoring processing and queuing delays, obtain an expression for the end-to-end-delay.
- (d) Suppose Host A begins to transmit the packet at time  $t = 0$ . At time  $t = d_{trans}$ , where is the last bit of the packet?

- (e) Suppose  $d_{prop}$  is greater than  $d_{trans}$ . At time  $t = d_{trans}$ , where is the first bit of the packet?
- (f) Suppose  $d_{prop}$  is less than  $d_{trans}$ . At time  $t = d_{trans}$ , where is the first bit of the packet?
- (g) Suppose  $s = 2.5 \times 10^8$ ,  $L = 120$  bits, and  $R = 56$  kbps. Find the distance  $m$  so that  $d_{prop}$  equals  $d_{trans}$ .

#### Question 4: Optimal Packet Size

Consider sending a large file of  $F$  bits from Host A to Host B using packet switching. There are three hops of links (therefore two switches) between A and B, and the links are uncongested, i.e., no queuing delays. Host A segments the file into segments of  $S$  bits each and adds 80 bits of header to each segment, forming packets of size  $L = 80 + S$  bits. Each link has a transmission rate of  $R$  bps.

- (a) Suppose you are the network administrator to decide on the value of  $S$ . Discuss, qualitatively, the pros and cons of choices of  $S$  values that are very large or very small.
- (b) Now do the math: find the value of  $S$  that minimizes the delay of moving the file from Host A to Host B. Disregard propagation delay.