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CSCI 4311/5311 Homework # 1

Due: **April 7, 2023 (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]

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.

a-) (5 points) Assuming no other traffic in the network, what is the throughput for the file transfer?

500 Kbps

b-) (5 points) Suppose the file is 4 million bytes. Dividing the file size by the throughput, roughly how long will it take to transfer the file to Host B? (Ignore all other delays, just focus on transmission delay)

32 000000 bits / 500000 bps

= 64 seconds

c-) (5 points) Repeat (a) and (b), but now with R2 reduced to 100 kbps.

32000000 bits / 100000 bps = 320 seconds

(Q2) [10 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?

1. it allows them to exchange traffic directly without having to pay a third party network to carry their traffic.

2. they charge its members fees for connecting to the exchange & exchanging traffic with other members.

(Q3) [5x4 = 20 points]

Hosts A and B are communicating over a TCP connection, and Host B has already received from A all bytes up through byte 500. Suppose Host A then sends three segments to Host B back-to-back. The first, second and third segments contain 100, 70, and 80 bytes of data respectively. In the first segment, the sequence number is 500, the source port number is 1000, and the destination port number is 2000. Host B sends an acknowledgment whenever it receives a segment from Host A.

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

500 + 100 + 70 = 670 , 1000 , 2000 The seqvence # of each subsequent segment is the sum of the seqvence number of the previous segment & the # of bytes in each one

600 + 70

b-) In Host B receives all three segments successfully, what are the acknowledgment number, source port number, and destination port number in the last segment that Host B sent? Briefly explain.

500 + 100 + 70 + 80 = 750 , 2000 1000 the acknowledge number in each ACK segment is the next expected byte from the sender

600 + 150

c-) If Host B receives the segments in the following order: "2-1-3". What is the first ACK number that Host B sends after receiving segment number 2? Briefly explain.

500 + 100 - 30 = 570 the acknowledge number in each ACK segment is the next expected byte from the receiver.

600

d-) Assume that Host B received all 3 segments without any problem and sent ACK segments for each arriving segment. Assume that the ACK segment 2 is lost. What will Host A do and why? E.g., retransmit packets, retransmit a packet or, do not retransmit the packet.

will retransmit segment 2 because it is protocol since it is guarenteed that all segments must deliver to the receiver.

(Q4) [23 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-)[7 points] Assume that all packets including ACK packets delivered without error. Assume that the sender sent all packets before timeout.

Sender : [0,1,2], win size = 3
Sender : [3,4,5], win size = 3 → Reciver : recieved [0,1,2], sends Ack 3
Sender : [6,7], win size = 2 → Reciever : recieved [3,4,5], sends Ack 6
→ Reciever : recieved [6,7], sends Ack 8

b-)[8 points] Assume that only packet #4 loss during the first transmission. All other packets and retransmission etc. delivered correctly.

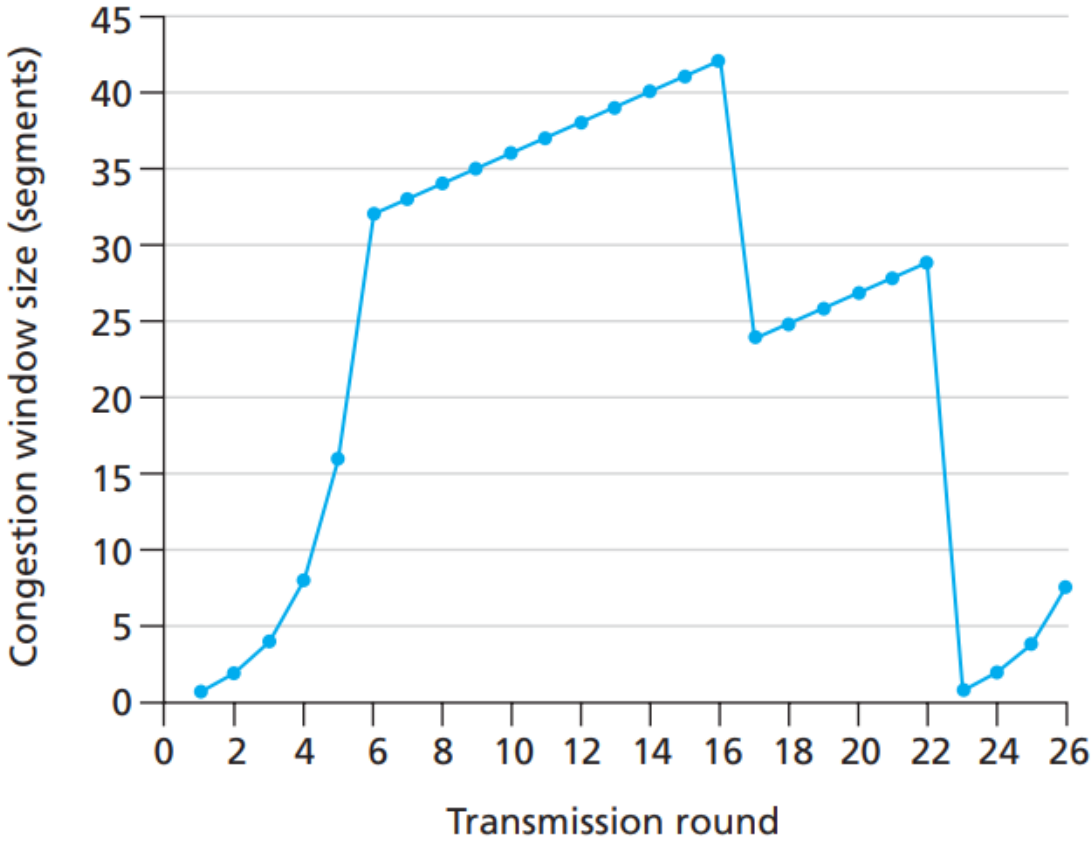
Sender : [0,1,2], win size = 3
Sender : [3,4,5], win size = 3 → Reciver : recieved [0,1,2], sends Ack 3
Sender : Timeout : 4, retransmit 4, win size = 3
Sender : [3,4,5], win size = 3 → Reciever : recieved [3,5], sends Ack 6
→ Reciever : recieved [4] retransmit, sends Ack 5
→ Reciever : recieved [6,7], sends Ack 8

c-)[8 points] Assume that only ACK packet #3 loss during the first transmission. All other packets and retransmission etc. delivered correctly.

Sender [0,1,2] win size = 3 → Reciever : recieved [0,1] sends Ack 2
Sender : Timeout on Ack 2, retransmit [2] win size = 3
Sender : [2,3,4], win size = 3 → Reciever : recieved [2] sends Ack 3 (original lost)
→ Reciever : Recieved [3,4,5] sends Ack 6
→ Reciever : recieved [6,7] send Ack 8

(Q5) [4x8 = 32 points]

Assuming TCP Reno is the protocol experiencing the behavior shown in the figure below, answer the following questions. In all cases, you should provide a short discussion justifying your answer.



a) Identify the intervals of time when TCP slow start is operating.

1-6, 23-26

b) Identify the intervals of time when TCP congestion avoidance is operating.

6-23

c) After the 16th transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?

triple duplicate

d) After the 22nd transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?

timeout

e) What is the initial value of ssthresh at the first transmission round?

32

f) What is the value of ssthresh at the 18th transmission round?

21

g) What is the value of ssthresh at the 24th transmission round?

13

h) During what transmission round is the 70th segment sent?

7