

# EE450 Introduction to Computer Networks

## Homework #2, Fall 2019

**Due Thursday, September 12<sup>th</sup>, 2019 in class**

### Reading Assignment:

Chapter 1

### Problems to be solved:

1. Chapter 1, Page 69: R19

Suppose Host A wants to send a large file to Host B. The path from Host A to Host B has three links, of rates  $R_1 = 500$  Kbps,  $R_2 = 2$  Mbps, and  $R_3 = 1$  Mbps.

- Assuming no other traffic in the network, what is the throughput for the file transfer?
- Suppose the file is 4 million bytes. Dividing the file size by the throughput, roughly how long will it take to transfer the file to Host B?
- Repeat (a) and (b), but now with  $R_2$  reduced to 100 kbps.

2. Chapter 1, Page 69: R23

What are the five layers in the Internet protocol stack? What are the principal responsibilities of each of these layers?

3. Chapter 1, Page 71: P5

Review the car-caravan analogy in Section 1.4. Assume a propagation speed of 100 km/hour.

- Suppose the caravan travels 150 km, beginning in from one tollbooth, passing through a second tollbooth, and finishing just after a third tollbooth. What is the end-to-end delay?
- Repeat (a) now assuming that there are eight cars in the caravan instead of ten.

4. Chapter 1, Page 72: P10

Consider a packet of length  $L$  that begins at end system A and travels over three links to a destination end system. These three links are connected by two packet switches. Let  $d_i$ ,  $s_i$ , and  $R_i$  denote the length, propagation speed, and the transmission rate of link  $i$ , for  $i=1,2,3$ . The packet switch delays each packet by  $d_{proc}$ . Assuming no queueing delays, in terms of  $d_i$ ,  $s_i$ ,  $R_i$ , ( $i = 1,2,3$ ), and  $L$ , what is the total end-to-end delay for the packet? Suppose now, the packet is 1,500 bytes, the propagation speed on all three links is  $2.5 \times 10^8$  m/s, the transmission rates of all three links are 2 Mbps, the packet switch processing delay is 3 msec, the length of the first link is 5,000 km, the length of the second link is 4,000 km, and the length of the last link is 1,000 km. For these values, what is the end-to-end delay?

5. Chapter 1, Page 75: P24

Suppose you would like to urgently deliver 40 terabytes data from Boston to Los Angeles. You have available a 100 Mbps dedicated link for data transfer. Would you prefer to transmit the data via this link or instead use FedEx overnight delivery? Explain.