COMP2190 – Semester 1 2020/2021

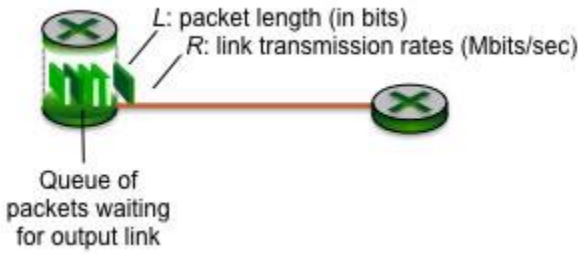
Tutorial 0

Problems

1. Imagine that you have trained your St. Bernard, Bernie, to carry a box of three 8mm tapes instead of a flask of brandy. These tapes each contain 2 terabytes. The dog can travel to your side, wherever you may be, at 18 km/hr. For what range of distances does Bernie have a higher data rate than a transmission line whose data rate (excluding overhead) is 48 Gbps? [1]

2. An image is 1366 x 768 pixels with 4 bytes/pixel. Assume the image is uncompressed. How long does it take to transmit it over a 56-kbps modem channel? Over a 1 Mbps cable modem? Over a 10-Mbps Ethernet? Over a 100-Mbps Ethernet? [1]

3. Consider the figure below, in which a single router is transmitting packets, each of length *L* bits, over a single link with transmission rate *R* Mbps to another router at the other end of the link.



   Suppose that the packet length is *L*= 8000 bits, and that the link transmission rate along the link to router on the right is *R* = 1 Mbps.

   a. What is the transmission delay (the time needed to transmit all of a packet's bits into the link)?
   b. What is the maximum number of packets per second that can be transmitted by the link?

4. Consider an application that transmits data at a steady rate (e.g., 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?

5. Suppose users share a 3 Mbps link. Also suppose each user requires 150 kbps when transmitting, but each user transmits only 10% of the time.
    a. When circuit switching is used how many users can be supported?
    b. What is the probability that a user is transmitting? What is the probability that a user is idle?
    c. For the remainder of this problem, suppose packet switching is used. Suppose that there are 120 users. Can this number of users be supported under circuit switching?
    d. What is the probability that a given (specific) user is transmitting, and the remaining users are not transmitting?
    e. What is the probability that one user (any one of the 120) is transmitting, and the remaining users are not transmitting? When one user is transmitting, what fraction of the link capacity will be used by this user?
    f. Find the probability that at any given time exactly *n* users are transmitting simultaneously.
    g. Find the probability that there are 21 or more users transmitting.