CSC 573 – Internet Protocols
Project #2
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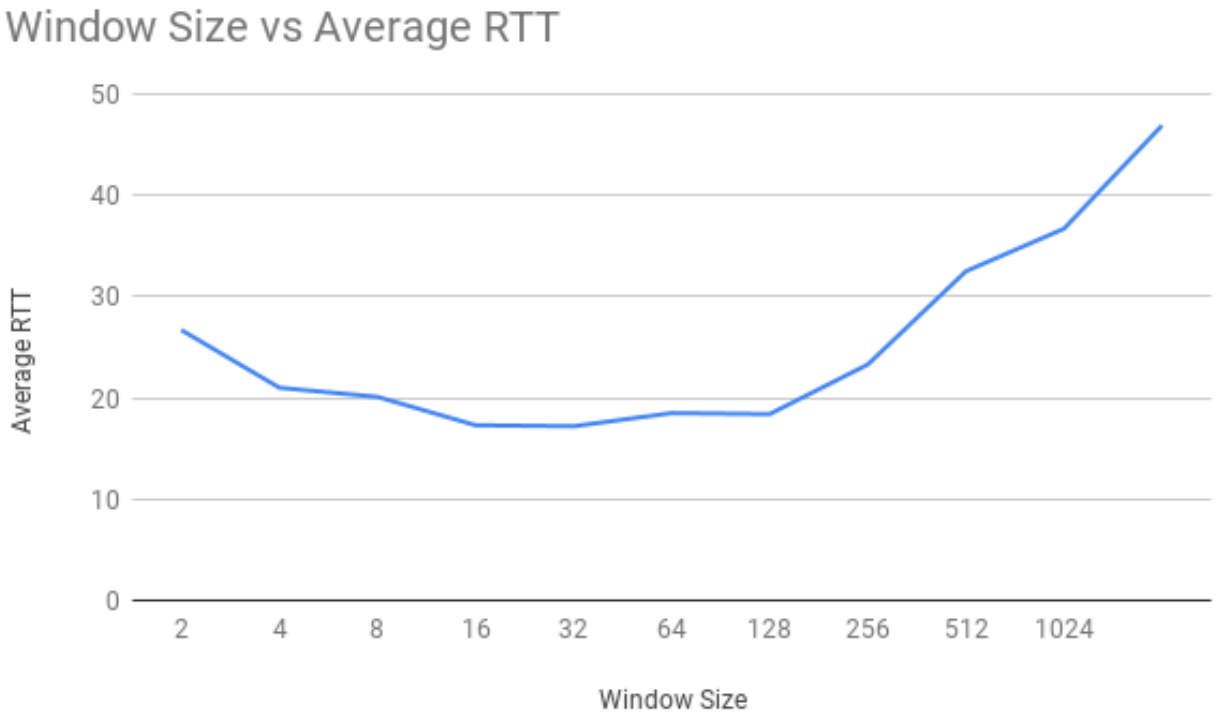
GO-Back-N ARQ

We've implemented simple file transfer protocol using UDP, for reliable delivery we've used Go-Back-N ARQ. Three experiments have been conducted to evaluate the effect of window size(N), maximum segment size(MSS) and packet loss probability(p) on the total delay for transferring a file. For the experiments, we used our own laptops when connected to University's WiFi, we were separated by seven hops and round trip time between the two machines was 2.79ms.

TASK 1: Effect of window size N
Size of file transferred = 1.1MB
MSS = 500
Error Probability = 0.05

Window Size(N)	Average RTT
1	26.7
2	21
4	20.1
8	17.3
16	17.2
32	18.5
64	18.4
128	23.3
256	32.5
512	36.7
1024	46.9

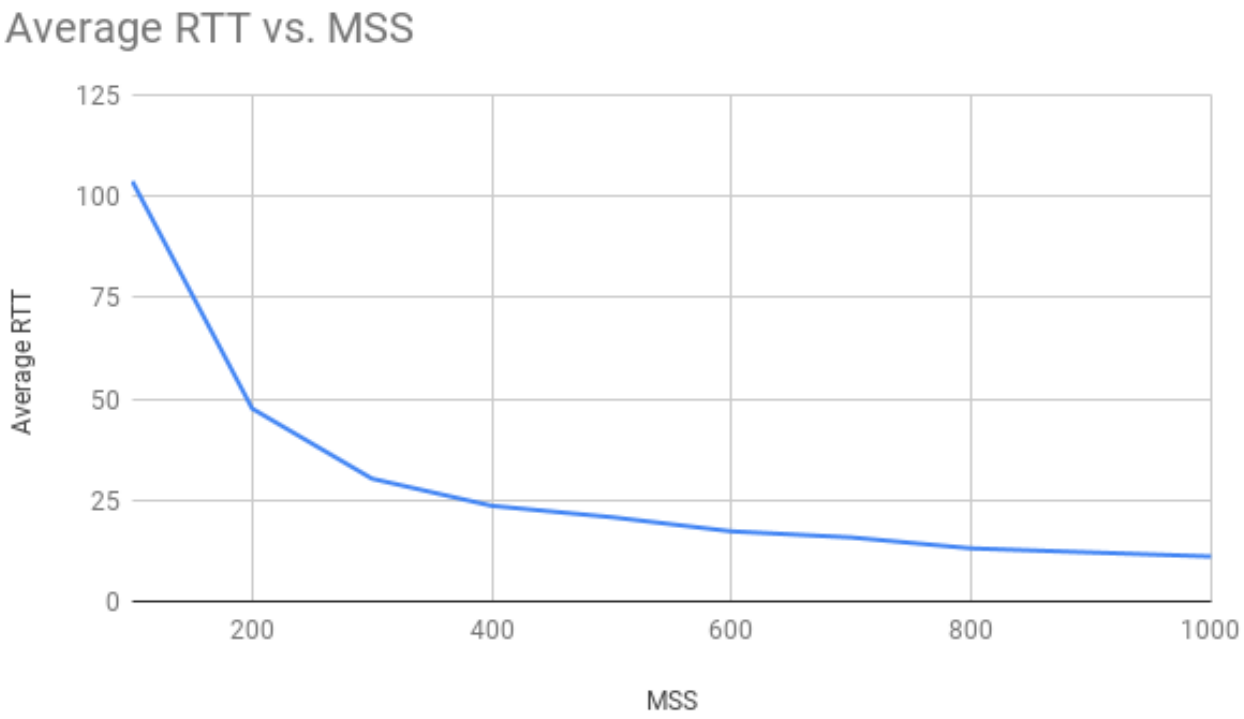


The graph above plots the average RTT against window size(N)
Observation:
For Go-Back-N ARQ , if the window size is small then there are multiple timeouts at the sender's side since the receiver will be consuming packets very slowly, this would cause a delay in the acknowledgements sent by the receiver. If the window size is very large then if a packet is lost due to acknowledgement loss or a timeout then all the non-acknowledged packets are resent leading to higher transfer time. So ideally N should be somewhere in the middle range. Best results are obtained in our experiments when N=16

TASK 2: Effect of MSS
Size of file transferred = 1.1MB
N = 64
Error Probability = 0.05

Maximum Segment Size(MSS)	Average RTT
100	103.7
200	47.6
300	30.3
400	23.6
500	20.8
600	17.3
700	15.8
800	13.1

900	12.1
1000	11.1



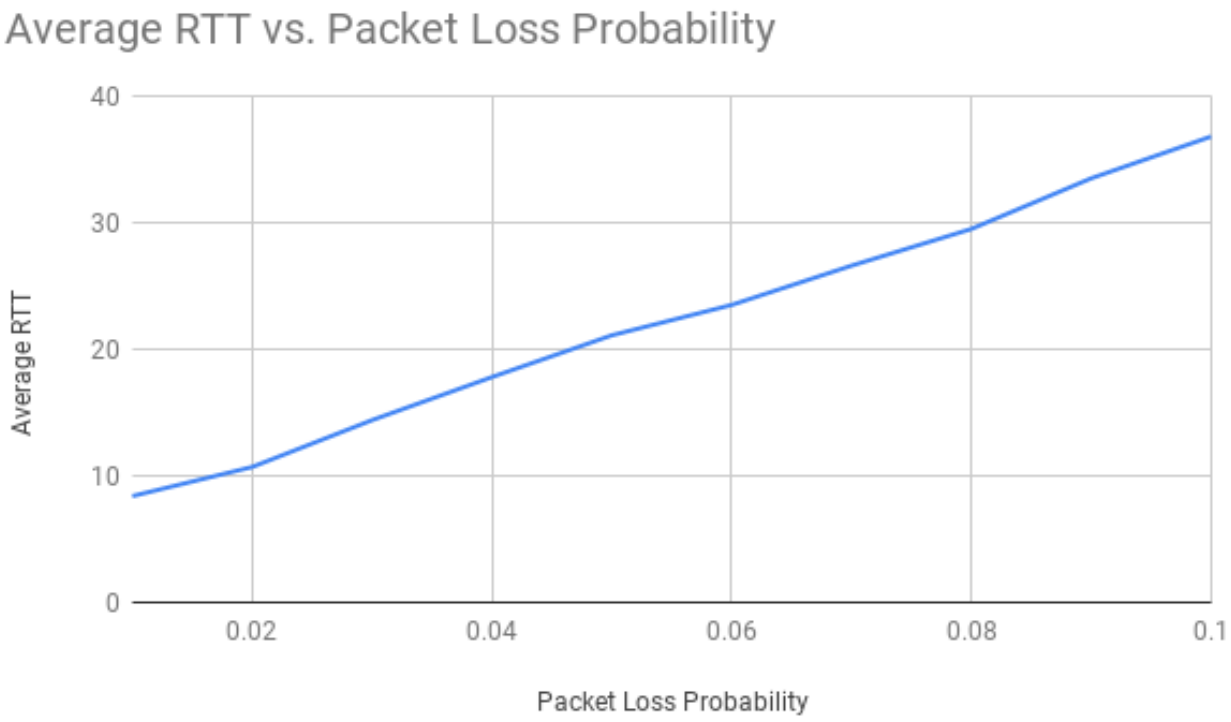
The graph above plots average RTT again maximum segment size(MSS)

Observation:
We can clearly see that as MSS increases average RTT decreases because now we are transmitting more data in one unit of time. This increases the transmission rate and hence decreases the delay.

TASK 3: Effect of packet loss probability(p)
Size of file transferred = 1.1MB
N = 64
MSS = 500

Packet Loss Probability	Average RTT
0.01	8.4
0.02	10.7
0.03	14.4
0.04	17.8
0.05	21.1

0.06	23.5
0.07	26.6
0.08	29.5
0.09	33.5
0.10	36.8



The graph above plots the average RTT against the packet loss probability.

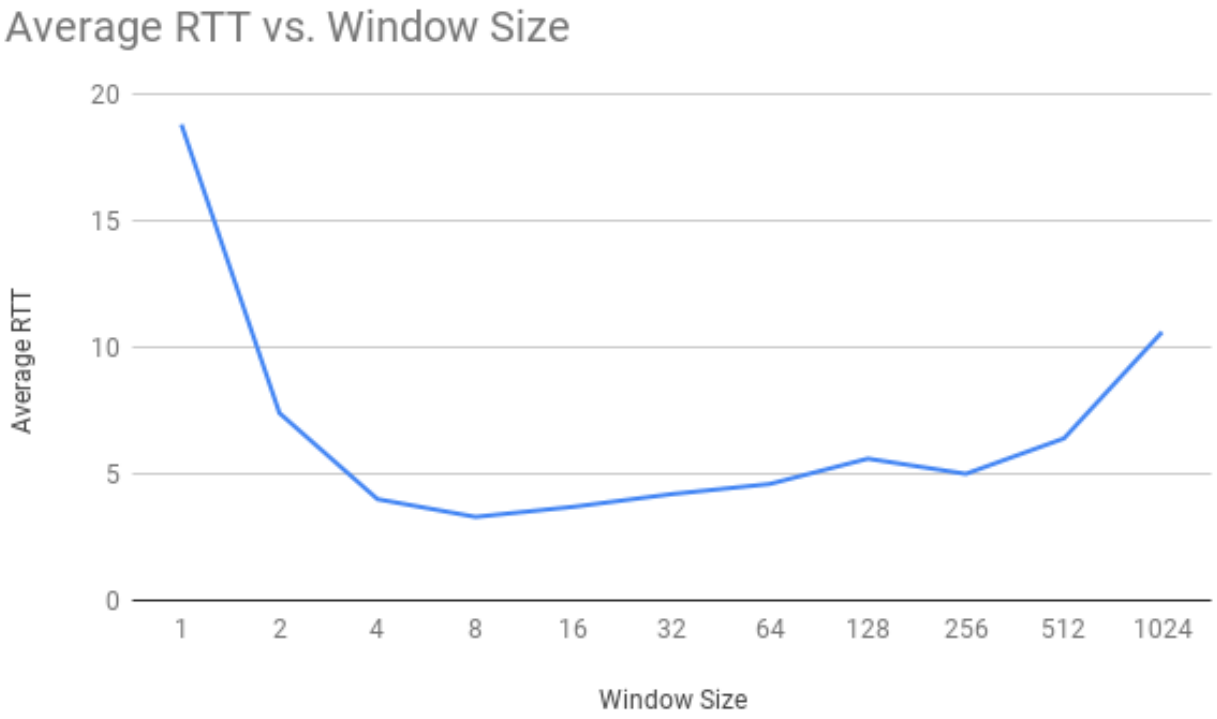
Observation:
RTT increases when we increases the packet loss probability. If packets are lost then the sender has to resend the packets till an ACK is received. If the packet loss rate increases then the sender has to send packets again hence the time needed to retransmit the lost packet increases. This leads to an increase in the average RTT.

Selective Repeat ARQ

We've used the same sender and receiver as in Go-Back-N ARQ. Hops, RTT and File Size remains the same.

TASK 1: Effect of window size N
Size of file transferred = 1.1MB
MSS = 500
Error Probability = 0.05

Window Size(N)	Average RTT
1	18.8
2	7.4
4	4.0
8	3.3
16	3.7
32	4.2
64	4.6
128	5.6
256	5.0
512	6.4
1024	10.6



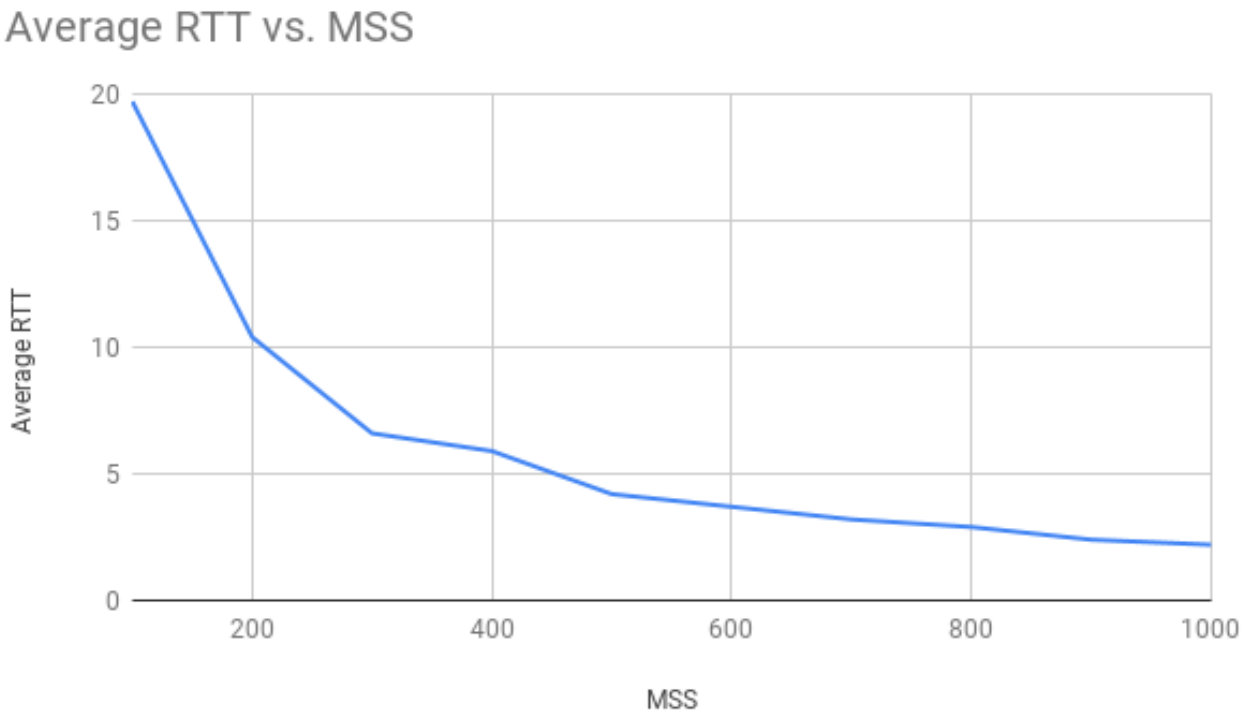
The graph above plots the average RTT against window size(N)

Observation:
In Selective Repeat ARQ, unnecessary retransmissions of the entire sliding window is avoided which leads to better performance when compared to Go-Back-N ARQ. Since only the negatively acknowledged packets are re-transmitted by the sender, this protocol is more efficient. For N greater than one there is significant reduction in average RTT, this is result of less unwanted re-transmissions. As was the case in Go-Back-N ARQ, the ideal N value lies in the middle. In out case it was N=8

TASK 2: Effect of MSS
Size of file transferred = 1.1MB
N = 64
Error Probability = 0.05

Maximum Segment Size(MSS)	Average RTT
100	19.7
200	10.4
300	6.6
400	5.9
500	4.2
600	3.7
700	3.2

800	2.9
900	2.4
1000	2.2



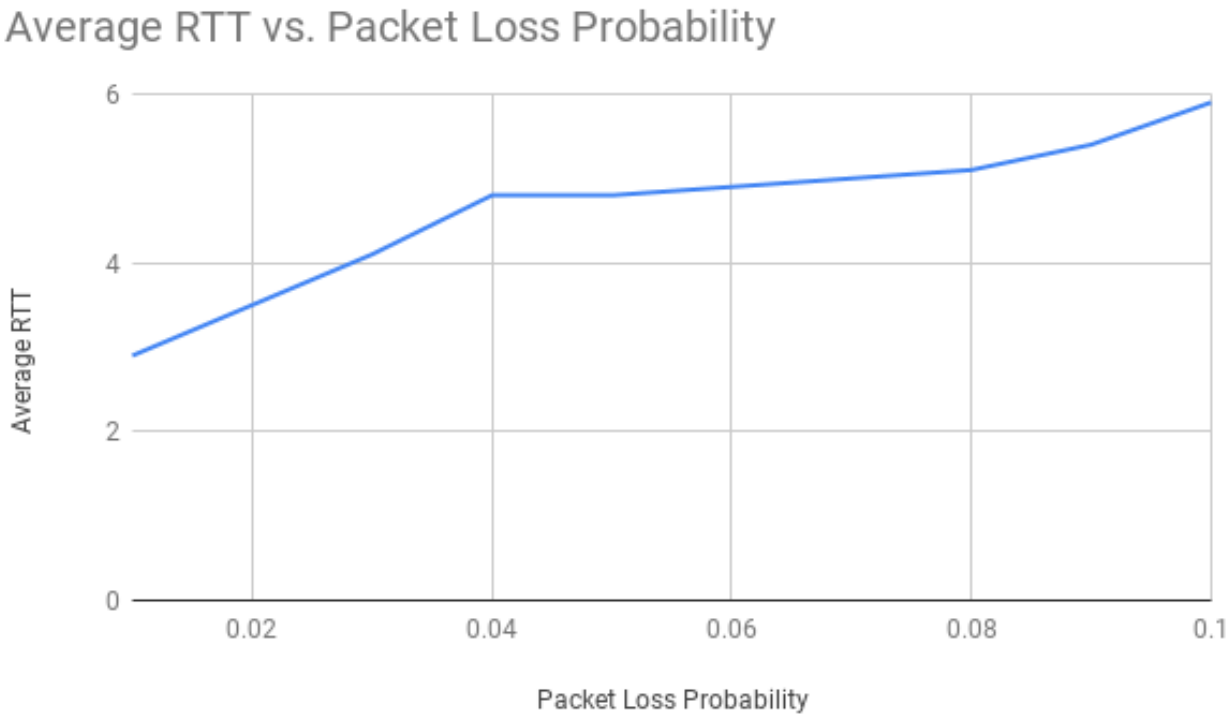
The graph above plots average RTT again maximum segment size(MSS)

Observation:
As observed the average RTT value decreases as the MSS increases. This is expected as larger MSS leads to better bandwidth utilisation. The performance is better when compared to Go-Back-N ARQ because there are less unwanted re-transmissions.

TASK 3: Effect of packet loss probability(p)
Size of file transferred = 1.1MB
N = 64
MSS = 500

Packet Loss Probability	Average RTT
0.01	2.9
0.02	3.5
0.03	4.1
0.04	4.8
0.05	4.8
0.06	4.9

Packet Loss Probability	Average RTT
0.07	5.0
0.08	5.1
0.09	5.4
0.10	6.0



The graph above plots the average RTT against the packet loss probability.

Observation:
Average RTT increases with increase in packet loss probability. The performance is better when compared with Go-Back-N ARQ because in selective repeat we only re-transmit those packets for which we got a NACK whereas in Go-Back-N ARQ we retransmit the entire sliding window. The average round trip time increases linearly initially then the increase is even slower.