Computer Communications and Networks (COMN)
2021/22, Semester 2

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 **average number of retransmissions** and **average throughput**.

Retransmission timeout (ms)	Average number of re-transmissions	Average throughput (Kilobytes per second)
5	1861	76.6
10	979	74.7
15	93	74.3
20	100	71.6
25	95	71.5
30	96	67.7
40	89	63.0
50	105	57.3
75	101	49.3
100	92	45.2

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).

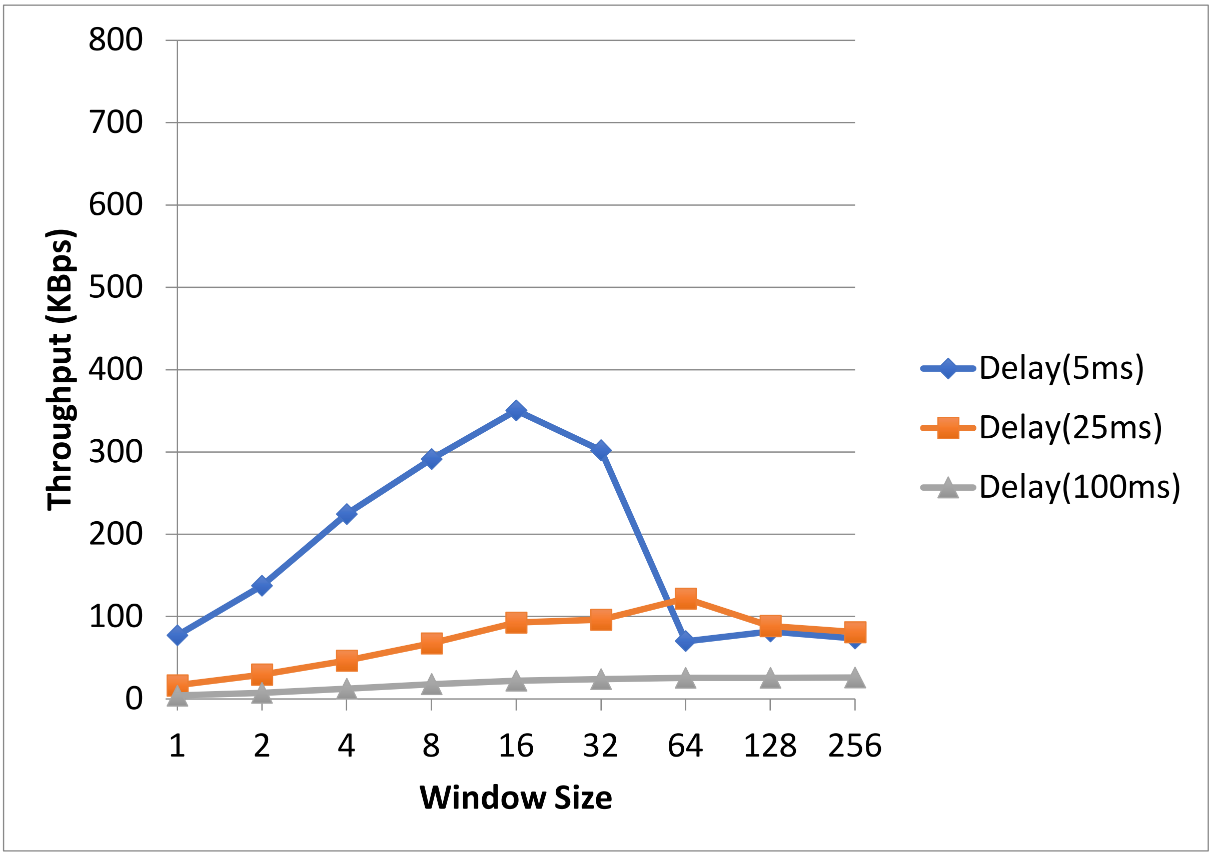
If the value of retransmission timeout(RTO) is set too large or too small, it will adversely affect the protocol. If the RTO is set too large, the sender will wait for a long time to find the packet loss, which will reduce the throughput of data transmission; on the other hand, if the RTO is too small, the sender can quickly detect the message Segments are lost, but some long-delayed segments may be mistaken for loss, causing unnecessary retransmission and wasting network resources.

The optimal timeout value in my case is **15ms**, which is three times of network delay. It minimizes the number of retransmissions while ensuring a high throughput.

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

	Average throughput (Kilobytes per second)		
Window Size	**Delay = 5ms**	**Delay = 25ms**	**Delay = 100ms**
1	77.6	16.8	4.3
2	137.4	30.0	7.6
4	224.6	46.7	12.5
8	291.4	67.8	18.3
16	350.6	93.0	22.1
32	302.0	96.2	24.0
64	70.2	122.0	25.5
128	82.0	88.8	25.6
256	73.8	81.4	26.1

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



Question 4 – Discuss your results from Question 3.

For the delay of 25ms and 100ms, I also chose a timeout that is three times the delay, that is, 75ms timeout for 25 ms delay, 300ms timeout for 100ms delay, because we want to ensure that the timeout is greater than the two-way propagation delay of the link to reduce retransmissions number, and we have to set a part of the redundant time to prevent the link instability from causing the delay to be greater than the two-way propagation time, so **timeout = delay*2 + delay**. In the table and graph, we found that the higher the delay, the lower the average throughput, this is due to sender will wait for a long time (timeout) to find the packet loss, which increases the overall time and reduces throughput. At the same time, we can find that the throughput increases first and then decreases as the window size gradually increases. If the sliding window is too small, it needs to transmit confirmation information frequently on the network, which occupies a lot of network bandwidth; if the sliding window is too large , for a network with high utilization rate and prone to packet loss, repeated data needs to be sent multiple times, which also consumes network bandwidth. The optimal window size of 25ms and 100ms is larger than 5ms, because if the delay is large, many packets will be on the road for a long time, and the receiver has more time to process the packets.

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

	Average throughput (Kilobytes per second)
Window Size	**Delay = 25ms**
1	18.0
2	34.2
4	63.7
8	113.0
16	186.8
32	224.0

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 average throughput of SR is much higher than that of GBN. When the number of windows is low, GBN is not much different from SR because the number of retransmitted packets is small. But when the window size is large, one packet error may cause GBN to retransmit a large number of packets, while in the SR protocol, many packets in the correct order do not need to be retransmitted in the process. Therefore, the number of SR protocol retransmissions is small, which improves the overall throughput.

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

Window Size (KB)	Average throughput (Kilobytes per second) Delay = 25ms
1	13.3
2	26.2
4	27.9
8	66.9
16	82.2
32	104.52

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.

We can find that with the increase of the window size, the throughput also increases, and we can also find that the throughput of iperf is relatively small than SR and GBP. Since iperf uses the TCP protocol, it also uses a cumulative ACK method similar to GBN, but due to Other mechanisms (such as handshake, flow control or congestion control) are added to TCP, which may cause the TCP protocol to be slower. For example, There is some delay and loss on our link, when TCP detected packet loss(No acknowledge received), it will start congestion avoidance and then the cwnd(throughput) is reduced.