# CSE 489/589 Programming Assignment 2 Reliable Transport Protocols

# 1 - Academic Integrity Policy Statement

I have read and understood the course's academic integrity policy.

# 2 - Group and Contributions

Name of member 1: Dexson D'souza

UBITName: dexsonjo

o Contributions: ABT, GBN protocol implementation and report.

Name of member 2: Anuj Shastri

UBITName: anujswap

o Contributions : SR, GBN protocol implementation.

Contribution Percentage – 50% each by both team members

# 3 - SANITY Tests

## [2.0] ABT

```
| Testing with MESSAGE:1800, 10SS:0.1, CORRUPTION:0.0, ARRIVAL:50, MINDOM:0 ...
| Running (iswal-ator [ig Nume] ...
| Running (iswal-ator [ig Nume] ...
| Done |
| Running (iswal-ator [ig Nume] ...
| Done |
| Running (iswal-ator [ig Nume] ...
| Done |
| Running (iswal-ator [ig Nume] ...
| Done |
| Running (iswal-ator [ig Nume] ...
| Done |
| Running (iswal-ator [ig Nume] ...
| Running (iswal-ator [ig Nume] ...
| Done |
| Running (iswal-ator [ig Nume] ...
| Ru
```

# **[5.0]** GBN

```
Stones (/local/Spring_2022/dexsonjo/cse489589_assignment2/grader) > ./sanity_tests -p ../dexsonjo/gbn -r ./run_experiments
Testing with MESSACES:1000, LOSS:0.1, CORRUPTION:0.0, ARRIVAL:50, MINDOW:10 ...
Runfl [seed-1234] ... Done!
Runfl [seed-1234] ... Done!
Runfl [seed-1233] ... Done!
Runfl [seed-3333] ... Done!
Runfl [seed-3333] ... Done!
Runfl [seed-9599] ... Done!
Runfl [seed-9599] ... Done!
Runfl [seed-9555] ... Done!
Runfl [seed-9555] ... Done!
Runfl [seed-950] ... Done!
```

#### [8.0] SR

```
stones (/local/spring 2022/anujswap/cse489589 assignment2/grader) > ./sanity tests -p ../anujswap/sr -r ./run_experiments
Testing with MESSAGES:1000, LOSS:0.1, CORRUPTION:0.0, ARRIVAL:50, MINDOM:10 ...
Runnil [seed-1224] ... Donel
Runnil [seed-1224] ... Donel
Runnil [seed-1224] ... Donel
Runnil [seed-222] ... Donel
Runnil [seed-222] ... Donel
Runnil [seed-222] ... Donel
Runnil [seed-222] ... Donel
Runnil [seed-22333] ... Donel
Runnil [seed-2555] ... Donel
Runnil [seed-2555] ... Donel
Runnil [seed-2666] ... Donel
Runnil [seed-2777] ... Donel
Runnil [seed-2777] ... Donel
Runnil [seed-222] ... Donel
Runnil [seed-2233] ... Donel
Runnil [seed-2234] ... Donel
Runnil [seed-3333] ... Donel
Runnil [seed-3888] ... Donel
```

```
Testing with MESSACES:1000, LOSS:0.6, CORRUPTION:0.0, ARRIVAL:50, MINDOM:10 ...

Running simulator [10 Runs] ...

Done!
Running seed=22221 ... Done!
Running seed=22221 ... Done!
Running seed=25555 ... Done!
Running seed=5555 ... Done!
Running seed=5555 ... Done!
Running seed=6666 ... Done!
Running seed=8888 ... Done!
Running seed=8888 ... Done!
Running simulator [10 Runs] ...

Running seed=2222 ... Done!
Running simulator [10 Runs] ...

Running seed=2222 ... Done!
Running seed=3333 ... Done!
Running seed=40444 ... Done!
Running seed=40444 ... Done!
Running seed=5555 ... Done!
Running seed=40444 ... Done!
Running seed=
```

```
| Resting with MESSAGES:1000, LOSS:0.0, CORRUPTION:0.2, ARRIVAL:50, WINDOW:10 ... | AR
```

```
| Restrict with MESSAGES:1080, IOSS:0.0, CORRUPTION:0.2, ARRIVAL:50, MINOON:10 ... | A
```

```
[seed=1234]
[seed=1111]
[seed=2222]
[seed=3333]
[seed=4444]
[seed=5555]
    Run#2
   Run#4
   Run#5
   Run#6
                                      seed=6666
   Run#7
    Run#8 [seed=7777] ... Done!
Run#9 [seed=8888] ... Done!
Run#10 [seed=9999] ... Done!
   Run#8
Run#9
     Testing with MESSAGES:20, LOSS:1.0, CORRUPTION:0.0, ARRIVAL:50, WINDOW:50 ...
Running simulator [10 Runs] ...
Running simulator [10 Runs] ...
Run#1 [seed=1234] ... Done!
Run#2 [seed=1111] ... Done!
Run#3 [seed=2222] ... Done!
Run#4 [seed=3333] ... Done!
Run#5 [seed=44444] ... Done!
                                     [seed=5555]
[seed=6666]
    Run#6
    Run#7
  Run#8 [seed=7777] ... Done!
Run#9 [seed=8888] ... Done!
Run#10 [seed=9999] ... Done!
    Testing with MESSAGES:20, LOSS:0.0, CORRUPTION:1.0, ARRIVAL:50, WINDOW:50 ...
   Running simulator [10 Runs] ...
   Run#1 [seed=1234]
Run#2 [seed=1111]
Run#3 [seed=2222]
 Rui#3 | Seed=2222| ... | Done! | Rui#4 | Seed=3333 | ... | Done! | Rui#5 | Seed=4444 | ... | Done! | Rui#6 | Seed=5555 | ... | Done! | Rui#7 | Seed=6666 | ... | Done! | Rui#8 | Seed=7777 | ... | Done! | Rui#9 | Seed=8888 | ... | Done! | Rui#10 | Seed=9999 | ... | Done! | Dose! 
   stones {/local/Spring_2022/anujswap/cse489589_assignment2/grader} > advanced_tests* basic_tests* kremcb mulxew
                                                                                                                                                                                                                                                                                                                                                                      ronavq
                                                                                                                                                                                                                                                                                                                                                                                                                                                              run_experiments* ryyidf
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 sanity_tests*
    stones {\(\bar{\gamma}\)local/Spring_2022/anujswap/cse489589_assignment2/grader\} >
```

# 4 - BASIC Tests

# **[5.0]** ABT

```
g with MESSAGES:20, LOSS:0.4, CORRUPTION:0.0, ARRIVAL:1000, WINDON:0 ...
g simulator [10 Runs] ...
[seed-1234] ... Done!
[seed-1111] ... Done!
[seed-2222] ... Done!
[seed-3223] ... Done!
[seed-3223] ... Done!
[seed-3666] ... Done!
[seed-5656] ... Done!
[seed-5666] ... Done!
[seed-5888] ... Done!
[seed-9999] ... Done!
                    with MESSAGES:20, LOSS:0.8, CORRUPTION:0.0, ARRIVAL:1000, WINDOW:0 ...
simulator [10 Runs] ...
seed-1234] .. Done!
seed-1111 .. Done!
seed-2222] .. Done!
seed-3033 ... Done!
seed-3555] ... Done!
seed-5555] ... Done!
seed-6666 ... Done!
seed-6666 ... Done!
seed-67777 ... Done!
seed-6988 ... Done!
[seed-9999] ... Done!
esting with MESSAGES:20, LOSS:0.0, CORRUPTION:0.1, ARRIVAL:1000, WINDOW:0 ...
unning simulator [10 Runs] ...
un#1 [seed-1234] ... Done!
un#2 [seed-1111] ... Done!
                        with MESSAGES:20, LOSS:0.0, CORRUPTION:0.4, ARRIVAL:1000, WINDOW:0 ... seed-1234] ... Done! seed-1111. Done! seed-1112. Done!
  ASSI
ssting with MESSAGES:20, LOSS:0.0, CORRUPTION:0.8, ARRIVAL:1000, WINDOW:0 ...
uning simulator [10 Runs] ...
unil [seed-1234] ... Done!
unil [seed-1234] ... Done!
unil [seed-2222] ... Done!
unil [seed-3333] ... Done!
unil [seed-3444] ... Done!
unil [seed-4444] ... Done!
unil [seed-47555] ... Done!
unil [seed-7777] ... Done!
unil [seed-7777] ... Done!
unil [seed-888] ... Done!
unil [seed-8999] ... Done!
unil [seed-8999] ... Done!
```

## [12.0] GBN

```
ASSI
asting with MESSAGES:20, LOSS:0.8, CORRUPTION:0.0, ARRIVAL:50, WINDOW:50 ...
unning simulator [10 Runs] ...
un#1 [seed-1234] ... Done!
un#3 [seed-1234] ... Done!
un#3 [seed-2222] ... Done!
un#4 [seed-3333] ... Done!
un#5 [seed-4444] ... Done!
un#6 [seed-5555] ... Done!
un#6 [seed-666] ... Done!
un#7 [seed-8888] ... Done!
un#9 [seed-9777] ... Done!
un#9 [seed-9999] ... Done!
un#10 [seed-9999] ... Done!
  Running simulator [10 Runs] ...
Run#1 [seed-1224] ... Done!
Run#2 [seed-1111] ... Done!
Run#3 [seed-2222] ... Done!
Run#4 [seed-3333] ... Done!
Run#4 [seed-3333] ... Done!
Run#5 [seed-4444] ... Done!
Run#6 [seed-5555] ... Done!
Run#7 [seed-6666] ... Done!
Run#8 [seed-7777] ... Done!
Run#8 [seed-8888] ... Done!
Run#9 [seed-9999] ... Done!
PASS!
   Rum#10 [seed-9999] ... Done!
Rum#1 [seed-9999] ... Done!
Rum#1 [seed-1234] ... Done!
Rum#2 [seed-1111] ... Done!
Rum#4 [seed-1234] ... Done!
Rum#4 [seed-3333] ... Done!
Rum#4 [seed-3535] ... Done!
Rum#6 [seed-9555] ... Done!
Rum#6 [seed-9555] ... Done!
Rum#6 [seed-95888] ... Done!
Rum#6 [seed-9599] ... Done!
Rum#6 [seed-9599] ... Done!
Runf10 (seed-9999) ... Done!
Runf10 (seed-9999) ... Done!
Runf1 (seed-1234) ... Done!
Runf2 (seed-1111) ... Done!
Runf3 (seed-2221) ... Done!
Runf4 (seed-2223) ... Done!
Runf5 (seed-3233) ... Done!
Runf6 (seed-9999) ... Done!
Runf7 (seed-4444) ... Done!
Runf8 (seed-4444) ... Done!
Runf8 (seed-9999) ... Done!
Runf9 (seed-9999) ... Done!
Runf10 (seed-9999) ... Done!
```

#### [**18.0**] SR

```
stones {/local/Spring_2022/anujswap/cse489589_assignment2/grader} > ./basic_tests -p ../anujswap/sr -r ./run_experiments
                                                                                                                                                                                                                                                                                                                                                                                                                                              \triangle
                                                                             0, LOSS:0.1, CORRUPTION:0.0, ARRIVAL:50, WINDOW:50 ...
     Running simulator [10 Runs] ...
   Running simulator
Runnil [seed=1234]
Runnil [seed=1211]
Runnil [seed=2222]
Runnil [seed=3333]
Runnil [seed=3333]
Runnil [seed=4444]
Runnil [seed=5555]
Runnil [seed=6666]
Runnil [seed=57777]
Runnil [seed=5888]
Runnil [seed=5888]
    Testing with MESSAGES:20, LOSS:0.4, CORRUPTION:0.0, ARRIVAL:50, WINDOW:50 ... Running simulator [10 Runs] ...
  Running simulator [10 Runs] .

Run#1 [seed=1234] . Done!

Run#2 [seed=1111] . Done!

Run#3 [seed=2222] . Done!

Run#4 [seed=3333] . Done!

Run#5 [seed=48444] . Done!

Run#6 [seed=5555] . Done!

Run#6 [seed=6666] . Done!

Run#9 [seed=7777] . Done!

Run#9 [seed=8888] . Done!

Run#10 [seed=9999] . Done!
  PASS!
Testing with MESSAGES:20, LOSS:0.8, CORRUPTION:0.0, ARRIVAL:50, WINDOW:50 ...
Running simulator [10 Runs] ...
Runii1 [seed=1234] ... Done!
Runii2 [seed=1111] ... Done!
Runii3 [seed=2222] ... Done!
Runii4 [seed=3333] ... Done!
Runii4 [seed=3333] ... Done!
Runii5 [seed=4444] ... Done!
Runii6 [seed=5555] ... Done!
Runii7 [seed=6666] ... Done!
Runii8 [seed=7777] ... Done!
Runii8 [seed=7777] ... Done!
Runii9 [seed=8888] ... Done!
Runii10 [seed=9999] ... Done!
PASS!
Testing with MESSAGES:20, LOSS:0.0, CORRUPTION:0.1, ARRIVAL:50, WINDOW:50 ... Running simulator [10 Runs] ...
  Run#1
Run#2
                     [seed=1234]
[seed=1111]
  Run#2 [seed=1111] ...
Run#3 [seed=2222] ...
Run#4 [seed=3333] ...
Run#5 [seed=4444] ...
Run#6 [seed=5555] ...
Run#7 [seed=6666] ...
Run#8 [seed=7777] ...
Run#9 [seed=8888] ...
Run#10 [seed=9999] ...
PASS|
Testing with MESSAGES:20, LOSS:0.0, CORRUPTION:0.4, ARRIVAL:50, WINDOW:50 ... Running simulator [10 Runs] ...
 Running simulator [10 Runs] ...
Run#1 [seed=1234] ... Done!
Run#2 [seed=1111] ... Done!
Run#3 [seed=2222] ... Done!
Run#4 [seed=3333] ... Done!
Run#5 [seed=3333] ... Done!
Run#6 [seed=5555] ... Done!
Run#7 [seed=6666] ... Done!
Run#8 [seed=7777] ... Done!
Run#8 [seed=8888] ... Done!
Run#10 [seed=9999] ... Done!
PASS!
Testing with MESSAGES:20, LOSS:0.0, CORRUPTION:0.8, ARRIVAL:50, WINDOW:50 ...
Running simulator [10 Runs] ...
  Run#1
Run#2
                   [seed=1234]
[seed=1111]
                                                      ... Done
                   [seed=1111]
[seed=2222]
[seed=3333]
[seed=4444]
[seed=5555]
[seed=6666]
[seed=7777]
  Run#4
  Run#5
  Run#7
Run#8
  BASIC TESTS: PASS
```

# 5 - ADVANCED Tests

# **[5.0]** ABT

```
SS:
string with MESSAGES:1000, LOSS:0.6, CORRUPTION:0.0, ARRIVAL:50, WINDOW:0 ...
nnning simulator [10 Runs] ...
mill [seed-1234] ... Done!
           with MESAGES:1000, LOSS:0.0, CORRUPTION:0.1, ARRIVAL:50, WINDOW:0 ... simulator [10 Runs] ... seed-1234] .. Done! seed-1111 .. Done! seed-2222] .. Done! seed-3233 .. Done! seed-3235 .. Done! seed-3666 ... Done! seed-6666 ... Done! [seed-9999] ... Done!
           with MESSAGES:1000, LOSS:0.0, CORRUPTION:0.2, ARRIVAL:50, WINDOW:0 ... simulator [10 Runs] ... seed-12324] ... Done! seed-1111] ... Done! seed-2222] ... Done!
```

## [**10.0**] GBN

```
| with MESSAGES:1000, LOS | simulator [10 Runs] | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... 
   PASS:
Pasting with MESSAGES:1000, LOSS:0.0, CORRUPTION:0.1, ARRIVAL:50, WINDOW:10 ...
Runfil [seed=1234] ... Donel
Runfil [seed=1234] ... Donel
Runfil [seed=3333] ... Donel
Runfil [seed=4244] ... Donel
Runfil [seed=4444] ... Donel
Runfil [seed=6666] ... Donel
Runfil [seed=6666] ... Donel
Runfil [seed=6668] ... Donel
Runfil [seed=6888] ... Donel
Runfil [seed-9999] ... Donel
Runfil [seed-9999] ... Donel
Runfil [seed-9999] ... Donel
       AASS| setting with MESSAGES:1000, LOSS:0.0, CORRUPTION:0.2, ARRIVAL:50, WINDOW:10 ... kunning simulator [10 Runs] ... kunwing simulator [10 Runs] ... bone! kunwing [seed-1234] ... bone! kunwing [seed-2111] ... bone! kunwing [seed-2222] ... bone! kunwing [seed-4244] ... bone! kunwing [seed-4444] ... bone! kunwing [seed-6566] ... bone! 
   Running simulator [10 Runs] ...
Runf1 [seed-1224] ... Done!
Runf2 [seed-1111] ... Done!
Runf3 [seed-2222] ... Done!
Runf4 [seed-3333] ... Done!
Runf4 [seed-3333] ... Done!
Runf5 [seed-4444] ... Done!
Runf6 [seed-5555] ... Done!
Runf7 [seed-6666] ... Done!
Runf8 [seed-7777] ... Done!
Runf9 [seed-8888] ... Done!
Runf9 [seed-8999] ... Done!
PASS!
   ADVANCED TESTS:
```

#### [20.0] SR

```
PASS!
Testing with MESSAGES:1000, LOSS:0.6, CORRUPTION:0.0, ARRIVAL:50, WINDOW:10 ...
Runril [seed-1224] ... Donel
Runril [seed-1224] ... Donel
Runril [seed-1224] ... Donel
Runril [seed-222] ... Donel
Runril [seed-222] ... Donel
Runril [seed-222] ... Donel
Runril [seed-222] ... Donel
Runril [seed-4444] ... Donel
Runril [seed-6666] ... Donel
Runril [seed-69999] ... Donel
Runril [seed-9999] ... Donel
Runril [seed-1234] ... Donel
Runril [seed-1234] ... Donel
Runril [seed-1234] ... Donel
Runril [seed-1111] ... Donel
Runril [seed-6666] ... Donel
Runril [seed-9999] ... Donel
Runril [seed-1111] ... Donel
Runril [seed-1234] ... Donel
Runril [seed-1234] ... Donel
Runril [seed-1234] ... Donel
Runril [seed-1236] ... Donel
Runril [seed-222] ... Donel
Runril [seed-222] ... Donel
Runril [seed-222] ... Donel
Runril [seed-223] ... Donel
Runril [seed-224] ... Donel
Runril [seed-22555] ... Donel
Runril [seed-226555] ... Donel
Runril [seed-22666] ... Donel
Runril [seed-226777] ... Donel
Runril [seed-226777] ... Donel
Runril [seed-22688] ... Donel
Runril [seed-22688] ... Donel
Runril [seed-226989] ... D
```

```
| PASS| | Testing with MESSAGES:1800, LOSS:8.0, CORRUPTION:0.2, ARRIVAL:50, WINDOW:10 ... | Runnil | seed-12.34| ... | Done | Runnil | seed-12.34| ... | Done | Runnil | seed-12.34| ... | Done | Runnil | seed-22.22| ... | Done | Runnil | seed-3333| ... | Done | Runnil | seed-32.33| ... | Done | Runnil | seed-32.33| ... | Done | Runnil | seed-6666| ... | Done | Runnil | seed-32.33| ... | Done | Runnil | seed-22.24| ... | Done | Runnil | seed-22.24| ... | Done | Runnil | seed-3333| ... | Done | Runnil | seed-6666| ... | Done | Runnil | seed-12.24| ... | Done | Runnil | seed-666| ... | Done | Runnil | seed-12.24| ... | Done | Ru
```

```
Testing with MESSAGES:1000, LOSS:0.0, CORRUPTION:0.8, ARRIVAL:50, WINDOW:10 ...
Runming simulator [10 Runs] ...
Run#1 [seed=1234] ... Done!
Run#2 [seed=1111] ... Done!
Run#3 [seed=2222] ... Done!
Run#4 [seed=3333] ... Done!
Run#5 [seed=4444] ... Done!
Run#6 [seed=5555] ... Done!
Run#7 [seed=6666] ... Done!
Run#8 [seed=7777] ... Done!
Run#8 [seed=7777] ... Done!
Run#10 [seed=9999] ... Done!
Run#10 [seed=9999] ... Done!
ADVANCED TESTS: PASS
stones {/local/Spring_2022/anujswap/cse489589_assignment2/grader} > ■
```

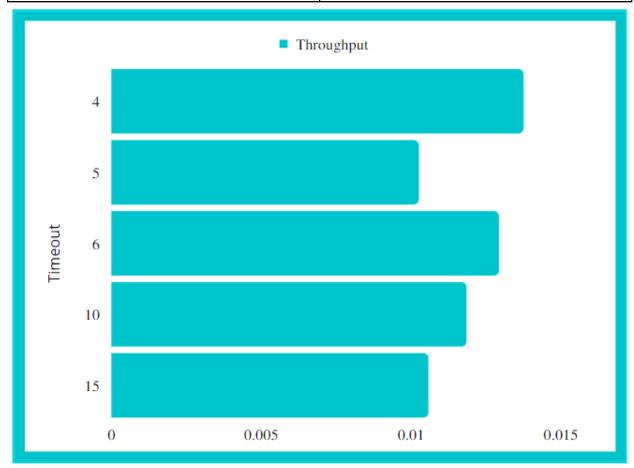
# 6 - ANALYSIS & REPORT [15.0]

We have implemented the following protocols: Alternating Bit, Go Back N and Selective Repeat.

#### 1. Alternating Bit Protocol

I ran my protocol for different loss values(0.1, 0.2, 0.4, 0.6, 0.8) which were mentioned in experiments, 1000 messages, 50 mean time, 0.2 corruption and calculated the average throughput.

Timeout Value	Average Throughput	
4	0.01374752	
5	0.010253544	
6	0.01292636	
10	0.01184158	
15	0.01057144	



As we can see, Average Throughput is maximum when Timeout is 4. Hence, We decide to set Timeout 4 for ABT protocol.

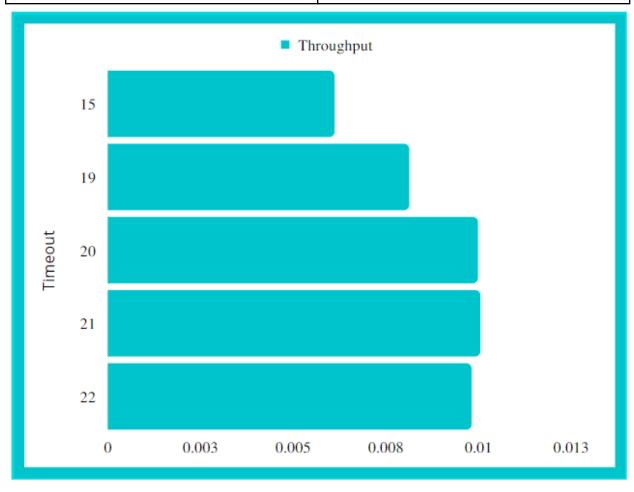
#### 2. Go Back N Protocol

I ran my protocol for different loss values(0.1, 0.2, 0.4, 0.6, 0.8) which were mentioned in experiments, 1000 messages, 50 mean time, 0.2 corruption and calculated the average throughput.

Here, I tried 2 different windows sizes 10 and 50.

For window 10, I got the following results:

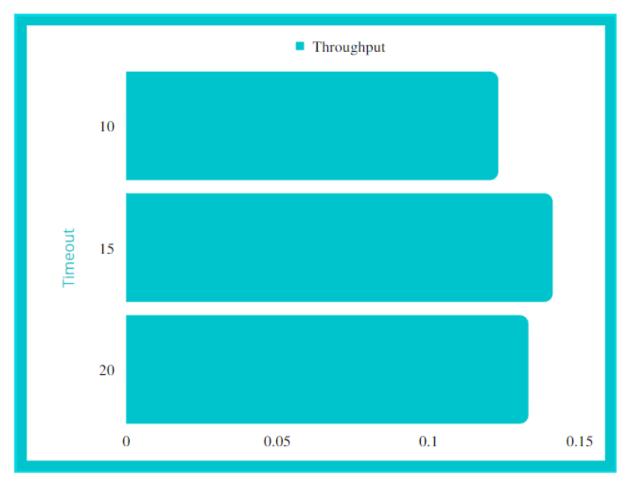
Timeout Value	Average Throughput	
15	0.00611178	
20	0.00998076	
19	0.00812682	
21	0.01004526	
22	0.00980786	



As we can see, Average Throughput for window size 10 is maximum when Timeout is 21. Hence, We decide to set Timeout 21 for GBN protocol when win size is 10.

For window 50, I got the following results:

Timeout Value	Average Throughput	
10	0.123	
15	0.141	
20	0.133	



As we can see, Average Throughput for window size 50 is maximum when Timeout is 15. Hence, We decide to set Timeout 15 for GBN protocol when win size is 50.

#### 3. Selective Repeat Protocol

Similar to GBM, I ran my protocol for different loss values (0.1, 0.2, 0.4, 0.6, 0.8) and same configurations but for different window sizes 10 and 50.

For window 10, I got the following results:

Timeout Value	Average Throughput	
20	0.00015378	
35	0.00015632	
45	0.00013868	

As we can see, Average Throughput is for window size 10 maximum when Timeout is 35. Hence, We decide to set Timeout 35 for GBN protocol when win size is 10.

For window 50, I got the following results:

Timeout Value	Average Throughput	
20	0.00015422	
35	0.00016358	
45	0.00013396	

As we can see, Average Throughput for window size 50 is maximum when Timeout is 35. Hence, We decide to set Timeout 35 for GBN protocol when win size is 50.

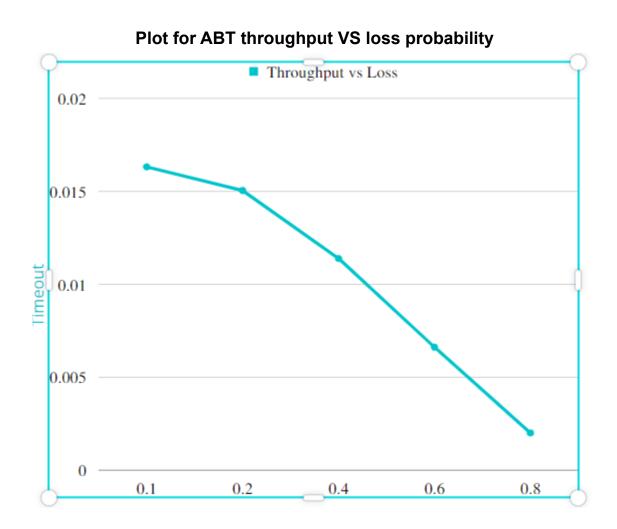
#### Implemented multiple software timers in SR

We have used only one timer and a vector (name: timer). I kept a vector list for each packet for selective repeat protocal. Each packet's sequence number corresponds to the index of this vector list.

I first check for timeout condition "get\_sim\_time() - timer[sbase] < RTtime", if true I resend the packet.

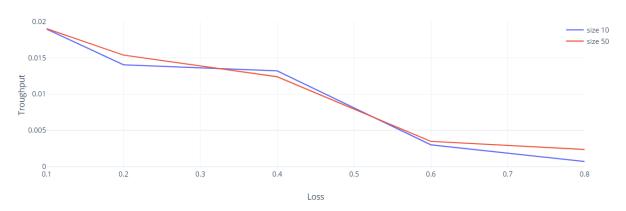
When I send a packet from the sender side, I use get sim time() in my timer to keep track of the current time. Then set the timer to "TimeOutVal" as a constant value and If this packet arrives on schedule, I will note it, Stop the timer as agreed upon and then restart the timer using the oldest setting. I then set the timer to "RTtime - (get\_sim\_time() - timer[sbase])" as this much time has passed since this packet was last delivered,

Then I update timer[i] with current time.



For ABT, We can see that Throughput decrease as the loss probability increases. This is expected behaviour of ABT as it is a very simple protocol for simple applications and when loss probability is high, it cannot handle lost packets efficiently.

Plot for GBN throughput for Window size 10 and 50 VS loss probability



We can see that GBN works great when loss probability is low for any window size. However, when the losses become high GBN with window 50 performed worse.

Also GBN takes a lot of time when window size is high, this is because the window does not move for a long time when packets are lost. Hence, we consider an implementation to increase RTT for GBN when Window size increases.

Plot for SR throughput for Window size 10 and 200 VS loss probability



SRN performs bad with small window size i.e.10 but when window size increases to 200 its performance is better. Higher windows size is better for SR protocol. If we use Adaptive Timeout Policies for SR, its performance will improve more. This is stated in the following paper:

https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.80.1268&rep=rep1&type=pdf

#### **EXPERIMENT-1**

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

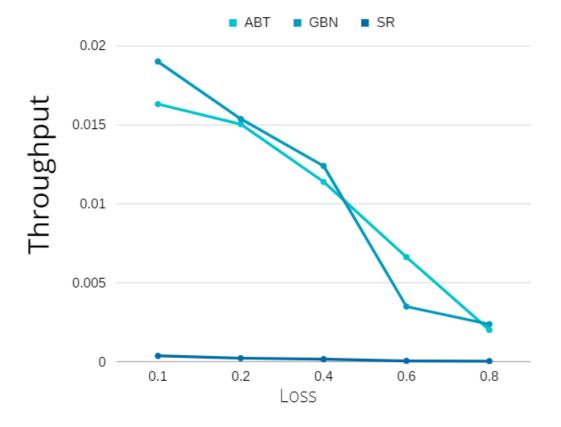
#### Window size=10

Loss Probability	ABT	GBN	SR
0.1	0.0163168	0.0189503	0.0003682
0.2	0.0150473	0.0140403	0.0002189
0.4	0.0113887	0.0131991	0.0001289
0.6	0.0066189	0.0030086	0.0000436
.8	0.0020061	0.0007055	0.000022



Window size = 50

Loss Probability	ABT	GBN	SR
0.1	0.0163168	0.0190157	0.0003633
0.2	0.0150473	0.0153779	0.0002187
0.4	0.0113887	0.012398	0.0001544
0.6	0.0066189	0.0034867	0.0000477
.8	0.0020061	0.0023752	0.0000338

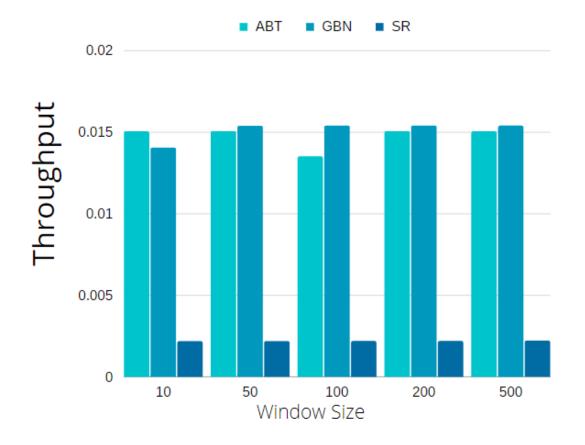


#### **EXPERIMENT-2**

1. With window sizes: {10, 50, 100, 200, 500} for GBN and SR, compare the 3 protocols' throughputs at the application layer of receiver B. Use 3 loss probabilities: {0.2, 0.5, 0.8} for all 3 protocols.

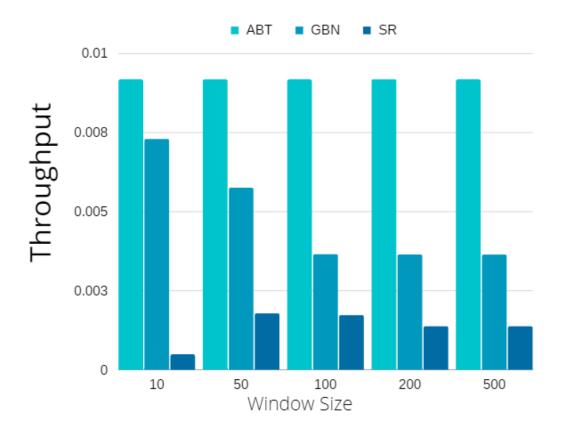
Loss= 0.2

Window size	ABT	GBN	SR
10	0.0150473	0.0140403	0.0002189
50	0.0150473	0.0153779	0.0002187
100	0.0135143	0.0153905	0.0002201
200	0.0150473	0.0153904	0.000220
500	0.0150473	0.0153901	0.000222



Loss= 0.5

Window size	ABT	GBN	SR
10	0.0091748	0.0072897	0.0004867
50	0.0091748	0.0057544	0.0017799
100	0.0091748	0.003648	0.0017239
200	0.0091748	0.003640	0.0013729
500	0.0091748	0.003638	0.0013735



Loss= 0.8

Window size	ABT	GBN	SR
10	0.0022802	0.0010888	0.0001107
50	0.0022802	0.00058944	0.0001586
100	0.0022802	0.00043112	0.0001497
200	0.0022802	0.00043105	0.0022428
500	0.0022802	0.00043099	0.0006055

