Please provide explanation for the answer to each question.

Q1

- In slow start, a sender doubles its window size every RTT if all sent packets were acknowledged
-
- T/F

True, during the Slow Start phase if there is no packet loss, the window will exponentially double in size until a certain point where it will trigger congestion avoidance and cause the window to grow linear.

Q2

- In steady state, a sender increases its window size by one packet for each acknowledgement
-
- T/F

```
True, the steady state or the congestion avoidance phase, the window size
is increased by one per packet to avoid overwhelming the network.
```

Q3

- A sender that underestimates the round-trip time of a connection may unnecessarily induce a TCP timeout
- T/F

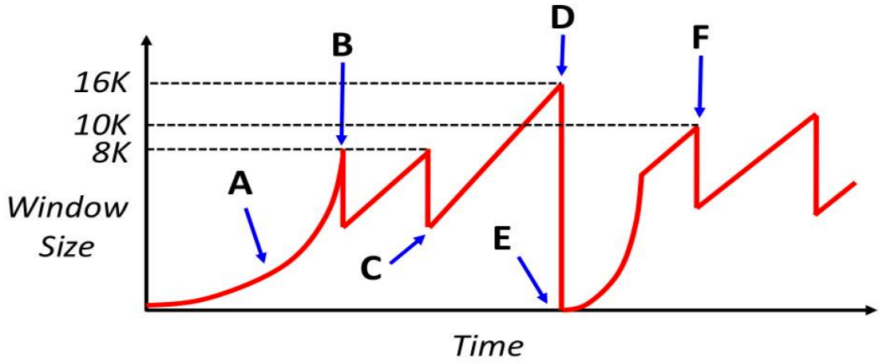
True, if the user underestimates the RTT it will cause the packet to be assumed lost and resend the packet, even though the original might still be on its way.

Q4

- After detecting packet loss through a timeout, TCP halves its window size as a response to the path congestion
-
- T/F

```
False, the TCP doesn't half the window size, but instead drastically reduces
it and enters a slow start and essentially starting allover again with a
conservative transmission rate.
```

Q5

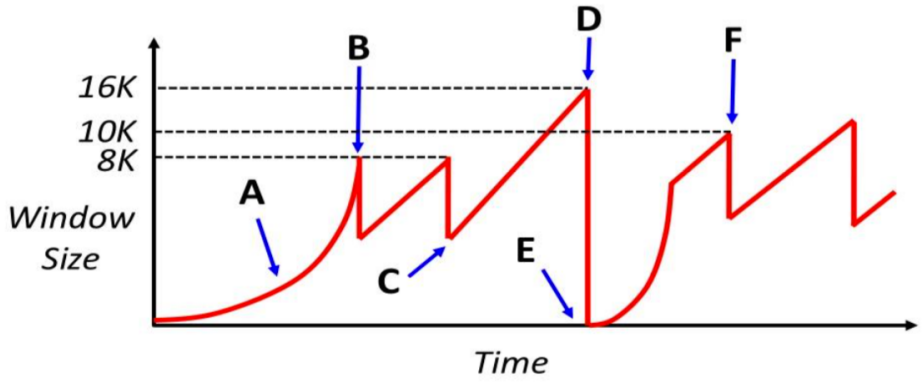


1. Name the event at B which occurs that causes the sender to decrease its window

(a) Triple Duplicate Ack
(b) Slow Start
(c) Packet loss
(d) Time out

Window size got reduced by half and then entered fast recovery phase

Q6

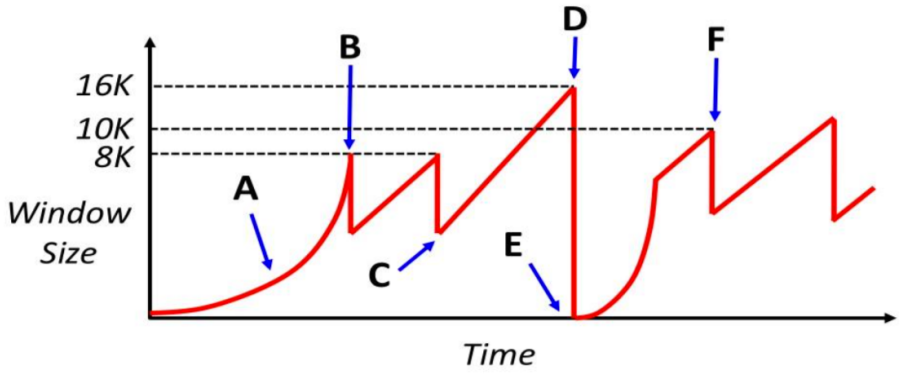


2. Does the event at B necessitate that the network discarded a packet ?

(a) Yes
(b) No
(c) Don't know

Triple Duplicate ACK is interprated as a packet loss

Q7

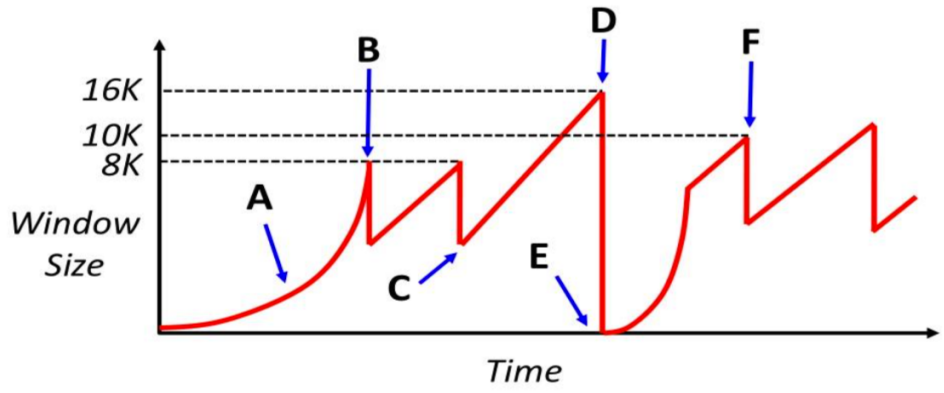


3. Name the event at D which occurs that causes the sender to decrease its window.

(a) Triple Duplicate Ack
(b) Slow Start
(c) Packet loss
(d) Time out

It dropped to the lowest window size and entered slow start, similar to a time out

Q8

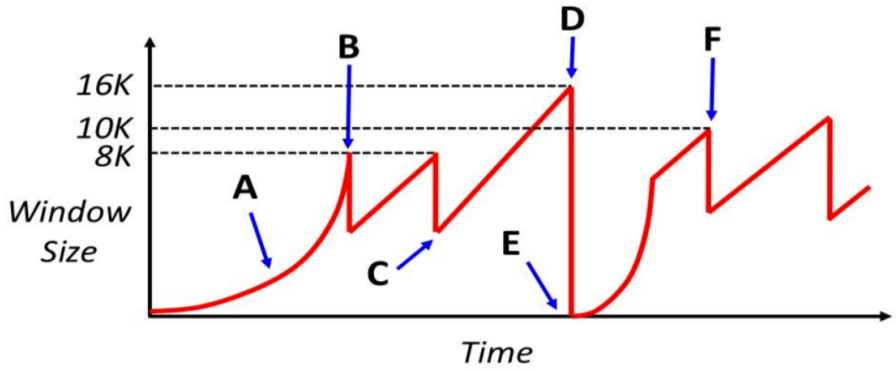


4. Does the event at D necessitate that the network discarded a packet

(a) Yes
(b) No
(c) Don't know

Yes, a timeout is drastic and means that the packet was lost

Q9

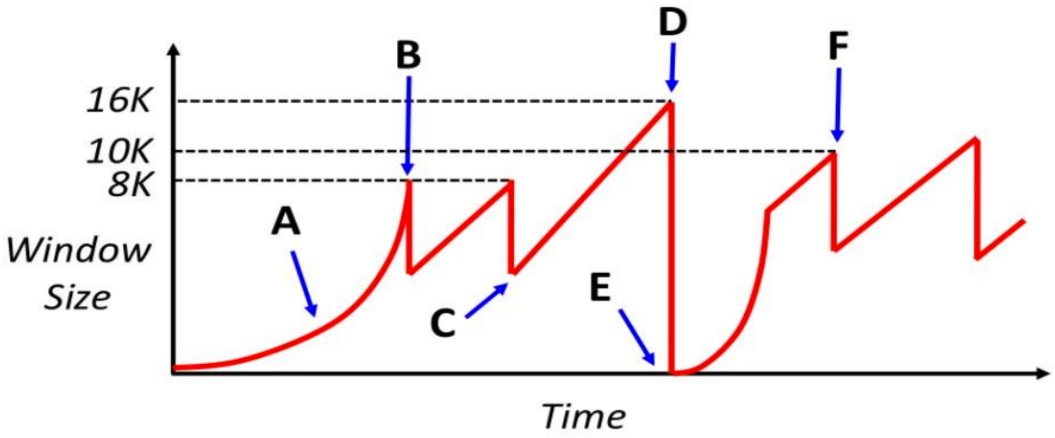


5. For a lightly-loaded network, is the event at D MORE likely or LESS likely to occur when the sender has multiple TCP segments outstanding

(a) MORE
(b) LESS
(c) ALMOST SAME

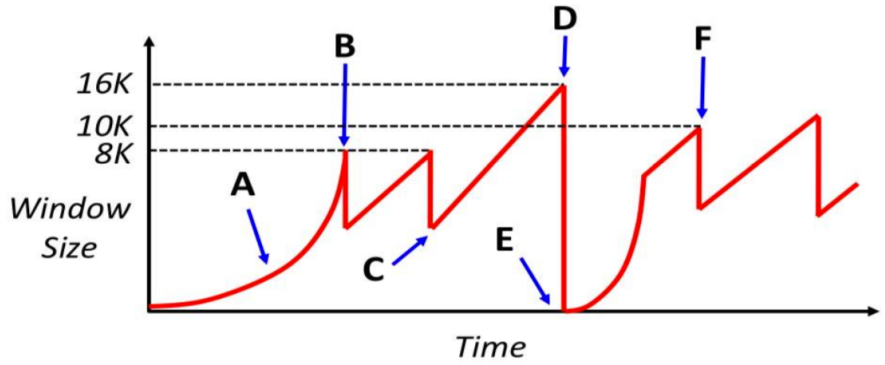
Less trafic, less likely to cause congestion and timeouts.

Q10



6. Consider the curved slope labeled by point A. Why does the TCP window behave in such a manner, rather than have a linear slope? (Put another way, why would it be bad if region A had a linear slope?)

The network needs to be probed slowly with exponential growth while rapid increase may cause congestion in it.

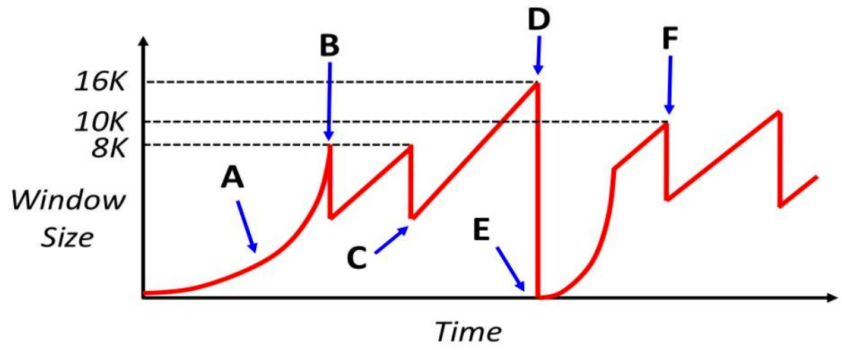


Assume that the network has an MSS of 1000 bytes and the round-trip-time between sender and receiver of 100 milliseconds.

Assume at time 0 the sender attempts to open the connection.

Also assume that the sender can "write" a full window's worth of data instantaneously, so the only latency you need to worry about is the actual propagation delay of the network.

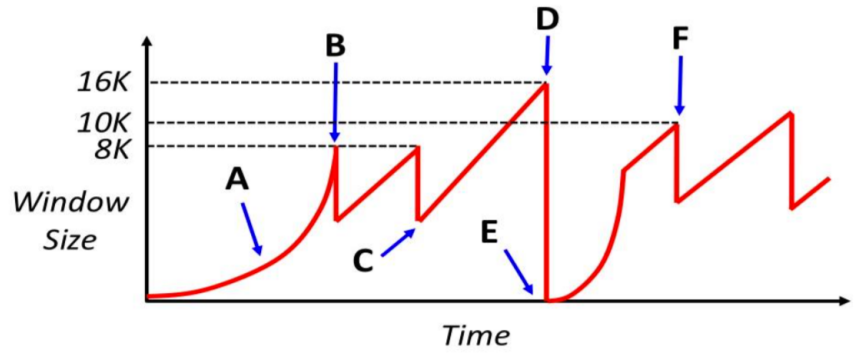
Q12



RTT = 100ms, MSS = 1000 bytes
7. How much time has progressed by point B ?

(a) 200ms
(b) 300ms
(c) 400ms
(d) 600ms
(e) 700ms

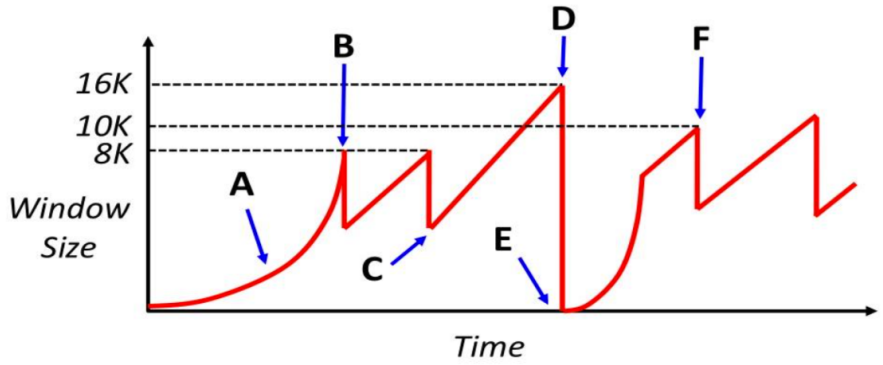
Q13



RTT = 100ms, MSS = 1000 bytes
8. How much time has progressed between points C and D?

(a) 800ms
(b) 1000ms
(c) 1200ms
(d) 1400ms

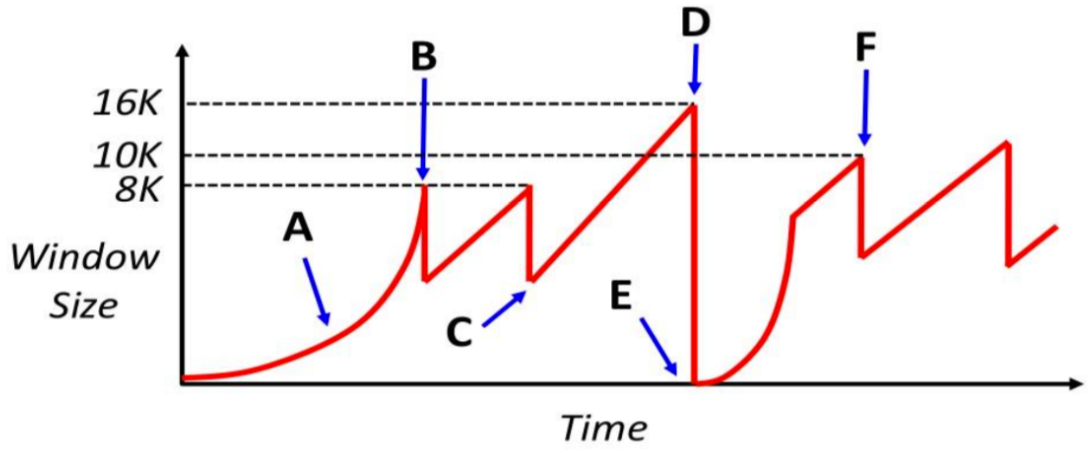
Q14



RTT = 100ms, MSS = 1000 bytes
9. How much time has progressed between points E and F?

(a) 400ms
(b) 600ms
(c) 800ms
(d) 900ms

Q15



10. If the sender shares its network with other clients whose traffic traverses the same IP routers, give one explanation for why point D is higher than point B?