Spring 2020

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CSCI 4311/5311 Homework # 1

Due: **Monday March 02, 2020 (11:59 pm), via Moodle.**

The rules:

❑ All work must be your own. You are not to work in teams on this assignment. You are not to use
materials from previous offerings of this course.

❑ Format: Submit as a single file (via moodle) containing a PDF file. Email me (ayn@cs.uno.edu) assignment only if moodle is not working.

❑ You may use the textbook and lecture notes, but do NOT search the Internet for solutions.

❑ The submission deadline is strict. Therefore, please submit on time.

Total Marks = 110 (10 bonus points)

(Q1) [17 points]

How long does it take a packet of length 1,000 bytes to be received over a link of distance 2,500 km, propagation speed 2.5×10^8 m/s, and transmission rate 2 Mbps? You can ignore queue and processing delay.

$d_{prop} = d/s = (2500 * 10^3 \text{ m}) / (2.5 * 10^8 \text{ m/s}) = 100 \text{ s} / 10^{-5} \text{ s} = 0.01 \text{ s} = 10 \text{ ms}$
$d_{trans} = L/R = 1000 \text{ bytes} / (2 * 10^6 \text{ bytes/s}) = 0.5 / 10^3 \text{ s} = 0.5 \text{ ms}$
Total time = $d_{prop} + d_{trans} = 10 \text{ ms} + 0.5 \text{ ms} = 10.5 \text{ ms}$

(Q2) [15 points]

Why will two ISPs at the same level of the hierarchy often prefer peering agreement with each other? How does an IXP earn money?

Two ISPs usually prefer peering because it reduces costs by eliminating the need to pay an intermediary ISP provider.

An IXP contains multiple ISPs that exchange internet traffic, so it earns money by charging each ISP a connection fee.

(Q3) [20 points] Suppose you would like to urgently deliver 40 terabytes data from Boston to Los Angeles. You have available a 100 Mbps dedicated link for data transfer. Would you prefer to transmit the data via this link or instead use FedEx overnight delivery? Explain. Assumptions:

- There is a direct fiber link between Boston and Los Angeles offices.
- Ignore processing, queueing, and propagation delay. Only calculate transmission delay.
- If you choose FedEx, you will give the packet at 9 am, and it will be delivered in the next day at 9 am.

d_{trans} = L/R = (40 * 10^{12} bytes) / (10 * 10^6 bytes/s) = 4 * 10^6 s

hours: (4 * 10^6 s) * (1 hr / 3600 s) = 10^6 / 9 hr = 1111.11 hr

I would send this via FedEx because it will only take 24 hours instead > 1100 hrs.

(Q4) [7x4 = 28 points]

Hosts A and B are communicating over a TCP connection, and Host B has already received from A all bytes up through byte 99. Suppose Host A then sends two segments to Host B back-to-back. The first and second segments contain 70 and 30 bytes of data respectively. In the first segment, the sequence number is 100, the source port number is 1500, and the destination port number is 1750. Host B sends an acknowledgment whenever it receives a segment from Host A.

a-) In the second segment sent from Host A to B, what are the sequence number, source port number, and destination port number? Briefly explain.

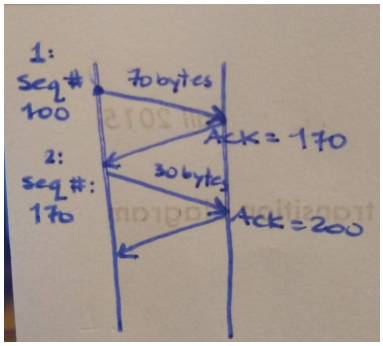
The source and destination port numbers remain the same because they're originating from A and being received at B. So: source port number = 1500 and destination port number = 1750.

The sequence number is equal to the previous sequence number + the segment size. So, sequence number = 100 + 70 = 170.

b-) In Host B receives the first segment and second segment successfully, what are the acknowledgment number, source port number, and destination port number? Briefly explain.

Both acknowledgements originate at B and go to A, so the source and destination port numbers are the same. Source port number = 1750. Destination port number = 1500.

The acknowledgement # for the first segment = sequence number + segment size = 100 + 70 = 170. The acknowledgement # for the second segment = 170 (see item 4a) + 30 = 200.

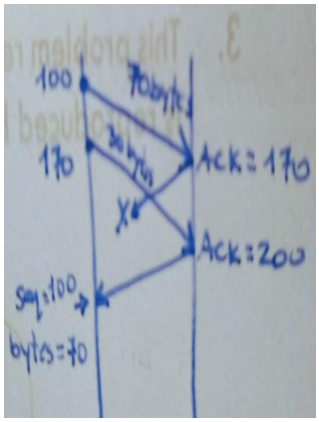


c-) If the first segment arrives before the second segment, in the acknowledgment of the first arriving segments, what is the ACK number, the source port number, and the destination port number? Briefly explain.

The acknowledgement number of the first arriving segment is 170 (see item 4b).
Since the acknowledgement is coming from B to A, the source port number is 1750 and the destination port number is 1500.

d-) If the second segment arrives before the first segment, in the ACK of the first arriving segment, what is the ACK number? Briefly explain.

The acknowledgement number is 100. Since ACK 170 never arrived, A is still waiting for confirmation that the first segment (sequence number 100, byte size = 70) arrived at B.



(Q5) [30 points]

A TCP connection uses the Reno version. Initial ssthresh is 8 MSS. We are trying to transfer a large file over this connection. MSS= 1KB. A triple double ACK arrives after having just transmitted 34KB. A timeout occurs at RTT 10. Assume that you successfully transfer all the date at RTT 15. Draw the Congestion Window (cwin) value against time (RTT). Identify slow start and congestion avoidance intervals. Find the ssthresh values for all intervals.