TITLE:-

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Class:- BCSE Third year
Group:- A2
Assignment No:- 1
Date:-02.11.2020

Problem Statement:-

Assignment 2: Implement three data link layer protocols, Stop and Wait, Go Back N Sliding
Window and Selective Repeat Sliding Window for flow control.
Sender, Receiver and Channel all are independent processes. There may be multiple Transmitter and
Receiver processes, but only one Channel process. The channel process introduces random delay and/or
bit error while transferring frames. Define your own frame format or you may use IEEE 802.3 Ethernet
frame format.
Hints: Some points you may consider in your design.
Following functions may be required in Sender.
Send: This function, invoked every time slot at the sender, decides if the sender should (1) do nothing,
(2) retransmit the previous data frame due to a timeout, or (3) send a new data frame. Also, you have to
consider current network time measure in time slots.
Recv_Ack: This function is invoked whenever an ACK packet is received. Need to consider network time
when the ACK was received, ack_num and timestamp are the sender's sequence number and timestamp
that were echoed in the ACK. This function must call the timeout function.
Timeout: This function should be called by ACK method to compute the most recent data packet's
round-trip time and then recompute the value of timeout.
Following functions may be required in Receiver.
Recv: This function at the receiver is invoked upon receiving a data frame from the sender.
Send_Ack: This function is required to build the ACK and transmit.
Sliding window:
The sliding window protocols (Go-Back-N and Selective Repeat) extend the stop-and-wait protocol by
allowing the sender to have multiple frames outstanding (i.e., unacknowledged) at any given time. The

maximum number of unacknowledged frames at the sender cannot exceed its "window size". Upon
receiving a frame, the receiver sends an ACK for the frame's sequence number. The receiver then
buffers the received frames and delivers them in sequence number order to the application.
Performance metrics: Receiver Throughput (packets per time slot), RTT, bandwidth-delay product,
utilization percentage.

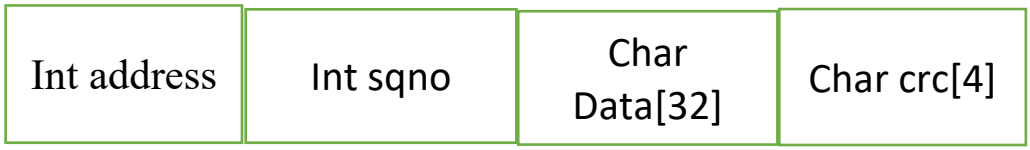
DESIGN:-

Purpose:- The given assignment is to implement the protocols of data link layer for flow control I.e:- Stop and Wait, Go Back N Sliding Window and Selective Repeat Sliding Window .The purpose of the program is to simulate the real implementation of these techniques. The User can visualize what actually happen in these techniques. All the code is written in c++ language and for interprocess communication Message Queue is used.

Input/Output Format:-
A channel should be started first. The sender and reciever process askd of their own address and sender and reciever's Address as user Input. Data.txt contains the data to be sent. The three different process has their own sender channel and receiever.

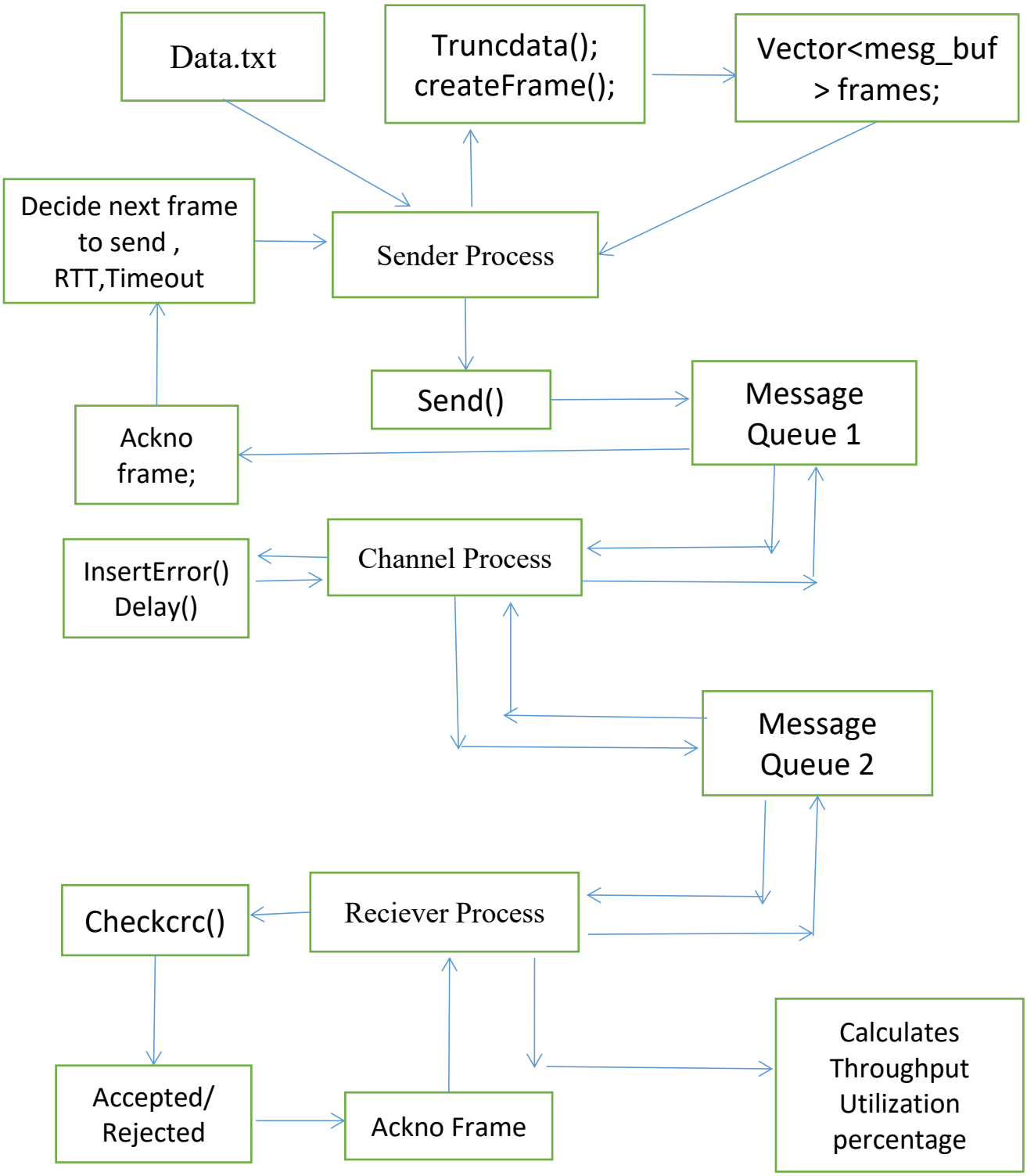
Diagram:-

Frame Structure:-



Message Frame

Acknowledgement frame


Data.txt
Truncdata();
createFrame();
Vector<mesg_buf
> frames;
Decide next frame
to send ,
RTT,Timeout
Sender Process
Send()
Message
Queue 1
Ackno
frame;
InsertError()
Delay()
Channel Process
Message
Queue 2
Checkcrc()
Reciever Process
Accepted/
Rejected
Ackno Frame
Calculates
Throughput
Utilization
percentage

Implementation

```
class timer{
Start();
elapsedTime();
isTimeOut(double seconds);
}
```

Frames:-

```
struct frame{
        int address;
        int sqno;
        char data[32];
        char crc[4];
};
struct mesg_buffer{
        long mes_type;
        frame Frame;
}message;
struct ackframe{
        int ack;
        int address;
};
struct ack{
        long mesg_type;
        ackframe frame;
};
```

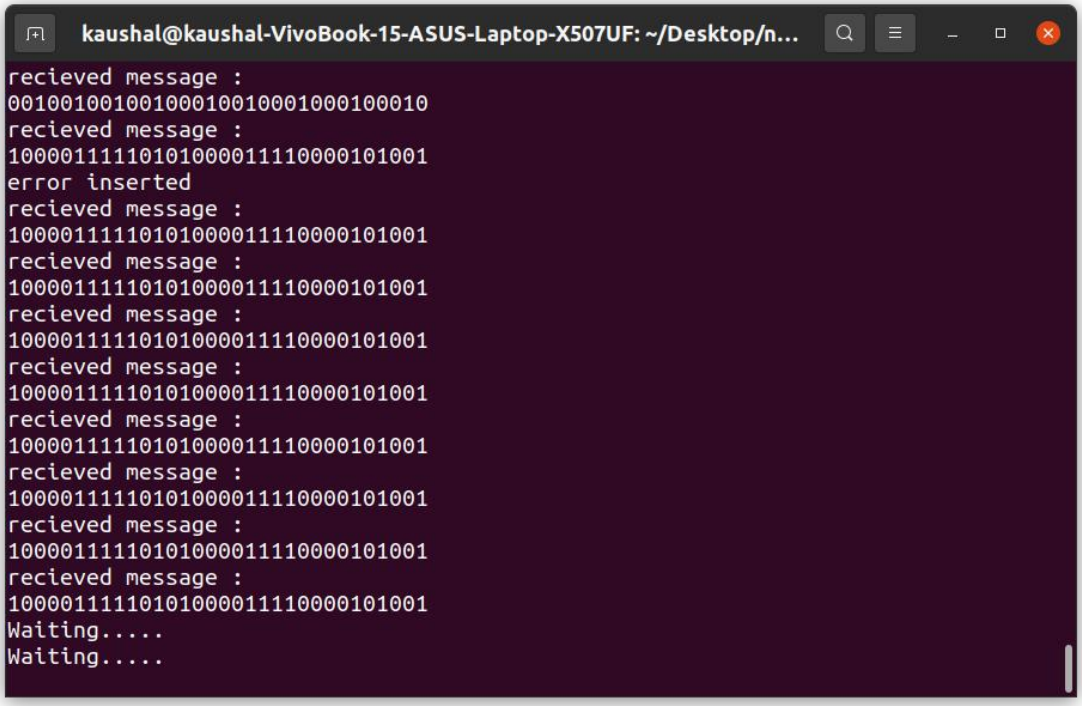
For sender:-

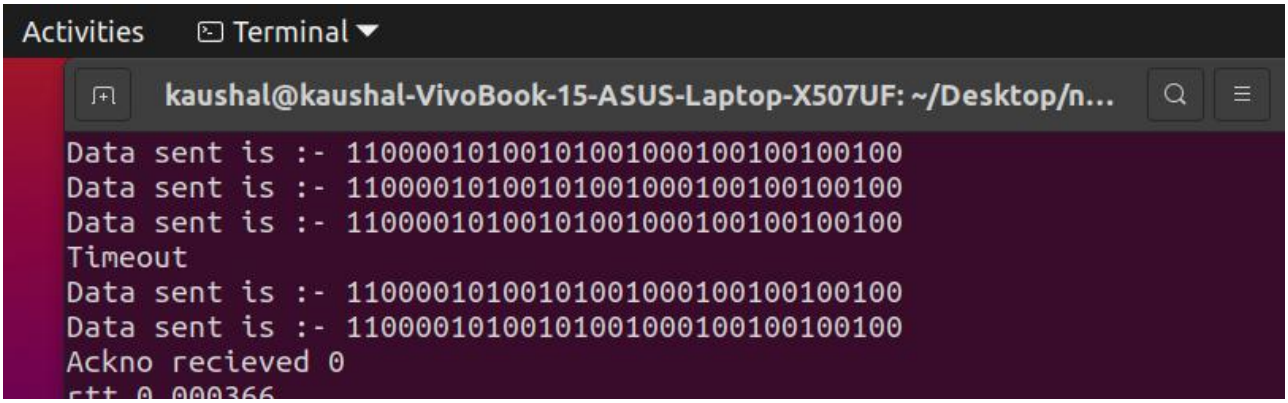
```
Truncdata();
Createframe();
Division();
Crc();
Send(int msgid, mesg_buffer message);
```

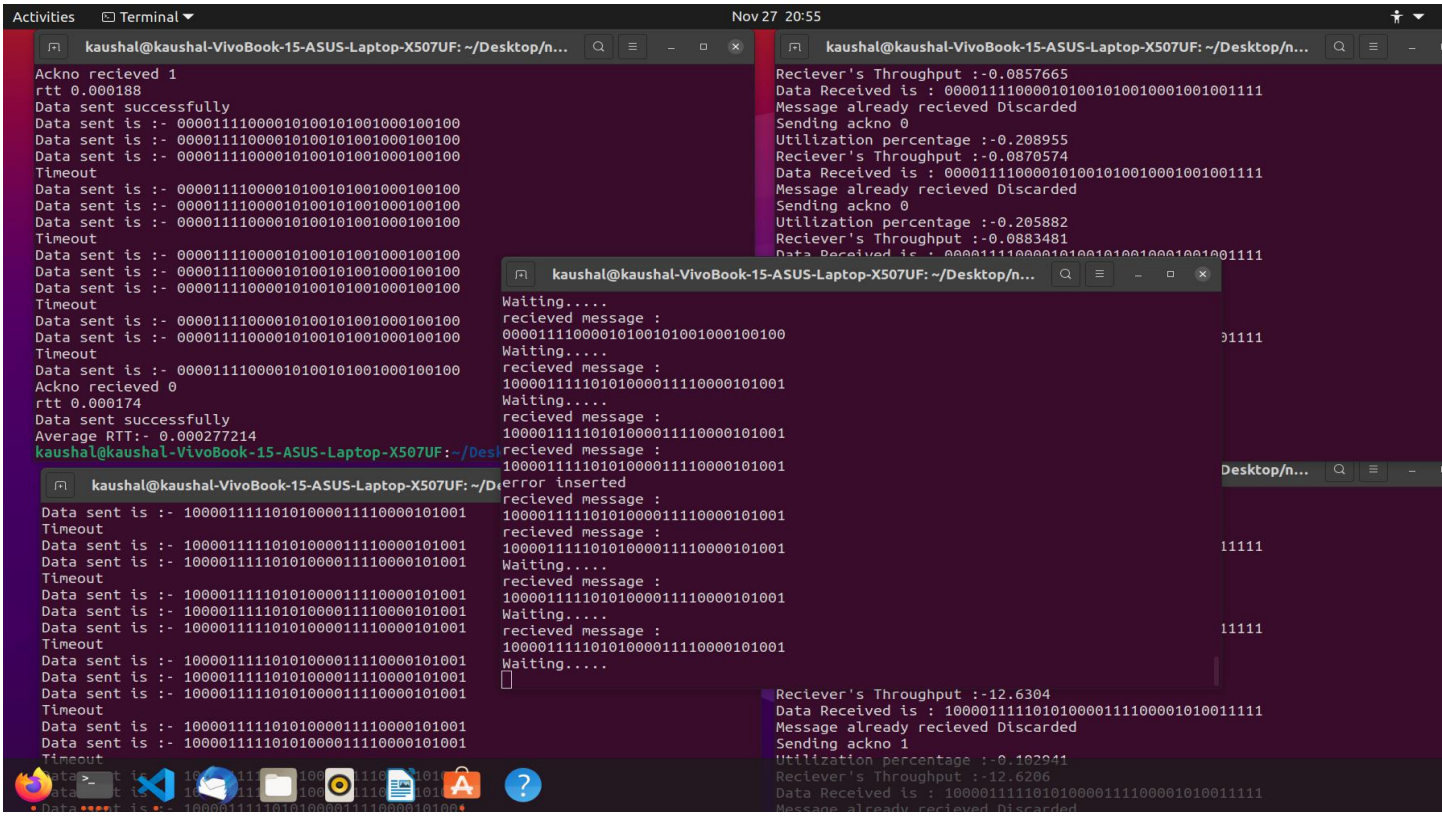
Main();
For channel :-
Inserterror();
Delay();
Main()

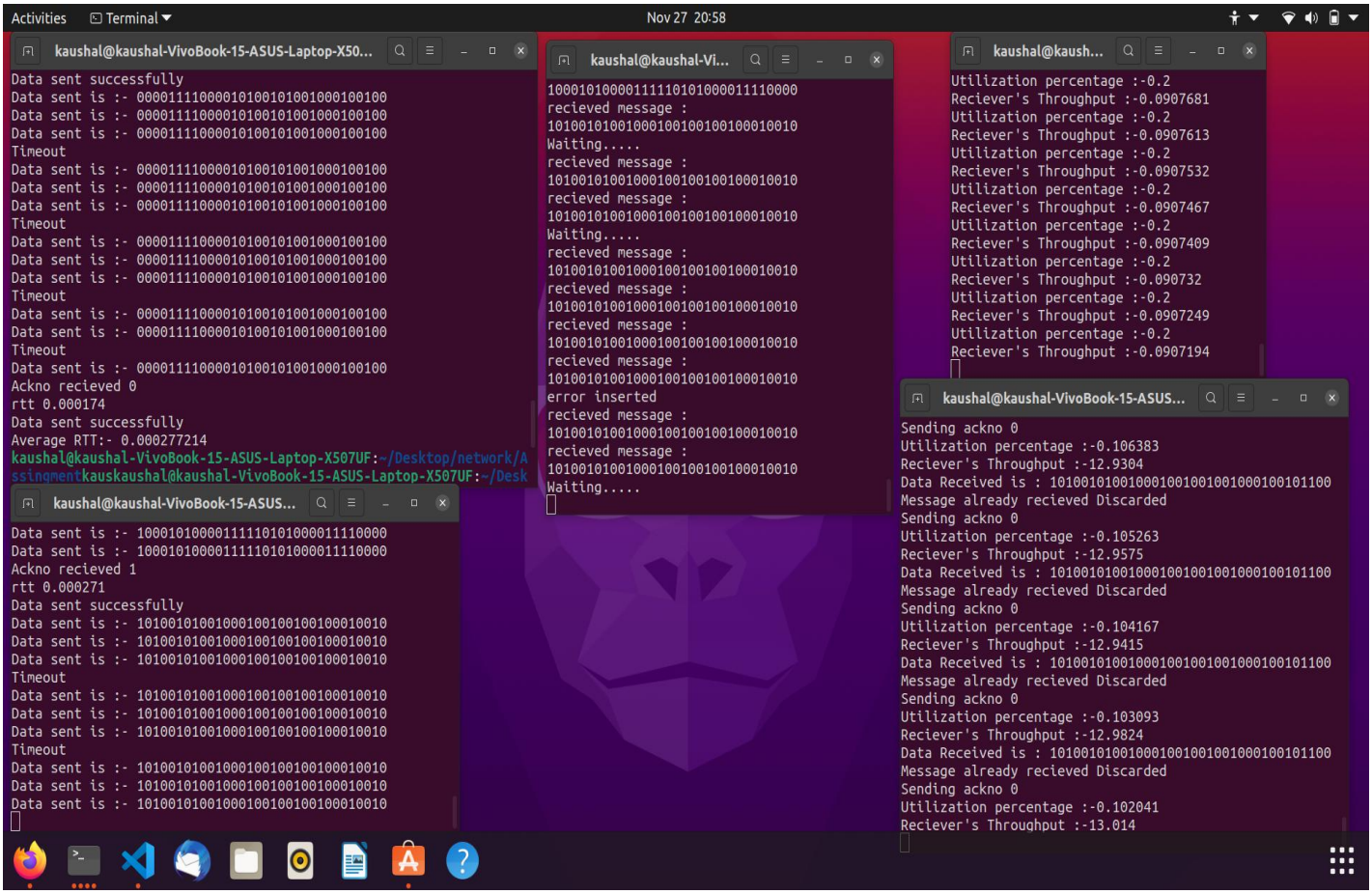
For reciever:-
Division();
Checkcrc();
Sendackno();
Main();

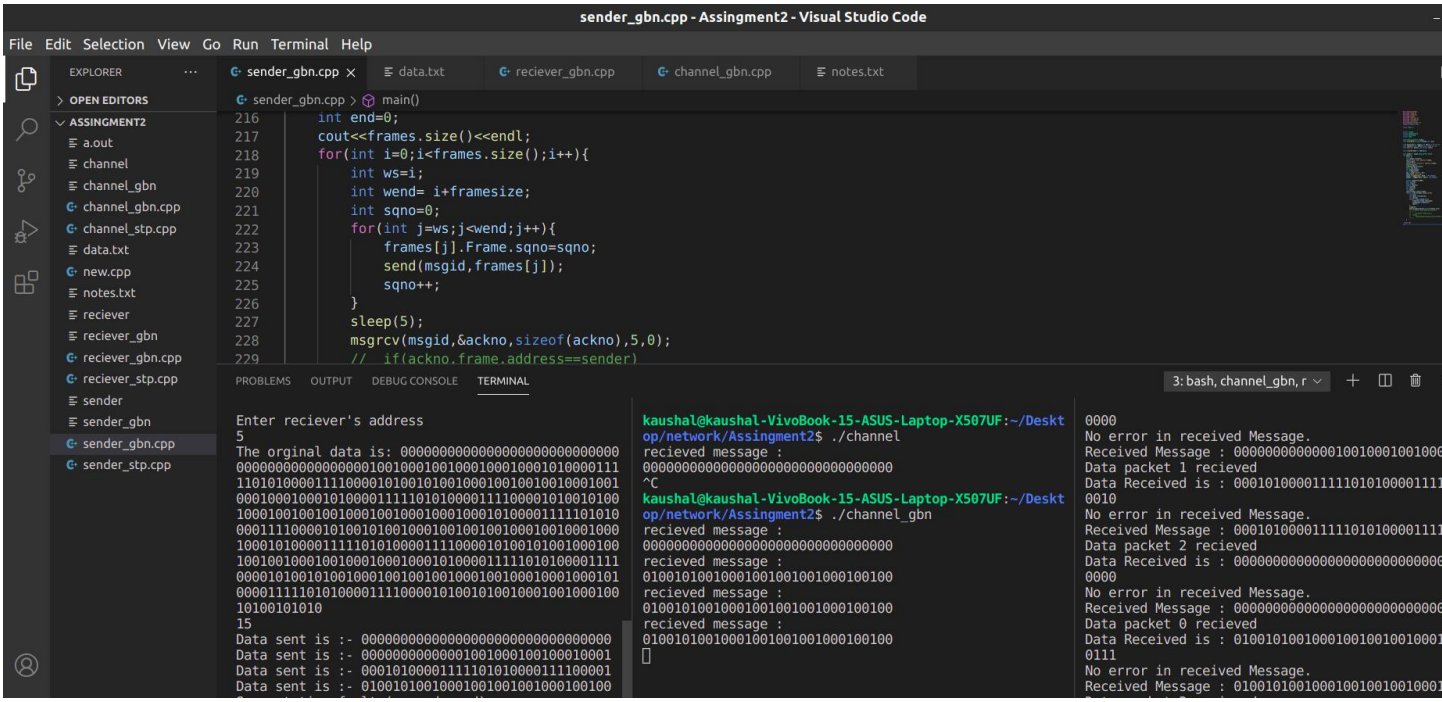
Testcase:-

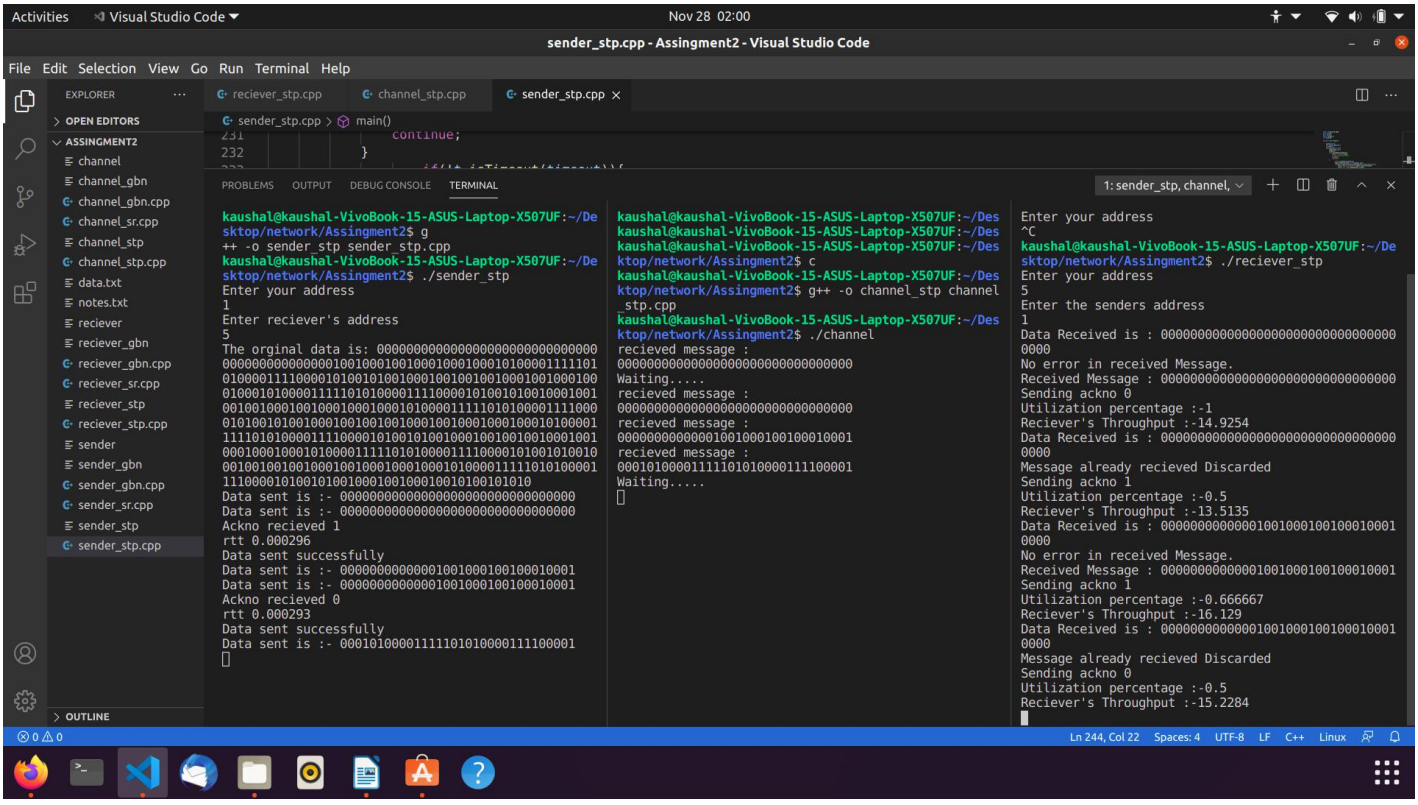

kaushal@kaushal-VivoBook-15-ASUS-Laptop-X507UF: ~/Desktop/n...
recieved message :
00100100100100010010001000100010
recieved message :
10000111110101000011110000101001
error inserted
recieved message :
10000111110101000011110000101001
recieved message :
10000111110101000011110000101001
recieved message :
10000111110101000011110000101001
recieved message :
10000111110101000011110000101001
recieved message :
10000111110101000011110000101001
recieved message :
10000111110101000011110000101001
recieved message :
10000111110101000011110000101001
recieved message :
10000111110101000011110000101001
Waiting.....
Waiting.....

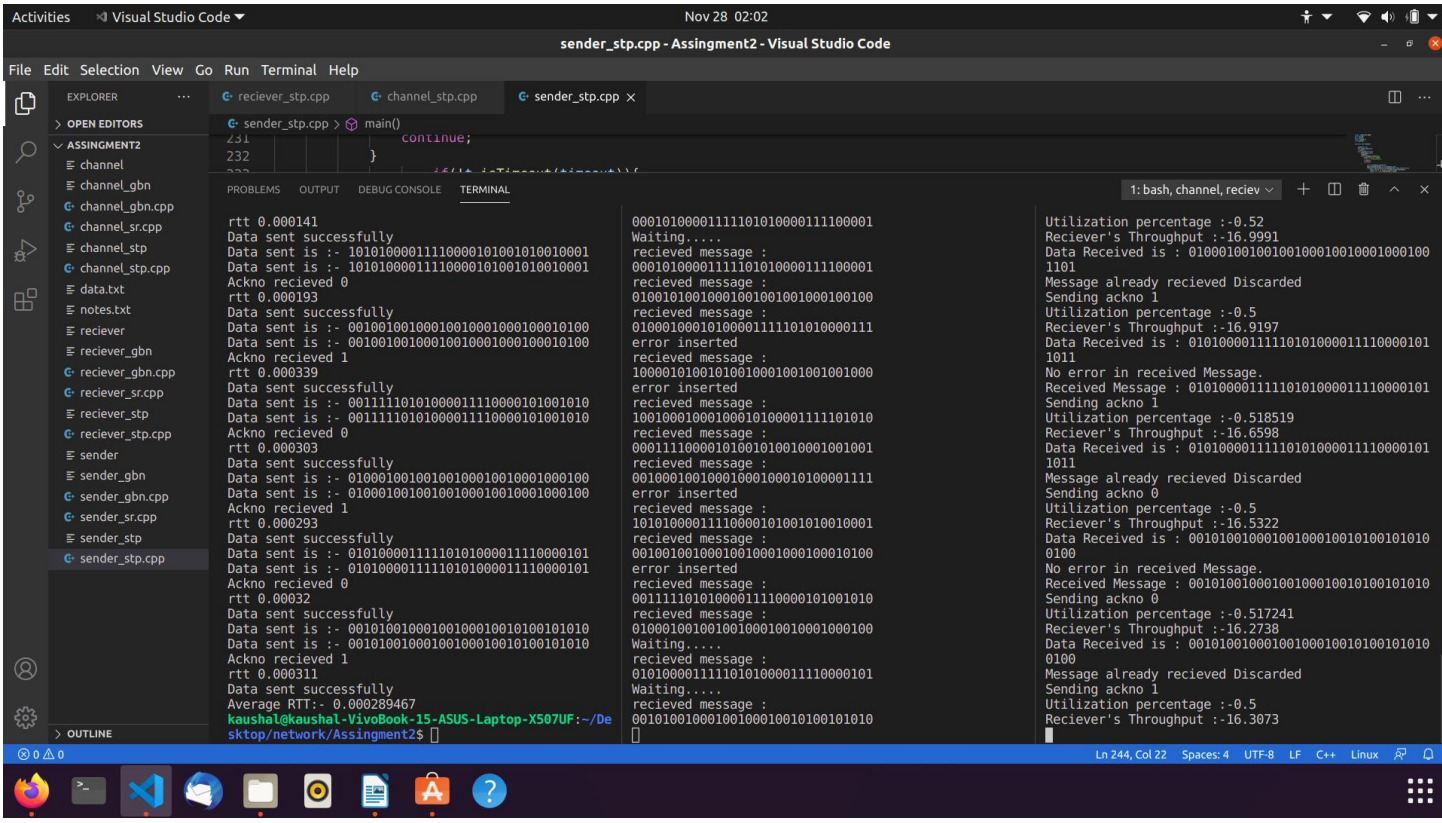

Activities
Terminal
kaushal@kaushal-VivoBook-15-ASUS-Laptop-X507UF: ~/Desktop/n...
Data sent is :- 11000010100101001000100100100100
Data sent is :- 11000010100101001000100100100100
Data sent is :- 11000010100101001000100100100100
Timeout
Data sent is :- 11000010100101001000100100100100
Data sent is :- 11000010100101001000100100100100
Ackno recieved 0


Activities
Terminal
Nov 27 20:55
kaushal@kaushal-VivoBook-15-ASUS-Laptop-X507UF: ~/Desktop/n...
Ackno recieved 1
rtt 0.000188
Data sent successfully
Data sent is :- 0000111100001010010100100010010 0
Data sent is :- 0000111100001010010100100010010 0
Data sent is :- 0000111100001010010100100010010 0
Timeout
Data sent is :- 0000111100001010010100100010010 0
Data sent is :- 0000111100001010010100100010010 0
Data sent is :- 0000111100001010010100100010010 0
Timeout
Data sent is :- 0000111100001010010100100010010 0
Data sent is :- 0000111100001010010100100010010 0
Data sent is :- 0000111100001010010100100010010 0
Timeout
Data sent is :- 0000111100001010010100100010010 0
Data sent is :- 0000111100001010010100100010010 0
Timeout
Data sent is :- 0000111100001010010100100010010 0
Ackno recieved 0
rtt 0.000174
Data sent successfully
Average RTT:- 0.000277214
kaushal@kaushal-VivoBook-15-ASUS-Laptop-X507UF:~/Desk
kaushal@kaushal-VivoBook-15-ASUS-Laptop-X507UF: ~/Desktop/n...
Reciever's Throughput :-0.0857665
Data Received is : 0000111100001010010100100010010011111
Message already recieved Discarded
Sending ackno 0
Utilization percentage :-0.208955
Reciever's Throughput :-0.0870574
Data Received is : 0000111100001010010100100010010011111
Message already recieved Discarded
Sending ackno 0
Utilization percentage :-0.205882
Reciever's Throughput :-0.0883481
kaushal@kaushal-VivoBook-15-ASUS-Laptop-X507UF: ~/Desktop/n...
Waiting.....
recieved message :
0000111100001010010100100010010 0
Waiting.....
recieved message :
1000011111010100001111000010100 1
Waiting.....
recieved message :
1000011111010100001111000010100 1
recieved message :
1000011111010100001111000010100 1
error inserted
recieved message :
1000011111010100001111000010100 1
recieved message :
1000011111010100001111000010100 1
Waiting.....
recieved message :
1000011111010100001111000010100 1
Waiting.....
recieved message :
1000011111010100001111000010100 1
Waiting.....
kaushal@kaushal-VivoBook-15-ASUS-Laptop-X507UF: ~/De
Data sent is :- 1000011111010100001111000010100 1
Timeout
Data sent is :- 1000011111010100001111000010100 1
Data sent is :- 1000011111010100001111000010100 1
Timeout
Data sent is :- 1000011111010100001111000010100 1
Data sent is :- 1000011111010100001111000010100 1
Data sent is :- 1000011111010100001111000010100 1
Timeout
Data sent is :- 1000011111010100001111000010100 1
Data sent is :- 1000011111010100001111000010100 1
Data sent is :- 1000011111010100001111000010100 1
Timeout
Data sent is :- 1000011111010100001111000010100 1
Data sent is :- 1000011111010100001111000010100 1
Timeout
Reciever's Throughput :-12.6304
Data Received is : 1000011111010100001111000010100 11111
Message already recieved Discarded
Sending ackno 1
Utilization percentage :-0.102941
Reciever's Throughput :-12.6206
Data Received is : 1000011111010100001111000010100 11111


Activities
Terminal
Nov 27 20:58
kaushal@kaushal-VivoBook-15-ASUS-Laptop-X50...
Data sent successfully
Data sent is :- 0000111100001010010100100010010 0
Data sent is :- 0000111100001010010100100010010 0
Data sent is :- 0000111100001010010100100010010 0
Timeout
Data sent is :- 0000111100001010010100100010010 0
Data sent is :- 0000111100001010010100100010010 0
Data sent is :- 0000111100001010010100100010010 0
Timeout
Data sent is :- 0000111100001010010100100010010 0
Data sent is :- 0000111100001010010100100010010 0
Data sent is :- 0000111100001010010100100010010 0
Timeout
Data sent is :- 0000111100001010010100100010010 0
Data sent is :- 0000111100001010010100100010010 0
Timeout
Data sent is :- 0000111100001010010100100010010 0
Ackno recieved 0
rtt 0.000174
Data sent successfully
Average RTT:- 0.000277214
kaushal@kaushal-VivoBook-15-ASUS-Laptop-X507UF:~/Desktop/network/Assignment
kauskaushal@kaushal-VivoBook-15-ASUS-Laptop-X507UF:~/Desk
kaushal@kaushal-VivoBook-15-ASUS...
Data sent is :- 1000101000011111010100001111000 0
Data sent is :- 1000101000011111010100001111000 0
Ackno recieved 1
rtt 0.000271
Data sent successfully
Data sent is :- 1010010100100010010010010010010 0
Data sent is :- 1010010100100010010010010010010 0
Data sent is :- 1010010100100010010010010010010 0
Timeout
Data sent is :- 1010010100100010010010010010010 0
Data sent is :- 1010010100100010010010010010010 0
Data sent is :- 1010010100100010010010010010010 0
Timeout
Data sent is :- 1010010100100010010010010010010 0
Data sent is :- 1010010100100010010010010010010 0
Data sent is :- 1010010100100010010010010010010 0
kaushal@kaushal-Vi...
1000101000011111010100001111000 0
recieved message :
1010010100100010010010010010010 0
Waiting.....
recieved message :
1010010100100010010010010010010 0
recieved message :
1010010100100010010010010010010 0
Waiting.....
recieved message :
1010010100100010010010010010010 0
recieved message :
1010010100100010010010010010010 0
recieved message :
1010010100100010010010010010010 0
recieved message :
1010010100100010010010010010010 0
error inserted
recieved message :
1010010100100010010010010010010 0
recieved message :
1010010100100010010010010010010 0
Waiting.....
kaushal@kaush...
Utilization percentage :-0.2
Reciever's Throughput :-0.0907681
Utilization percentage :-0.2
Reciever's Throughput :-0.0907613
Utilization percentage :-0.2
Reciever's Throughput :-0.0907532
Utilization percentage :-0.2
Reciever's Throughput :-0.0907467
Utilization percentage :-0.2
Reciever's Throughput :-0.0907409
Utilization percentage :-0.2
Reciever's Throughput :-0.090732
Utilization percentage :-0.2
Reciever's Throughput :-0.0907249
Utilization percentage :-0.2
Reciever's Throughput :-0.0907194
kaushal@kaushal-VivoBook-15-ASUS...
Sending ackno 0
Utilization percentage :-0.106383
Reciever's Throughput :-12.9304
Data Received is : 1010010100100010010010010001001011 00
Message already recieved Discarded
Sending ackno 0
Utilization percentage :-0.105263
Reciever's Throughput :-12.9575
Data Received is : 1010010100100010010010010001001011 00
Message already recieved Discarded
Sending ackno 0
Utilization percentage :-0.104167
Reciever's Throughput :-12.9415
Data Received is : 1010010100100010010010010001001011 00
Message already recieved Discarded
Sending ackno 0
Utilization percentage :-0.103093
Reciever's Throughput :-12.9824
Data Received is : 1010010100100010010010010001001011 00
Message already recieved Discarded
Sending ackno 0
Utilization percentage :-0.102041
Reciever's Throughput :-13.014


sender_gbn.cpp - Assignment2 - Visual Studio Code
File Edit Selection View Go Run Terminal Help
EXPLORER
OPEN EDITORS
ASSIGNMENT2
a.out
channel
channel_gbn
channel_gbn.cpp
channel_stp.cpp
data.txt
new.cpp
notes.txt
reciever
reciever_gbn
reciever_gbn.cpp
reciever_stp.cpp
sender
sender_gbn
sender_gbn.cpp
sender_stp.cpp
sender_gbn.cpp
data.txt
reciever_gbn.cpp
channel_gbn.cpp
notes.txt
sender_gbn.cpp > main()
int end=0;
cout<<frames.size()<<endl;
for(int i=0;i<frames.size();i++){
int ws=i;
int wend= i+framesize;
int sqno=0;
for(int j=ws;j<wend;j++){
frames[j].Frame.sqno=sqno;
send(msgid,frames[j]);
sqno++;
}
sleep(5);
msgrcv(msgid,&ackno,sizeof(ackno),5,0);
// if(ackno.frame.address==sender)
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
3: bash, channel_gbn, r
Enter reciever's address
5
The orginal data is: 00000000000000000000000000000000
00000000000000000010010001001000100010010100000111
11010100001111000010100101001000100100100100010001
00010001000101000011111010100001111000010100101000
10001001001001000100100010001000100101000011111010
00011110000101001010010001001001000100100010001000
10001010000111110101000011110000101001010010001000
10010010001001000100010001010000111110101000011110
00001010010100100010010010001000100010001000101000
00001111101010000111100001010010100010010001000100
10100101010
15
Data sent is :- 00000000000000000000000000000000
Data sent is :- 00000000000001001000100100010001
Data sent is :- 00010100001111101010000111100001
Data sent is :- 01001010010001001001001000100100
kaushal@kaushal-VivoBook-15-ASUS-Laptop-X507UF:~/Desktop/network/Assingment2$ ./channel
recieved message :
00000000000000000000000000000000
^C
kaushal@kaushal-VivoBook-15-ASUS-Laptop-X507UF:~/Desktop/network/Assingment2$ ./channel_gbn
recieved message :
00000000000000000000000000000000
recieved message :
01001010010001001001001000100100
recieved message :
01001010010001001001001000100100
recieved message :
01001010010001001001001000100100
0000
No error in received Message.
Received Message : 00000000000001001000100100010001
Data packet 1 recieved
Data Received is : 00010100001111101010000111100001
0010
No error in received Message.
Received Message : 00010100001111101010000111100001
Data packet 2 recieved
Data Received is : 00000000000000000000000000000000
0000
No error in received Message.
Received Message : 00000000000000000000000000000000
Data packet 0 recieved
Data Received is : 01001010010001001001001000100100
0111
No error in received Message.
Received Message : 01001010010001001001001000100100


Activities
Visual Studio Code
Nov 28 02:00
sender_stp.cpp - Assingment2 - Visual Studio Code
File Edit Selection View Go Run Terminal Help
EXPLORER
OPEN EDITORS
ASSIGNMENT2
channel
channel_gbn
channel_gbn.cpp
channel_sr.cpp
channel_stp
channel_stp.cpp
data.txt
notes.txt
reciever
reciever_gbn
reciever_gbn.cpp
reciever_sr.cpp
reciever_stp
reciever_stp.cpp
sender
sender_gbn
sender_gbn.cpp
sender_sr.cpp
sender_stp
sender_stp.cpp
reciever_stp.cpp
channel_stp.cpp
sender_stp.cpp
sender_stp.cpp > main()
continue;
}
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
1: sender_stp, channel,
kaushal@kaushal-VivoBook-15-ASUS-Laptop-X507UF:~/Desktop/network/Assingment2$ g
++ -o sender_stp sender_stp.cpp
kaushal@kaushal-VivoBook-15-ASUS-Laptop-X507UF:~/Desktop/network/Assingment2$ ./sender_stp
Enter your address
1
Enter reciever's address
5
The orginal data is: 00000000000000000000000000000000
00000000000000010010001001000100010010100001111101
01000011110000101001010010001001001001000100100100
01000101000011111010100001111000010100101001001001
00100100010010001000100010100001111101010000111100
01010010010001001001001000100100010001001000010001
11110101000011110001010010010001001001010100100010
00010001000101000011111010100001111000010100101001
00100100100100010001000100010100001111101010000111
11100001010010010001001000100101010010100101010
Data sent is :- 00000000000000000000000000000000
Data sent is :- 00000000000000000000000000000000
Ackno recieved 1
rtt 0.000296
Data sent successfully
Data sent is :- 00000000000001001000100100010001
Data sent is :- 00000000000001001000100100010001
Ackno recieved 0
rtt 0.000293
Data sent successfully
Data sent is :- 00010100001111101010000111100001
kaushal@kaushal-VivoBook-15-ASUS-Laptop-X507UF:~/Desktop/network/Assingment2$ c
kaushal@kaushal-VivoBook-15-ASUS-Laptop-X507UF:~/Desktop/network/Assingment2$ g++ -o channel_stp channel_stp.cpp
kaushal@kaushal-VivoBook-15-ASUS-Laptop-X507UF:~/Desktop/network/Assingment2$ ./channel
recieved message :
00000000000000000000000000000000
Waiting.....
recieved message :
00000000000000000000000000000000
recieved message :
00000000000001001000100100010001
recieved message :
00010100001111101010000111100001
Waiting.....
Enter your address
^C
kaushal@kaushal-VivoBook-15-ASUS-Laptop-X507UF:~/Desktop/network/Assingment2$ ./reciever_stp
Enter your address
5
Enter the senders address
1
Data Received is : 00000000000000000000000000000000
0000
No error in received Message.
Received Message : 00000000000000000000000000000000
Sending ackno 0
Utilization percentage :-1
Reciever's Throughput :-14.9254
Data Received is : 00000000000000000000000000000000
0000
Message already recieved Discarded
Sending ackno 1
Utilization percentage :-0.5
Reciever's Throughput :-13.5135
Data Received is : 00000000000001001000100100010001
0000
No error in received Message.
Received Message : 00000000000001001000100100010001
Sending ackno 1
Utilization percentage :-0.666667
Reciever's Throughput :-16.129
Data Received is : 00000000000001001000100100010001
0000
Message already recieved Discarded
Sending ackno 0
Utilization percentage :-0.5
Reciever's Throughput :-15.2284
OUTLINE
Ln 244, Col 22 Spaces: 4 UTF-8 LF C++ Linux



Results:-

The programs performs implementationof flow control techniques correctly and appropriate messages are displayed. The suitable encoded data can be seen in the respective files.Mutiple recievers and sender can send data through one channel . The round trip time, utilization percentage and the through put is calculated. Also the timeout is done when the time exceeds 0.0003s Overall the task is achieved.

Analysis:-

The possible error prone areas are the strict input/output guideline. The disk should have space for “notes.txt” and “data.txt” . Wrong input may lead to exceptions and

program to behave inappropriately. Improvements can be done in synchronization and error handling. Random delays and error are inserted. The avg rtt for stop and wait comes to be 0.00025s. timeout occurs when time exceeds 0.0003s.
Throughput decreases as time increases since the no of erroneous data increases more than correct data packet. Utilization percentage varies between 50 to 20%.

Comment:-

Overall the assignment was tricky and hard to implement Requires good knowledge of IPC . The theory of subject is understood if one implements it and tests for different testcases.