**CSCE 560 Homework / Wireshark Lab 1**

**Chapter 1 – Computer Networks and the Internet**

**Fall 17**

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**Problem 1.**  Chapter 1, P6

This elementary problem begins to explore propagation delay and transmission delay, two central concepts in data networking. 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.

* 1. Express the propagation delay, *dprop*, in terms of *m* and *s*.
  2. Determine the transmission time of the packet, *dtrans*, in terms of *L* and *R*.
  3. Ignoring processing and queuing delays, obtain an expression for the end-to-end delay.
  4. Suppose Host A begins to transmit the packet at time *t* = 0. At time *t* = *dtrans*, where is the last bit of the packet?
  5. Suppose *dprop* is greater than *dtrans*. At time *t* = *dtrans*, where is the first bit of the packet?
  6. Suppose *dprop* is less than *dtrans*. At time *t* = *dtrans*, where is the first bit of the packet?
  7. Suppose *s* = 2.5 x 108, *L* = 120 bits, and *R* = 56 kbps. Find the distance *m* so that *dprop* equals *dtrans*.

**Problem 2.** Chapter 1, P7

In this problem, we consider sending real-time voice from Host A to Host B over a packet-switched network (VoIP). Host A converts analog voice to a digital 64 kbps bit stream on the fly. Host A then groups the bits into 56-byte packets. There is one link between Host A and B; its transmission rate is 2 Mbps and its propagation delay is 10 msec. As soon as Host A gathers a packet, it sends it to Host B. As soon as Host B receives an entire packet, it converts the packet's bits to an analog signal. [Assume the conversion of the digital signal back to analog takes 0 seconds.] How much time elapses from the time a bit is created (from the original analog signal at Host A) until the bit is decoded (as part of the analog signal at Host B)?

**Problem 3.** Chapter 1, P25

Suppose two hosts, A and B, are separated by 20,000 kilometers and are connected by direct link of *R* = 2 Mbps. Suppose the propagation speed over the link is 2.5 x 108 meters/sec. Assume the protocol does not require acknowledgements.

* 1. Calculate the bandwidth-delay product, *R* x *dprop*.
  2. Consider sending a file of 800,000 bits from Host A to Host B. Suppose the file is sent continuously as one big message. What is the maximum number of bits that will be in the link at any given time?
  3. Provide an interpretation of the bandwidth-delay product [for this scenario as well as if acknowledgements were required].
  4. What is the width (in meters) of a bit in the link? Is it longer than a football field?
  5. Derive a general expression for the width of a bit in terms of the propagation speed *s*, the transmission rate *R*, and the length of the link *m*.

**Problem 4.**  Chapter 1, P26

Referring to problem 25, suppose we can modify R. For what value of R is the width of a bit as long as the length of the link?

**Problem 5.**  Chapter 1, P27

Consider problem 25 but now with a link of R = 1 Gbps.

1. Calculate the bandwidth-delay product, R x dprop.
2. Consider sending a file of 800,000 bits from Host A to Host B. Suppose the file is sent continuously as one big message. What is the maximum number of bits that will be in the link at any given time?
3. What is the width (in meters) of a bit in the link?

**Problem 6.**  Chapter 1, P28

Refer again to problem 25.

1. How long does it take before the entire file is received at the destination assuming it is sent continuously?
2. Suppose now the file is broken up into 20 packets with each packet containing 40,000 bits. Suppose that each packet is acknowledged by the receiver and the transmission time of an acknowledgment packet is negligible. Finally, assume that the sender cannot send a packet until the preceding one is acknowledged. How long does it take to send the file?

**Problem 7.**  Chapter 1, P29

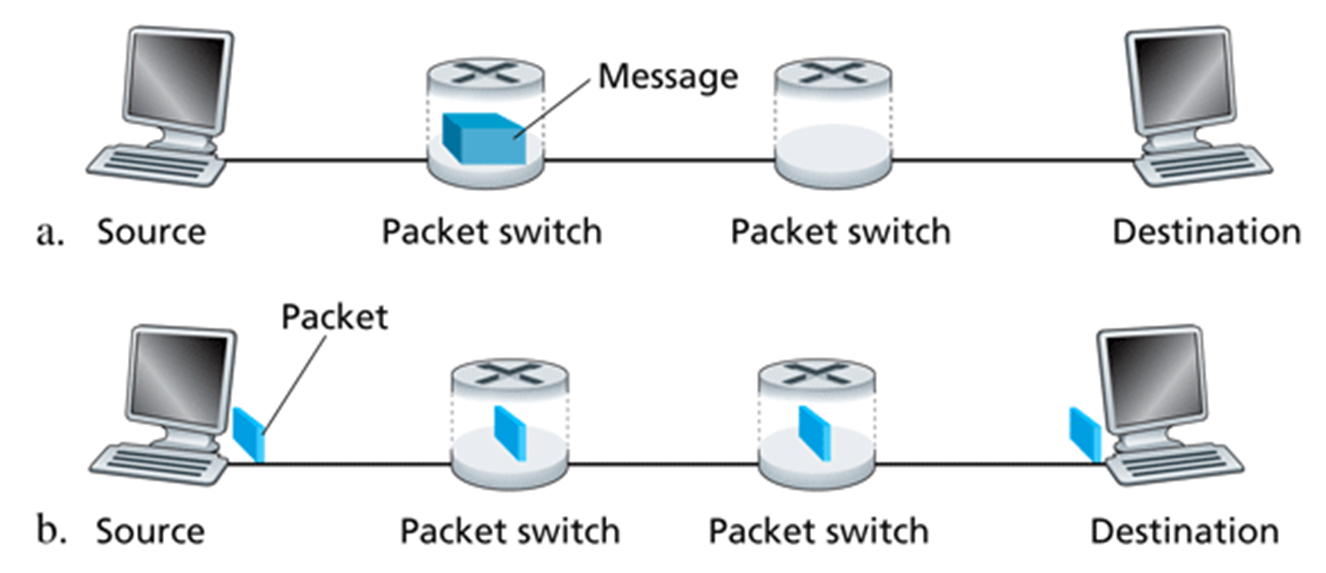
Suppose there is a 10 Mbps microwave link between a geostationary satellite [36 x 106 meters above Earth] and its base station on Earth. Every minute the satellite takes a digital photo and sends it to the base station. Assume a propagation speed of 2.4 x 108 meters/sec. Also assume acknowledgements are not required.

1. What is the propagation delay of the link?
2. What is the bandwidth-delay product, R x dprop?
3. Let x denote the size of the photo. What is the minimum value of x for the microwave link to be continuously transmitting?

**Problem 8.** Chapter 1, P31

In modern packet-switched networks, including the Internet, the source host segments long, application-layer messages (for example, an image or a music file) into smaller packets and sends the packets into the network. The receiver then reassembles the packets back into the original message. We refer to this process as message segmentation. Figure 1.27 illustrates the end-to-end transport of a message with and without message segmentation. Consider a message that is 8 x 106 bits long that is to be sent from source to destination in Figure 1.27. Suppose each link in the figure is 2 Mbps. Ignore propagation, queuing, and processing delays.

1. Consider sending the message from source to destination *without* message segmentation. How long does it take to move the message from the source host to the first packet switch? Keeping in mind that each switch uses store-and-forward packet switching, what is the total time to move the message from source host to destination host?
2. Now suppose that the message is segmented into 800 packets, with each packet being 10,000 bits long. How long does it take to move the first packet from source host to the first switch? When the first packet is being sent from the first switch to the second switch, the second packet is being sent from the source host to the first switch. At what time will the second packet be fully received at the first switch?
3. How long does it take to move the file from source host to destination host when message segmentation is used? Compare this result with your answer in part (a) and comment.



**Problem 9.** History of Networking Video

Watch the video Modern Marvels Wiring America.mp4 from 32:00 minutes to the end (44:18). Indicate on your homework solution that you actually watched the video.

Answer: I watched the Modern Marvels Wiring America video