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	2642.2	78.83
10	1507.6	70.05
15	218.2	69.62
20	102	67.59
25	105	63.75
30	103.2	60.4
40	107	59.53
50	109.2	52.22
75	106	44.52
100	98	39.99

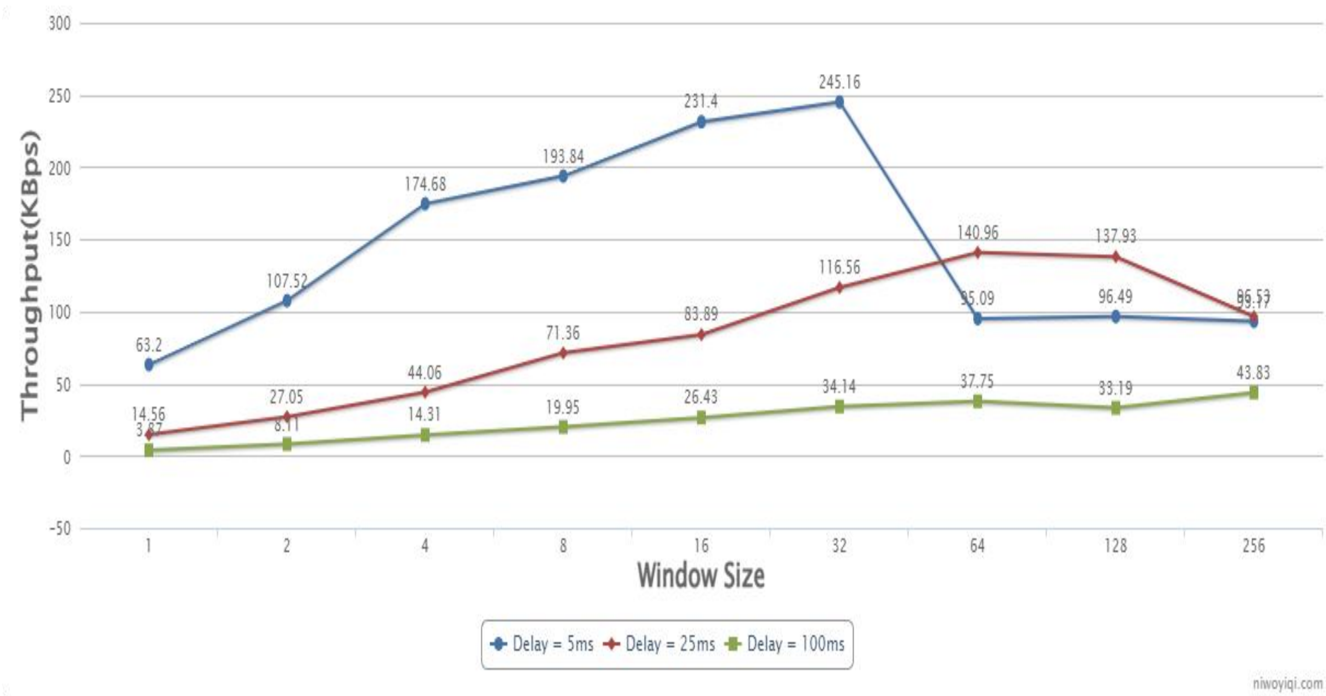
Question 2 – Discuss the impact of retransmission timeout value on the number of retransmissions and throughput. Indicate the optimal timeout value from a communication efficiency viewpoint (i.e., the timeout that minimizes the number of retransmissions while ensuring a high throughput).

When the transmission timeout is set to 5ms and 10ms, corresponding average number of retransmissions is extremely high (2642.2 and 1507.6 respectively). If sender have not receive the response from receiver before the timeout, sender will regard previous sent packet as not receiving by receiver and resend the packet by default. If the timeout is too small so that the timeout is much smaller than the time needed for receiver to receive a packet and give response to sender, sender will do many useless retransmissions. When the timeout is 15ms, average number drop dramatically to 218.2. It can be observed that as the timeout increases, average throughput decreases gradually from maximum : 78.83KBps (at 5ms timeout) to minimum : 39.99KBps(at 100ms timeout). Because there are some packets lose during the transmission, there will be no response(Ack) sent from receiver. Hence, no matter how long sender wait, there will not be ack sent from receiver. Thus, long timeout waste lots of time and reduce throughput. The effective ratio of throughput used is defined as Average throughput / Average number of retransmission. The higher the effective ratio of throughput used is, the less time sender is wasting on useless retransmissions or useless waiting for ack response. The optimal timeout value is 20ms because the effective ratio of used throughput is largest at timeout of 20ms.

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	63.2	14.56	3.87
2	107.52	27.05	8.11
4	174.68	44.06	14.31
8	193.84	71.36	19.95
16	231.4	83.89	26.43
32	245.16	116.56	34.14
64	95.09	140.96	37.75
128	96.49	137.93	33.19
256	93.17	96.53	43.83

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



Question 4 – Discuss your results from Question 3.

The timeout is set to 20ms when delay=5ms. The timeout is set to 60ms when delay=25ms. The timeout is set to 210ms when delay = 100ms. It can be observed that timeout and delay and window size affect the throughput(KBps). For delay=5ms, when window size is 1, The throughput is 63.2KBps. When window size increases, Throughput keep increasing until reaching a maximum of 245.16KBps at window size of 32. Then throughput dramatically decrease to 95.09KBps at window size of 64 and then remain at near 90KBps for window size above 32. The larger the window size is, the greater probability of retransmission is because if the first packet in window loses during transmission, receiver will drop all received packets and all packets in the window have to be retransmitted by sender. Hence, when window size is too large, the throughput will be small for delay=5ms. For delay=25ms, overall throughput is decreased because for larger delay, the optimal time out will be larger and the window size to achieve maximum throughput of delay=25ms becomes larger, which is the window size of 64 and then decreases due to the same reason for delay=5ms. For delay=100ms, the overall throughput becomes smaller due to the same reason for delay=25ms and the window size to achieve maximum throughput of delay=100ms becomes larger, which is the window size of 256 or above and then decreases due to the same reason for delay=5ms.

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	14.6
2	30.43
4	51.72
8	102.24
16	164.84
32	304.69

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 timeout is set to 60ms. The throughput for selective repeat and go-back-to-N is roughly the same (window size : 1 ~ 4) because when window size is very small, both selective repeat and go-back-to-N behaves roughly similar to stop-and-wait protocol. When the window size is above 4, selective repeat and go-back-to-N behaves very distinctly. The increase rate for selective repeat is much larger than increase rate for go-back-to-N because because Selective repeat only retransmit the packets that are time out , unlike go-back-to-N retransmit all packets in the window size no matter whether the packet in window is time out. Hence, selective repeat is more efficient than go-back-to-N. The other difference is that the window size for receiver and sender have to be set to be equal in selective repeat and for go-back-to-N the window size for sender and receiver can be different.

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

Window Size (KB)	**Average throughput (Kilobytes per second)** **Delay = 25ms**
1	8.73
2	18.813
4	27.39
8	56.195
16	75.66
32	81.79

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.

For iperf, the average throughput increases as window size and the reason for it is same as the reason for both selective repeat and go-back-N explained above. It can be observed that overall throughput for iperf is smaller than both selective repeat and go-back-N. This is because :

1.TCP uses a three-way handshake to establish a reliable connection. This takes more time to process a packet.

2.The header size of TCP(20Bytes) is bigger than UDP(3Bytes). This means transmitted information per packet in TCP is fewer than transmitted information per packet in UDP. Hence, the information transmission speed is lowered down by TCP

3.TCP does an error checking for data stream. Hence, This takes more time to process a packet.

4.UDP send packets as many as it can send during connection and process data in application layer. Hence, UDP is faster than TCP.

5.TCP has overflow control and TCP has to check whether each packet is overwhelming. Hence, it slow down the transmission.