

**Homework Assignment 2: 100 points**

**Due date: Oct. 23, 2024 (Wednesday)**

**Question 1 (15 points):** Regarding the delay in packet switching systems,

- (i) please specify four types of delay in packet switching. **(5 points)**
- (ii) Please explain the difference between the queueing delay and transmission delay. **(5 points)**
- (iii) Please explain the reason for the packet loss. **(5 points)**

**Question 2 (15 points):** Consider a packet delivery shown in Figure 1 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.

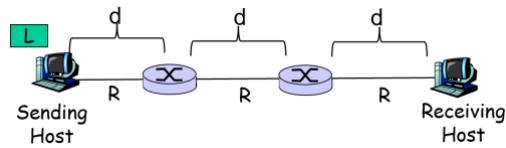


Figure 1

**Question 3 (5 points):** Please specify the difference between the Client/Server (CS) service model and Peer-to-Peer (P2P) service model.

**Question 4: (35 points)** Suppose that we have a file of size  $F=20\text{MBits}$  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  $u_s = 40\text{MHz}$ , and each peer has an equal uploading bandwidth  $u_i = 5 \text{ MHz}$  and equal downloading bandwidth  $d_i = 10\text{MHz}$ . 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)? **(5 points)**
- (d): Suppose that there are infinite number of the peers in the system, i.e.,  $N=\infty$ , 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)**

**Question 5 (10 points):** Regarding the layered protocol in Internet,

- (i) please specify the names of the five layers in the TCP/IP reference model. **(5 points)**
- (ii) Please specify the names of the seven layers in the ISO/OSI reference model. **(5 points)**

**Question 6 (10 points):** Please specify three types of network attacks.

**Question 7 (10 points):** Regarding the data-link layer service,

- (i) what is the key functionality of the data-link layer service? **(4 points)**
- (ii) Consider the packet delivery in Figure 2. Suppose that host A sends a packet to Host F. How many times will the encapsulation operations between the data-link layer and the network layer be invoked, and how many times will the de-capsulation operations invoked accordingly? **(6 points)**