# Sheet 1

1- What are some of the physical media that Ethernet can run over?

2- What advantage does a circuit-switched network have over a packet-switched network?

3- 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?

4- Consider sending a packet from a source host to a destination host over a fixed route. List the delay components in the end-to-end delay. Which of these delays are constant and which are variable?

5- How long does it take a packet of length 1,000 bytes to propagate over a link of distance 2,500 km, propagation speed $2.5 * 10^8$ m/s, and transmission rate 2 Mbps? More generally, how long does it take a packet of length L to propagate over a link of distance d, propagation speed s, and transmission rate R bps? Does this delay depend on packet length? Does this delay depend on transmission rate?

6- 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 R1 = 500 kbps, R2 = 2 Mbps, and R3 = 1 Mbps.
a) Assuming no other traffic in the network, what is the throughput for the file transfer?
b) 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?
c) Repeat (a) and (b), but now with R2 reduced to 100 kbps.

7- What is the difference between synchronous and asynchronous transmission?

8- What does the Nyquist theorem have to do with communications?

9- What does the Shannon capacity have to do with communications?

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10- We have a channel with a 1 MHz bandwidth. The SNR for this channel is 63; what is the appropriate bit rate and signal level?

11- Consider a noiseless channel with a bandwidth of 3000 Hz, transmitting a signal with four signal levels (for each level, we send two bits). What is the maximum bit rate?

12- Consider an extremely noisy channel in which the value of the signal-to-noise ratio is almost zero. What is the capacity for this channel?

13- Using Nyquist theorem, calculate the sampling rate for the following analog signals.
   a. An analog signal with bandwidth of 2000 HZ
   b. An analog signal with frequencies from 2000 to 6000 HZ
   c. A signal with a horizontal line in the time domain representation