Computer Communications and Networks (COMN) 2022/23, Semester 1

Assignment 2 Results Sheet

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Question 1 – Number of retransmissions and throughput with different retransmission timeout values with stop-and-wait protocol. For each value of retransmission timeout, run the experiments for **5 times** and write down the **average number of retransmissions** and the **average throughput**.

Retransmission timeout (ms)	Average number of retransmissions	Average throughput (Kilobytes per second)
5	893.4	54.60566337
10	604.2	62.80311868
15	113.6	61.86403557
20	99.4	55.50894475
25	101.6	54.74231313
30	93	49.56651857
40	105.8	47.46123545
50	92.6	47.46204297
75	96.4	40.16993751
100	92.8	36.18465151

Question 2 – Discuss the impact of retransmission timeout value on the number of retransmissions and throughput. Indicate the optimal timeout value from a communication efficiency viewpoint (i.e., the timeout that minimizes the number of retransmissions while ensuring a high throughput).

Compared to 5ms and 10ms, the average number of retransmission under 15ms of retransmission timout decreases significantly. However, retransmission numbers keep at a same level ~100 as the retransmission timout increasing from 15ms to 100ms.

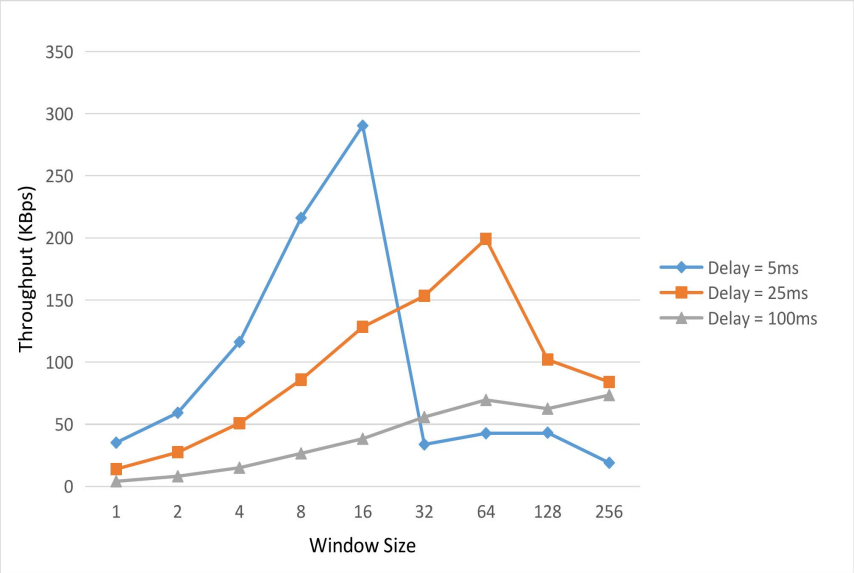
From 5ms to 25ms, retransmission timout does not draw much impact on the average throughput. Beyond 40ms of retransmission timout, the throughput drops slowly.

The optimal timeout value, according to the above table, is 15ms, while it enables the highest average throughput and relative low numbers of retransmissions.

Question 3 – Experimentation with Go-Back-N. For each value of window size, run the experiments for **5 times** and write down the **average throughput**.

	Average throughput (Kilobytes per second)		
Window Size	**Delay = 5ms**	**Delay = 25ms**	**Delay = 100ms**
1	35.27266379	14.03117883	4.165822942
2	59.33578414	27.50938974	8.252922662
4	116.2964034	50.98009519	15.10683943
8	216.1378209	85.92171061	26.64217826
16	290.3555274	128.3201763	38.43672582
32	33.84002456	153.2866255	55.90538252
64	42.79971772	199.2353445	69.66350676
128	43.31558639	102.0534429	62.63486664
256	19.06138429	84.11974719	73.54363521

Create a graph as shown below using the results from the above table:



Question 4 – Discuss your results from Question 3.

The retransmission timeout setting for Delay(25ms) is 60ms and for Delay(100ms) is 210ms, since the round trip of packets and ACKs need more than two times of one-way-delay.
Based on the above graph, we can find that the throughput will be at maximum when the window size is 16. It probably because the sender would not have to wait for every ACK before sending the next packet. But when the window size is too large, the throughput will drop as the receiver becomes overwhelmed with incoming packets.
And when the delay becomes larger, the peak throughput will move right, which means the communication needs larger window size to increase the number of in-flight packets for the best performance.

Question 5 – Experimentation with Selective Repeat. For each value of window size, run the experiments for **5 times** and write down the **average throughput**.

	Average throughput (Kilobytes per second)
Window Size	**Delay = 25ms**
1	13.79457618
2	20.29298169
4	32.3113165
8	53.90477749
16	91.25871614
32	143.9461033

Question 6 - Compare the throughput obtained when using "Selective Repeat" with the corresponding results you got from the "Go Back N" experiment and explain the reasons behind any differences.

The retransmission timeout is set to 60ms for Selective Repeat under 25ms delay.
SR and GBN shows similar performance when the window size is small (ws=1, 2, 4) because there is no obvious difference between selective retransmission and retransmission of the whole window. But with the window size becomes much larger, the sender have to maintain too much timers to check the timeout for each packets in the sliding window. And it will slower the transmission process due to the limitation of hardware.

Question 7 – Experimentation with *iperf*. For each value of window size, run the experiments for **5 times** and write down the **average throughput**.

	Average throughput (Kilobytes per second)
Window Size (KB)	**Delay = 25ms**
1	12.67875
2	25.9625
4	30.7875
8	60.8
16	77.7125
32	88.2375

Question 8 - Compare the throughput obtained when using "Selective Repeat" and "Go Back N" with the corresponding results you got from the *iperf* experiment and explain the reasons behind any differences.

Though the trend of thoughput is increasing with the window size becomes larger, it is obvious that the overall throughput of iperf is smaller than that of Selective-Repeat and Go-Back-N.
Because iperf use TCP as the underlying transport layer protocol, which provides several properties of reliable data transmission. To achieve that, TCP needs to spend more time handling packets, such as handshake and flip check.
Also, the larger header fields of TCP segments will lower the percentage of data payload in each packet. In addition, TCP applies flow control to avoid overwhelming, while UDP tries to send as much as possible.