CSCE 4753 Computer Networks Homework #1

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35 points
7 questions with multiple parts

Instructions
- Type your work, print it to a **single** PDF, and upload it to Blackboard before the due date and time. It is strongly suggested that you use the given document.
- Show all of your work. Correct answers alone may not carry full credit without proper justification and details of steps.
- -2 points if you do not insert your name and ID at the top of the document.
- -5 points if it is not typed or legible. For this homework, you may scan it with something like the CamScanner app, but just make sure it is a legible PDF.
- -5 points if it is not a PDF file.
- -5 points if it is not a single PDF file. Submit one PDF file. Do not submit zip files containing one or more files.
- -5 points if you present the worked problems out of order. In other words, please show the problems in the order assigned, 1, 2, 3, …

1. (3 pts.) List the three layers a router must implement to operate.

   1. Physical Layer
   2. Data Link Layer
   3. Network Layer

2. (3 pts.) **Packet switching versus circuit switching**

   Which of the characteristics below are associated with the technique of packet switching?

   Correct answers are (write down the letters here): _____bcde_____

   a. Reserves resources needed for a call from source to destination.
   b. Resources are used on demand and are not reserved in advance.
   c. Data may be queued before being transmitted due to other users' data also being queued for transmission.
   d. Congestion loss and variable end-end delays are possible with this technique.
   e. This technique is used on the Internet.
   f. This technique was the basis for telephone call switching during the 20th century and into the beginning of this current century.

3. (5 pts.) **Internet protocol stack**

What layer in the network stack best corresponds to the phrase? (write down the corresponding letters in the blanks)

(a) Application layer   (b) Transport layer   (c) Network layer   (d) Link Layer   (e) Physical Layer

_c___ moves datagrams from the source host to the destination host.

___b_ handles the delivery of segments from the application layer, which may be reliable or unreliable.

___e_ transmit bits directly over the wire.

___b_ passes frames from one node to another across some medium.

__a__ handles messages from a variety of network applications.

4. (4 pts.) **Components failure**

Suppose a communication involves 60 components that work correctly (independently) 98% of the time. What's the likelihood the communication fails at a given point in time? (Show the result as ab.x%, rounded to the closest .x, e.g., 39.5%)

 70.2%

5. (6 pts.) Consider the scenario below, with 4 servers connected to 4 clients over 4 three-hop paths. The 4 pairs share a joint middle hop with an R = 300 Mbps transmission capacity. The 4 links from the servers to the shared link have a transmission capacity of R_S = 50 Mbps. Each of the 4 links from the shared middle link to a client has a transmission capacity of R_C = 90 Mbps.
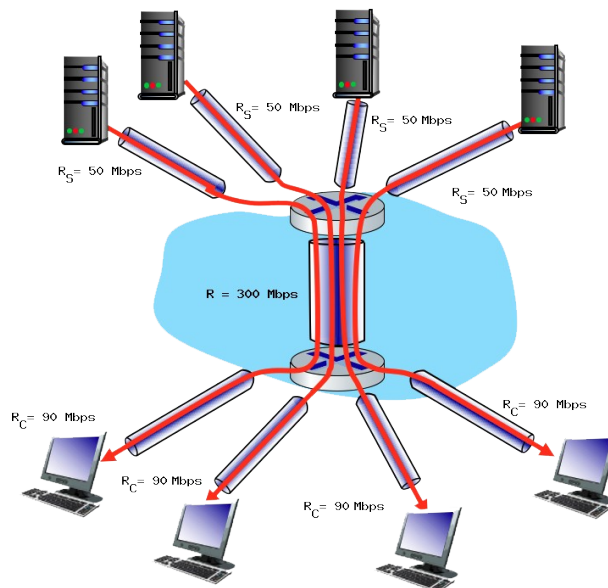
a. (2 pts.) What is the maximum achievable end-end throughput (an integer value, in Mbps) for each of the 4 client-to-server pairs, assuming that the middle link is fairly shared (divides its transmission rate equally) and all servers are trying to send at their maximum rate? Please write the answer with a brief explanation.

   50 mbs, due to the smallest value in the server client model being 50. Therefore the bottleneck is 50

b. (2 pts.) Assuming that the servers are all sending at the maximum rate possible, what are the link utilizations for the server links (with transmission capacity R_S)? Enter your answer in a decimal form of 1.00 (if the utilization is 1) or 0.xx (if the utilization is less than 1, rounded to the closest xx). Please write the answer with a brief explanation.

100% as the bottleneck is the server, therefore all the utilization will be on the servers.

c. (2 pts.) Assuming that the servers are all sending at the maximum rate possible, what are the link utilizations of the client links (with transmission capacity R_C)? Enter your answer in a decimal form of 1.00 (if the utilization is 1) or 0.xx (if the utilization is less than 1, rounded to the closest xx). Please write the answer with a brief explanation.

The Utilization rate would be 50/90 or 56% utilization. As all of the utilization is on the server end.

6. (4 pts.) Suppose two hosts, A and B, are separated by 5000 kilometers and connected by a direct R = 500 Mbps link. Assume the propagation speed over the link is $2.0x10^8$ meters/second.

a. (2 pts.) Calculate the propagation delay t_{prop}.

5000 kilometers / $2.0x10^8$ meters/second = 0.025 second delay

b. (2 pts) How many bits are in transit between hosts A and B?

500 mps * 0.025 delay = 12.5 million

7. (10 pts.) Consider sending a file of $1x10^6$ bits over a path of 35 links. Each link transmits at 1 Mbps (bit per second), and the network is lightly loaded so that there are no queueing delays.

a. (5 pts.) Suppose that the network is circuit-switched and the transmission rate of the circuit between the source and destination is 1Mbps. Assuming the set-up time is 250 milliseconds and 40 bits of header appended to the entire file, how long does it take to send the file?

Send = 1250.04 milliseconds

b. (5 pts.) Suppose the network is a packet-switched, store-and-forward datagram network, and a connectionless service is used. The file of $1x10^6$ bits is broken into packets, each packet with 1000 bits, of which 40 bits are headers. The propagation delay is negligible. How long does it take to send the file?

Send = 1077 milliseconds