COMP 4985
Assignment 2

Comparing TCP and UDP Speed and Packet Loss

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Introduction

The main goal for this assignment is to send files through sockets using TCP and UDP to compare the differences between the two protocols. This assignment was developed using C++ with the assistance of Qt. The sockets used for this application are QTcpSocket and QUdpSocket. Qt's slots and signals are asynchronous by nature which help drive up the program's performance.

There were many challenges faced while developing this program. First of all, when coming across a data communications problem, the problem is very hard to debug. One way to overcome this was using Wireshark to track the packets, or see if the two endpoints are even communicating. Another problem faced was getting an accurate time to be able to compare datasets accurately. In order to achieve this, the time is recorded when the first byte is written on the sender side for UDP, or when the connection is established on TCP. The time is also recorded when the last byte is received on the receiver side. Lastly, the hardest part to control is the number of operations that are performed with the reading. Adding in an arithmetic operation to try and calculate data while reading slowed down the program a lot. So much to the point that the reader's buffer is always full and always ends up losing data(UDP).

The Analysis of this report covers TCP and UDP being tested with 1kB, 4kB, 20kB, and 60kB packet sizes. Each of those combinations are then paired with either sending that packet 10 times or 100 times.

Analysis

Speed Performance:

The following graphs are used to visualize the average difference between TCP and UDP. Each average is calculated by using 3 tests.

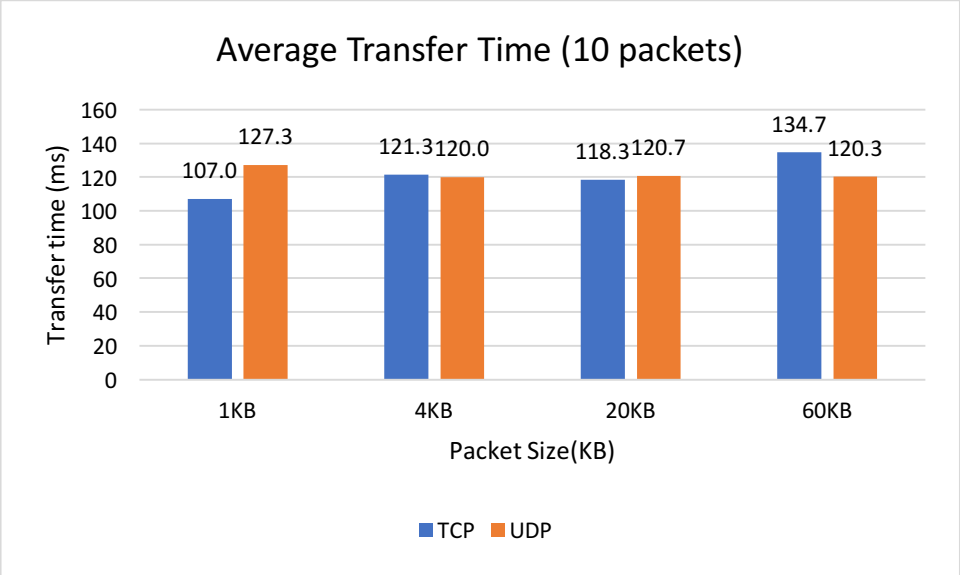

Figure 1

As seen in Figure 1, the average transfer time for TCP and UDP are very similar in small messages. The biggest message here is 60kB sent 10 times which result in a 600kB file. Not including the 1kB packet size(included an outlier point shown in Figure 1b below), the biggest difference in time is seen in the 60kB packet sizes. Here it is seen that UDP is faster than TCP which is the expected result from the theory learned.

1KB-10packe	time(ms)		
run	1	2	3
tcp	77	122	122
udp	125	129	128

Figure 1b

As seen in figure 1b, TCP transmission of 1kB packets 1st run had a very different time which unbalanced the graphs.

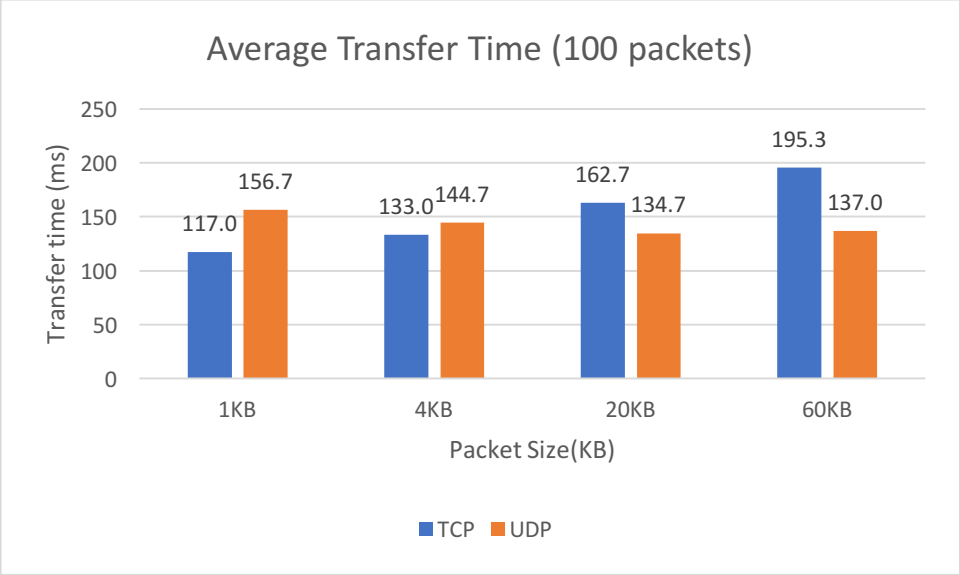

Figure 2

As seen in figure 2, the bigger files again show a bigger difference in speed performance. Again UDP being faster between the two.

Packet Loss Performance:

TCP, even at high packet sizes does not show any signs of packet loss. This is expected as TCP is supposed to be reliable. UDP on the other hand, proved to be unreliable with packet loss going up to 82% (only receiving 18%).

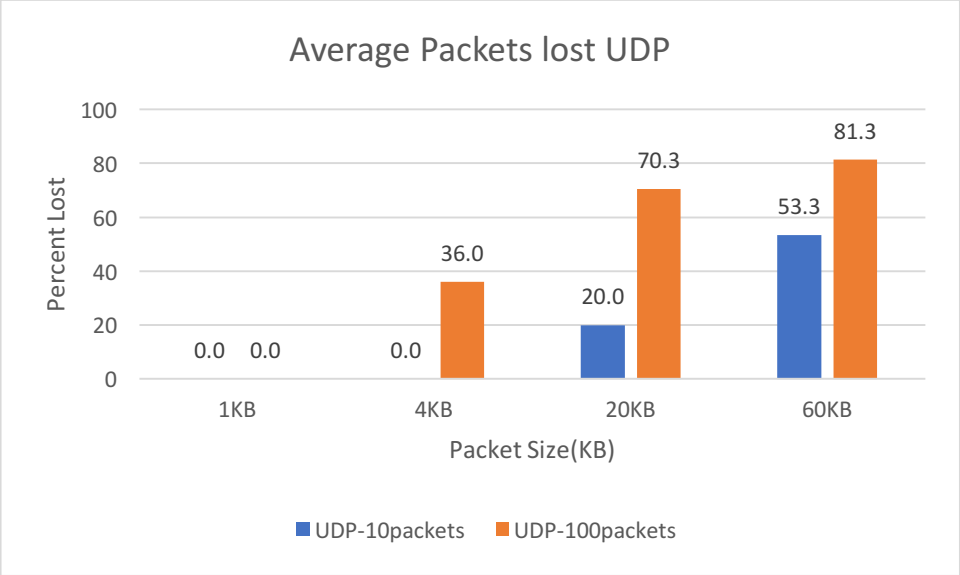

Figure 3

As seen in figure 3, UDP at smaller packet sizes showed little to none packet loss. Going up to 60kB packet sizes being sent 100 times, resulting in a 60MB file, packet loss went up by an average of 81.3%.

Conclusion:

To conclude, the datasets agree with the expected behavior of TCP and UDP based on theory. This shows that's TCP is reliable and generally slower. There are some cases when TCP is faster, especially with smaller files because of environmental factors such as network traffic. This also shows that UDP is generally a lot faster than TCP but is unreliable especially for big datagrams.

Appendix A:

avg time				
10-packets	1KB	4KB	20KB	60KB
TCP	107.0	121.3	118.3	134.7
UDP	127.3	120.0	120.7	120.3
100-packets	1KB	4KB	20KB	60KB
TCP	117.0	133.0	162.7	195.3
UDP	156.7	144.7	134.7	137.0
avg packets lost				
	1KB	4KB	20KB	60KB
UDP-10packe	0.0	0.0	20.0	53.3
UDP-100pacl	0.0	36.0	70.3	81.3

Figure 4

Figure 4: Shows averaged out values from the test data below

1KB-10packe	time(ms)			packets lost		
run	1	2	3	1	2	3
tcp	77	122	122	0	0	0
udp	125	129	128	0	0	0
4KB-10packe	time(ms)			packets lost		
run	1	2	3	1	2	3
tcp	119	124	121	0	0	0
udp	121	119	120	0	0	0
20KB-10pack	time(ms)			packets lost		
run	1	2	3	1	2	3
tcp	118	118	119	0	0	0
udp	122	121	119	20	20	20
60KB-10pack	time(ms)			packets lost		
run	1	2	3	1	2	3
tcp	134	135	135	0	0	0
udp	119	121	121	60	50	50

Figure 5

Figure 5 above shows all the test data for 1kB, 4kB, 20kB, and 60kB for both TCP and UDP being sent 10 times each.

1KB-100pack	time(ms)			packets lost		
run	1	2	3	1	2	3
tcp	117	123	122	0	0	0
udp	160	153	157	0	0	0
4KB-100pack	time(ms)			packets lost		
run	1	2	3	1	2	3
tcp	133	132	134	0	0	0
udp	149	148	137	36	36	36
20KB-100pac	time(ms)			packets lost		
run	1	2	3	1	2	3
tcp	161	163	164	0	0	0
udp	136	133	135	65	65	81
60KB-100pac	time(ms)			packets lost		
run	1	2	3	1	2	3
tcp	195	194	197	0	0	0
udp	142	133	136	81	82	81

Figure 6

Figure 6 above shows all the test data for 1kB, 4kB, 20kB, and 60kB for both TCP and UDP being sent 100 times each.