Tutorial – Problems

1.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?

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.

Problem 3

Suppose N packets arrive simultaneously to a link at which no packets are currently being transmitted or queued. Each packet is of length L bits and the link has a transmission rate of R bits/sec. What is the average queueing delay for the N packets ?

Problems

- 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 $R_1 = 500\text{kbps}$, $R_2 = 2\text{Mbps}$, $R_3 = 1\text{Mbps}$.
  - Assuming no other traffic, what is the throughput for the file transfer
  - Suppose the file size is 4 million bytes, how long will it take to transfer the file from A to B?
- How long does it take for a packet of length 1000 bytes to propagate over a link of propagation speed 2.5×10^8 m/s. Length of the link is 2,500 Km and transmission rate is 2Mbps.

P6. This elementary problem begins to explore propagation delay and transmission delay, two central concepts in data networking. 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 the propagation speed along the link is s meters/sec. 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 processing and queuing 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 $s = 2.5 \cdot 10^8$, $L = 120$ bits, and $R = 56$ kbps. Find the distance m so that d_{prop} equals d_{trans}.

P12. A packet switch receives a packet and determines the outbound link to which the packet should be forwarded. When the packet arrives, one other packet is halfway done being transmitted on this outbound link and four other packets are waiting to be transmitted. Packets are transmitted in order of arrival. Suppose all packets are 1,500 bytes and the link rate is 2 Mbps. What is the queuing delay for the packet? More generally, what is the queuing delay when all packets have length L, the transmission rate is R, x bits of the currently-being-transmitted packet have been transmitted, and n packets are already in the queue?