Quiz II
EE465/565: Computer Networks and Protocols
11/08/05
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You have 60 minutes to complete the quiz with 20 points total. Please clearly state your assumptions. You will be given partial credits for showing your work. Good luck.

Multiple choice questions: 1 point each

1) Transport-layer protocol provides logical communication between
   (a) Application processes
   (b) End-hosts
   (c) Routers
   (d) None of the above

2) Which of the following statements about TCP and UDP is true?

   (a) Both UDP and TCP maintain connection state in the end systems.
   (b) Only UDP maintains connection state
   (c) Only TCP maintains connection state
   (d) None of the above

3) Lost packets in TCP can be detected by

   (a) Sender only
   (b) Receiver only
   (c) Both sender and receiver
   (d) Application layer

4) The flow control is used to

   (a) Control network congestion
   (b) Prevent the sender from sending packets too fast to overwhelm the receiver.
   (c) Reserve bandwidth for a given flow.
   (d) Both (a) and (b)

5) Average throughput of a TCP connection based on congestion window W and round trip time RTT is

(a) RTT*W/2
(b) 0.75*W/RTT (from the book)
(c) W/RTT
(d) 0.75*RTT/W

6) If the loss rate increases by 4, the throughput of a TCP connection will

(a) Increase by 2
(b) Increase by 4
(c) Decrease by 2 (bandwidth is inversely proportional to sqrt(loss rate))
(d) Decrease by 4

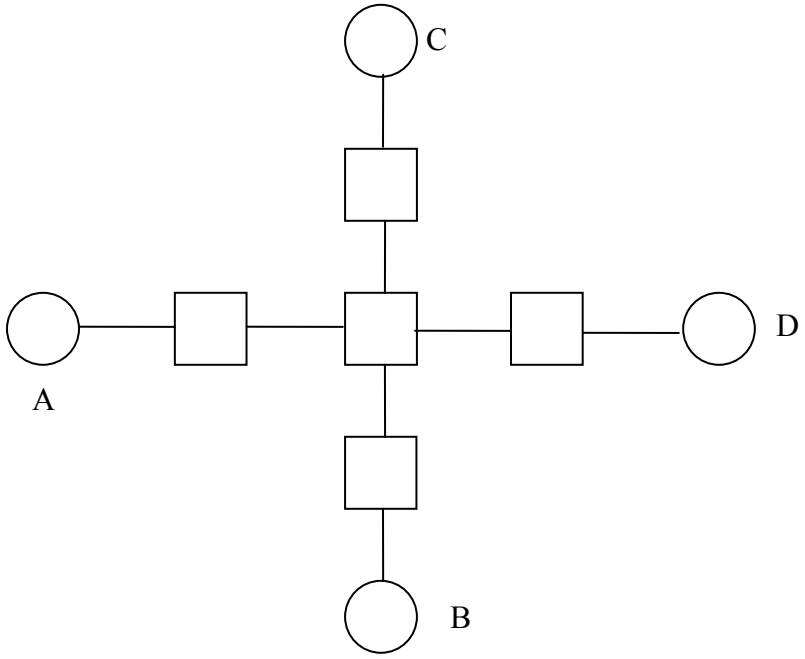
7) A TCP connection is completely identified by

(a) Source IP and destination IP
(b) Source IP, source port, destination IP
(c) Source port and destination port
(d) Source IP, destination IP, source port, destination port

8) Suppose a Go-Back-N protocol is used to send data on 10 Mbps link from host A to host B. The round trip time is 100ms and the packet size is 10 Kbits. Assuming no packet loss, if N = 20, what is the approximate link utilization of the protocol?

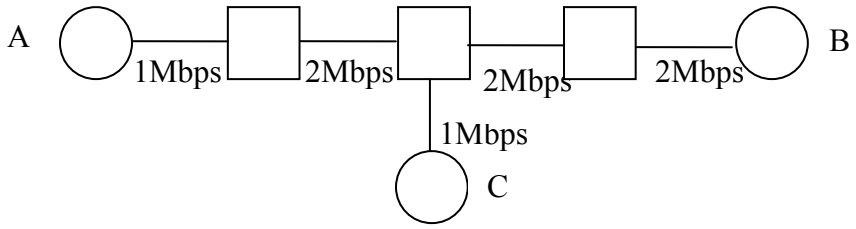
(a) 0.2 10Kbits*20/101ms ≈ 2000 Kbps → U ≈ 2Mbps/10Mbps = 0.2
(b) 0.5
(c) 0.9
(d) None of the above

9) Consider the topology below. The circles denote computers and the squares denote routers. Suppose there are two TCP connections: one from A to C and the other from D to C. Now if one starts another TCP connection from A to B, which of the following will happen?



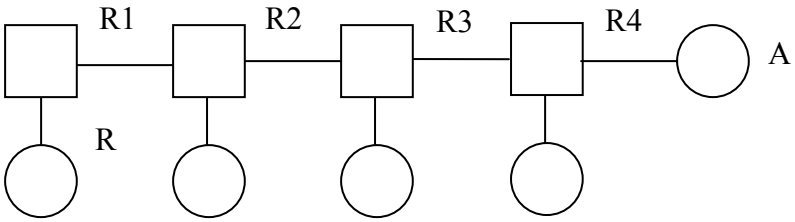
(a) Throughput from A to C decreases
(b) Both throughputs from A to C and from D to C decrease
(c) Throughput from D to C increases
(d) Both a and c
(A to B competes with A to C, hence A to C decreases therefore D to C increases)

10) Consider the network below with squares denoting the routers and circles denoting the endhosts. Suppose capacity of each link is shown in the Figure below and all the links have identical delay of 10 ms. Initially, there is a TCP connection from A to C with the observed approximate average throughput of 1 Mbps. Then, another TCP connection from A to B is initiated. What is the approximate average throughput of this new TCP connection?



(a) 0.5 Mbps
(b) 0.57 Mbps
(c) 0.42 Mbps (due to RTT of AB = 4/3 RTT of AC, bandwidth of AC = 4/3 bandwidth of AB. $X + 4X/3 = 1 \rightarrow X = 3/7 = .42$
(d) None of the above

11) Suppose we have the network topology below. Each of the unlabeled nodes simultaneously sends data at the rate R = 1 Mbps to node A. Which of the following bandwidth links for R1, R2, R3, and R4 such that the network is most utilized in this scenario?



(a) R1 = 1 Mbps, R2 = 1.1 Mbps, R3 = 1.2 Mbps, R4 = 1.3 Mbps
(b) R1 = 1.1 Mbps R2 = 1.3 Mbps R3 = 1.2 Mbps, R4 = 1 Mbps
(c) R1 = 1 Mbps, R2 = 1.3 Mbps, R3 = 1.1 Mbps, R4 = 1.2 Mbps
(d) R1 = 1 Mbps, R2 = 1.2 Mbps, R3 = 1.3 Mbps, R4 = 1.1 Mbps

12) Suppose one uses a reliable protocol that employs **ACK** only to send a file from host A to host B. The packet loss rates from A to B are p1 and from B to A is p2. Which of the following scenarios has the shortest time to transfer the file?

(a) p1 = 5%, p2 = 10%
(b) p1 = 10%, p2 = 5%
(c) p1 = p2 = 7.5%
(d) All scenarios have the same transfer time.

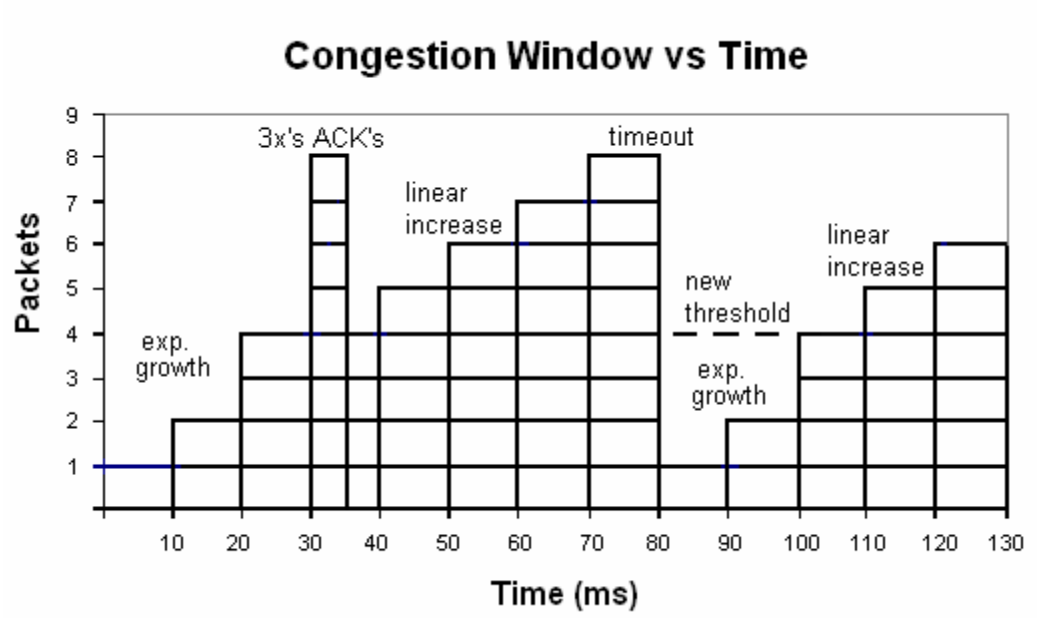
Because question 12 was mistyped, all answers will be accepted.

Problem:

Suppose you are using TCP to transfer a file between two hosts A and B. The round trip time between the two hosts is 10 milliseconds.

1) Draw a graph showing how the congestion window W varies with time from t = 0 to 130 ms if the following events happen at the sender: (3 pts)

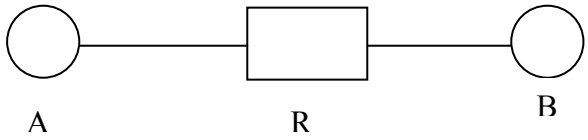
   - At 35ms, triple ACKS
   - At 80ms, timeout



2) Calculate the total packets sent during the first 130 milliseconds (2 pts)

   1 + 2 + 4 + 4 + 4 + 5 + 6 + 7 + 8 + 1 + 2 + 4 + 5 + 6 = **59**

3) Suppose there is a router between A and B as shown in the Figure below. If the link RB has the maximum capacity of sending 4 packets **per round trip time** while the capacity of the link AR is 8 packets **per round trip time.** The router R has the queue that can support at most 3 packets in waiting, not couting the one that is transmitting.



A starts a TCP connection to B, and the packets has sequence number 0, 1, 2, … N. What will be the first lost packet? (3 pts)

After: 1st RTT: [0] pass through R
2nd RTT: [1][2] pass through R
3rd RTT: [3][4][5] [6] pass though R
4th RTT: [7] pass through R, [8][9][10] in queue
[8] passing through R, [9][10][11][12] in queue

Because the router's queue only holds 3 packets, **packet 12** is lost

Bonus: (2 pts)

Suppose it takes 10 seconds for TCP to send a file of size 10,000 packets. What is the average packet loss rate?

RTT = 10ms

Avg. throughput = $(10{,}000 + 10{,}000 \cdot L)/10s = 1.22 / (RTT \cdot L^{1/2}) \rightarrow 10L^{1/2} + 10L^{3/2} = 1.22$
$\rightarrow$ $\boxed{L = .014}$

Note: MSS can be ignored since we are solving throughput in terms of packet per time instead of bits per time.