Indian Institute of Technology, Guwahati
CS341 - Computer Networks
ASSIGNMENT 1

Answer all questions

1. (a) What is meant by the word 'protocol'?

   (b) Write about some of the physical media that Ethernet can run over.

   (c) What advantage does a circuit-switched network have over a packet-switched network? What advantages does TDM have over FDM in a circuit-switched network?

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

   (e) List four access technologies. Classify each one as home access, enterprise access, or wide-area wireless access.

   (f) Describe the most popular wireless Internet access technologies today. Compare and contrast them.

2. Consider an application that transmits data at a steady rate (for example, the sender generates an N-bit unit of data every k time units, where k is small and fixed). Also, when such an application starts, it will continue running for a relatively long period of time. Answer the following questions, briefly justifying your answer:

   (a) Would a packet-switched network or a circuit-switched network be more appropriate for this application? Why?

   (b) Suppose that a packet-switched network is used and the only traffic in this network comes from such applications as described above. Furthermore, assume that the sum of the application data rates is less than the capacities of each and every link. Is some form of congestion control needed? Why?

3. Suppose there is a 10 Mbps microwave link between a geostationary satellite 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 $2.4 \cdot 10^8$ meters/sec.

(a) What is the propagation delay of the link?

(b) What is the bandwidth-delay product, $R \cdot d_{prop}$?

(c) Let x denote the size of the photo. What is the minimum value of x for the microwave link to be continuously transmitting?

4. Suppose two hosts, A and B, are separated by 20,000 kilometers and are connected by a direct link of $R = 5$ Mbps. Suppose the propagation speed over the link is $2.5 \cdot 10^8$ meters/sec. Answer the following questions, briefly justifying your answer:

   (a) Calculate the bandwidth-delay product, $R \cdot d_{prop}$.

   (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) Provide an interpretation of the bandwidth-delay product.

   (d) What is the width (in meters) of a bit in the link?

   (e) 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.

5. 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. The given figure illustrates the end-to-end transport of a message with and without message segmentation. Consider a message that is 106 bits long that is to be sent from source to destination in the figure. Suppose each link in the figure is 5 Mbps. Ignore propagation, queuing, and processing delays.

   (a) 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?

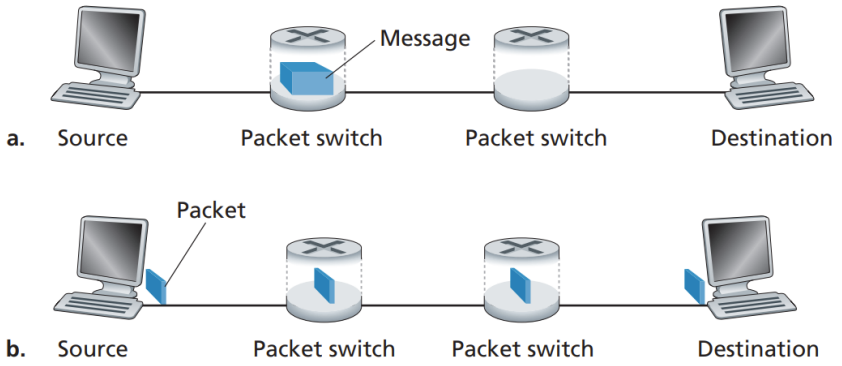
   (b) Now suppose that the message is segmented into 100 packets, with each packet being 10,000 bits long. How long does it take to move the first packet from source host to the first switch? When the first packet is being sent from the first

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?

(c) 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.

(d) In addition to reducing delay, what are reasons to use message segmentation?

(e) Discuss the possible drawbacks of message segmentation.



End-to-end message transport: (a) without message segmentation; (b) with message segmentation

Best wishes