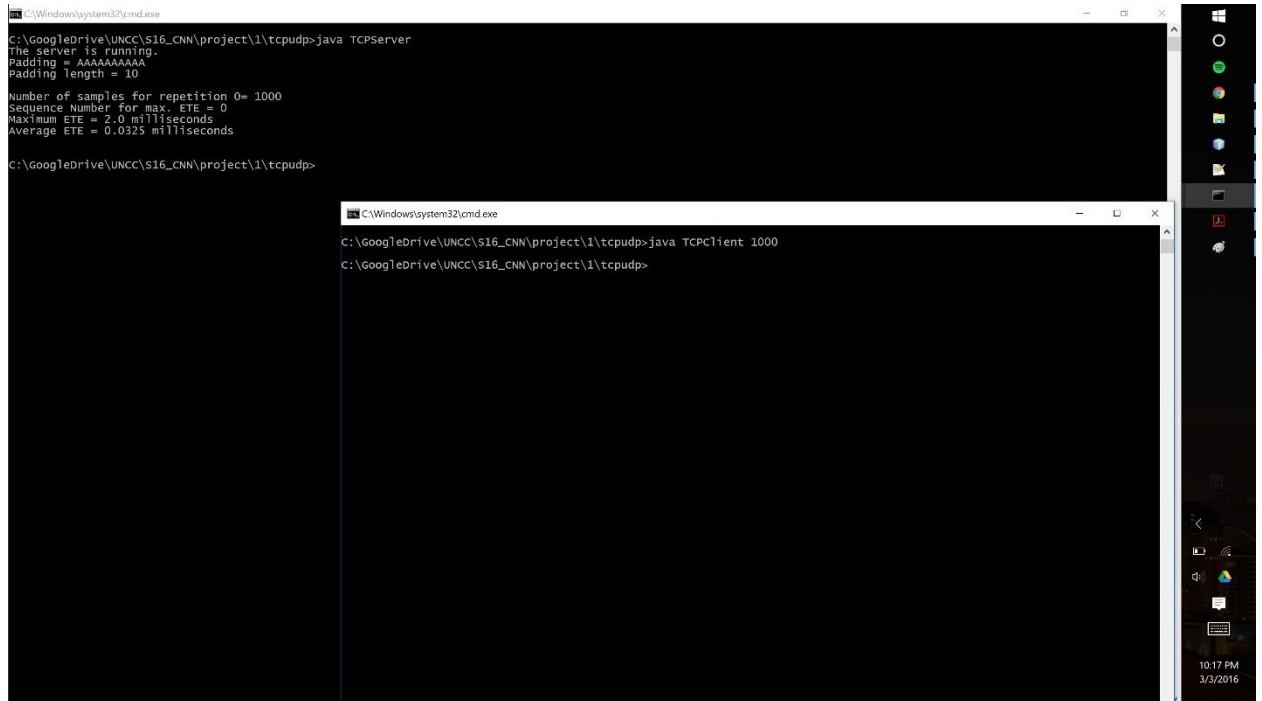


Part 2 : UDP vs TCP Performance Evaluation:

TCP:

1. Padding length = 10,
Repetitions = 1

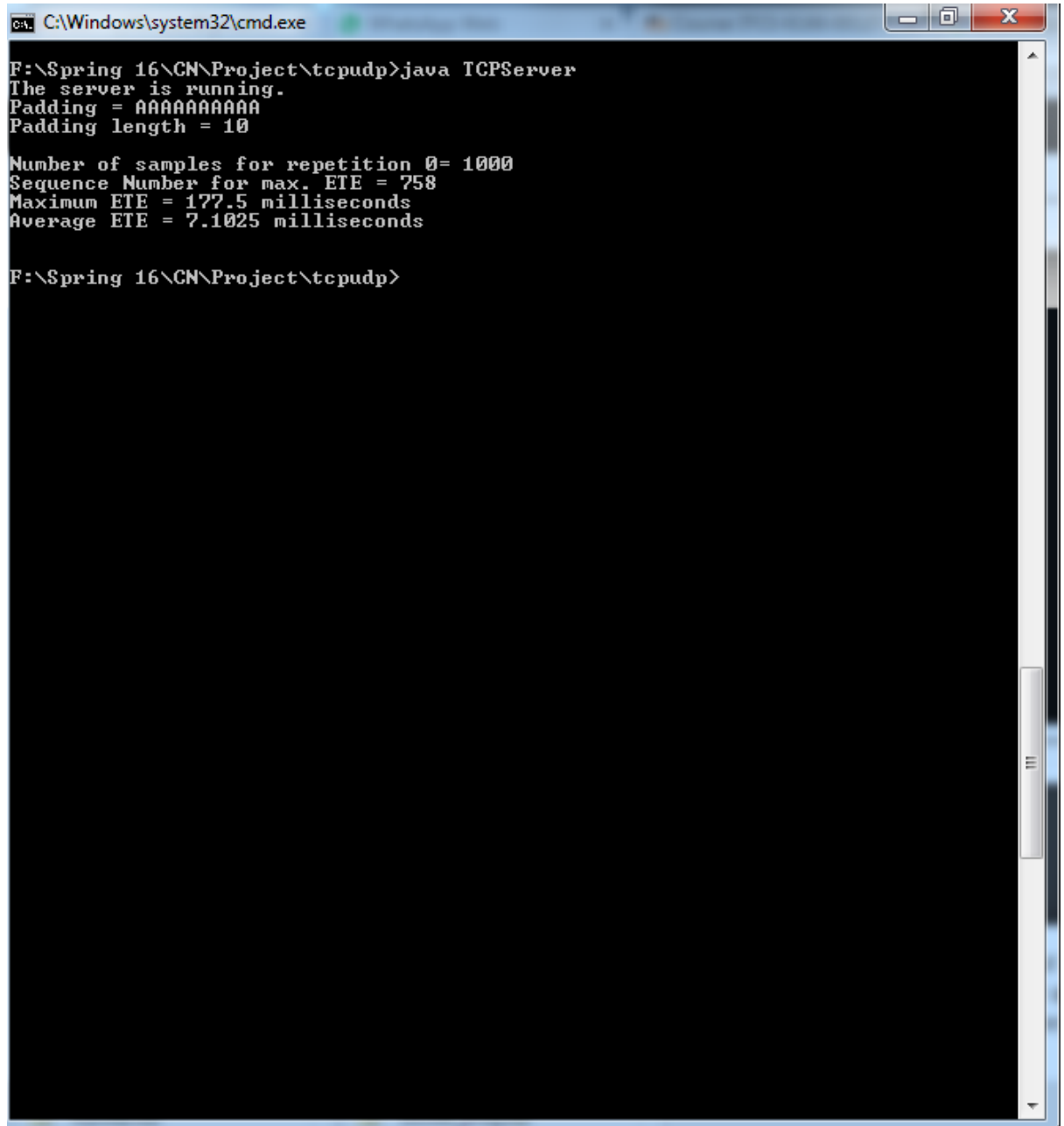


The screenshot shows two overlapping Windows command prompt windows. The top window is titled 'C:\Windows\system32\cmd.exe' and displays the output of running 'java TCPServer'. The output indicates the server is running with a padding length of 10 and shows performance metrics for 1000 samples. The bottom window is also titled 'C:\Windows\system32\cmd.exe' and shows the output of running 'java TCPClient 1000', which appears to be waiting for a response from the server.

```
C:\Windows\system32\cmd.exe
C:\GoogleDrive\UNCC\S16_CNN\project\1\tcpudp>java TCPServer
The server is running.
Padding = AAAAAAAAAA
Padding length = 10
Number of samples for repetition 0= 1000
Sequence Number for max. ETE = 0
Maximum ETE = 2.0 milliseconds
Average ETE = 0.0325 milliseconds
C:\GoogleDrive\UNCC\S16_CNN\project\1\tcpudp>
```

```
C:\Windows\system32\cmd.exe
C:\GoogleDrive\UNCC\S16_CNN\project\1\tcpudp>java TCPClient 1000
C:\GoogleDrive\UNCC\S16_CNN\project\1\tcpudp>
```

10:17 PM
3/3/2016



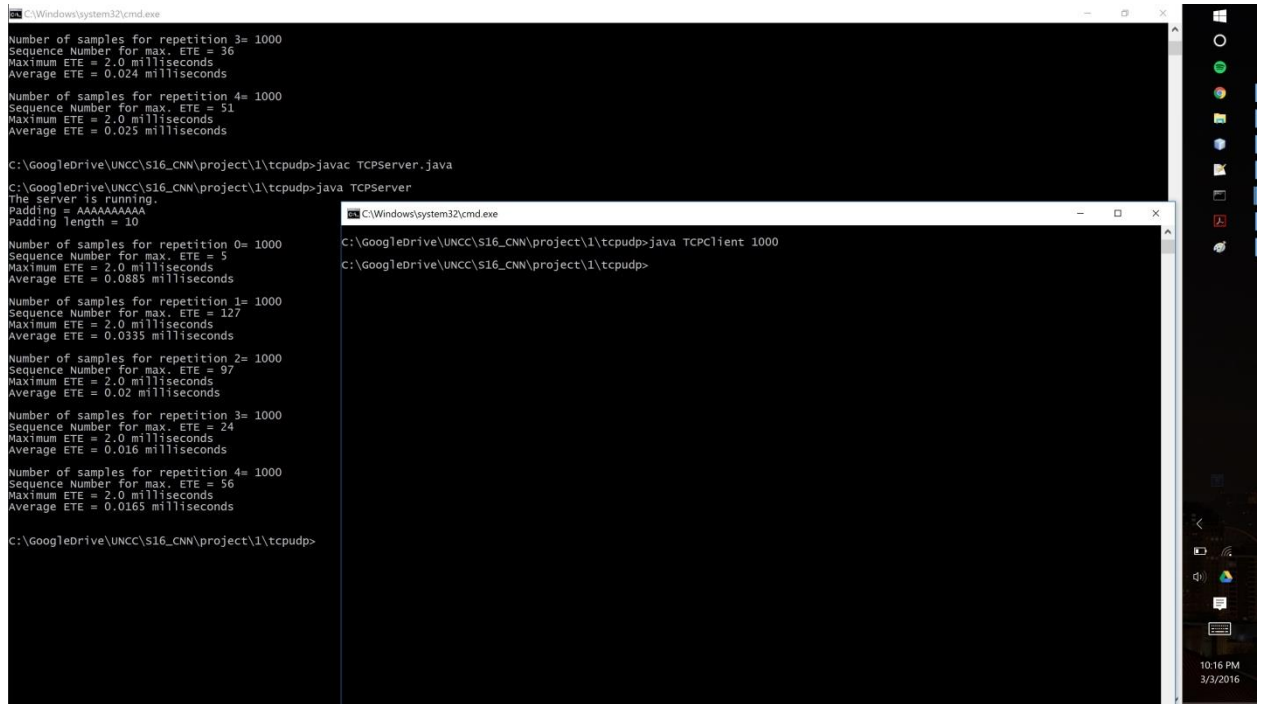
```
C:\Windows\system32\cmd.exe

F:\Spring 16\CN\Project\tcpudp>java TCPServer
The server is running.
Padding = AAAAAAAAAAAA
Padding length = 10

Number of samples for repetition 0= 1000
Sequence Number for max. ETE = 758
Maximum ETE = 177.5 milliseconds
Average ETE = 7.1025 milliseconds

F:\Spring 16\CN\Project\tcpudp>
```

2. Padding length = 10,
Repetitions = 5



The screenshot shows two overlapping Windows command prompt windows. The background window is titled 'C:\Windows\system32\cmd.exe' and shows the compilation and execution of a Java TCP server. The foreground window is also titled 'C:\Windows\system32\cmd.exe' and shows the execution of a Java TCP client.

```
C:\Windows\system32\cmd.exe
Number of samples for repetition 3= 1000
Sequence Number for max. ETE = 36
Maximum ETE = 2.0 milliseconds
Average ETE = 0.024 milliseconds
Number of samples for repetition 4= 1000
Sequence Number for max. ETE = 51
Maximum ETE = 2.0 milliseconds
Average ETE = 0.025 milliseconds

C:\GoogleDrive\UNCC\S16_CNN\project\1\tcpudp>javac TCPServer.java
C:\GoogleDrive\UNCC\S16_CNN\project\1\tcpudp>java TCPServer
The server is running.
Padding = AAAAAAAAAA
padding length = 10

Number of samples for repetition 0= 1000
Sequence Number for max. ETE = 5
Maximum ETE = 2.0 milliseconds
Average ETE = 0.0885 milliseconds
Number of samples for repetition 1= 1000
Sequence Number for max. ETE = 127
Maximum ETE = 2.0 milliseconds
Average ETE = 0.0335 milliseconds
Number of samples for repetition 2= 1000
Sequence Number for max. ETE = 97
Maximum ETE = 2.0 milliseconds
Average ETE = 0.02 milliseconds
Number of samples for repetition 3= 1000
Sequence Number for max. ETE = 24
Maximum ETE = 2.0 milliseconds
Average ETE = 0.016 milliseconds
Number of samples for repetition 4= 1000
Sequence Number for max. ETE = 56
Maximum ETE = 2.0 milliseconds
Average ETE = 0.0165 milliseconds

C:\GoogleDrive\UNCC\S16_CNN\project\1\tcpudp>
```

```
C:\Windows\system32\cmd.exe
C:\GoogleDrive\UNCC\S16_CNN\project\1\tcpudp>java TCPClient 1000
C:\GoogleDrive\UNCC\S16_CNN\project\1\tcpudp>
```

```
C:\Windows\system32\cmd.exe
F:\Spring 16\CN\Project\tcpudp>java TCPServer
The server is running.
Padding = AAAAAAAAAAAA
Padding length = 10

Number of samples for repetition 0= 1000
Sequence Number for max. ETE = 758
Maximum ETE = 177.5 milliseconds
Average ETE = 7.1025 milliseconds

F:\Spring 16\CN\Project\tcpudp>javac TCPServer.java

F:\Spring 16\CN\Project\tcpudp>java TCPServer
The server is running.
Padding = AAAAAAAAAAAA
Padding length = 10

Number of samples for repetition 0= 1000
Sequence Number for max. ETE = 218
Maximum ETE = 159.0 milliseconds
Average ETE = 4.3285 milliseconds

Number of samples for repetition 1= 1000
Sequence Number for max. ETE = 504
Maximum ETE = 162.0 milliseconds
Average ETE = 4.325 milliseconds

Number of samples for repetition 2= 1000
Sequence Number for max. ETE = 524
Maximum ETE = 222.5 milliseconds
Average ETE = 4.1875 milliseconds

Number of samples for repetition 3= 1000
Sequence Number for max. ETE = 36
Maximum ETE = 159.5 milliseconds
Average ETE = 3.4255 milliseconds

Number of samples for repetition 4= 1000
Sequence Number for max. ETE = 86
Maximum ETE = 152.0 milliseconds
Average ETE = 3.36 milliseconds

F:\Spring 16\CN\Project\tcpudp>_
```

3. Padding length = 200,
Repetitions = 5

The screenshot displays two overlapping Windows Command Prompt windows. The background window, titled "C:\Windows\system32\cmd.exe", shows the execution of a Java program. It starts by running "javac TCPserver.java" and then "java TCPserver". The output indicates the server is running with a padding length of 200. It then performs five repetitions of sample collection, each with 1000 samples. The results for each repetition are as follows:

Repetition	Sequence Number for max. ETE	Maximum ETE	Average ETE
0	0	2.0 milliseconds	0.0475 milliseconds
1	26	2.0 milliseconds	0.03 milliseconds
2	27	2.0 milliseconds	0.024 milliseconds
3	36	2.0 milliseconds	0.024 milliseconds
4	51	2.0 milliseconds	0.025 milliseconds

The foreground window, also titled "C:\Windows\system32\cmd.exe", shows the execution of "TCPClient 1000".

C:\GoogleDrive\UNCC\S16_CNN\project\l\tcpudp>javac TCPserver.java
C:\GoogleDrive\UNCC\S16_CNN\project\l\tcpudp>java TCPserver
The server is running.
Padding = AA
AA
Padding Length = 200

Number of samples for repetition 0= 1000
Sequence Number for max. ETE = 0
Maximum ETE = 2.0 milliseconds
Average ETE = 0.0475 milliseconds

Number of samples for repetition 1= 1000
Sequence Number for max. ETE = 26
Maximum ETE = 2.0 milliseconds
Average ETE = 0.03 milliseconds

Number of samples for repetition 2= 1000
Sequence Number for max. ETE = 27
Maximum ETE = 2.0 milliseconds
Average ETE = 0.024 milliseconds

Number of samples for repetition 3= 1000
Sequence Number for max. ETE = 36
Maximum ETE = 2.0 milliseconds
Average ETE = 0.024 milliseconds

Number of samples for repetition 4= 1000
Sequence Number for max. ETE = 51
Maximum ETE = 2.0 milliseconds
Average ETE = 0.025 milliseconds

C:\GoogleDrive\UNCC\S16_CNN\project\l\tcpudp>

C:\Windows\system32\cmd.exe
C:\GoogleDrive\UNCC\S16_CNN\project\l\tcpudp>java TCPClient 1000
C:\GoogleDrive\UNCC\S16_CNN\project\l\tcpudp>

4. Padding length = 1000,
Repetitions = 5

```
C:\Windows\system32\cmd.exe
C:\GoogleDrive\UNCC\S16_CNN\project\l\tcpudp>java TCPServer
File server is running.
padding = AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
padding length = 1000

Number of samples for repetition 0= 1000
Sequence Number for max. ETE = 3
Maximum ETE = 2.0 milliseconds
Average ETE = 0.07 milliseconds

Number of samples for repetition 1= 1000
Sequence Number for max. ETE = 21
Maximum ETE = 2.0 milliseconds
Average ETE = 0.0385 milliseconds

Number of samples for repetition 2= 1000
Sequence Number for max. ETE = 27
Maximum ETE = 2.0 milliseconds
Average ETE = 0.034 milliseconds

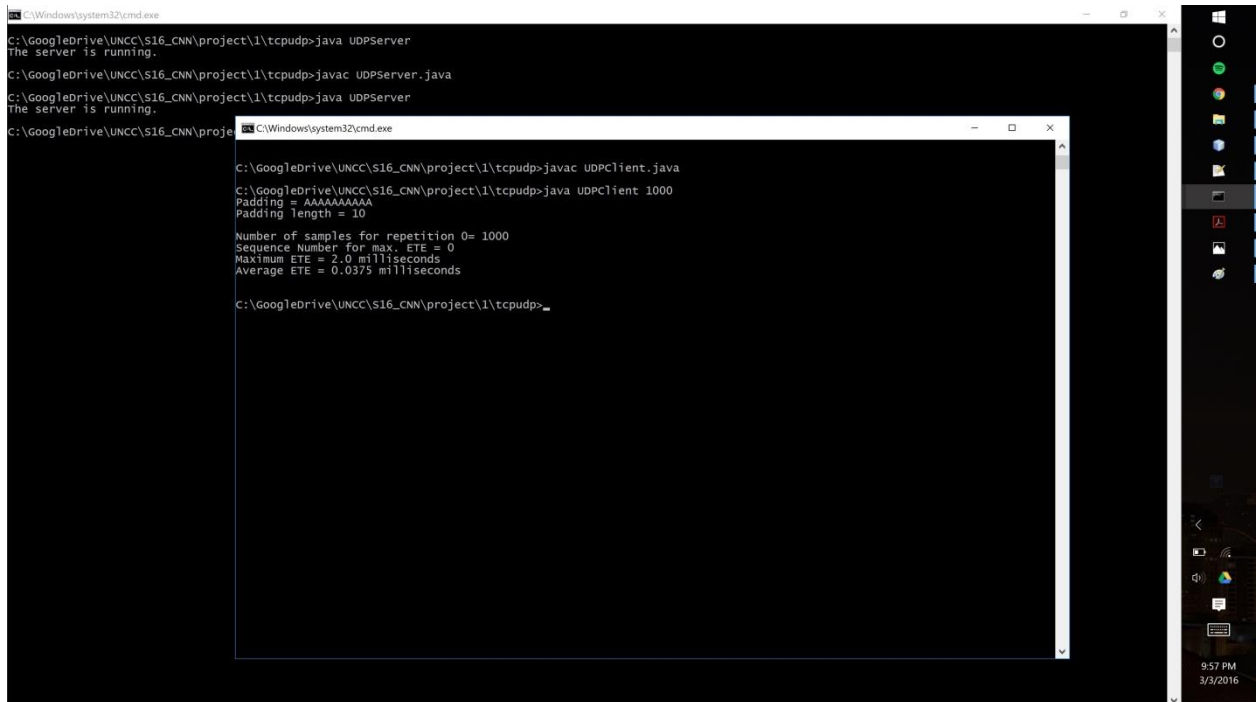
Number of samples for repetition 3= 1000
Sequence Number for max. ETE = 446
Maximum ETE = 2.5 milliseconds
Average ETE = 0.0325 milliseconds

Number of samples for repetition 4= 1000
Sequence Number for max. ETE = 62
Maximum ETE = 2.0 milliseconds
Average ETE = 0.0315 milliseconds

C:\GoogleDrive\UNCC\S16_CNN\project\l\tcpudp>
```


UDP:

1. Padding length = 10,
Repetitions = 1



```
C:\Windows\system32\cmd.exe
C:\GoogleDrive\UNCC\S16_CNN\project\1\tcpudp>java UDPServer
The server is running.
C:\GoogleDrive\UNCC\S16_CNN\project\1\tcpudp>javac UDPServer.java
C:\GoogleDrive\UNCC\S16_CNN\project\1\tcpudp>java UDPServer
The server is running.
C:\GoogleDrive\UNCC\S16_CNN\project\1\tcpudp>

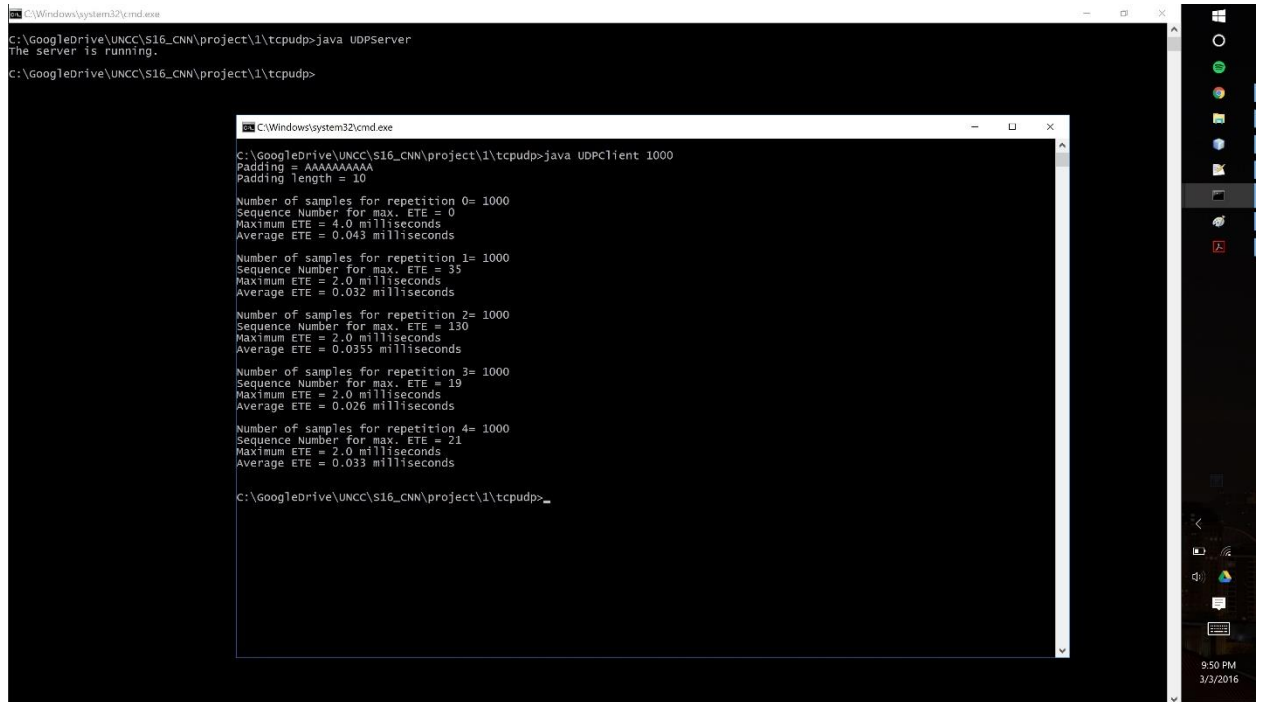
C:\Windows\system32\cmd.exe
C:\GoogleDrive\UNCC\S16_CNN\project\1\tcpudp>javac UDPClient.java
C:\GoogleDrive\UNCC\S16_CNN\project\1\tcpudp>java UDPClient 1000
Padding = AAAAAAAAAA
Padding length = 10

Number of samples for repetition 0= 1000
Sequence Number for max. ETE = 0
Maximum ETE = 2.0 milliseconds
Average ETE = 0.0375 milliseconds

C:\GoogleDrive\UNCC\S16_CNN\project\1\tcpudp>
```

2. Padding length = 10,

Repetitions = 5



```
C:\Windows\system32\cmd.exe
C:\GoogleDrive\UNCC\S16_CNN\project\1\tcpudp>java UDPServer
The server is running.
C:\GoogleDrive\UNCC\S16_CNN\project\1\tcpudp>

C:\Windows\system32\cmd.exe
C:\GoogleDrive\UNCC\S16_CNN\project\1\tcpudp>java UDPClient 1000
Padding = AAAAAAAAAA
Padding Length = 10
Number of samples for repetition 0= 1000
Sequence Number for max. ETE = 0
Maximum ETE = 4.0 milliseconds
Average ETE = 0.043 milliseconds
Number of samples for repetition 1= 1000
Sequence Number for max. ETE = 35
Maximum ETE = 2.0 milliseconds
Average ETE = 0.032 milliseconds
Number of samples for repetition 2= 1000
Sequence Number for max. ETE = 130
Maximum ETE = 2.0 milliseconds
Average ETE = 0.0355 milliseconds
Number of samples for repetition 3= 1000
Sequence Number for max. ETE = 19
Maximum ETE = 2.0 milliseconds
Average ETE = 0.026 milliseconds
Number of samples for repetition 4= 1000
Sequence Number for max. ETE = 21
Maximum ETE = 2.0 milliseconds
Average ETE = 0.033 milliseconds
C:\GoogleDrive\UNCC\S16_CNN\project\1\tcpudp>_
```

3. Padding length = 200,

Repetitions = 5

[illegible]

4. Padding length = 1000,
Repetitions = 5

[illegible]

Questions

- 1) Are the average ETE values, obtained from step 2, different for each of the 5 times that step 1 is repeated? Why?

Answer:

Yes, the average ETEs obtained in each of the 5 times are different in each repetition.

This is because the ETE depends on many factors like collision, timeout, network congestion, etc. and the average can get affected greatly because of a few low or high outliers.

- 2) Compare the average and maximum ETE for steps 2, 3, and 4 for TCP only. Explain the differences.

Answer:

Average and maximum ETE for 10 characters

AVG ETE = 1.845milliseconds

MAX ETE = 8.5 milliseconds

Average and maximum ETE for 200 characters

AVG ETE: 2.136 milliseconds

MAX ETE: 12.5 milliseconds

Average and maximum ETE for 1000 characters

AVG ETE: 3.711 milliseconds

MAX ETE: 16.0 milliseconds

It can be observed that as the size of the packet increases the time taken for transmission increases.

- 3) Compare the average and maximum ETE between TCP and UDP, for each of steps 2, 3, and 4. Explain the differences between TCP and UDP. What conclusion can you draw in terms of the performance of TCP and UDP?

Answer:

Step	TCP		UDP	
	Max ETE	Avg ETE	Max ETE	Avg ETE
2	1.845ms	8.5ms	2.633ms	16ms
3	2.136ms	12.5ms	2.3335ms	23.5ms
4	3.711ms	16ms	4.2275ms	42ms

From the above observations, it can be understood that TCP performance is better than that of UDP.

- 4) If the tests were run over the Internet, where there is a chance of packet loss, how would the ETE values be different between UDP and TCP?

Answer:

Both the protocols differ in the way the Connection setup and Retransmission of failed packets are handled. In case of TCP, which is connection oriented, a connection is established and maintained. Also a lost packet is retransmitted. Both of these do not happen in case of UDP. So in general, the performance of UDP will be better than TCP in a unreliable network.