Programming Assignment - 2
Fundamentals of Computer Networks

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I have read and understood the course academic integrity policy.

1 Introduction

The three reliable data transport protocols: Alternating-Bit (ABT), Go-Back-N (GBN), and Selective-Repeat (SR), have been implemented in the given simulator, and the performance of the three has been compared with different loss and corruption probabilities.

2 Timeout strategies

2.1 Optimum Timeout values

The three protocols were tested with different values of timeout ranging from 3 to 50 timeout units for 50 messages sent from the application side of A in order to compare throughputs. The average time between messages being sent was set to 1 time unit, and SR was tested with a window size of 10, to produce the following results.

Timeout	ABT	GBN	SR
3	0.056482	0.087954	0.120757
5	0.060905	0.116134	0.148914
10	0.069544	0.155169	0.145089
12	0.049501	0.155722	0.119615
13	0.067842	0.154037	0.120147
14	0.091875	0.148637	0.139034
15	0.091875	0.153216	0.148145
16	0.091875	0.155254	0.144172
20	0.091875	0.155254	0.133419
25	0.091875	0.155254	0.168535
30	0.091875	0.155254	0.178373
35	0.091875	0.155254	0.180398
38	0.091875	0.155254	0.181811
40	0.091875	0.155254	0.178664
50	0.091875	0.155254	0.172440

Figure 1: Throughput vs timeout

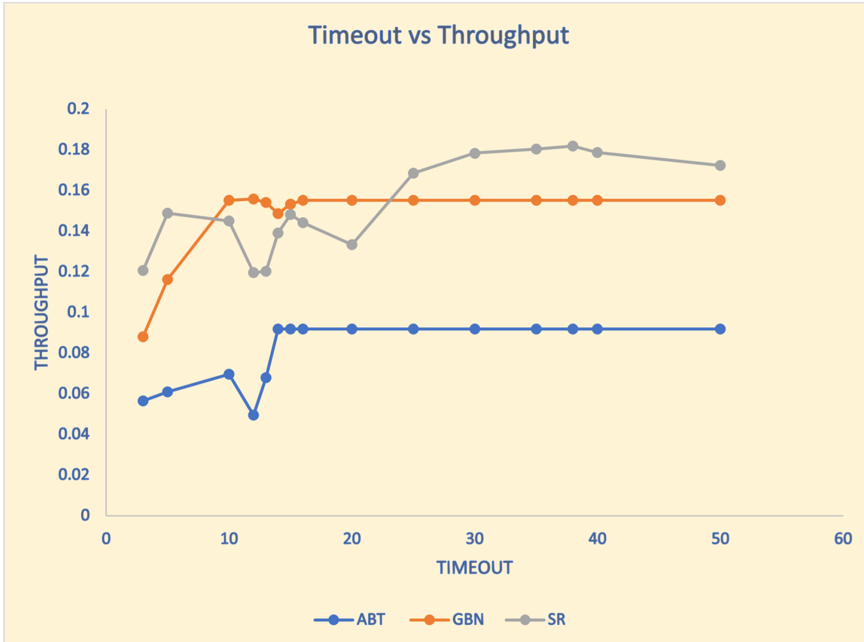

Figure 2: Throughput vs timeout

The optimum timeout values from this data seems to be 14 units for ABT, 16 units for GBN and 38 units for SR.

The optimum timeout values may vary for different window sizes and intervals between messages from the application layer of A.

2.2 Selective Repeat - implementation of multiple clocks

Selective repeat requires implementation of per-packet time out strategies. This was implemented by storing the time when a packet was sent out, calculating the elapsed time (difference between the start time and the current time), and comparing it with the timeout value. When an acknowledgement is received, the timer is not immediately restarted, but the acknowledged state of the packet is stored.

When the clock for A times out, the latest unacked packet is retrieved from the buffer on A's end. Thus, for these interrupted packets which need selective repeat, a new time interrupt value is set, using the time of the elapsed since the last packet was sent and the current time.

2.3 Window size versus timeout value for GBN

As the window size can play a crucial role in the performance of GBN, the relationship between throughput and timeout was compared for different window sizes, by sending 1000 messages from the application level of A. The results corroborate that 16 units is the optimal timeout value for GBN, and the variation in the performance follows similar trends for different window sizes.

Timeout	10	50	100	500
10	0.029927	0.064057	0.097819	0.100031
15	0.038846	0.068336	0.121093	0.135765
16	0.182822	0.173484	0.176962	0.178658
20	0.182822	0.173484	0.176962	0.178658
25	0.182822	0.173484	0.176962	0.178658
30	0.182822	0.173484	0.176962	0.178658

Figure 3: GBN - Throughput variation with window size

Figure 4: GBN - Throughput variation with window size

3 Experiments

3.1 Experiment 1

With loss probabilities: 0.1, 0.2, 0.4, 0.6, 0.8, the 3 protocols' throughputs at the application layer of receiver B are compared. 2 window sizes: 10, 50 are used for the Go-Back-N version and the Selective-Repeat Version.

GBN shows a better performance at window size = 10, and SR shows a better performance at window size = 50. This is expected, as a higher window size in GBN will lead to lower performance, as more packets need to be resent, in case loss occurs.

The total time taken does not reflect much disparity between SR and GBN, and this can be attributed to the high timeout value assigned for SR.

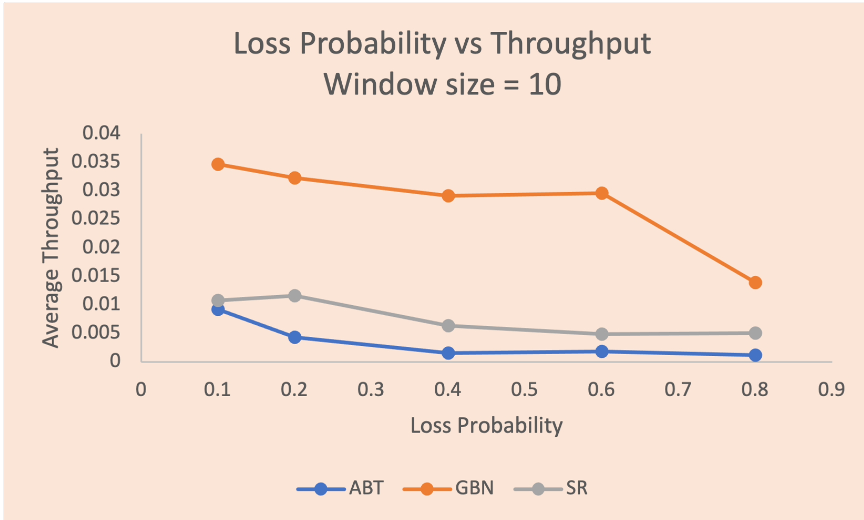

Figure 5: Window size = 10 : Throughput variation with loss probability

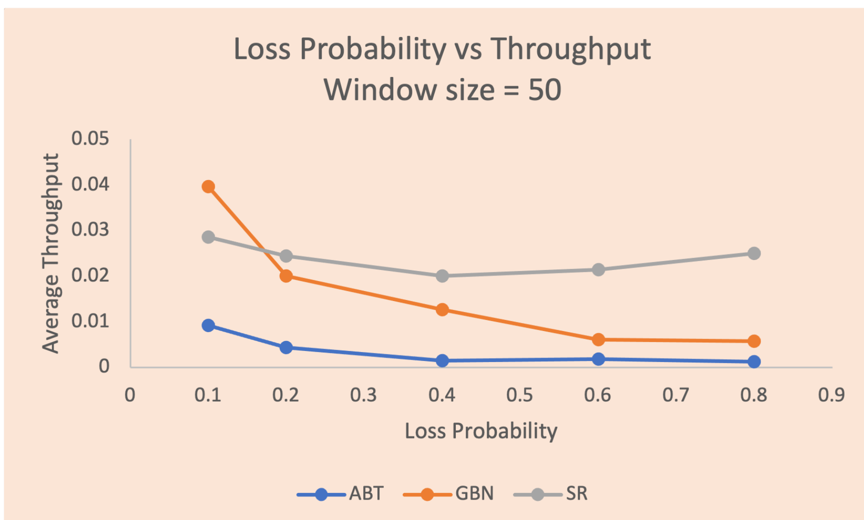

Figure 6: window size = 50 :Throughput variation with loss probability

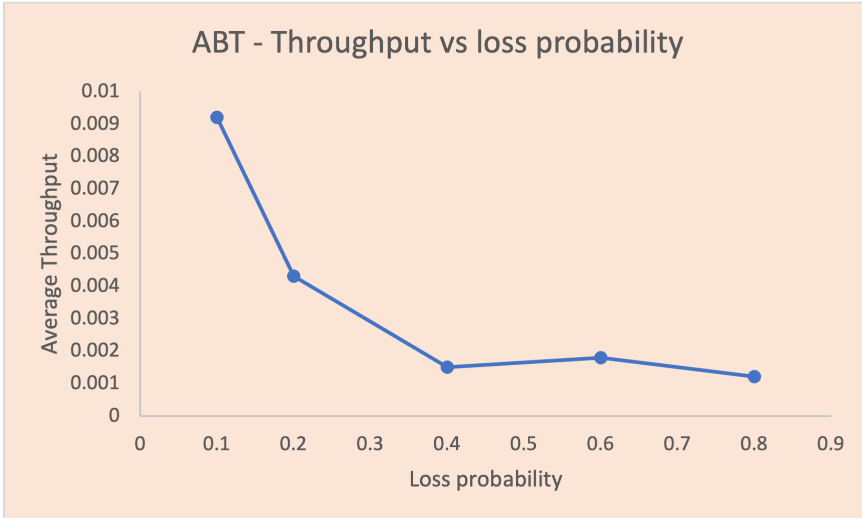

Figure 7: ABT - Throughput variation with loss probability

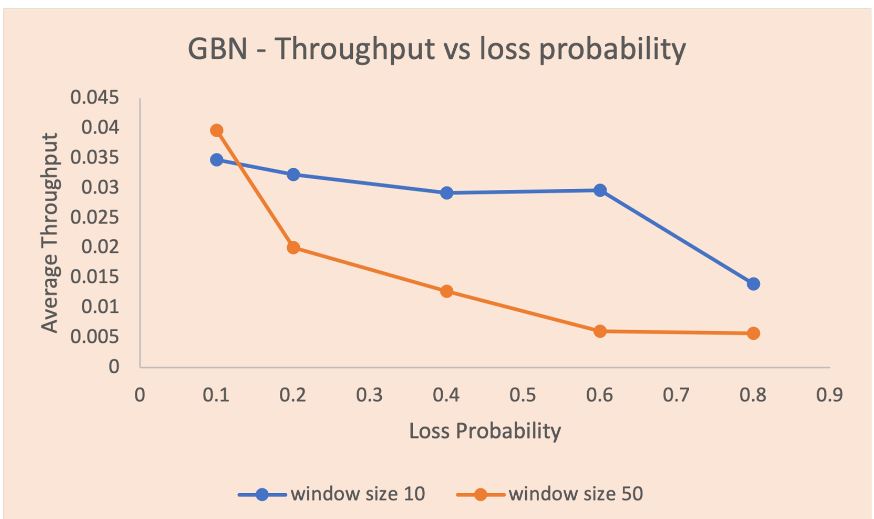

Figure 8: GBN - Throughput variation with loss probability

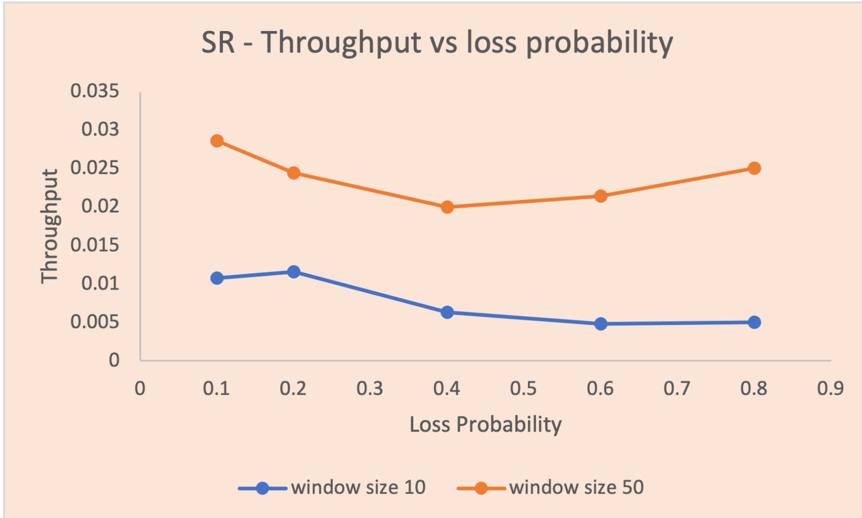

Figure 9: SR - Throughput variation with loss probability

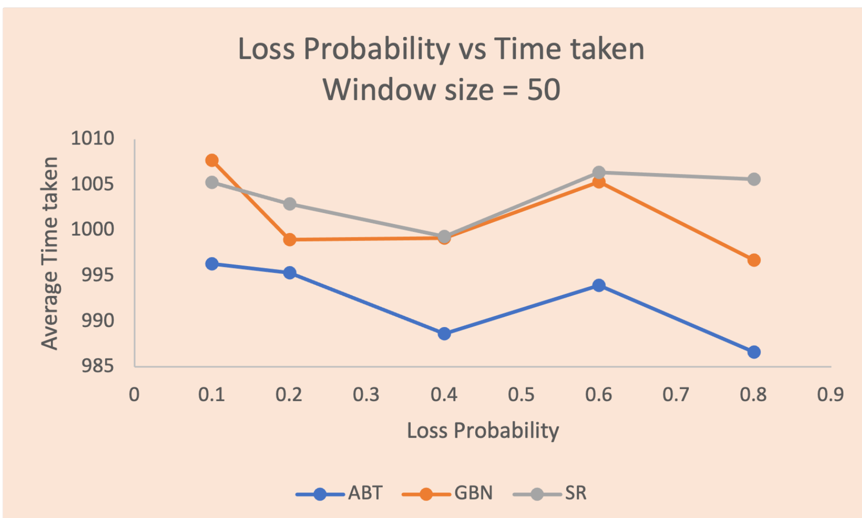

Figure 10: Window size - 50 : Average time taken

3.2 Experiment 2

With window sizes: 10, 50, 100, 200, 500 for GBN and SR, throughputs are compared at the application layer of receiver B, for different loss probabilities.

SR consistently shows a better performance than GBN and ABT, as expected. The performance of GBN drops sharply as the loss probability increases from 0.2 to 0.5, and further drops with increase in window size.

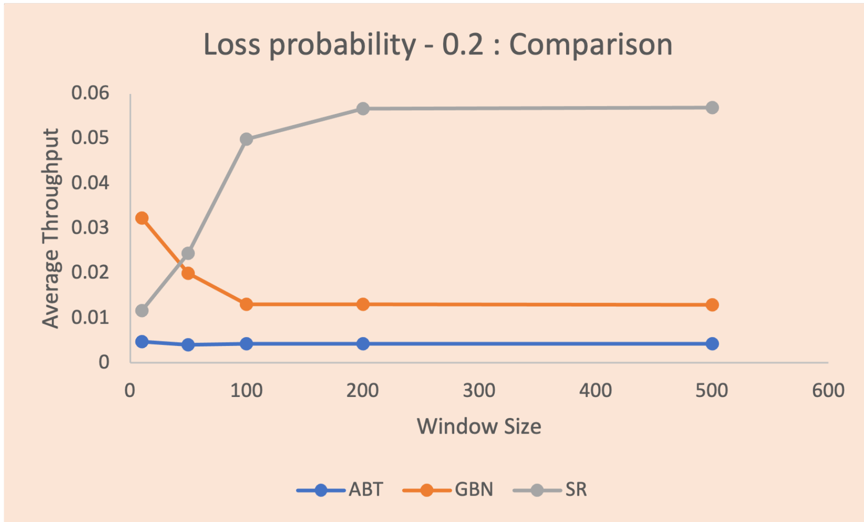

Figure 11: Loss probability = 0.2

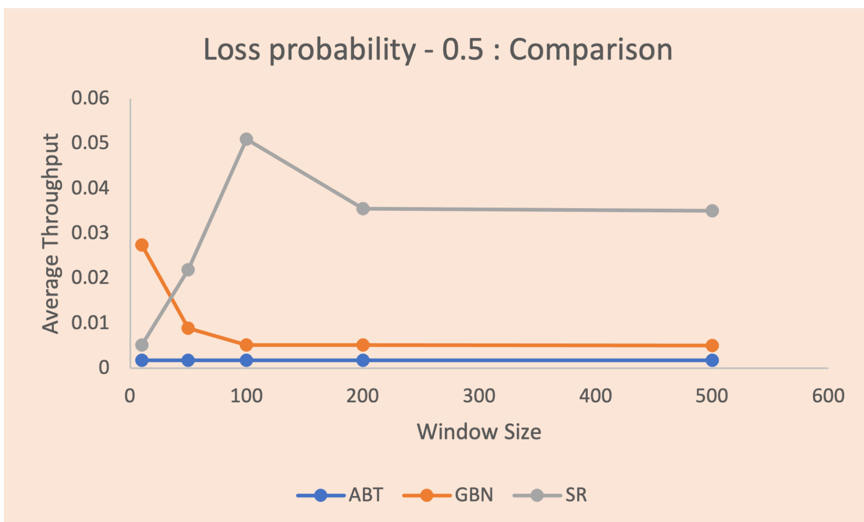

Figure 12: Loss probability = 0.5

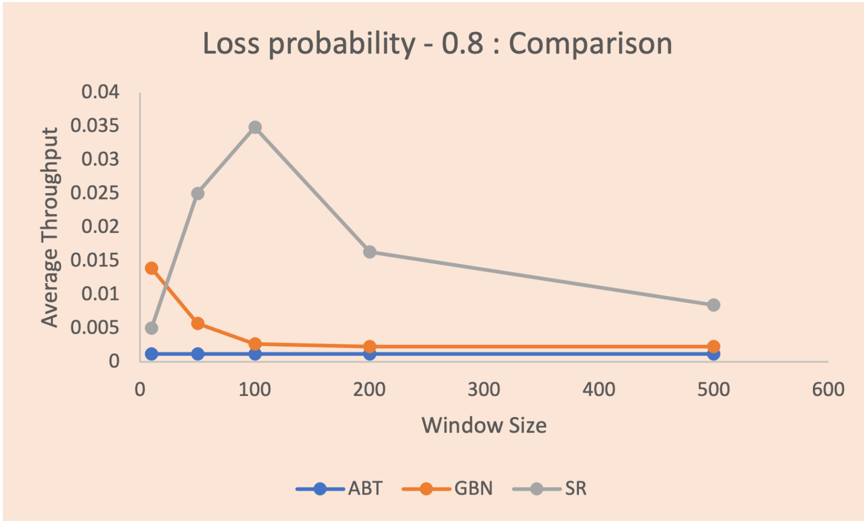

Figure 13: Loss probability = 0.8

3.3 Experiment 3

With corruption probabilities: 0.1, 0.2, 0.4, 0.6, 0.8, the 3 protocols' throughputs at the application layer of receiver B are compared. 2 window sizes: 10, 50 are used for the Go-Back-N version and the Selective-Repeat Version.

Similar results are observed, as in experiment 1, with GBN outperforming SR and ABT at lower window size, and SR performing better at higher window size.

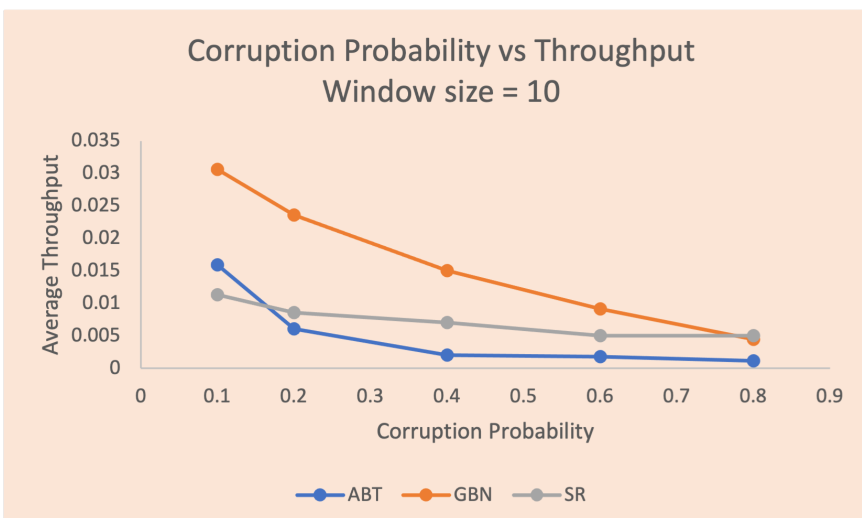

Figure 14: Window size - 10 : Corruption probability vs throughput

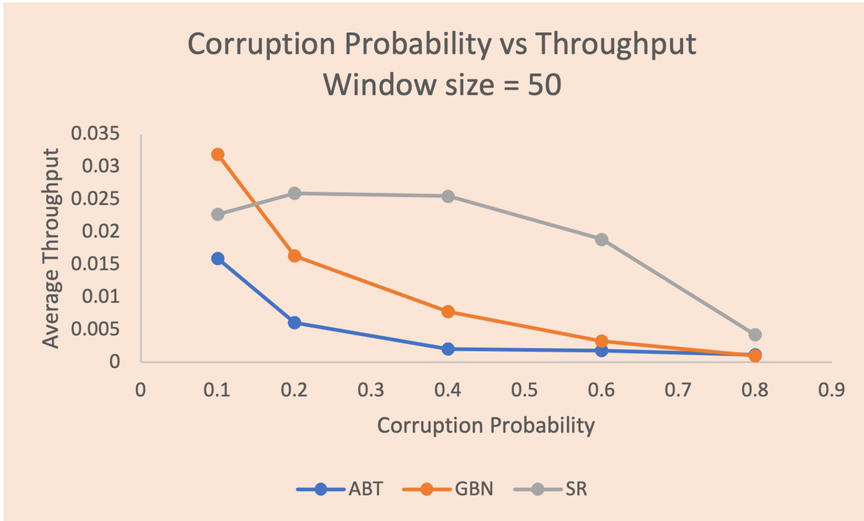

Figure 15: Window size - 50 : Corruption probability vs throughput

4 Conclusion

- Over all the experiments, SR generally outperforms GBN, and GBN generally outperforms ABT, with respect to throughput, as is expected.
- GBN performs best with lower window rates.
- There is no discernible trend in the average time taken for the protocols to send messages, and this can be attributed to the difference in the timeout values.