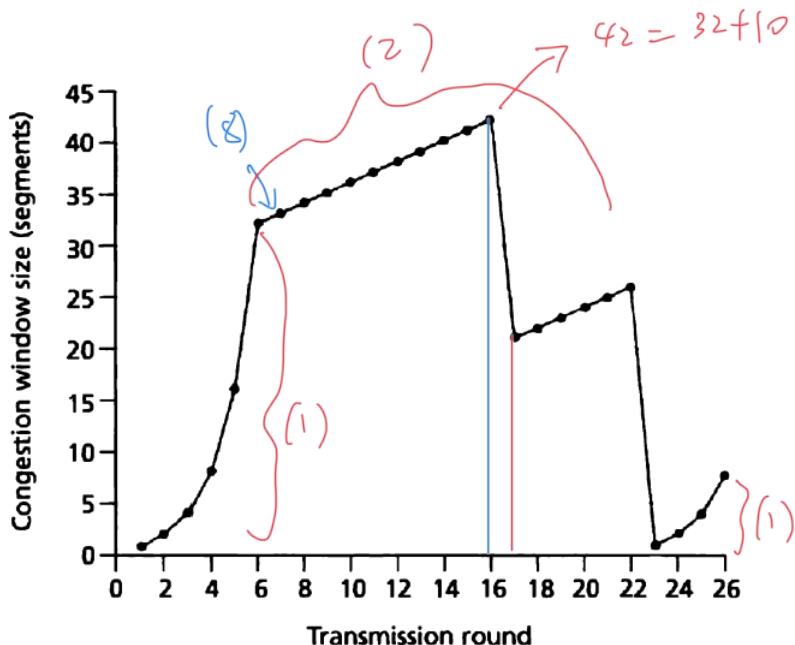


COMP 9121 Week 9 Tutorial

1. TCP



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

- (1). Identify the intervals of time when TCP slow start is operating. $(0-5)$, $(22-26)$ include 26 because there is a trend
- (2). Identify the intervals of time when TCP congestion avoidance is operating. $(6-21)$
- (3). After the 16th transmission round, is segment loss detected by a triple duplicate ACK or by a timeout? *triple duplicate*
- (4). After the 22nd transmission round, is segment loss detected by a triple duplicate ACK or by a timeout? *timeout*
- (5). What is the initial value of ssthresh at the first transmission round? $32 \rightarrow 1 \rightarrow 2 \rightarrow 4 \dots \rightarrow 32$
- (6). What is the value of ssthresh at the 18th transmission round? $21 = 42/2$
- (7). What is the value of ssthresh at the 24th transmission round? $26/2 = 13$
- (8). During what transmission round is the 70th segment sent? 7
- (9). Suppose TCP Tahoe is used (instead of TCP Reno), and assume that triple duplicate ACKs are received at the 16th round. What are the ssthresh and the congestion window size at the 19th round? $Ssthresh = 21$; $window: 1, 2, 4, 8, 16, 32$ 17^{th} 18^{th} 19^{th} 20^{th} 21^{th} 22^{nd}
- (10). Again suppose TCP Tahoe is used, and there is a timeout event at 22nd round. How many packets have been sent out from 17th round till 22nd round, inclusive? 52

Count $1 + 2 + 4 + 8 + 16 + 32 = 52$

round $17^{th} 18^{th} 19^{th} 20^{th} 21^{th} 22^{nd}$

ssthresh $21 \ 21 \ 21 \ 21 \ 21 \ 21$

notice 23^{rd} should be 1 again

2. Cross-layer (HTTP, TCP, Routing)

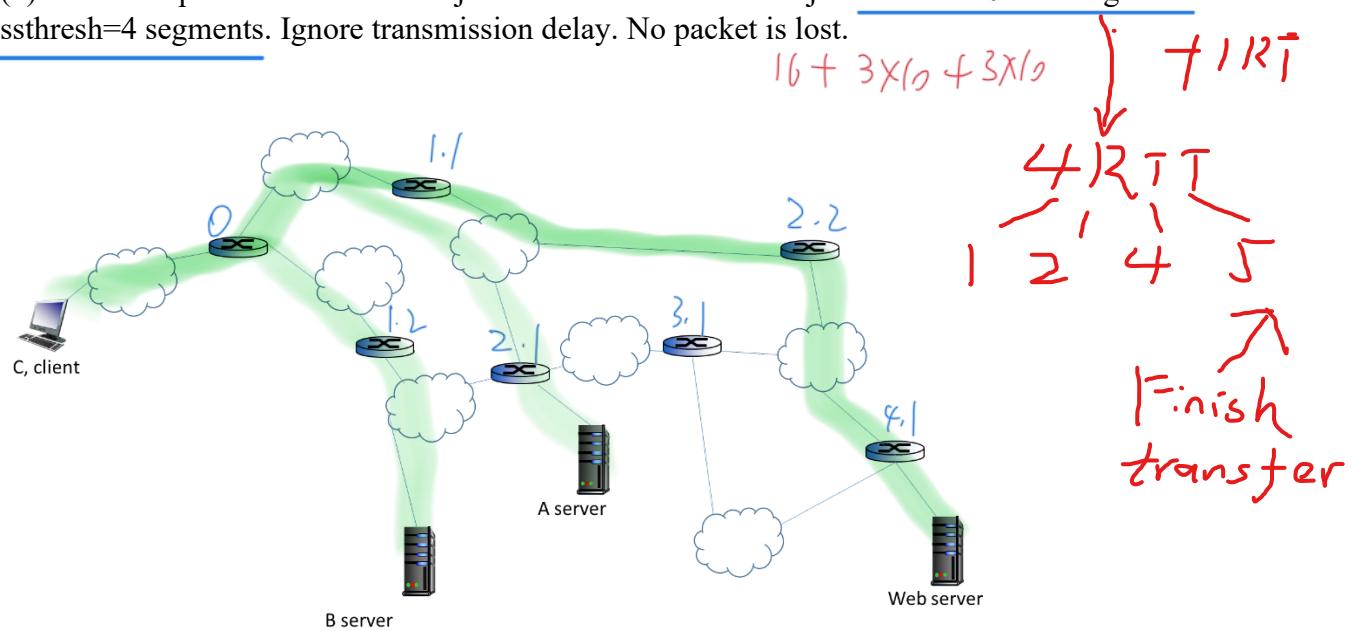
Consider the network shown below. Assume that the one-way delay through each “cloud” in the figure is 1 ms (for example, it takes 1 ms from C to LC). In the system, RIP routing protocol is used. The cost of each “cloud” is 1.

Client C wishes to see a webpage on Web server. The size of the main web page is small. After obtaining the main page, C finds that there are 2 small objects to be fetched. One object is stored in Server A, the other object is stored in Server B. Suppose that persistent HTTP is used.

(1) How long in total does it take for C to successfully obtain the webpage (including the main page and two objects). Suppose that C can start to connect to server A after the main page is fully downloaded. C can start to connect to server B after object 1 is fully downloaded.

$$16 + 12 + 12$$

(2) Re-do the problem if the two objects are not small. Each object fits into 10 TCP segments. ssthresh=4 segments. Ignore transmission delay. No packet is lost.



(1) take 2^4 (4+4) ms to get main page from web server

take 2^k ms to get from A

$$2 \times (3+3)$$

3

The diagram illustrates a sequence of events over five seconds (s1 to s5) between a host and a web server. The host's window (cwnd) starts at 3 and increases by 3 each second. The server's window (scwnd) starts at 1 and increases by 1 each second. Red arrows indicate segments sent from the host to the server, and blue arrows indicate segments sent from the server to the host. A red box highlights the calculation $2 \times (4+4)$ for the host.

Host (Left):

- Establish connection: cwnd = 3
- s1: cwnd = 3 + 3 = 6
- s2: cwnd = 6 + 3 = 9
- s3: cwnd = 9 + 3 = 12
- s4: cwnd = 12 + 3 = 15
- s5: cwnd = 15 + 3 = 18

Server (Right):

- s1: scwnd = 1
- s2: scwnd = 1 + 1 = 2
- s3: scwnd = 2 + 1 = 3
- s4: scwnd = 3 + 1 = 4
- s5: scwnd = 4 + 1 = 5

Segment Exchange:

- s1: Host sends segment 1 to client (red arrow), Server receives segment 1 (blue arrow).
- s2: Host sends segment 2 to client (red arrow), Server receives segment 2 (blue arrow).
- s3: Host sends segment 3 to client (red arrow), Server receives segment 3 (blue arrow).
- s4: Host sends segment 4 to client (red arrow), Server receives segment 4 (blue arrow).
- s5: Host sends segment 5 to client (red arrow), Server receives segment 5 (blue arrow).

Annotations:

- (2) $2 \times (4+4)$ for host**: A red box highlights the calculation $2 \times (4+4)$ for the host.
- since receive all Done**: A red annotation on the right side of the diagram.

$$16 + 20 + 30 = 76$$

收到ACK，web才能再发，By TCP