CS 549: Performance Analysis of Computer Networks
Theory Assignment 1

Assigned: February 3, 2024 *Due*: February 8, 2024

Write your answers by hand on plain paper, scan and submit on Moodle. Descriptive answers must be written in your own words, copying verbatim from the textbook will not fetch you any marks.

1. Consider an application that transmits data at a steady rate (for example, the sender generates an N-bit unit of data every k time units, where k is small and fixed). When such an application starts, it will continue running for a relatively long period of time. Describe some real-world scenario that generates such traffic, and answer the following questions, briefly justifying your answer:

   (a) What kind of a network would be appropriate for this application? A packet-switched or a circuit-switched network? Justify your answer?

   (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?

2. A user uses a travel management website to book a flight from Chandigarh to Goa on airline X for her vactaion. The user begins by searching for the flight on the website, the website presents all the available flights by fetching details for X's database. The user then selects a flight, the website confirms availability of seat on the flight, then redirects the user to a page where she is asked to fill her details and then make a payment. When the user chooses a payment mode, the website redirects her to a webpage belonging to a payment gateway. The gateway interacts with the user's bank, which uses an OTP authentication before releasing money to the gateway, the gateway upon receiving the money from the bank transfers it to the airline. Upon receiving the money, the airline confirms the booking to the travel management company, which in turn issues a ticket to the user. Draw a neat UML Sequence Diagram depicting this sequence of events involving all the entities involved.

3. You are required to measure the time taken by a data packet to reach a gateway router in your network from a particular end system. List 3 tools you would use for this measurement. Arrange these tools in (a) increasing order to accuracy, (b) increasing order of precision. Justify your answer.

4. List 3 metrics you would consider while choosing an access technology (physical medium) to connect to the Internet. List 4 such access technologies along with the range of expected readings for the 3 metrics listed by you.

5. A user can connect to a server through either wireless channel or a twisteddpair cable for transmitting a 1460 bytes file. The transmission rate of the wireless channel is 2 Mbps and that of the cable is 100 Mbps. Assume that the propagation speed in air is 3×10^8 m/s, while the speed in the twisted pair cable is 2×10^8 m/s. If the user is located 500 m away from the server, what is the total delay experienced by the user when using each of the two access technologies.

6. Android/Apple phones offer a service called WiFi calling which enables a user to make calls, send and receive text messages over WiFi network, when available, rather than relying on a telecom operator. Using an space-time diagram explain how a WiFi access network, an IP network and a telecommunication network interact to enable WiFi calling.