COMP 4985
ASSIGNMENT #2
COMPARING TCP AND UDP OVER WIRED LAN

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Abstract

This report examines protocol statistics of UDP and TCP through by creating an application to handle client/server requests. Due to buffer issues in the TCP implementation of the application, I can only obtain information regarding the transmission of TCP packets at 1024 bytes. Comparing UDP and TCP packet transfers with that much packet size indicates that UDP is faster than TCP.

Introduction

TCP and UDP are two popular protocols that devices today rely on to transmit information. In this study, we are going to examine the throughput of both protocols through the transmission rate, total data transferred, and total packets lost. At the end of this study, we can explain some properties that TCP and UDP and conclude their intended applications.

In order to compare the two protocols, we design a program to handle client and server traffic. One program will serve as a client, and another program will serve as a server. Based on user input parameters, such as packet size, sending frequency, and protocol, the user should be able to send either TCP or UDP over a local area network. The packet statistics will be examined through Wireshark.

Results

Table 1: TCP Data

Packet Size	Frequency	Number of packets received	Initial Time (s)	Final Time (s)	Time (s)
1024	10	10	82.62434	82.67658	0.052241
	100	100	344.627616	345.084365	0.456749
4096	10	N/A	N/A	N/A	N/A
	100	N/A	N/A	N/A	N/A
20000	10	N/A	N/A	N/A	N/A
	100	N/A	N/A	N/A	N/A
60000	10	N/A	N/A	N/A	N/A
	100	N/A	N/A	N/A	N/A

Table 2: UDP Data

Packet Size	Frequency	Number of packets received	Initial Time (s)	Final Time (s)	Time (s)
1024	10	10	61.78278	61.80321	0.020433
	100	100	94.77546	95.00712	0.231663
4096	10	10	23.97233	23.99953	0.027203
	100	100	35.19018	35.43241	0.242225
20000	10	10	45.54247	45.58175	0.03928
	100	100	10.02783	10.41748	0.389646
60000	10	0	0	0	0
	100	0	0	0	0

Table 3 Comparing UDP and TCP Data (1024 bytes)

Packet Size	Frequency	Number of packets received	TCP Transmission Time (s)	UDP Transmission Time (s)	%
1024	10	10	0.052241	0.020433	1.556697
	100	100	0.456749	0.231663	0.97161

Analysis

In UDP, I have trouble receiving packets of 60KB. This might be because of the limitation of UDP, where larger packet sizes seem to decrease the throughput. In Wireshark, the transmission of the packet resulted in a timeout and blocked the server from echoing the packets back to the client.

In TCP, there is a major issue in receiving data beyond 1024 bytes. The problem is not because of the nature of the protocol, but how I designed the application. Most likely a buffer overflow error happened in the program, but I could not locate where that arises. This problem affected me from collecting more data to test the integrity of the TCP protocol.

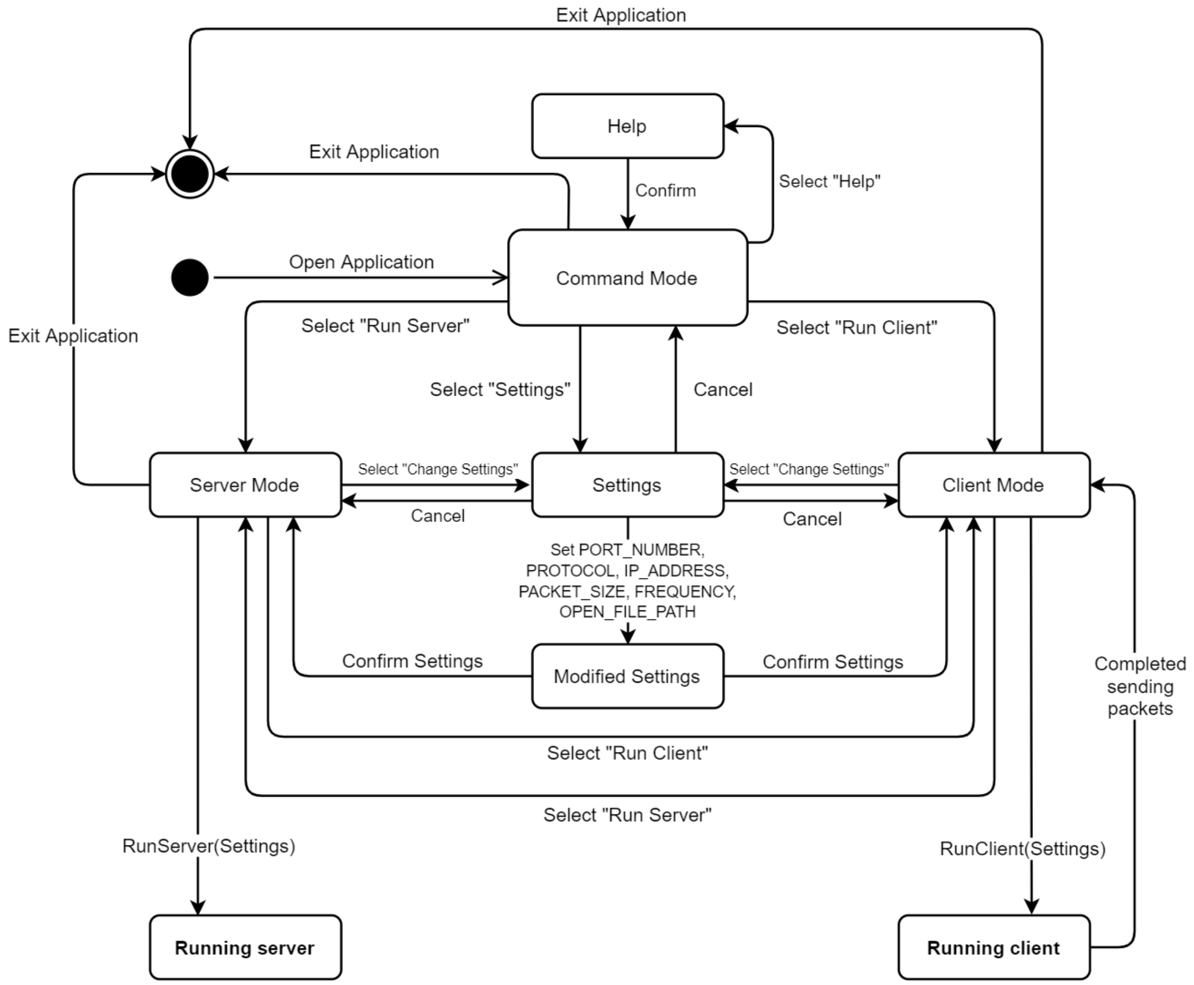
Based on the limited sample sizes, I can only compare the differences between sending 1024 bytes in TCP and UDP. Both TCP and UDP are able to receive the full amount of bytes and packets; however, the transmission speed is different. For both 10 and 100 number times, UDP transmission speed is 1.556697% faster and 0.97161% faster than TCP times respectively.

Conclusion

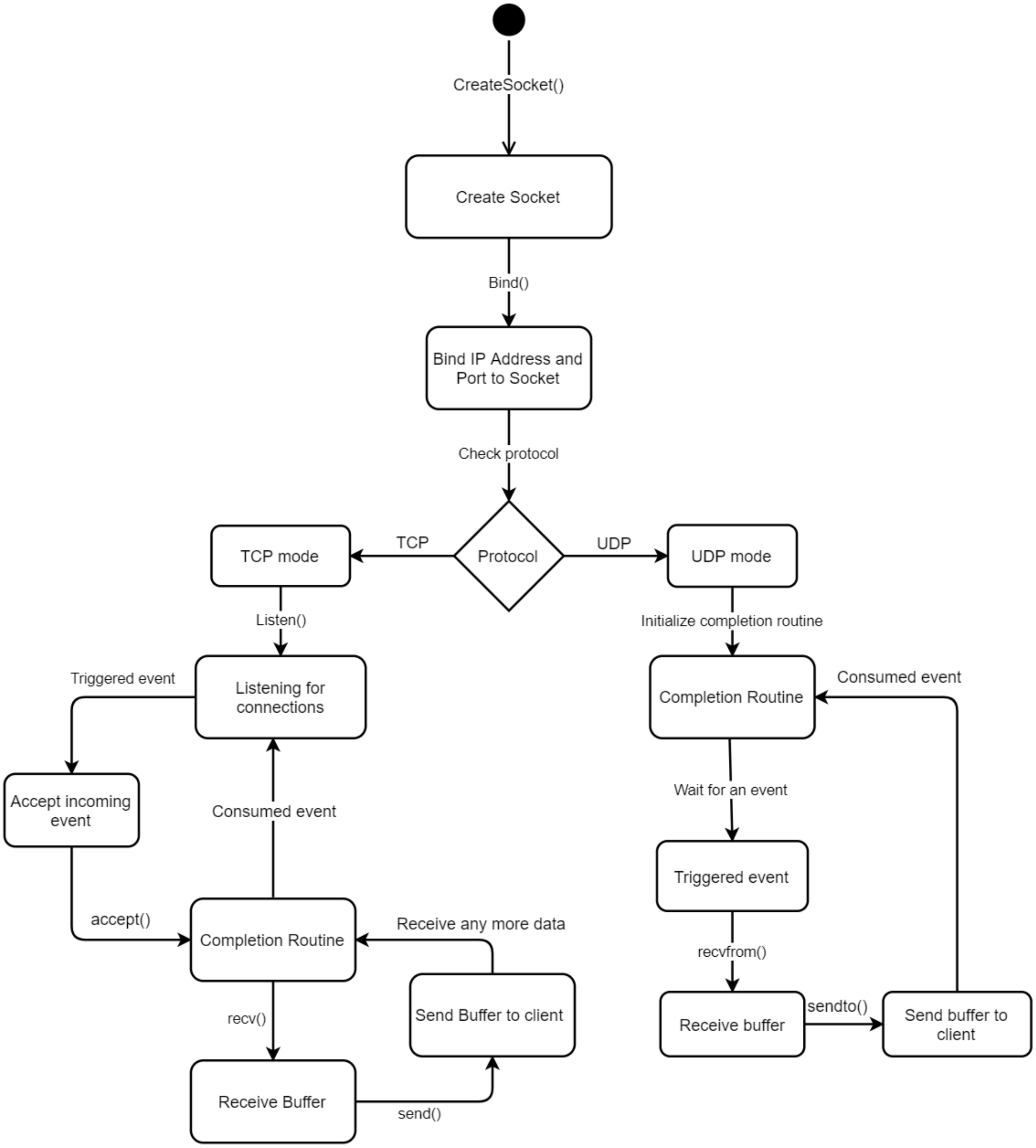
TCP transmission is generally slower than UDP transmission; however, UDP is unreliable at packet sizes of at least 60,000 bytes.

Appendix A: State Transition Diagram

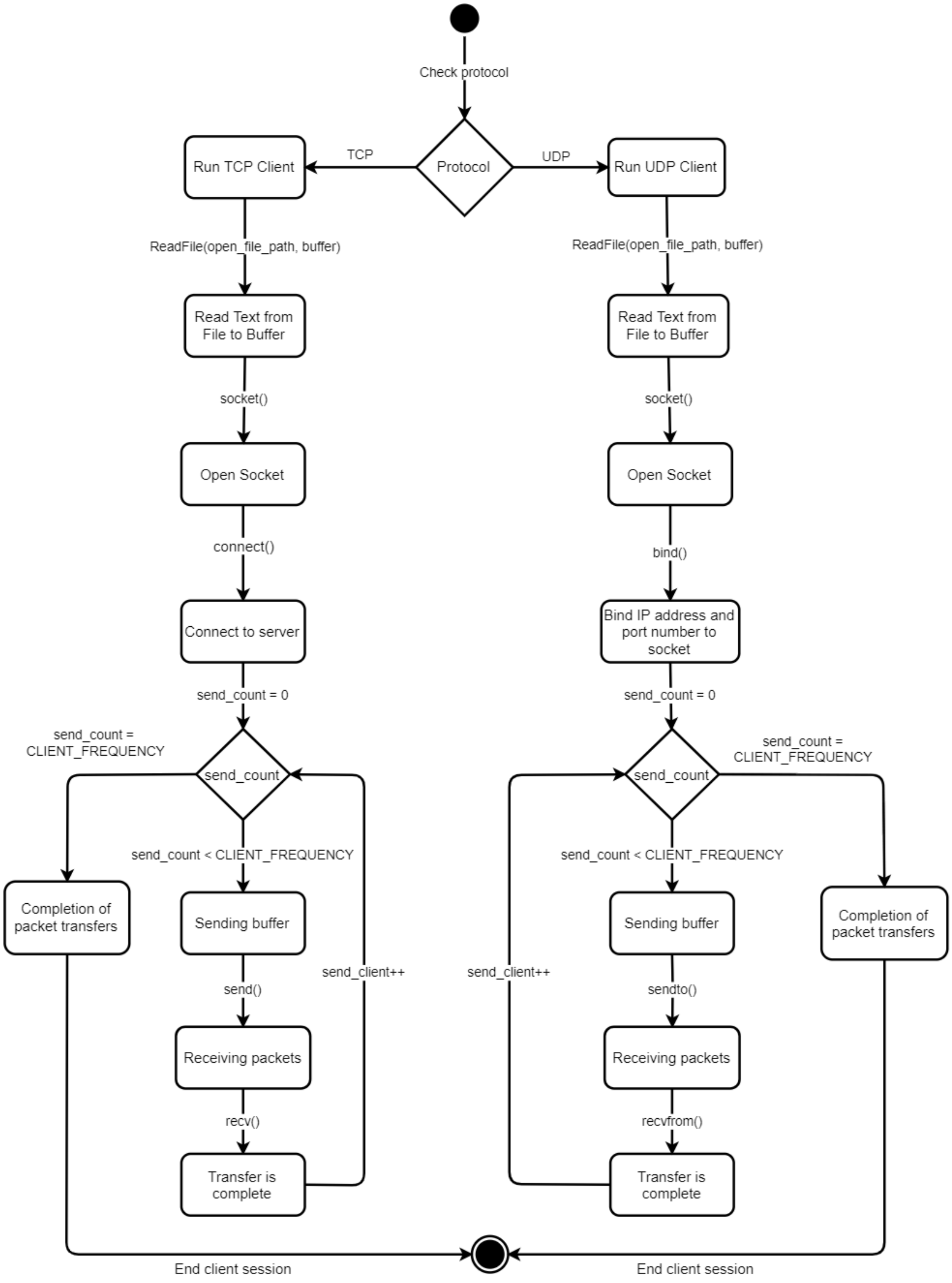
Application View



Running Server View



Running Client View



Appendix B: Pseudocode

Application View Pseudocode

```
Main

{

    Initialize Windows structure

    Fill default connection settings

    Create Main Window

    Create Server child window

    Hide Server child window

    Create Client child window

    Hide Client child window

    Show Main Window

    Update Main window

    Loop messages

        Translate message

        Dispatch message

}
```

MainWindowProc

```
{
     Loop through messages
          If message is a menu
               If ‘Run Server’ is clicked
                    Hide Client child window
                    Show Server child window
               If ‘Run Client’ is clicked
                    Hide Server child window
                    Show Client child window
               If ‘Run Settings’ is clicked
                    Show Settings dialog box
}
```

Server View Pseudocode

RunServer

```
{
    Initialize WinSock
    Create a ListenSocket socket
    Fill IP address and port number to the sockaddr structure
    Bind sockaddr to ListenSocket
    If protocol is TCP
        Output to application that protocol is TCP
        Attach a listener to ListenSocket
        Create an AcceptEvent object
        Create a TCPWorkerThread to handle accepted TCP events
        Loop forever
            Accept ListenSocket and assign its result to
            AcceptSocket
            Set AcceptEvent object

    If protocol is UDP
        Create a UDPWorkerThread to handle accepted UDP events
}
```

TCPWorkerThread

```
{
     Loop forever
          Loop forever
               If program receives an accepted event,
                    Break loop
          Reset Event
          Initialize socket information structure
          Fill accepted socket information
          Call Recv, passing in TCPWorkerRoutine to callback
          task completion
}
```

```
TCPWorkerRoutine
{
    If error in transferring bytes
        Return
    If BytesRECV = 0
        BytesRECV = ByteTransferred
        BytesSEND = 0
    Else
        BytesSEND += BytesTransferred

    If BytesRECV > BytesSEND
        Databuffer = Buffer + BytesSEND
        Bufferlen = BytesRECV – BytesSEND
        Call Send, passing in TCPWorkerRoutine to callback
        task completion
    Else
        BytesRECV = 0
        Call Recv, passing in TCPWorkerRoutine to callback
        task completion

    If BytesRECV > 0
        Get BytesRECV
        Output to application about number of bytes received
}
```

```
UDPWorkerThread

{

    Initialize socket information structure

    Fill socket information structure

    Loop forever

        Call Reform

        If Reform is pending

            Wait for overlapped events

            If there is an overlapped event,

                Output to application about number of bytes
                received

                Call SendTo to client

}
```

Client View Pseudocode

```
RunClient
{

    Clear output application messages

    If protocol is TCP

        Create TCPClient thread to handle data transfers

    If protocol is UDP

        Create UDPClient thread to handle data transfers

}
```

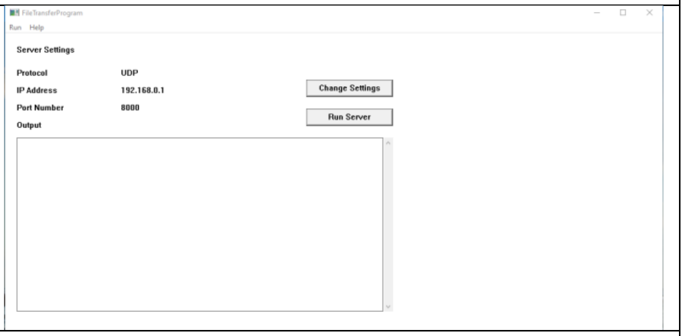
TCPClient

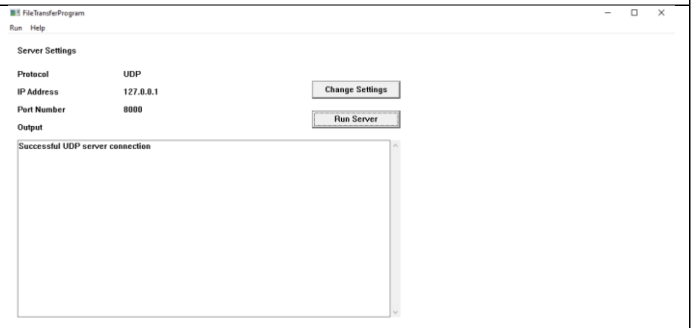
```
{
    Initialize buffer to send
    Read from file path and store contents in buffer
    Initialize WinSock
    Open Socket
    Fill IP address and port number to sockaddr structure
    Connect to server
    Output successful connection message to application
    Output buffer message to application
    Output sending packet size to application
    Get CLIENT_FREQUENCY from settings
    Set count to 0
    Loop CLIENT_FREQUENCY times
        Call Send to send buffer to socket
        Initialize buffer to receive
        While socket is receiving
            Call Recv to store receiving data to buffer
    Increment count
    Output count number of successful packets sent to application
}
```

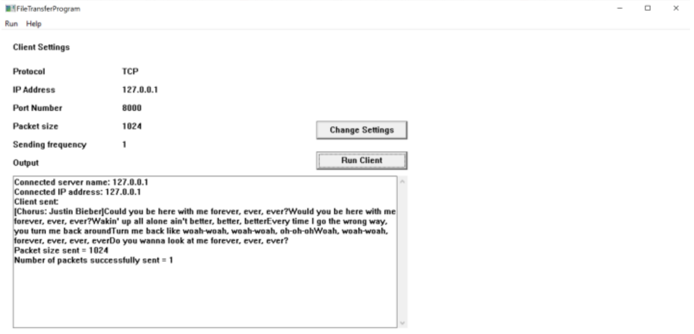
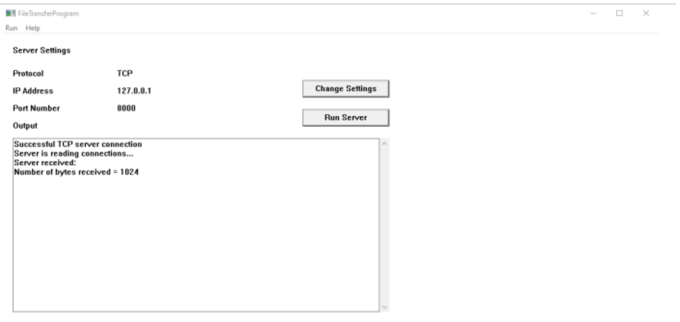
UDPClient

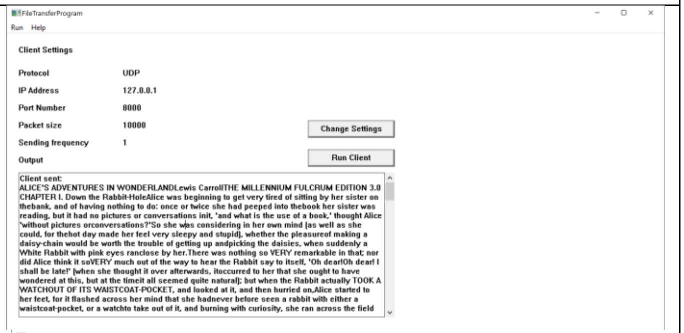
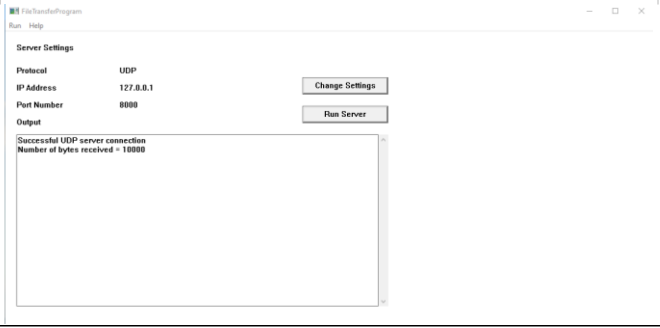
```
{
    Initialize buffer to send
    Read from file path and store contents in buffer
    Initialize WinSock
    Open Socket
    Fill IP address and port number to sockaddr structure
    Bind sockaddr to socket
    Output successful connection message to application
    Output buffer message to application
    Output sending packet size to application
    Get CLIENT_FREQUENCY from settings
    Set count to 0
    Loop CLIENT_FREQUENCY times
        Call SendTo to send buffer to socket
        Initialize buffer to receive data
        Call RecvFrom to store receiving data to buffer
        Increment count
    Output count number of successful packets sent to
    application
}
```

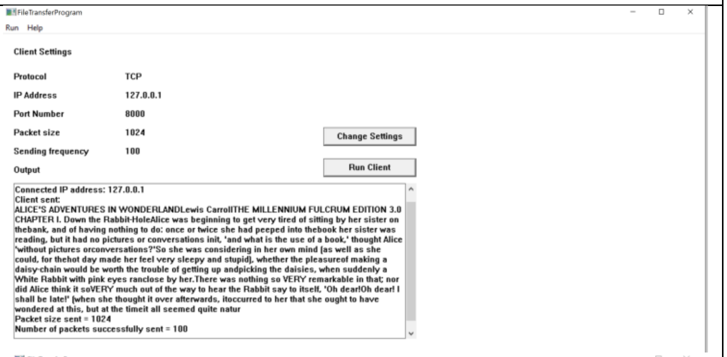
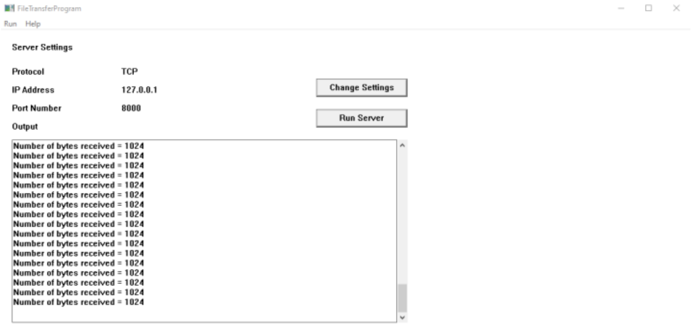
Appendix C: Test Cases

Test Case #1	Setting information on server window
Procedure	[Run] >> [Run Server] >> [Change Settings] >> Change IP Address from 127.0.0.1 to 192.168.0.1 >> [OK]
Expectation	You should see the updated IP Address on the server window
Screenshot	 Server Settings Protocol UDP IP Address 192.168.0.1 Port Number 8000 Output
Result	IP Address now reads 192.168.0.1
Test Passed?	Yes

Test Case #2	Running a UDP server to localhost
Procedure	[Run] >> [Run Server] >> [Run Server]
Expectation	You should see a message to confirm server connection.
Screenshot	 Server Settings Protocol UDP IP Address 127.0.0.1 Port Number 8000 Output Successful UDP server connection
Result	Message output, “Successful UDP server connection”
Test Passed?	Yes

Test Case #3	Running a TCP client on localhost
Procedure	Assuming that a TCP server is connected to localhost, [Run] >> [Run Client] >> [Change Settings] >> Check “TCP” >> Open a file >> [OK] >> [Run Client]
Expectation	On the client, the user should see that the file content has been sent to the server. On the server, the user should see that the number of bytes received is the same as the packet size sent.
Screenshot	 FileTransferProgram Run Help Change Settings Run Client Client Settings Protocol TCP IP Address 127.0.0.1 Port Number 8000 Packet size 1024 Sending frequency 1 Output Connected server name: 127.0.0.1 Connected IP address: 127.0.0.1 Client sent: [Chorus: Justin Bieber]Could you be here with me forever, ever, ever?Would you be here with me forever, ever, ever?Wakin' up all alone ain't better, better, betterEvery time I go the wrong way, you turn me back aroundTurn me back like woah-woah, woah-woah, oh-oh-ohWoah, woah-woah, forever, ever, ever, everDo you wanna look at me forever, ever, ever? Packet size sent = 1024 Number of packets successfully sent = 1  FileTransferProgram Run Help Change Settings Run Server Server Settings Protocol TCP IP Address 127.0.0.1 Port Number 8000 Output Successful TCP server connection Server is reading connections... Server received: Number of bytes received = 1024
Result	Server outputs information when client sends a message.
Test Passed?	Yes.

Test Case #4	Sending a 10,000 byte datagram on UDP through localhost
Procedure	Assuming that a UDP server is connected to localhost, [Run] >> [Run Client] >> [Change Settings] >> Open a file >> Change "Client Packet Size" to 10,000 >> [OK] >> [Run Client]
Expectation	On the client, the user should see that the file content has been sent to the server. On the server, the user should see that the number of bytes received is the same as the packet size sent. The file used in this example is the first 10,000 byte text from the story, Alice in Wonderland.
Screenshot	 FileTransferProgram Run Help Change Settings Run Client Client Settings Protocol UDP IP Address 127.0.0.1 Port Number 8000 Packet size 10000 Sending frequency 1 Output Client sent: ALICE'S ADVENTURES IN WONDERLANDLewis CarrollTHE MILLENNIUM FULCRUM EDITION 3.0 CHAPTER I. Down the Rabbit-HoleAlice was beginning to get very tired of sitting by her sister on thebank, and of having nothing to do: once or twice she had peeped into thebook her sister was reading, but it had no pictures or conversations init, 'and what is the use of a book,' thought Alice 'without pictures orconversations?'So she was considering in her own mind (as well as she could, for thehot day made her feel very sleepy and stupid), whether the pleasureof making a daisy-chain would be worth the trouble of getting up andpicking the daisies, when suddenly a White Rabbit with pink eyes ranclose by her.There was nothing so VERY remarkable in that; nor did Alice think it soVERY much out of the way to hear the Rabbit say to itself, 'Oh dear!Oh dear! I shall be late!' (when she thought it over afterwards, itoccurred to her that she ought to have wondered at this, but at the timeit all seemed quite natural); but when the Rabbit actually TOOK A WATCHOUT OF ITS WAISTCOAT-POCKET, and looked at it, and then hurried on,Alice started to her feet, for it flashed across her mind that she hadnever before seen a rabbit with either a waistcoat-pocket, or a watchto take out of it, and burning with curiosity, she ran across the field  FileTransferProgram Run Help Change Settings Run Server Server Settings Protocol UDP IP Address 127.0.0.1 Port Number 8000 Output Successful UDP server connection Number of bytes received = 10000
Result	Server outputs information when client sends a message.
Test Passed?	Yes.

Test Case #5	Sending 100 packets of size 1024 bytes through TCP
Procedure	Assuming that a TCP server is connected to localhost, [Run] >> [Run Client] >> [Change Settings] >> Open a file >> Change “Client Send Frequency” to 100 >> Check “TCP” >> [OK] >> [Run Client]
Expectation	On the client, the user should see that the file content has been sent to the server. On the server, the user should see that the number of bytes received is the same as the packet size sent. Since there were 100 packets sent, the server displays a message for each packet.The file used in this example is the first 1024 byte text from the story, Alice in Wonderland.
Screenshot	 FileTransferProgram Run Help Change Settings Run Client Client Settings Protocol TCP IP Address 127.0.0.1 Port Number 8000 Packet size 1024 Sending frequency 100 Output Connected IP address: 127.0.0.1 Client sent: ALICE'S ADVENTURES IN WONDERLANDLewis CarrollTHE MILLENNIUM FULCRUM EDITION 3.0 CHAPTER I. Down the Rabbit-HoleAlice was beginning to get very tired of sitting by her sister on thebank, and of having nothing to do: once or twice she had peeped into thebook her sister was reading, but it had no pictures or conversations init, 'and what is the use of a book,' thought Alice 'without pictures orconversations?'So she was considering in her own mind (as well as she could, for thehot day made her feel very sleepy and stupid), whether the pleasureof making a daisy-chain would be worth the trouble of getting up andpicking the daisies, when suddenly a White Rabbit with pink eyes ranclose by her.There was nothing so VERY remarkable in that; nor did Alice think it soVERY much out of the way to hear the Rabbit say to itself, 'Oh dear!Oh dear! I shall be late!' (when she thought it over afterwards, itoccurred to her that she ought to have wondered at this, but at the timeit all seemed quite natur Packet size sent = 1024 Number of packets successfully sent = 100  FileTransferProgram Run Help Change Settings Run Server Server Settings Protocol TCP IP Address 127.0.0.1 Port Number 8000 Output Number of bytes received = 1024 Number of bytes received = 1024 Number of bytes received = 1024 Number of bytes received = 1024 Number of bytes received = 1024 Number of bytes received = 1024 Number of bytes received = 1024 Number of bytes received = 1024 Number of bytes received = 1024 Number of bytes received = 1024 Number of bytes received = 1024 Number of bytes received = 1024 Number of bytes received = 1024 Number of bytes received = 1024 Number of bytes received = 1024 Number of bytes received = 1024 Number of bytes received = 1024
Result	On the client view, the user sees that all 100 packets of size 1024 bytes are successfully sent and echoed back. On the server view, the user sees a message for each client.
Test Passed?	Yes