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CSCI 4311/5311 Homework # 1

Due: **Thursday March 17, 2022 (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 = 100

(Q1) [15 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.

$t = \frac{d}{s} = \frac{2500\,km}{2.5 \cdot 10^8\,m/s} = \frac{2500000\,m}{2.5 \cdot 10^8\,m/s} = 0.01\,s = \boxed{10\,ms}$

(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 at the same level of the hierarchy often prefer peering with each other to save money. By peering, they both avoid paying another ISP.

IXPs earn money by charging ISPs that connect to it and send or receive internet traffic.

1 TB = 1000 GB 1 GB = 1000 MB 1 MB = 1000 KB 1 KB = 1000 bytes 1 byte = 8 bits

(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.

$40\ TB \cdot \frac{1000\ GB}{1\ TB} \cdot \frac{1000\ MB}{1\ GB} \cdot \frac{1000\ KB}{1\ MB} \cdot \frac{1000\ bytes}{1\ KB} \cdot \frac{8\ bits}{1\ byte} = 3.2 \cdot 10^{14}\ bits$

$\frac{100\ Mb}{1\ s} \cdot \frac{1000\ Kb}{1\ Mb} \cdot \frac{1000\ b}{1\ Kb} = 10^8\ bits/s$

$\frac{3.2 \cdot 10^{14}}{10^8} = 3.2 \cdot 10^6\ s \cdot \frac{1\ hr}{60\ s} \cdot \frac{1\ hr}{60\ m} \cdot \frac{1\ day}{24\ hrs}$

$= 37\ days$

I would use the fedex delivery for delivery in 1 day vs 37 days.

(Q4) [6x4 = 24 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.

Sequence # = 100 + 70 = 170
Source port = 1500
dest. port = 1750

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.

ACK = 1880
source = 1750
dest. = 1500

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.

ACK = 1850
source = 1750
dest. = 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.

ACK = 100. still waiting

(Q5) [26 points]

Assume that we have a GBN protocol with a window size 3. We are trying to send 8 packets total (e.g. [0,1,2,3,4,5,6,7]).
Show both sender and receiver side for given cases. For the receiver side, write what is the ACK number. In the sender side, show what is the packet number. Also, show the sender window each time it changes. Finally, show what happens after the timeout, e.g. Sender retransmits some packets, receiver sends ACK, show the values. Explain your steps briefly.

Main assumptions for the question:

- Assume that the timeout does not occur prematurely.
- We do not have network congestion or additional delay.
- You can reference slide #49.

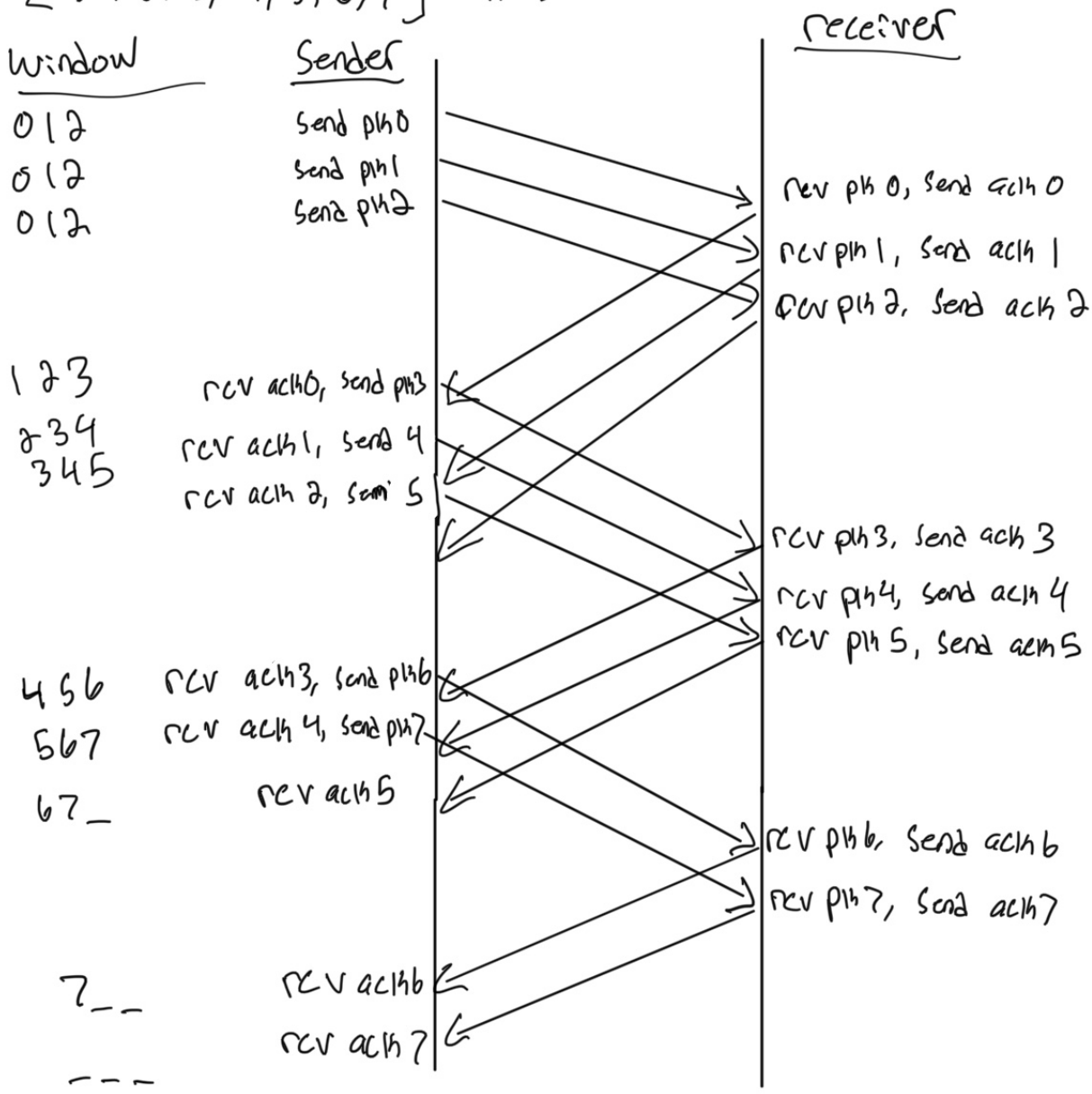
a-)[8 points] Assume that all packets including ACK packets delivered without error. Assume that the sender sent all packets before timeout.

b-)[9 points] Assume that only packet #4 loss during the first transmission. All other packets and retransmission etc. delivered correctly.

c-)[9 points] Assume that only ACK packet #3 loss during the first transmission. All other packets and retransmission etc. delivered correctly.

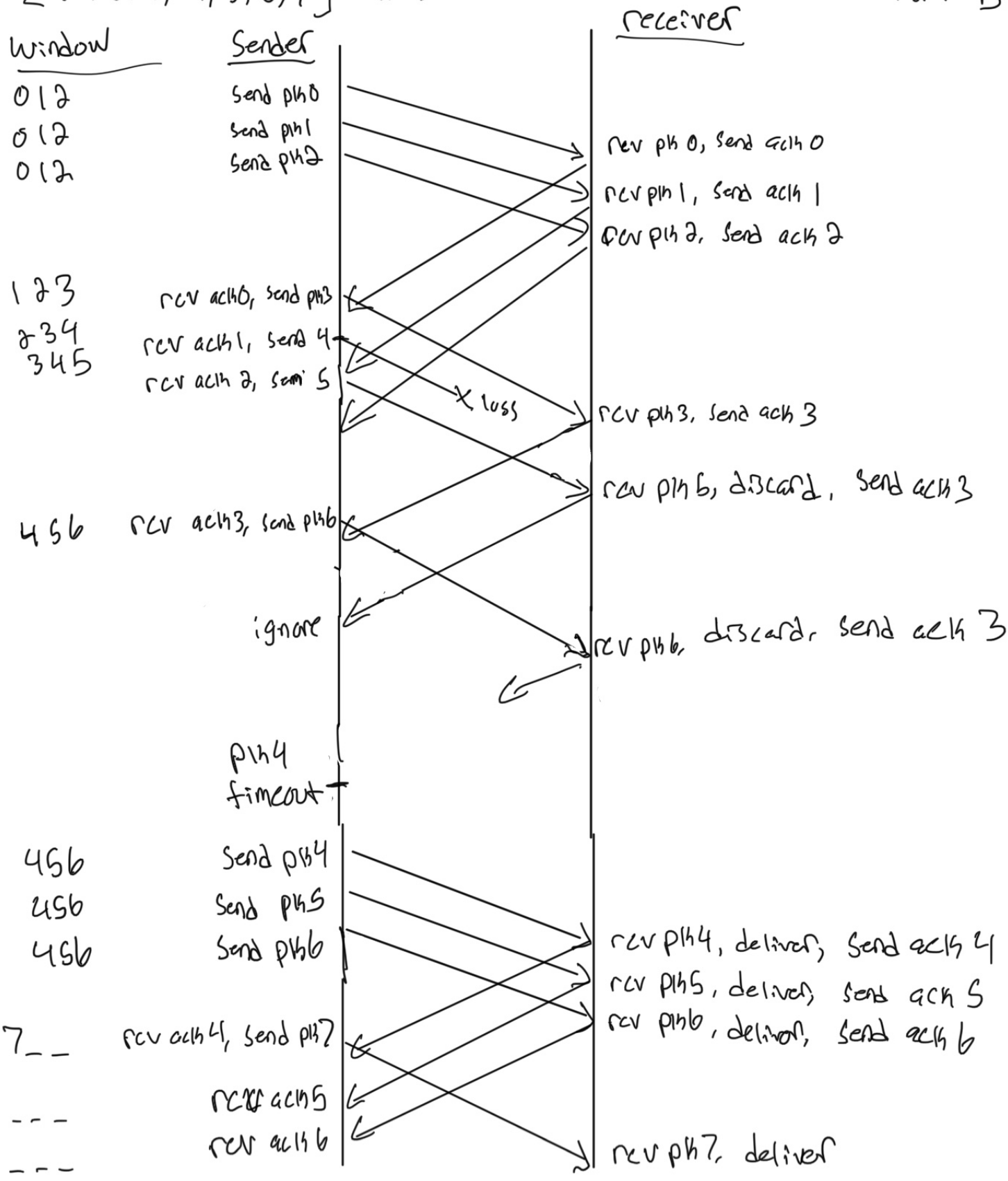
Q5, Part A

[0, 1, 2, 3, 4, 5, 6, 7] n=3



Q5, Part B

[0, 1, 2, 3, 4, 5, 6, 7] n=3



Q5, Part C

[0, 1, 2, 3, 4, 5, 6, 7] n=3