CSL334: Computer Networks
Theory Assignment No 1
Chapter 1 and 2

Date of submission : By the end of Office hours, 3rd September 2018

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Instructions:

- **Be brief and precise in your answers.**

- This assignment is to be submitted in the form of a hand-wirtten hard copy to the Graduate Intern Mr Adil, in Computer Lab.

1. Consider two hosts on the Internet viz. A and B. Enlist the desired attributes that a protocol that implements semantically correct communication between A and B must offer. Assume that the communciation link between A and B is not direct, it is an open, publicly accessible channel.

2. How long does it take a packet of length 1,000 bytes to propagate over a link of distance 2,500 km, propagation speed 2.510^8 m/s, and transmission rate 2 Mbps? More generally, how long does it take a packet of length L to propagate over a link of distance d, propagation speed s, and transmission rate R bps? Does this delay depend on packet length? Does this delay depend on transmission rate?

3. Suppose Host A wants to send a large file to Host B. The path from Host A to Host B has three links, of rates R1 = 500 kbps, R2 = 2 Mbps, and R3 = 1 Mbps.

4.   a. Assuming no other traffic in the network, what is the throughput for the file transfer?

      b. Supposethefileis4millionbytes.Dividingthefilesizebythethroughput, roughly how long will it take to transfer the file to Host B?

      c. Repeat (a) and (b), but now with R2 reduced to 100 kbps.

5. Suppose end system A wants to send a large file to end system B. At a very high level, describe how end system A creates packets from the file. When one of these packets arrives to a packet switch, what information in the packet does the switch use to determine the link onto which the packet is forwarded? Why is packet switching in the Internet analogous to driving from one city to another and asking directions along the way?

6. Which layers in the Internet protocol stack does a router process? Which layers does a link-layer switch process? Which layers does a host process?

7. Review the car-caravan analogy discussed in the class. Assume a propagation speed of 100 km/hour.

      a. Supposethecaravantravels150km,beginninginfrontofonetollbooth, passing through a second tollbooth, and finishing just after a third toll- booth. What is the end-to-end delay?

      b. Repeat(a),now assuming that there are eight cars in the caravan instead of ten.

8. Consider a packet of length L which begins at end system A and travels over three links to a destination end system. These three links are connected by two packet switches. Let d_i, s_i, and R_i denote the length, propagation speed, and the transmission rate of link i, for i = 1, 2, 3. The packet switch delays each packet by *dproc*. Assuming no queuing delays, in terms of d_i, s_i, and R_i, (i = 1,2,3), and L, what is the total end-to-end delay for the packet? Suppose now the packet is 1,500 bytes, the propagation speed on all three links is 2.5 x 10^8 m/s, the transmission rates of all three links are 2 Mbps, the packet switch processing delay is 3 msec, the length of the first link is 5,000 km, the length of the second link is 4,000 km, and the length of the last link is 1,000 km. For these values, what is the end-to-end delay?

9. In problem number 8, suppose $R1 = R2 = R3 = R$ and *dproc* $= 0$. Further suppose the packet switch does not store-and-forward packets but instead imme- diately transmits each bit it receives before waiting for the entire packet to arrive. What is the end-to-end delay?

10. A packet switch receives a packet and determines the outbound link to which the packet should be forwarded. When the packet arrives, one other packet is halfway done being transmitted on this outbound link and four other packets are waiting to be transmitted. Packets are transmitted in order of arrival. Suppose all packets are 1,500 bytes and the link rate is 2 Mbps. What is the queuing delay for the packet? More generally, what is the queuing delay when all packets have length L, the transmission rate is R, x bits of the currently-being-transmitted packet have been transmitted, and n packets are already in the queue?

11. a. (a) Suppose N packets arrive simultaneously to a link at which no packets are currently being transmitted or queued. Each packet is of length L and the link has transmission rate R. What is the average queuing delay for the N packets?

   b. Now suppose that N such packets arrive to the link every LN/R seconds. What is the average queuing delay of a packet?

12. The Instant Messaging services like WhatsApp and Skype offer a service that allows you to make a phone call from a PC to an ordinary conventional phone. This means that the voice call must pass through both the Internet and through a telephone network. Discuss how this might be done.