Homework Assignment 1: 100 points
Due date: April 14, 2023 (Friday)

Question 1 (25 points): We consider the following scenario in Figure 1. There is an access link with bandwidth of 1Mbit per second (i.e., 1Mbps) to serve a number of hosts (i.e., end-system) in a local area network. Each host requires a bandwidth of 100kbps for sending its data when its active, and each host's active probability is 0.2. Please provide your solutions for the following two questions.

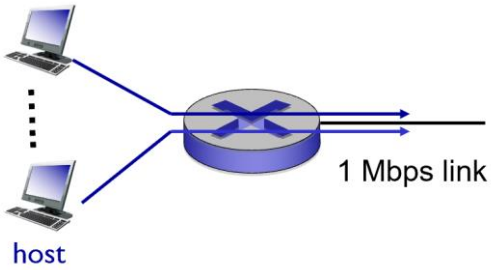

Figure 1

(a) Suppose that circuit switching is adopted, how many hosts can be admitted by this access link? (10 points)

(b) Suppose that packet switching is adopted and that there are 25 hosts are admitted by this access link. In this case, what is the probability that admitted hosts cannot obtain the required bandwidth (i.e., 100kbps)? (15 points)

Question 2 (15 points): Suppose that we consider the store-forward-delay in packet switching. As shown in Figure 2, a source host send 3 packets to a destination host via one router. The size of each packet is L bits, and the bandwidth of each link is R bps. The source host sends the three packets in sequence. Assume that only the transmission delay in considered in this scenario. What is the overall latency for the destination host to receive all the three packets?

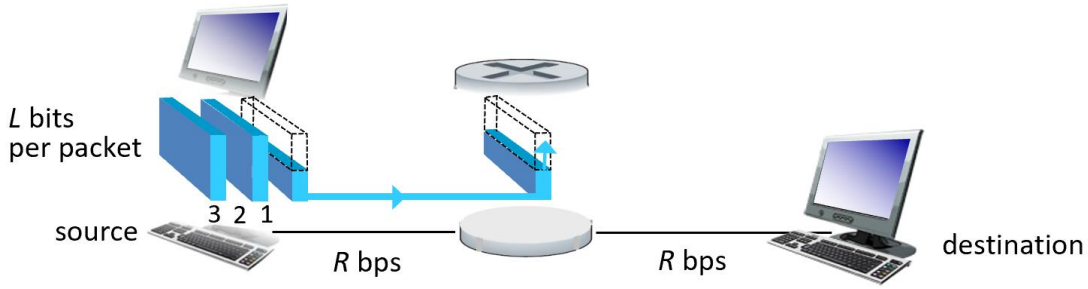

Figure 2

Question 3 (20 points): Consider a packet delivery shown in Figure 3 below. A sending-host sends a packet to a receiving-host via two routers. The packet size is of L. The distance between two different routers and the distance between host and router are denoted by d. The link bandwidth is denoted by R. The signal propagation in each link is denoted by v. For each individual router, its total node processing delay and queuing delay is denoted by T. Please calculate the overall delay for the whole packet is received by the receiving host.

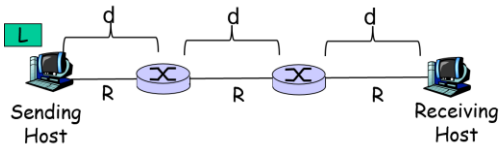

Figure 3

Question 4 (40 points): Suppose that we have a file of size F=20MBits and we need to distribute this file from one server to a group of peers. The number of the peers is N. Assume that the server's uploading bandwidth u_s =40MHz, and each peer has an equal uploading bandwidth u_i =5 MHz and equal downloading bandwidth d_i =10MHz. Then, please provide your solution to the following four questions:

(a): Suppose that we use Client/Server service model to distribute the file. How long does it for the case N=5, N=10, N=20, N=40, and N=60, respectively? (10 points)

(b): Suppose that we use Peer-to-Peer service model to distribute the file. How long does it for the case N=5, N=10, N=20, N=40, and N=60, respectively? (10 points)

(c): What can you find by comparing the solutions from (a) with the solutions from (b)? (10 points)

(d): Suppose that there are infinite number of the peers in the system, i.e., N=∞, how long does the Client/Server model to distribute the file, and how long does the Peer-to-Peer model to distribute the file? (10 points)