COMP445 – Winter 2022
Data Communications & Computer Networks
Theoretical Assignment 1
Due Date: Tuesday, February 1st by 11:59PM

1. Circuit Switching aims at providing a better service through the reservation of the circuit (i.e., 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 will indeed always provide the best service to its users.

2. With DSL ISPs, dedicated lines usually connect to the local offices to the location where the service is provided (i.e., residential homes). In contrast, with Cable ISPs, the connection is shared between multiple homes in a neighborhood. Despite this configuration that is clearly to the benefit of DSL users, service provided by Cable ISPs may still be superior to the one provided by DSL providers. Explain the reasons behind this. Further, if you are hired by a DSL provider, and considering that changes to the company's infrastructure (i.e., wiring) are quite costly, what would you propose to speed up the provided service while balancing the cost.

3. 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.

4. 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.

5. 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.

6. Suppose there are two links between source and destination, with one router connecting the two links. Each link is 5,000 km long. There is an MP3 file sent as one message. Suppose there is no congestion, so that 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

7. Now suppose that 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

8. Now suppose there is only one link between source and destination, and there are 10 FDM channels in the link. The 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

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

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

11. A message of size 4096 bytes is sent using TCP, IP, and Ethernet as network protocols. The application sending the message uses a 16-byte header. TCP employs a 20-byte header, IP employs a 20-byte header, and Ethernet uses a 14-byte header and a 4-byte trailer. Considering that Ethernet defines a maximum data field size of 1500 bytes (also known as the MTU – Maximum Transmission Unit), what is the percentage of overhead incurred in the transmission of the message.