COMP445 – Winter 2022
Data Communications & Computer Networks
Theoretical Assignment 1

1. Yes, if traffic from a user changes over time and it requires a dynamic allocation of resources to account for the changes, the fixed reservation using circuit switching may impede such dynamic allocation and hence may end up harming its users.

2. A couple of reasons:

   - DSL's quality of service is largely dependant of the distance and quality of the cooper cable for the last-mile connection. If the user is located at the edge of the supported distance, it will get reduced transmission rates
   - In cable ISPs, the shared cable offers an aggregated transmission rate to the residential homes sharing the connection. Which means that, depending on the users behavior, at a given time users may experience large transmission rates (because other users are not using the network at the same time) that are far superior to the ones offered by DSL.

3. Question was solved in the Q&A session, but using M= 15 Mbits instead of 15 Mbytes

4. Time taken from source to the router= $3+(5000\text{x}10^3)/(2\text{x}10^8)$=3.025 sec.

   Time taken from router to destination is the same, hence total time

   =6.05sec

5. When source starts to send the first packet, the destination needs to

   wait for: $2\cdot(\frac{10\cdot 10^6}{10\cdot 10^6}+\frac{5000000}{200000000}) = 2\cdot(1.025) = 2.05\text{sec}$ to get it,

   after that it will need to wait additional 2*(1.0)=2 sec to get the

   remaining 2 packets. The total time is : 2.05+2 = 4.05sec

6. Each channel is of 1 Mbps (10 Mbps/10 channels). Assuming the distance is 10 km, the end-to-end delay, i.e., transmission delay + propagation delay is 30.05 sec

7. To mention one, there is additional overhead created by the control information appended at each layer

8. Encapsulation is the process of passing a packet from a higher layer to a lower layer. In the simplest case, it simply appends additional information (i.e., a header) to the

source packet. In more complicated scenarios, the original packet can be split into multiple packets, each carrying its own header. Decapsulation is the opposite process of encapsulation. It extracts the header from a source packet from a lower layer and passes the payload to the higher layer. If lower layer packets are part of a sequence, the corresponding payloads are put together before they are passed to the higher layer. Each protocol in a layer of a protocol stack relies on the services of the lower layers but not on their information. Thus, the information a protocol needs to process a packet should entirely be contained in the header of that protocol. Encapsulation and decapsulation are flexible mechanisms to allow each protocol to operate independently from others while being able to interface with each other.

9. Overhead included up to the network layer=16+20+20=56 bytes

   Since MTU is 1500 bytes, packets delivered to the Ethernet protocol need to have up to 1500-56=1444 bytes of actual data. Then, the original message should be broken into 4096/1444= 2.8 → 3 packets. Each packet will carry a total overhead of 56+14+4=74 bytes. Hence, the percentage of overhead is (3*74)/4096=5,4%