COMP6461 – Winter 2023
Computer Networks & Protocols
Theoretical Assignment 1
Due Date: Friday, January 27th by 11:59PM

1. Circuit Switching aims at providing a better service through the reservation of the circuit (i.e., the circuit is dedicated). Now, considering only the perspective of the communicating users over a Circuit Switching network (i.e., you should not be concerned with the entire utilization of the network or the advantages to other users), is it possible that Circuit Switching may end up harming its users instead of providing a better service to them? If yes, provide a scenario/case that shows that. If no, explain why this service always provides the best service to its users.

2. Consider two hosts A and B separated by 2 nodes (switches or routers). A wants to send a file of size M = 15 Mbytes over to B. Each link has the same data rate C = 1.5 Mb/s.

   - Assume message switching, how long would it take for the whole file to be received by B? Explain your assumptions. Comment. Write first the formula giving the time in terms of C, M, and possibly other parameters.

   - Assume packet switching and that all packets have the same size L=1200 bits, how long would it take for the whole file to be received by B? Explain your assumptions. Write first the formula giving the time in terms of C, M, and possibly other parameters. Comment and compare.

3. Suppose there are two links between source and destination, with one router connecting the two links. Each link is 5,000 km long with a transmission rate of 10 Mbps. Assume the propagation speed is 2×10^8 meters/sec. There is a 30 Mbit MP3 file sent as one message. Suppose there is no congestion, so the message is transmitted onto the second link as soon as the router receives the entire message. The end-to-end delay is
   a. 6.05 seconds
   b. 6.1 seconds
   c. 3.05 seconds
   d. none of the above

4. Suppose the same network of question 4, but now the MP3 file is broken into 3 packets, each of 10 Mbits. Ignore headers that may be added to these packets. Also, ignore router processing delays. Assuming store and forward packet switching at the router, the total delay is
   a. 3.05 seconds
   b. 4.05 seconds
   c. 6.05 seconds
   d. none of the above

5. Now, suppose the network of question 5 is reduced to only one link between source and destination, and there are 10 FDM channels in the link. The 30 Mbit MP3 file is sent over one of the channels. The end-to-end delay is
    a. 30.05 seconds
    b. 30 seconds
    c. 300 microseconds
    d. none of the above

6. Suppose that a 10 Mbps link is being shared among users. Furthermore, assume that each user needs 500 kbps when transmitting but only does so 1% of the time.

    a. How many users can the link handle if we assume that circuit switching is used?

    b. Now, assume packet switching is used and suppose there are 100 users in the set. Find the probability that, at any given time, exactly 10 users are transmitting simultaneously.

7. What are the disadvantages of using a layered architecture in computer networks?

8. What do encapsulation and de-encapsulation mean? Why are they needed in a layered protocol stack?