Chapter 1 sample questions

(Rxx and Pxx are the sequence numbers in the textbook. Exx are extra problems designed by the instructor and TAs)

R13. 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. (See the discussion of statistical multiplexing in Section 1.3.)

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?
c) Find the probability that a given user is transmitting.
d) Suppose now there are three users. Find the probability that at any given time, all three users are transmitting simultaneously. Find the fraction of time during which the queue grows.

R18. How long does it take a packet of length 1,000 bytes to propagate over a link of distance 2,500 km, propagation speed $2.5 \cdot 10^8$ 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?

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.

a) Assuming no other traffic in the network, what is the throughput for the file transfer?
b) Suppose the file is 4million 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 R_2 reduced to 100 kbps.

R23. What are the five layers in the Internet protocol stack? What are the principal responsibilities of each of these layers?

R26. What is the difference between a virus and a worm?

P3. 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. Further- more, 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?

P8. Suppose 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. (See the discussion of packet switching versus circuit switching in Section 1.3 or the slides.)

a) When circuit switching is used, how many users can be supported?
b) For the remainder of this problem, suppose packet switching is used. Find the probability that a given user is transmitting.
c) Suppose there are 120 users. Find the probability that at any given time, exactly *n* users are transmitting simultaneously. (*Hint*: Use the binomial distribution.)

P29. Suppose there is a 10Mbps 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 $2.4*10^8$ meters/sec.

a) What is the propagation delay of the link?
b) Let *x* denote the size of the photo. What is the minimum value of *x* for the microwave link to be continuously transmitting?

E1. Circuit switching versus packet switching

i. In a circuit switching network, when Alice wants to communicate with Bob, a physical "circuit" is established between Alice and Bob before any data can be sent.

a. Why do you think this is necessary?

b. What is(are) the advantage(s)?

c. What is(are) the disadvantage(s)?

ii. In a packet switching network, when Alice wants to communicate with Bob, no circuit is established and Alice simply starts sending data to Bob.

a. What is(are) the advantage(s)?

b. What is(are) the disadvantage(s)?