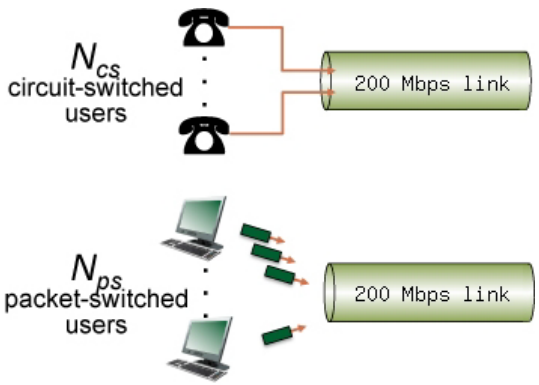
City University of Hong Kong
Department of Electrical Engineering

EE3009 Data Communications and Networking

Tutorial 1

1. Referring to the following figure, considering the two scenarios below:
   - A circuit-switching scenario in which N_{cs} users, each requiring a bandwidth of 10 Mbps, must share a link of capacity 200 Mbps.
   - A packet-switching scenario with N_{ps} users sharing a 200 Mbps link, where each user again requires 10 Mbps when transmitting, but only needs to transmit 30 percent of the time.



   a. When circuit switching is used, what is the maximum number of circuit-switched users that can be supported? Explain your answer.

   b. For the remainder of this problem, suppose packet switching is used. Suppose there are 39 packet-switching users (i.e., N_{ps} = 39). Can this many users be supported under circuit-switching? Explain.

   c. What is the probability that a given (*specific*) user is transmitting, and the remaining users are not transmitting?

   d. What is the probability that one user (*any* one among the 39 users) 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?

   e. What is the probability that any 20 users (of the total 39 users) are transmitting and the remaining users are not transmitting?

   f. What is the probability that *more* than 20 users are transmitting? Comment on what this implies about the number of users supportable under circuit switching and packet switching.

2. 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 that the propagation speed along the link is s m/s. Host A is to send a packet of size L bits to Host B.
    a. Express the propagation delay, d_{prop}, in terms of m and s.
    b. Determine the transmission time of the packet, d_{trans}, in terms of L and R.
    c. Ignoring the processing delay and queueing delays, obtain an expression for the end-to-end delay.
    d. Suppose Host A begins to transmit the packet at time $t=0$. At time $t=d_{trans}$, where is the last bit of the packet?
    e. Suppose d_{prop} is greater than d_{trans}. At time $t= d_{trans}$, where is the first bit of the packet?
    f. Suppose d_{prop} is less than d_{trans}. At time $t= d_{trans}$, where is the first bit of the packet?
    g. Suppose $s=2.5x10^8$, L=120 bits, and R=56 kbps. Find the distance m so that d_{prop} equals $d_{trans.}$

3. Consider a TCP connection between Host A and Host B. Suppose that the TCP segments travelling from Host A to Host B have source port number 37 and destination port number 61. What are the source and destination port numbers for the segments travelling from Host B to Host A?

4. For IP telephony and IP video calls, which one of TCP and UDP would be preferable? Justify your answer.

5. Suppose a process in Host C has a UDP socket with port number 6789. Suppose both Host A and Host B each send a UDP segment to Host C with destination port number 6789. Will both of these segments be directed to the same socket at Host C? If so, how will the process at Host C know that these two segments originated from two different hosts?