# 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 | 3174.2 | 50.2 |
| 10 | 1585.4 | 62.4 |
| 15 | 129.8 | 74 |
| 20 | 103.8 | 70 |
| 25 | 113.4 | 65 |
| 30 | 123.6 | 62.8 |
| 40 | 114.6 | 57.8 |
| 50 | 107.6 | 56.4 |
| 75 | 184.0 | 39.6 |
| 100 | 123.4 | 39.8 |

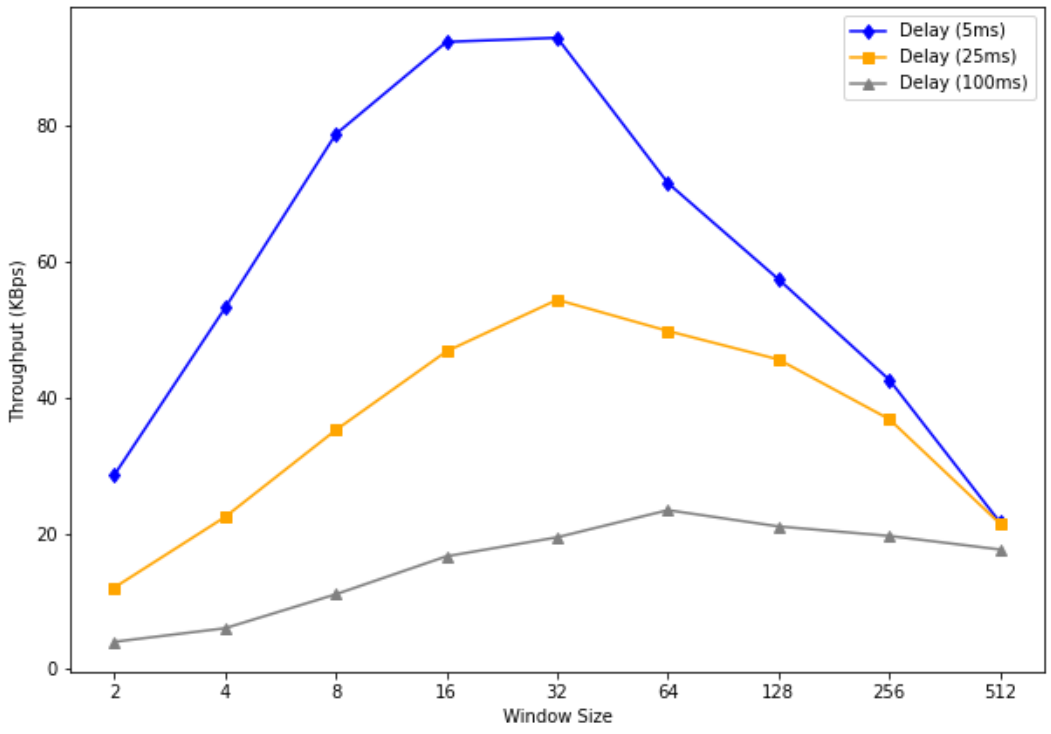
**Question 2** – Discuss the impact of retransmission timeout value on the number of retransmissions and throughput. Indicate the optimal timeout value from a communication efficiency viewpoint (i.e., the timeout that minimizes the number of retransmissions while ensuring a high throughput).

We notice that the average throughput decreases as the retransmission timeout value increases. This is because a smaller retransmission timeout value ensures that lost packets are recovered quickly enough by the receiver. The optimal value for the retransmission timeout is 20ms, at which we have the minimum average number of retransmissions (103) while keeping up with a considerable throughput value (at 70KB/s).

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

| | | | |
|---|---|---|---|
| 1 | 28.6 | 12.0 | 4.0 |
| 2 | 53.2 | 22.4 | 6.0 |
| 4 | 78.8 | 35.2 | 11.0 |
| 8 | 92.4 | 46.8 | 16.6 |
| 16 | 93.0 | 54.4 | 19.4 |
| 32 | 71.6 | 49.8 | 23.4 |
| 64 | 57.4 | 45.6 | 21.0 |
| 128 | 42.6 | 36.8 | 19.6 |
| 256 | 21.6 | 21.4 | 17.6 |

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



**Question 4** – Discuss your results from Question 3.

For each of the propagation delays, as the window size increases, the average throughput increases to a maximum value at around N=32 and then decreases as we keep increasing the window size. This is because as we keep increasing the window size from 1, we increase the rate of transfer of packets. At a certain point, one failed ACK in the window is sufficient to cause us to resend the whole window size of packets and we incur a huge cost because of this. As the window size increases, the probability of having packets whose ACKs were not received also increases and thus the decrease in average throughput as the window size increases. The larger the propagation delay, the slower the transmission of packets and so for a given window size average throughput decreases as the propagation delay increases.

For the 25ms and 100ms delays, I used 75ms and 300ms (3 times the one-way propagation delay) respectively for their timeout values. I chose this because under normal circumstances we expect sending a packet and receiving its ACK to take one RTT (twice the one-way propagation delay) plus some processing time, by which we approximate the timeout value to 3 times the one-way propagation delay.

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

| | |
|---|---|
| 1 | 12.0 |
| 2 | 22.4 |
| 4 | 39.2 |
| 8 | 64.2 |
| 16 | 76.0 |
| 32 | 66.2 |

**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.

For the window sizes 1 and 2, Selective Repeat (SR) has the same average throughput as Go Back N (GBN) but as we increase the window size further, SR performs significantly better and better than GBN. This is obviously due to the fact that SR resends just a single un-ACKed packet while GBN resends an entire window.

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

| | |
|---|---|
| 1 | 11.8 |
| 2 | 21.8 |
| 4 | 25.9 |
| 8 | 62.0 |
| 16 | 82.0 |
| 32 | 107.0 |

**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.

From window sizes 1 to 4, Selective Repeat (SR) and Go Back N (GBN) perform better than the TCP on average throughput. This is because of the overhead incurred by the TCP handshake protocol when a connection is initialized. As the window size increases from 16 onwards, TCP's average throughput overtakes those of SR and GBN as expected since the reliable data transfer protocol in TCP uses cumulative acknowledgements resulting in less traffic along the transmission medium.