

Alright, let's do this one last time.

The purpose of this program is to transfer a file from a client, through a server by means of DATA packets, and have the server write the file on it's side. It will then send an ACK packet to the client. BUT there's a catch this time; the client can send to MULTIPLE servers at one, via pthreads. Before I explain the core components of the program, I will provide starting commands.

```
./myserver server_port droppc root_folder_path  
./myclient servn servaddr.conf MTU WINSZ in_file_path out_file_path
```

“myserver” starts the server. You need to do this *before* running the other command. In addition, *server\_port* sets the server's port. Simple as that.

*droppc* is the chance for the server to drop packets. It's mainly used for testing.

*root\_folder\_path* is the folder path that the server will make files in.

Moving on to “myclient”.

*servn* stands for the number of servers you'll be connecting to. It must be positive, nonzero.

You must make *servaddr.conf* yourself, through any text editor. Inside *servaddr.conf*, there must be text in the following format.

```
server_ip server_port  
server_ip server_port  
Etc...
```

You can leave comments with # at the start of the line, but you cannot have any other text in these files AT ALL. *Server\_ip* corresponds to the server's ip, *server\_port* corresponds to the server's port. The *server\_ip* must ALWAYS match the hardcoded IP in myserver.c. This can be changed manually, but otherwise, must be 127.0.0.1.

*MTU* is the maximum bytes that can be transferred across one **packet**. The **maximum MTU value** is **32768**, while the minimum is 194.

*WINSZ* is the size of the sliding window, or maximum number of packets that can be out at once.

*in\_file\_path* is the path to the first file, the one that will be duplicated. This can be a folder path to a file.

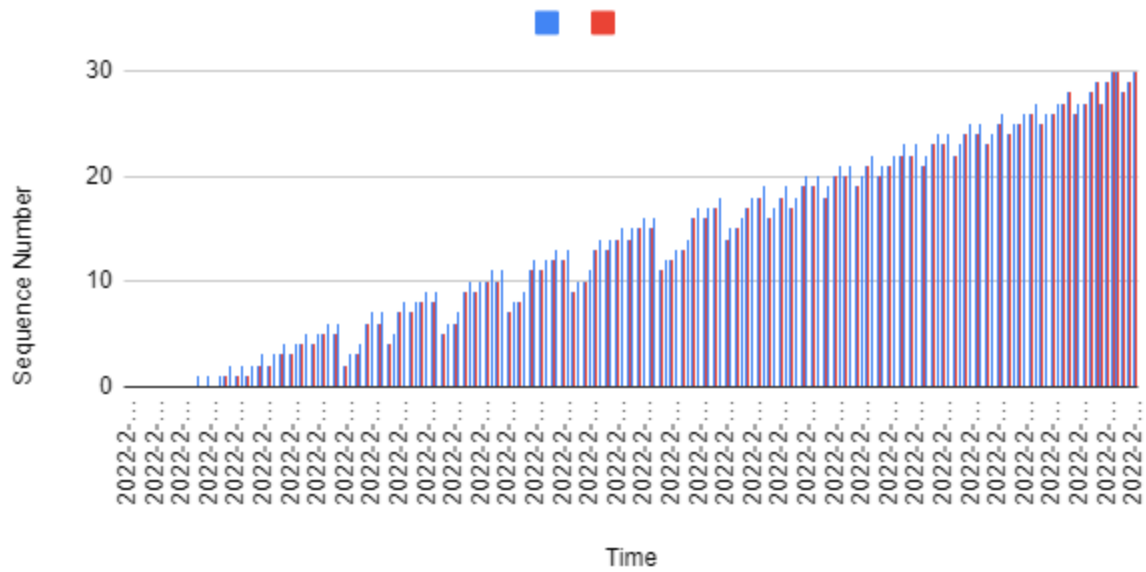
*out\_file\_path* is the name that the new, copied file will be given. This can be a folder path too.

Finally, a **disclaimer**. I based my code off the textbook we were assigned for our class, “UNIX Network Programming Volume 1, Third Edition: The Sockets Networking API”, and as such, the server code is mostly unchanged from the examples given in Chapter 8. We were permitted to do this.

Additionally, I used this specific page to figure out how to print the current time and date:  
<https://www.techiedelight.com/print-current-date-and-time-in-c/> .

## DATA and ACK for a 5 Threaded Client

Blue = DATA, Red = ACK



Data and Ack chart for a 5 Threaded Client.

Tests:

Test 1, 998 words in alphabetical order, from 1 client, across 5 threads, to 5 servers, with no loss:

```
bash-4.2$ bin/myclient 5 servaddr.conf 32000 4 alpha1.txt ALPHABET_COPY.txt
2022-2-19T17:59:37.107Z, 53984, 127.0.0.1, 9092, DATA, 0, 1, 4
2022-2-19T17:59:37.107Z, 52626, 127.0.0.1, 9093, DATA, 0, 1, 4
2022-2-19T17:59:37.108Z, 59496, 127.0.0.1, 9090, DATA, 0, 1, 4
2022-2-19T17:59:37.108Z, 49377, 127.0.0.1, 9094, DATA, 0, 1, 4
2022-2-19T17:59:37.110Z, 42426, 127.0.0.1, 9091, DATA, 0, 1, 4
2022-2-19T17:59:37.112Z, 59496, 127.0.0.1, 9090, ACK, 0, 1, 4
2022-2-19T17:59:37.115Z, 52626, 127.0.0.1, 9093, ACK, 0, 1, 4
2022-2-19T17:59:37.118Z, 49377, 127.0.0.1, 9094, ACK, 0, 1, 4
2022-2-19T17:59:37.120Z, 53984, 127.0.0.1, 9092, ACK, 0, 1, 4
2022-2-19T17:59:37.128Z, 42426, 127.0.0.1, 9091, ACK, 0, 1, 4

bash-4.2$ bin/myserver 9090 0 SERVER_1 & bin/myserver 9091 0 SERVER_2 & bin/myserver 9092 0 SERVER_
3 & bin/myserver 9093 0 SERVER_4 & bin/myserver 9094 0 SERVER_5
[1] 23693
[2] 23694
[3] 23695
[4] 23696
[]

bash-4.2$ diff alpha1.txt SERVER_1/ALPHABET_COPY.txt & diff alpha1.txt SERVER_2/ALPHABET_COPY.txt &
diff alpha1.txt SERVER_3/ALPHABET_COPY.txt & diff alpha1.txt SERVER_4/ALPHABET_COPY.txt & diff alp
ha1.txt SERVER_5/ALPHABET_COPY.txt
[1] 24215
[2] 24216
[3] 24217
[4] 24218
[2] Done diff alpha1.txt SERVER_2/ALPHABET_COPY.txt
[3]- Done diff alpha1.txt SERVER_3/ALPHABET_COPY.txt
[4]+ Done diff alpha1.txt SERVER_4/ALPHABET_COPY.txt
bash-4.2$ ^C
[1]+ Done diff alpha1.txt SERVER_1/ALPHABET_COPY.txt
```

Test 2, the same test as before, but in addition to it, a second client, this time transferring an empty file as well:

```
bash-4.2$ bin/myclient 5 servaddr.conf 512 4 emptyfolder/theemptyfile EMPTY_FILE & bin/myclient 5 s  
ervaddr2.conf 512 2 alpha1.txt BETA_ALPHABET.txt
```

```
bash-4.2$ diff emptyfolder/theemptyfile SERVER_1/EMPTY_FILE & diff emptyfolder/theemptyfile SERVER_  
2/EMPTY_FILE & diff emptyfolder/theemptyfile SERVER_3/EMPTY_FILE & diff emptyfolder/theemptyfile SE  
RVER_4/EMPTY_FILE & diff emptyfolder/theemptyfile SERVER_5/EMPTY_FILE
```

```
[1] 29346  
[2] 29347  
[3] 29348  
[4] 29349
```

```
bash-4.2$ ^C
```

```
[1] Done diff emptyfolder/theemptyfile SERVER_1/EMPTY_FILE  
[2] Done diff emptyfolder/theemptyfile SERVER_2/EMPTY_FILE  
[3]- Done diff emptyfolder/theemptyfile SERVER_3/EMPTY_FILE  
[4]+ Done diff emptyfolder/theemptyfile SERVER_4/EMPTY_FILE
```

```
bash-4.2$ diff alpha1.txt SERVER_1/BETA_ALPHABET.txt & diff alpha1.txt SERVER_2/BETA_ALPHABET.txt &  
diff alpha1.txt SERVER_3/BETA_ALPHABET.txt & diff alpha1.txt SERVER_4/BETA_ALPHABET.txt & diff alp  
ha1.txt SERVER_5/BETA_ALPHABET.txt
```

```
[1] 32360  
[2] 32361  
[3] 32362  
[4] 32363
```

```
[2] Done diff alpha1.txt SERVER_2/BETA_ALPHABET.txt  
[3]- Done diff alpha1.txt SERVER_3/BETA_ALPHABET.txt  
[4]+ Done diff alpha1.txt SERVER_4/BETA_ALPHABET.txt
```

```
bash-4.2$ ^C
```

```
[1]+ Done diff alpha1.txt SERVER_1/BETA_ALPHABET.txt
```

Test 3, we've add the server's executable as a binary file:

```
bash-4.2$ bin/myclient 5 servaddr.conf 512 4 emptyfolder/theemptyfile EMPTY_FILE & bin/myclient 5 s  
ervaddr2.conf 512 2 alpha1.txt BETA_ALPHABET.txt & bin/myclient 5 servaddr3.conf 1024 8 bin/myserve  
r SERVER_COPY
```

```
bash-4.2$ diff bin/myserver SERVER_1/SERVER_COPY & diff bin/myserver SERVER_2/SERVER_COPY & diff bi  
n/myserver SERVER_3/SERVER_COPY & diff bin/myserver SERVER_4/SERVER_COPY & diff bin/myserver SERVER  
_5/SERVER_COPY
```

```
[1] 3495
```

```
[2] 3496
```

```
[3] 3497
```

```
[4] 3498
```

```
[4]+ Done diff bin/myserver SERVER_4/SERVER_COPY
```

```
bash-4.2$
```

```
[1] Done diff bin/myserver SERVER_1/SERVER_COPY
```

```
[2]- Done diff bin/myserver SERVER_2/SERVER_COPY
```

```
[3]+ Done diff bin/myserver SERVER_3/SERVER_COPY
```

```
bash-4.2$
```

Test 4, We're gonna run the intentional error cases here this time, because the final test takes around an hour to complete so I want to do it last:

Test 4.1, dropc of 100.

```
bash-4.2$ bin/myclient 5 servaddr.conf 512 4 emptyfolder/theemptyfile EMPTY_FILE
2022-2-19T18:37:55.536Z, 47814, 127.0.0.1, 9892, DATA, 0, 1, 4
2022-2-19T18:37:55.536Z, 58717, 127.0.0.1, 9894, DATA, 0, 1, 4
2022-2-19T18:37:55.538Z, 56229, 127.0.0.1, 9893, DATA, 0, 1, 4
2022-2-19T18:37:55.540Z, 51119, 127.0.0.1, 9891, DATA, 0, 1, 4
2022-2-19T18:37:55.548Z, 42951, 127.0.0.1, 9890, DATA, 0, 1, 4
2022-2-19T18:37:58.536Z, 47814, 127.0.0.1, 9892, DATA, 0, 1, 4
2022-2-19T18:37:58.536Z, 58717, 127.0.0.1, 9894, DATA, 0, 1, 4
2022-2-19T18:37:58.538Z, 56229, 127.0.0.1, 9893, DATA, 0, 1, 4
2022-2-19T18:37:58.540Z, 51119, 127.0.0.1, 9891, DATA, 0, 1, 4
2022-2-19T18:37:58.548Z, 42951, 127.0.0.1, 9890, DATA, 0, 1, 4
2022-2-19T18:38:01.536Z, 58717, 127.0.0.1, 9894, DATA, 0, 1, 4
2022-2-19T18:38:01.536Z, 47814, 127.0.0.1, 9892, DATA, 0, 1, 4
2022-2-19T18:38:01.538Z, 56229, 127.0.0.1, 9893, DATA, 0, 1, 4
2022-2-19T18:38:01.540Z, 51119, 127.0.0.1, 9891, DATA, 0, 1, 4
2022-2-19T18:38:01.548Z, 42951, 127.0.0.1, 9890, DATA, 0, 1, 4
2022-2-19T18:38:04.536Z, 47814, 127.0.0.1, 9892, DATA, 0, 1, 4
2022-2-19T18:38:04.536Z, 58717, 127.0.0.1, 9894, DATA, 0, 1, 4
2022-2-19T18:38:04.538Z, 56229, 127.0.0.1, 9893, DATA, 0, 1, 4
2022-2-19T18:38:04.540Z, 51119, 127.0.0.1, 9891, DATA, 0, 1, 4
2022-2-19T18:38:04.548Z, 42951, 127.0.0.1, 9890, DATA, 0, 1, 4
2022-2-19T18:38:07.536Z, 47814, 127.0.0.1, 9892, DATA, 0, 1, 4
2022-2-19T18:38:07.536Z, 58717, 127.0.0.1, 9894, DATA, 0, 1, 4
2022-2-19T18:38:07.538Z, 56229, 127.0.0.1, 9893, DATA, 0, 1, 4
2022-2-19T18:38:07.540Z, 51119, 127.0.0.1, 9891, DATA, 0, 1, 4
2022-2-19T18:38:07.548Z, 42951, 127.0.0.1, 9890, DATA, 0, 1, 4
2022-2-19T18:38:10.536Z, 58717, 127.0.0.1, 9894, DATA, 0, 1, 4
2022-2-19T18:38:10.536Z, 47814, 127.0.0.1, 9892, DATA, 0, 1, 4
2022-2-19T18:38:10.538Z, 56229, 127.0.0.1, 9893, DATA, 0, 1, 4
2022-2-19T18:38:10.540Z, 51119, 127.0.0.1, 9891, DATA, 0, 1, 4
2022-2-19T18:38:10.548Z, 42951, 127.0.0.1, 9890, DATA, 0, 1, 4
Cannot detect server
Cannot detect server
Cannot detect server
Cannot detect server
Cannot detect server
[1] Done diff bin/myserver SERVER_1/SERVER_COPY
[2] Done diff bin/myserver SERVER_2/SERVER_COPY
[3]- Done diff bin/myserver SERVER_3/SERVER_COPY
[4]+ Done diff bin/myserver SERVER_4/SERVER_COPY

bash: fg: current: no such job
bash-4.2$ ^C
bash-4.2$ fg
bash: fg: current: no such job
bash-4.2$ bin/myserver 9090 100 SERVER_1 & bin/myserver 9091 100 SERVER_2 & bin/myserver 9092 100 S
ER_3 & bin/myserver 9093 100 SERVER_4 & bin/myserver 9094 100 SERVER_5
[1] 8910
[2] 8911
[3] 8912
[4] 8913
2022-2-19T18:37:55.537Z, DATA, 0
2022-2-19T18:37:55.538Z, DATA, 0
2022-2-19T18:37:55.538Z, DATA, 0
2022-2-19T18:37:55.540Z, DATA, 0
2022-2-19T18:37:55.548Z, DATA, 0
2022-2-19T18:37:58.536Z, DATA, 0
2022-2-19T18:37:58.536Z, DATA, 0
2022-2-19T18:37:58.538Z, DATA, 0
2022-2-19T18:37:58.540Z, DATA, 0
2022-2-19T18:37:58.548Z, DATA, 0
2022-2-19T18:38:01.536Z, DATA, 0
2022-2-19T18:38:01.536Z, DATA, 0
2022-2-19T18:38:01.538Z, DATA, 0
2022-2-19T18:38:01.540Z, DATA, 0
2022-2-19T18:38:01.548Z, DATA, 0
2022-2-19T18:38:04.536Z, DATA, 0
2022-2-19T18:38:04.536Z, DATA, 0
2022-2-19T18:38:04.538Z, DATA, 0
2022-2-19T18:38:04.540Z, DATA, 0
2022-2-19T18:38:04.548Z, DATA, 0
2022-2-19T18:38:07.536Z, DATA, 0
2022-2-19T18:38:07.536Z, DATA, 0
2022-2-19T18:38:07.538Z, DATA, 0
2022-2-19T18:38:07.540Z, DATA, 0
2022-2-19T18:38:07.548Z, DATA, 0
2022-2-19T18:38:10.536Z, DATA, 0
2022-2-19T18:38:10.536Z, DATA, 0
2022-2-19T18:38:10.538Z, DATA, 0
2022-2-19T18:38:10.540Z, DATA, 0
2022-2-19T18:38:10.548Z, DATA, 0
```

Test 4.2, incorrect number of arguments into client.

```
bash-4.2$ bin/myclient 5 servaddr.conf 512 4 emptyfolder/theemptyfile EMPTY_FILE HELLO_GRADER
Not enough/too many initial parameters.
```

Test 4.3, bad client path.

```
bash-4.2$ bin/myclient 5 servaddr.conf 512 4 //emptyfolder/theemptyfile EMPTY_FILE
Invalid in_file_path.
Invalid in_file_path.
Invalid in_file_path.
Invalid in_file_path.
Invalid in_file_path.
Invalid in_file_path.
bash-4.2$ █
```

Test 4.4, MTU size of 10.

```
bash-4.2$ bin/myclient 5 servaddr.conf 10 4 emptyfolder/theemptyfile EMPTY_FILE
The MTU is invalid!
The MTU is invalid!
The MTU is invalid!
The MTU is invalid!
The MTU is invalid!
```

Test 4.5 incorrect IP address.

```
# comment line starting with #
# IP address port
10.0.10.1 9090
10.0.20.1 9091
#
#
##### # # # asjshdkaSBDABSKBDSAKBDASdhaVSDUYSA
10.04.0.2 9099
10.0.03.6 9097
10.110.0.1 9094
```

```
bash-4.2$ bin/myclient 5 servaddr.conf 512 4 thebookofroanin.txt ROAMIN.txt
```

```
2022-2-19T18:44:17.143Z, 60097, 10.0.10.1, 9090, DATA, 0, 1, 4
2022-2-19T18:44:17.143Z, 60097, 10.0.10.1, 9090, DATA, 0, 2, 4
2022-2-19T18:44:17.143Z, 60858, 10.04.0.2, 9099, DATA, 0, 1, 4
2022-2-19T18:44:17.143Z, 60858, 10.04.0.2, 9099, DATA, 0, 2, 4
2022-2-19T18:44:17.143Z, 60858, 10.04.0.2, 9099, DATA, 0, 3, 4
2022-2-19T18:44:17.143Z, 60858, 10.04.0.2, 9099, DATA, 0, 4, 4
2022-2-19T18:44:17.143Z, 42021, 10.0.03.6, 9097, DATA, 0, 1, 4
2022-2-19T18:44:17.144Z, 42021, 10.0.03.6, 9097, DATA, 0, 2, 4
2022-2-19T18:44:17.144Z, 33753, 10.0.20.1, 9091, DATA, 0, 1, 4
2022-2-19T18:44:17.144Z, 33753, 10.0.20.1, 9091, DATA, 0, 2, 4
2022-2-19T18:44:17.144Z, 33753, 10.0.20.1, 9091, DATA, 0, 3, 4
2022-2-19T18:44:17.144Z, 33753, 10.0.20.1, 9091, DATA, 0, 4, 4
2022-2-19T18:44:17.144Z, 42021, 10.0.03.6, 9097, DATA, 0, 3, 4
2022-2-19T18:44:17.144Z, 42021, 10.0.03.6, 9097, DATA, 0, 4, 4
2022-2-19T18:44:17.143Z, 60097, 10.0.10.1, 9090, DATA, 0, 3, 4
2022-2-19T18:44:17.144Z, 60097, 10.0.10.1, 9090, DATA, 0, 4, 4
2022-2-19T18:44:17.145Z, 41837, 10.110.0.1, 9094, DATA, 0, 1, 4
2022-2-19T18:44:17.145Z, 41837, 10.110.0.1, 9094, DATA, 0, 2, 4
2022-2-19T18:44:17.145Z, 41837, 10.110.0.1, 9094, DATA, 0, 3, 4
2022-2-19T18:44:17.145Z, 41837, 10.110.0.1, 9094, DATA, 0, 4, 4
2022-2-19T18:44:20.143Z, 60858, 10.04.0.2, 9099, DATA, 0, 1, 4
2022-2-19T18:44:20.144Z, 33753, 10.0.20.1, 9091, DATA, 0, 1, 4
2022-2-19T18:44:20.144Z, 42021, 10.0.03.6, 9097, DATA, 0, 1, 4
2022-2-19T18:44:20.144Z, 60097, 10.0.10.1, 9090, DATA, 0, 1, 4
2022-2-19T18:44:20.145Z, 41837, 10.110.0.1, 9094, DATA, 0, 1, 4
2022-2-19T18:44:23.143Z, 60858, 10.04.0.2, 9099, DATA, 0, 1, 4
2022-2-19T18:44:23.144Z, 33753, 10.0.20.1, 9091, DATA, 0, 1, 4
2022-2-19T18:44:23.144Z, 60097, 10.0.10.1, 9090, DATA, 0, 1, 4
2022-2-19T18:44:23.144Z, 42021, 10.0.03.6, 9097, DATA, 0, 1, 4
2022-2-19T18:44:23.145Z, 41837, 10.110.0.1, 9094, DATA, 0, 1, 4
2022-2-19T18:44:26.143Z, 60858, 10.04.0.2, 9099, DATA, 0, 1, 4
2022-2-19T18:44:26.144Z, 42021, 10.0.03.6, 9097, DATA, 0, 1, 4
2022-2-19T18:44:26.144Z, 33753, 10.0.20.1, 9091, DATA, 0, 1, 4
2022-2-19T18:44:26.144Z, 60097, 10.0.10.1, 9090, DATA, 0, 1, 4
2022-2-19T18:44:26.145Z, 41837, 10.110.0.1, 9094, DATA, 0, 1, 4
2022-2-19T18:44:29.143Z, 60858, 10.04.0.2, 9099, DATA, 0, 1, 4
2022-2-19T18:44:29.144Z, 33753, 10.0.20.1, 9091, DATA, 0, 1, 4
2022-2-19T18:44:29.144Z, 60097, 10.0.10.1, 9090, DATA, 0, 1, 4
2022-2-19T18:44:29.144Z, 42021, 10.0.03.6, 9097, DATA, 0, 1, 4
2022-2-19T18:44:29.145Z, 41837, 10.110.0.1, 9094, DATA, 0, 1, 4
2022-2-19T18:44:32.143Z, 60858, 10.04.0.2, 9099, DATA, 0, 1, 4
2022-2-19T18:44:32.144Z, 33753, 10.0.20.1, 9091, DATA, 0, 1, 4
2022-2-19T18:44:32.144Z, 60097, 10.0.10.1, 9090, DATA, 0, 1, 4
2022-2-19T18:44:32.144Z, 42021, 10.0.03.6, 9097, DATA, 0, 1, 4
2022-2-19T18:44:32.145Z, 41837, 10.110.0.1, 9094, DATA, 0, 1, 4
Cannot detect server
Cannot detect server
Cannot detect server
Cannot detect server
Cannot detect server
```



Test 5: 12.8 MILLION BYTES ON THE STACK AT ONCE, WITH A 10% DROP CHANCE.  
76 MB OF FILES AFTER REPLICATION. INCLUDES THE LONGEST PIECE OF  
LITERATURE IN HUMAN HISTORY.

```
bin/myclient 5 servaddr.conf 32000 16 5mb.txt FINAL.txt & bin/myclient 5 servaddr2.conf  
32000 16 thesubspaceemissarysworldconquest.txt EMISSARY.txt & bin/myclient 5  
servaddr3.conf 32000 16 5mb.txt OTHER_FINAL.txt & bin/myclient 5 servaddr4.conf 32000 16  
thesubspaceemissarysworldconquest.txt FICTION/LONGEST_FICTION.txt & bin/myclient 5  
servaddr5.conf 32000 16 5mb.txt GOODBYE_TIMESHAKE.txt
```

```
bin/myserver 9090 10 SERVER_1 & bin/myserver 9091 10 SERVER_2 & bin/myserver 9092 10  
SERVER_3 & bin/myserver 9093 10 SERVER_4 & bin/myserver 9094 10 SERVER_5
```

```
[1] Done bin/myclient 5 servaddr.conf 32000 16 5mb.txt FINAL.txt  
[2] Done bin/myclient 5 servaddr2.conf 32000 16 thesubspaceemissarysworldconqu  
est.txt EMISSARY.txt  
[3]- Done bin/myclient 5 servaddr3.conf 32000 16 5mb.txt OTHER_FINAL.txt  
[4]+ Done bin/myclient 5 servaddr4.conf 32000 16 thesubspaceemissarysworldconqu  
est.txt FICTION/LONGEST_FICTION.txt  
  
2022-2-19T19:09:26.990Z, 50386, 127.0.0.1, 9094, ACK, 710, 713, 726  
2022-2-19T19:09:26.990Z, 50386, 127.0.0.1, 9094, ACK, 711, 713, 727  
bash-4.2$  
[2]- Done bin/myclient 5 servaddr2.conf 32000 16 thesubspaceemissarysworldconqu  
est.txt EMISSARY.txt  
[4]+ Done bin/myclient 5 servaddr4.conf 32000 16 thesubspaceemissarysworldconqu  
est.txt FICTION/LONGEST_FICTION.txt  
bash-4.2$  
bash-4.2$  
bash-4.2$ diff thesubspaceemissarysworldconquest.txt SERVER_4/EMISSARY.txt  
bash-4.2$ █
```

I rest my case.

It ended up only taking around 10 minutes.