

# COMP 8005: Final Project

Port Forwarding

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## 1 Introduction

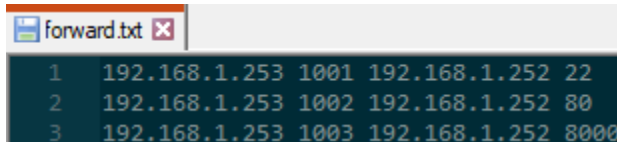
This project is to create a program that port forwards any IP + port pair to another IP + port pair and to test its functionality such as performance and functions.

## 2 How to Use

Input the IP + port combinations to forward in **forward.txt** and interfaces to use for port forwarding in **forward.txt** then run the **portforward.py** on the Linux machine to be used as a port forwarder by using iptables rules to forward the rules to the computer.

Eg. forward.txt

**srcIP srcDport dstIP dstDport**



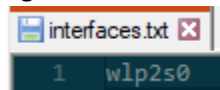
	srcIP	srcDport	dstIP	dstDport
1	192.168.1.253	1001	192.168.1.252	22
2	192.168.1.253	1002	192.168.1.252	80
3	192.168.1.253	1003	192.168.1.252	8000

Forwards packets coming from 192.168.1.253 on dport 1001 to 192.168.1.252 dport 22

Forwards packets coming from 192.168.1.253 on dport 1002 to 192.168.1.252 dport 80

Forwards packets coming from 192.168.1.253 on dport 1003 to 192.168.1.252 dport 8000

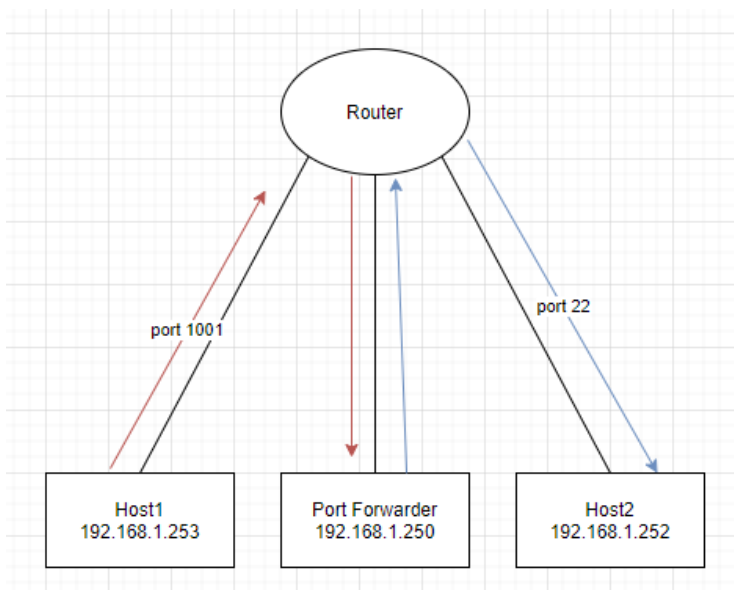
Eg. interfaces.txt



1	wlp2s0
---	--------

Overwrites any packets coming out my wlp2s0 NIC interface as the port forward's IP, this is required for the port forwarder to work properly. You may need to use more than one interface if it is required to port forward to more than one network.

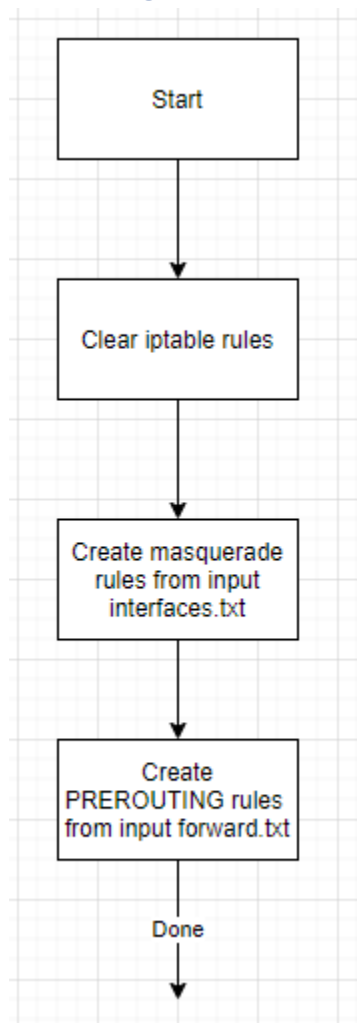
Example of how going from host 192.168.1.253:1001 to get forwarded to 192.168.1.252:22 by sending it to 192.168.1.250 on dport 1001.



### 3 Operating System

At minimum, the computer used as the port forwarder must be using any form of Linux distro that has iptables to use for port forwarding because this program creates iptables rules to do port forwarding.

## 4 Design



## 5 Pseudocode

Clear all iptables rules

read interface.txt

    for line in interface.txt

        run ("iptables -A POSTROUTING -t nat -o " + line + " -j MASQUERADE")

read forward.txt

    for line in forward.txt

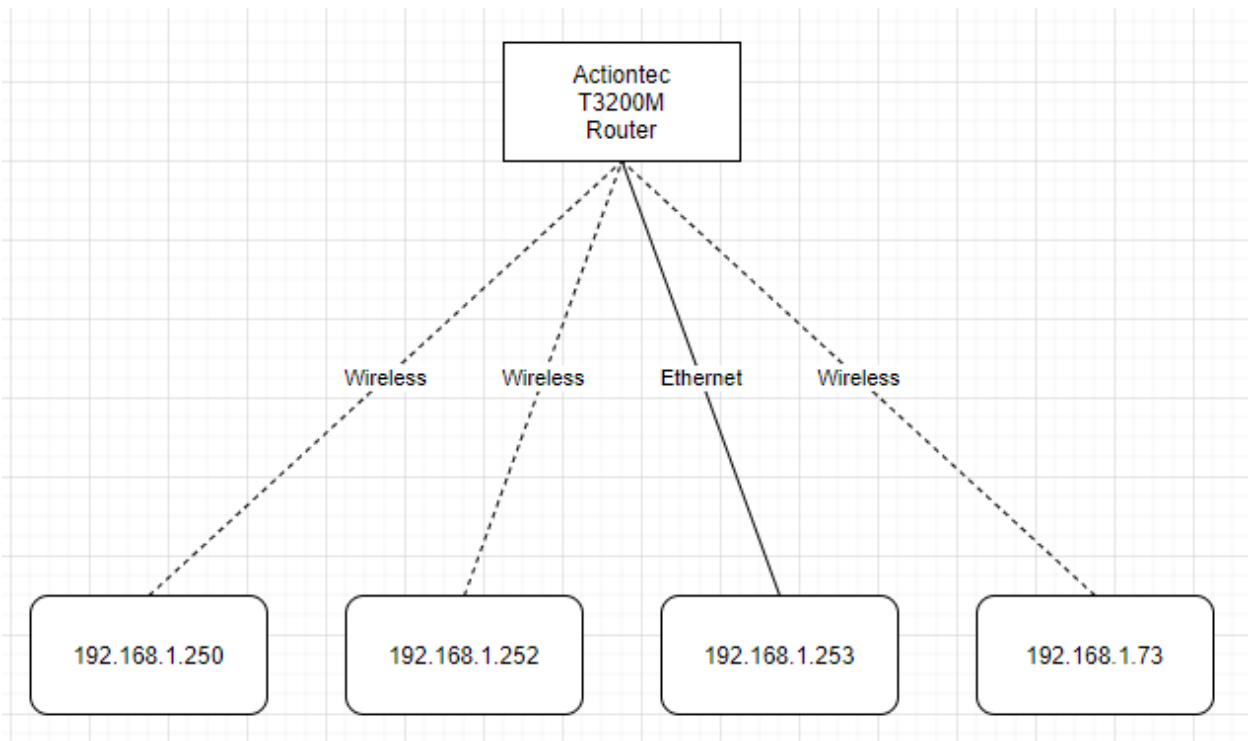
        run ("iptables -A PREROUTING -t nat -s " + srcIP + " p tcp - dport " + srcDport + " -j DNAT

        -to-destination " + dstIP + ":" + dstDport)

## 6 Testbench

There is a list of 4 computers as hardware I use for this project to test the functionality of my port forwarder.

- 192.168.1.250 (i7 6500U 12GB RAM Laptop)
- 192.168.1.252 (Raspberry Pi 4)
- 192.168.1.253 (Ryzen 7 3800x 32GB RAM Desktop)
- 192.168.1.73 (i7 4790k 32GB RAM Desktop)



## 7 Tests

Tests were done with mostly the same computers however, for test 8 I used an RPI4 as port forwarder because it was unable to run my Epoll server code.

Rule #	Test Description	Tool Used	Expected Result	Pass/Fail
1	Send 192.168.1.253 dport 1001 to the forwarder to forward to 192.168.1.252 dport 22 for SSH. <b>Client: 192.168.1.253</b> <b>Forwarder: 192.168.1.250</b> <b>Server: 192.168.1.252</b>	SSH	The rule should forward the packet to 192.168.1.252 and behave like regular SSH	Pass
2	Send 192.168.1.253 dport 1002 to the forwarder to forward to 192.168.1.252 dport 80 for HTML. <b>Client: 192.168.1.253</b> <b>Forwarder: 192.168.1.250</b> <b>Server: 192.168.1.252</b>	IE Explorer	The rule should forward the packet to 192.168.1.252 and show the default apache page on 192.168.1.252	Pass
3	Send 192.168.1.253 dport 1003 to the forwarder to forward to 192.168.1.252 dport 8000 for echo server testing. <b>Client: 192.168.1.253</b> <b>Forwarder: 192.168.1.250</b> <b>Server: 192.168.1.252</b>	Echo Server Client	The rule should forward the packet 192.168.1.252 and return a message to 192.168.1.253	Pass
4	100 client load using epoll server on dport 1004>8000 <b>Client: 192.168.1.253</b> <b>Forwarder: 192.168.1.250</b> <b>Server: 192.168.1.73</b>	Epoll server	It should function normally but slightly slower than without the forwarder	Pass
5	500 client load using epoll server on dport 1004>8000 <b>Client: 192.168.1.253</b> <b>Forwarder: 192.168.1.250</b> <b>Server: 192.168.1.73</b>	Epoll server	It should function normally but slightly slower than without the forwarder	Pass
6	1000 client load using epoll server on dport 1004>8000 <b>Client: 192.168.1.253</b> <b>Forwarder: 192.168.1.250</b> <b>Server: 192.168.1.73</b>	Epoll server	It should function normally but slightly slower than without the forwarder	Pass
7	1500 client load using epoll server on dport 1004>8000 <b>Client: 192.168.1.253</b> <b>Forwarder: 192.168.1.250</b> <b>Server: 192.168.1.73</b>	Epoll server	It should function normally but slightly slower than without the forwarder	Fail
8	100+100 client two way traffic <b>Host1: 192.168.1.250</b> <b>Forwarder: 192.168.1.252</b> <b>Host2: 192.168.1.73</b>	Epoll server	It should be work but might be slow because RPI4 forwarder	Pass

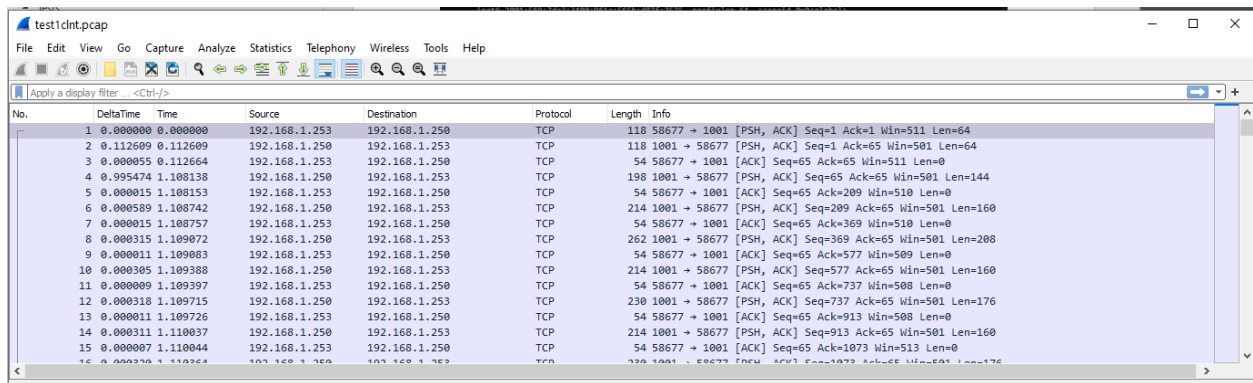
## 7.1 Test 1 SSH

I was able to successfully be forwarded to 192.168.1.252 dport 22 by SSH 192.168.1.250 dport 1001. The **forward.txt** rule used to do this is **192.168.1.253 1001 192.168.1.252 22** which means to forward any packets from 192.168.1.253 going to my port forwarder on port 1001 will then be port forwarded to 192.168.1.252 22. Both client and server will communicate to 192.168.1.250 as the intermediary.

```
pi@raspberrypi: ~  
IPv4 Address. . . . . : 192.168.1.253  
Subnet Mask . . . . . : 255.255.255.0  
Default Gateway . . . . . : fe80::9e1e:95ff:feb6:8310%11  
192.168.1.254  
  
Ethernet adapter Bluetooth Network Connection:  
  
Media State . . . . . : Media disconnected  
Connection-specific DNS Suffix . :  
  
C:\Users\Yuiko>ssh -p 1001 pi@192.168.1.250  
The authenticity of host '[192.168.1.250]:1001 ([192.168.1.250]:1001)' can't be established.  
ECDSA key fingerprint is SHA256:/qltOEMIX/DpPxxCMeqQBK2h3alUPgtIQe7mKLD20GU.  
Are you sure you want to continue connecting (yes/no)? yes  
Warning: Permanently added '[192.168.1.250]:1001' (ECDSA) to the list of known hosts.  
pi@192.168.1.250's password:  
Linux raspberrypi 5.4.83-v7l+ #1379 SMP Mon Dec 14 13:11:54 GMT 2020 armv7l  
  
The programs included with the Debian GNU/Linux system are free software;  
the exact distribution terms for each program are described in the  
individual files in /usr/share/doc/*/copyright.  
  
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent  
permitted by applicable law.  
Last login: Mon Apr 5 02:07:07 2021 from 192.168.1.250  
  
SSH is enabled and the default password for the 'pi' user has not been changed.  
This is a security risk - please login as the 'pi' user and type 'passwd' to set a new password.  
pi@raspberrypi:~ $  
  
pi@raspberrypi: ~  
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent  
permitted by applicable law.  
Last login: Mon Apr 5 02:07:07 2021 from 192.168.1.250  
  
SSH is enabled and the default password for the 'pi' user has not been changed.  
This is a security risk - please login as the 'pi' user and type 'passwd' to set a new password.  
pi@raspberrypi:~ $ ifconfig  
lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536  
    inet 127.0.0.1 netmask 255.0.0.0  
    inet6 ::1 prefixlen 128 scopeid 0x10<host>  
    loop txqueuelen 1000 (Local Loopback)  
    RX packets 446 bytes 49641 (48.4 KiB)  
    RX errors 0 dropped 0 overruns 0 frame 0  
    TX packets 446 bytes 49641 (48.4 KiB)  
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0  
  
wlan0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500  
    inet 192.168.1.252 netmask 255.255.255.0 broadcast 192.168.1.255  
    inet6 2001:569:7da3:3400:961a:565b:d87f:2575 prefixlen 64 scopeid 0x0<global>  
    inet6 fe80::4084:e67b:67aa:862c prefixlen 64 scopeid 0x20<link>  
    ether dc:a6:32:88:5f:eb txqueuelen 1000 (Ethernet)  
    RX packets 167038 bytes 84343244 (80.4 MiB)  
    RX errors 0 dropped 0 overruns 0 frame 0  
    TX packets 15733 bytes 6463256 (6.1 MiB)  
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0  
  
pi@raspberrypi:~ $ sudo su  
root@raspberrypi:/home/pi#
```



## Client



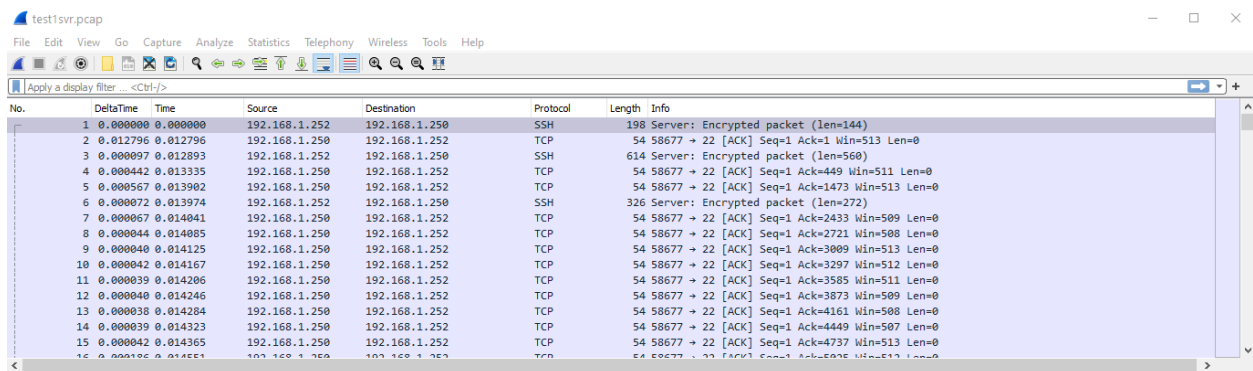
test1clnt.pcap

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter: <Ctrl-F>

No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.000000	192.168.1.253	192.168.1.250	TCP	118	58677 → 1001 [PSH, ACK] Seq=1 Ack=1 Win=511 Len=64
2	0.112609	0.112609	192.168.1.250	192.168.1.253	TCP	118	1001 → 58677 [PSH, ACK] Seq=1 Ack=65 Win=501 Len=64
3	0.000055	0.112664	192.168.1.253	192.168.1.250	TCP	54	58677 → 1001 [ACK] Seq=65 Ack=65 Win=511 Len=0
4	0.995474	1.108138	192.168.1.250	192.168.1.253	TCP	198	1001 → 58677 [PSH, ACK] Seq=65 Ack=65 Win=501 Len=144
5	0.000015	1.108153	192.168.1.253	192.168.1.250	TCP	54	58677 → 1001 [ACK] Seq=65 Ack=209 Win=510 Len=0
6	0.000589	1.108742	192.168.1.250	192.168.1.253	TCP	214	1001 → 58677 [PSH, ACK] Seq=209 Ack=65 Win=501 Len=160
7	0.000015	1.108757	192.168.1.253	192.168.1.250	TCP	54	58677 → 1001 [ACK] Seq=65 Ack=369 Win=510 Len=0
8	0.000315	1.109072	192.168.1.250	192.168.1.253	TCP	262	1001 → 58677 [PSH, ACK] Seq=369 Ack=65 Win=501 Len=208
9	0.000011	1.109083	192.168.1.253	192.168.1.250	TCP	54	58677 → 1001 [ACK] Seq=65 Ack=577 Win=509 Len=0
10	0.000305	1.109388	192.168.1.250	192.168.1.253	TCP	214	1001 → 58677 [PSH, ACK] Seq=577 Ack=65 Win=501 Len=160
11	0.000009	1.109397	192.168.1.253	192.168.1.250	TCP	54	58677 → 1001 [ACK] Seq=65 Ack=737 Win=508 Len=0
12	0.000318	1.109715	192.168.1.250	192.168.1.253	TCP	230	1001 → 58677 [PSH, ACK] Seq=737 Ack=65 Win=501 Len=176
13	0.000011	1.109726	192.168.1.253	192.168.1.250	TCP	54	58677 → 1001 [ACK] Seq=65 Ack=913 Win=508 Len=0
14	0.000311	1.110037	192.168.1.250	192.168.1.253	TCP	214	1001 → 58677 [PSH, ACK] Seq=913 Ack=65 Win=501 Len=160
15	0.000007	1.110044	192.168.1.253	192.168.1.250	TCP	54	58677 → 1001 [ACK] Seq=65 Ack=1073 Win=513 Len=0

## Server



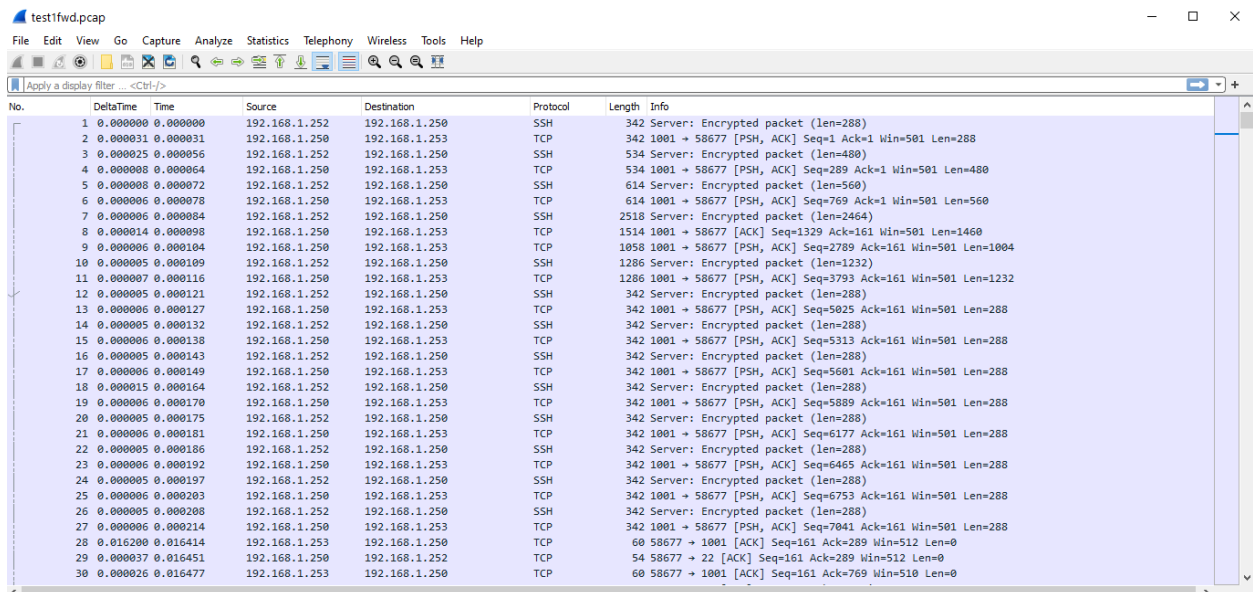
test1svr.pcap

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter: <Ctrl-F>

No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.000000	192.168.1.252	192.168.1.250	SSH	198	Server: Encrypted packet (Len=144)
2	0.012796	0.012796	192.168.1.250	192.168.1.252	TCP	54	58677 → 22 [ACK] Seq=1 Ack=1 Win=513 Len=0
3	0.000097	0.012893	192.168.1.252	192.168.1.250	SSH	614	Server: Encrypted packet (Len=560)
4	0.000442	0.013335	192.168.1.250	192.168.1.252	TCP	54	58677 → 22 [ACK] Seq=1 Ack=449 Win=511 Len=0
5	0.000567	0.013902	192.168.1.250	192.168.1.252	TCP	54	58677 → 22 [ACK] Seq=1 Ack=1473 Win=513 Len=0
6	0.000072	0.013974	192.168.1.252	192.168.1.250	SSH	326	Server: Encrypted packet (Len=272)
7	0.000067	0.014041	192.168.1.250	192.168.1.252	TCP	54	58677 → 22 [ACK] Seq=1 Ack=2433 Win=509 Len=0
8	0.000044	0.014085	192.168.1.250	192.168.1.252	TCP	54	58677 → 22 [ACK] Seq=1 Ack=2721 Win=508 Len=0
9	0.000040	0.014125	192.168.1.250	192.168.1.252	TCP	54	58677 → 22 [ACK] Seq=1 Ack=3009 Win=513 Len=0
10	0.000042	0.014167	192.168.1.250	192.168.1.252	TCP	54	58677 → 22 [ACK] Seq=1 Ack=3297 Win=512 Len=0
11	0.000039	0.014206	192.168.1.250	192.168.1.252	TCP	54	58677 → 22 [ACK] Seq=1 Ack=3585 Win=511 Len=0
12	0.000040	0.014246	192.168.1.250	192.168.1.252	TCP	54	58677 → 22 [ACK] Seq=1 Ack=3873 Win=509 Len=0
13	0.000038	0.014284	192.168.1.250	192.168.1.252	TCP	54	58677 → 22 [ACK] Seq=1 Ack=4161 Win=508 Len=0
14	0.000039	0.014323	192.168.1.250	192.168.1.252	TCP	54	58677 → 22 [ACK] Seq=1 Ack=4449 Win=507 Len=0
15	0.000042	0.014365	192.168.1.250	192.168.1.252	TCP	54	58677 → 22 [ACK] Seq=1 Ack=4737 Win=513 Len=0

## Forwarder



test1fwd.pcap

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

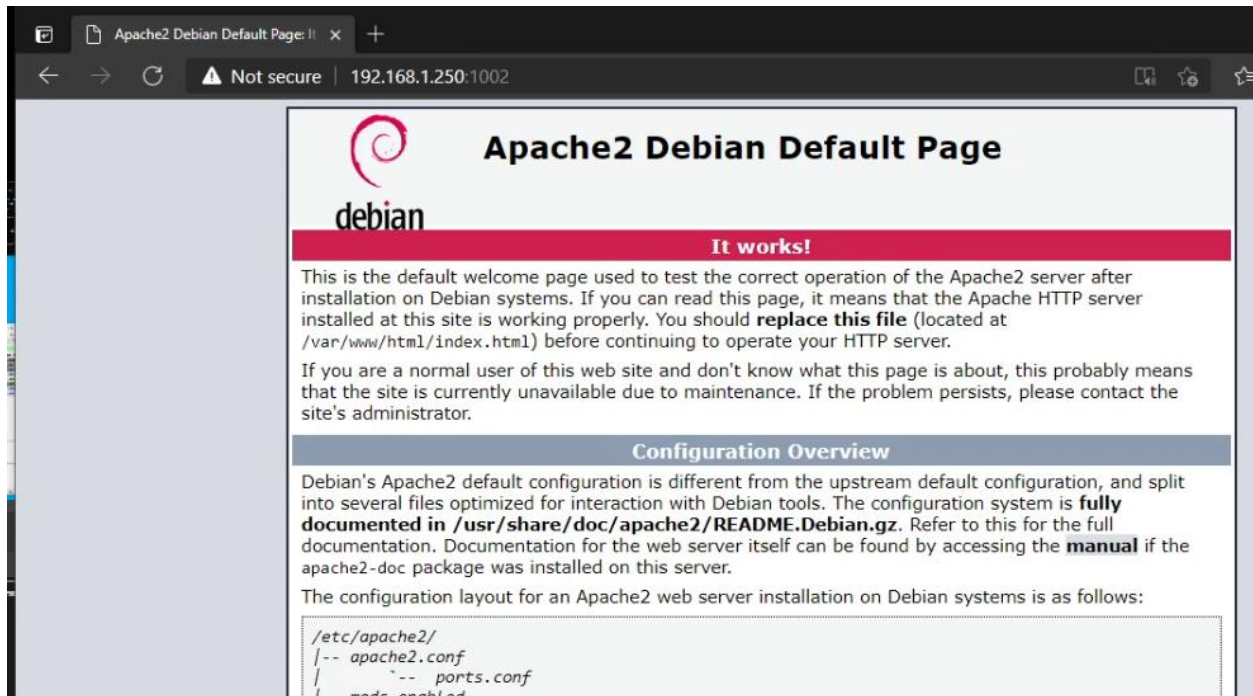
Apply a display filter: <Ctrl-F>

No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.000000	192.168.1.252	192.168.1.250	SSH	342	Server: Encrypted packet (Len=288)
2	0.000031	0.000031	192.168.1.250	192.168.1.253	TCP	342	1001 → 58677 [PSH, ACK] Seq=1 Ack=1 Win=501 Len=288
3	0.000025	0.000056	192.168.1.252	192.168.1.250	SSH	534	Server: Encrypted packet (Len=480)
4	0.000008	0.000064	192.168.1.250	192.168.1.253	TCP	534	1001 → 58677 [PSH, ACK] Seq=289 Ack=1 Win=501 Len=480
5	0.000008	0.000072	192.168.1.252	192.168.1.250	SSH	614	Server: Encrypted packet (Len=560)
6	0.000006	0.000078	192.168.1.250	192.168.1.253	TCP	614	1001 → 58677 [PSH, ACK] Seq=769 Ack=1 Win=501 Len=560
7	0.000006	0.000084	192.168.1.252	192.168.1.250	SSH	2518	Server: Encrypted packet (Len=2464)
8	0.000014	0.000098	192.168.1.250	192.168.1.253	TCP	1514	1001 → 58677 [ACK] Seq=1329 Ack=161 Win=501 Len=1460
9	0.000006	0.000104	192.168.1.250	192.168.1.253	TCP	1058	1001 → 58677 [PSH, ACK] Seq=2789 Ack=161 Win=501 Len=1004
10	0.000005	0.000109	192.168.1.252	192.168.1.250	SSH	1286	Server: Encrypted packet (Len=1232)
11	0.000007	0.000116	192.168.1.250	192.168.1.253	TCP	1286	1001 → 58677 [PSH, ACK] Seq=3793 Ack=161 Win=501 Len=1232
12	0.000005	0.000121	192.168.1.252	192.168.1.250	SSH	342	Server: Encrypted packet (Len=288)
13	0.000006	0.000127	192.168.1.250	192.168.1.253	TCP	342	1001 → 58677 [PSH, ACK] Seq=5025 Ack=161 Win=501 Len=288
14	0.000005	0.000132	192.168.1.252	192.168.1.250	SSH	342	Server: Encrypted packet (Len=288)
15	0.000006	0.000138	192.168.1.250	192.168.1.253	TCP	342	1001 → 58677 [PSH, ACK] Seq=5313 Ack=161 Win=501 Len=288
16	0.000005	0.000143	192.168.1.252	192.168.1.250	SSH	342	Server: Encrypted packet (Len=288)
17	0.000006	0.000149	192.168.1.250	192.168.1.253	TCP	342	1001 → 58677 [PSH, ACK] Seq=5601 Ack=161 Win=501 Len=288
18	0.000015	0.000164	192.168.1.252	192.168.1.250	SSH	342	Server: Encrypted packet (Len=288)
19	0.000006	0.000170	192.168.1.250	192.168.1.253	TCP	342	1001 → 58677 [PSH, ACK] Seq=5889 Ack=161 Win=501 Len=288
20	0.000005	0.000175	192.168.1.252	192.168.1.250	SSH	342	Server: Encrypted packet (Len=288)
21	0.000006	0.000181	192.168.1.250	192.168.1.253	TCP	342	1001 → 58677 [PSH, ACK] Seq=6177 Ack=161 Win=501 Len=288
22	0.000005	0.000186	192.168.1.252	192.168.1.250	SSH	342	Server: Encrypted packet (Len=288)
23	0.000006	0.000192	192.168.1.250	192.168.1.253	TCP	342	1001 → 58677 [PSH, ACK] Seq=6465 Ack=161 Win=501 Len=288
24	0.000005	0.000197	192.168.1.252	192.168.1.250	SSH	342	Server: Encrypted packet (Len=288)
25	0.000006	0.000203	192.168.1.250	192.168.1.253	TCP	342	1001 → 58677 [PSH, ACK] Seq=6753 Ack=161 Win=501 Len=288
26	0.000005	0.000208	192.168.1.252	192.168.1.250	SSH	342	Server: Encrypted packet (Len=288)
27	0.000006	0.000214	192.168.1.250	192.168.1.253	TCP	342	1001 → 58677 [PSH, ACK] Seq=7041 Ack=161 Win=501 Len=288
28	0.016200	0.016414	192.168.1.253	192.168.1.250	TCP	60	58677 → 1001 [ACK] Seq=161 Ack=289 Win=512 Len=0
29	0.000037	0.016451	192.168.1.250	192.168.1.252	TCP	54	58677 → 22 [ACK] Seq=161 Ack=289 Win=512 Len=0
30	0.000026	0.016477	192.168.1.253	192.168.1.250	TCP	60	58677 → 1001 [ACK] Seq=161 Ack=769 Win=510 Len=0

As shown by the packet captures the forwarder is the one responsible for managing communications between both client and server by passing packets to each other

## 7.2 Test 2 HTTP

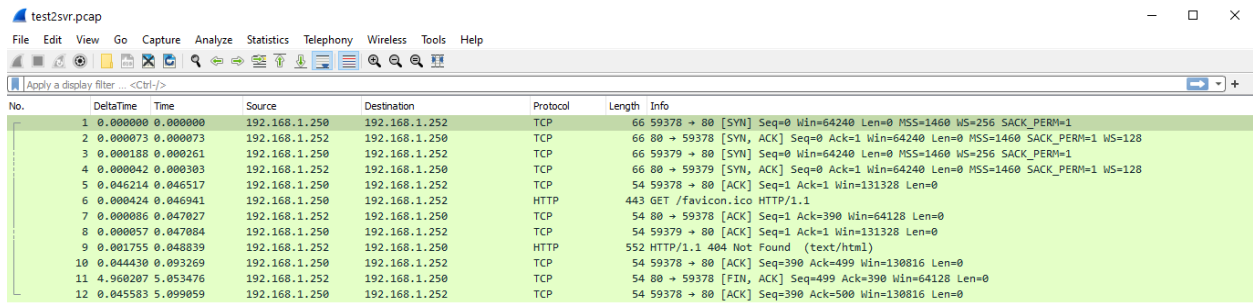
I was able to successfully be forwarded to 192.168.1.252 dport 80 by HTML 192.168.1.250 dport 1002. The **forward.txt** rule used to do this is **192.168.1.253 1002 192.168.1.252 80** which means to forward any packets from 192.168.1.253 going to my port forwarder on port 1002 will then be port forwarded to 192.168.1.252 80. Both client and server will communicate to 192.168.1.250 as the intermediary.



## Client

No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.000000	192.168.1.253	192.168.1.250	TCP	66	59378 → 1002 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2	0.000114	0.000114	192.168.1.253	192.168.1.250	TCP	66	59379 → 1002 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
3	0.134927	0.135041	192.168.1.250	192.168.1.253	TCP	66	1002 → 59378 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
4	0.000045	0.135086	192.168.1.253	192.168.1.250	TCP	54	59378 → 1002 [ACK] Seq=1 Ack=1 Win=131328 Len=0
5	0.000138	0.135224	192.168.1.253	192.168.1.250	HTTP	443	GET /favicon.ico HTTP/1.1
6	0.000143	0.135367	192.168.1.250	192.168.1.253	TCP	66	1002 → 59379 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
7	0.000029	0.135396	192.168.1.253	192.168.1.250	TCP	54	59379 → 1002 [ACK] Seq=1 Ack=1 Win=131328 Len=0
8	0.047704	0.183100	192.168.1.250	192.168.1.253	TCP	60	1002 → 59378 [ACK] Seq=1 Ack=390 Win=64128 Len=0
9	0.000001	0.183101	192.168.1.250	192.168.1.253	HTTP	552	HTTP/1.1 404 Not Found (text/html)
10	0.000071	0.183172	192.168.1.253	192.168.1.250	TCP	54	59378 → 1002 [ACK] Seq=390 Ack=499 Win=130816 Len=0
11	5.005212	5.188384	192.168.1.250	192.168.1.253	TCP	60	1002 → 59378 [FIN, ACK] Seq=499 Ack=390 Win=64128 Len=0
12	0.000033	5.188417	192.168.1.253	192.168.1.250	TCP	54	59378 → 1002 [ACK] Seq=390 Ack=500 Win=130816 Len=0
13	12.2614	17.449899	192.168.1.253	192.168.1.250	TCP	54	59379 → 1002 [FIN, ACK] Seq=1 Ack=1 Win=131328 Len=0
14	0.000032	17.449931	192.168.1.253	192.168.1.250	TCP	54	59378 → 1002 [FIN, ACK] Seq=390 Ack=500 Win=130816 Len=0
15	0.091823	17.541754	192.168.1.250	192.168.1.253	TCP	60	1002 → 59378 [ACK] Seq=500 Ack=391 Win=64128 Len=0

## Server



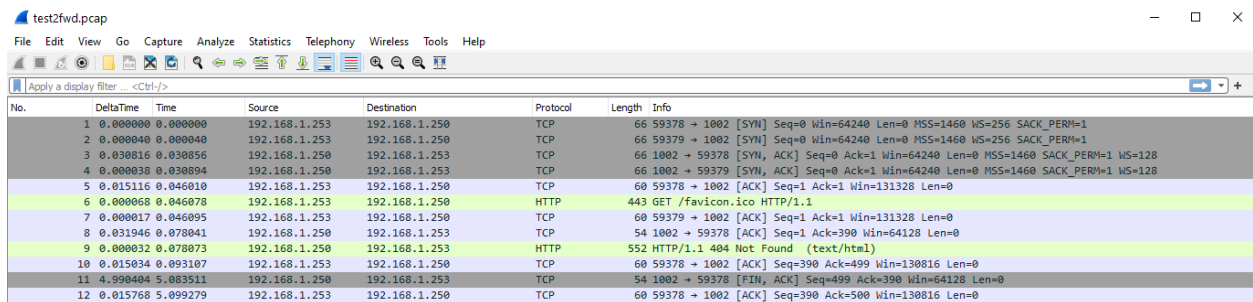
test2svr.pcap

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter: <Ctrl-F>

No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.000000	192.168.1.250	192.168.1.252	TCP	66	59378 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2	0.000073	0.000073	192.168.1.252	192.168.1.250	TCP	66	80 → 59378 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
3	0.000188	0.000261	192.168.1.250	192.168.1.252	TCP	66	59379 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
4	0.000042	0.000303	192.168.1.252	192.168.1.250	TCP	66	80 → 59379 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
5	0.046214	0.046517	192.168.1.250	192.168.1.252	TCP	54	59378 → 80 [ACK] Seq=1 Ack=1 Win=131328 Len=0
6	0.000424	0.046941	192.168.1.250	192.168.1.252	HTTP	443	GET /favicon.ico HTTP/1.1
7	0.000086	0.047027	192.168.1.252	192.168.1.250	TCP	54	80 → 59378 [ACK] Seq=1 Ack=390 Win=64128 Len=0
8	0.000057	0.047084	192.168.1.250	192.168.1.252	TCP	54	59379 → 80 [ACK] Seq=1 Ack=1 Win=131328 Len=0
9	0.001755	0.048839	192.168.1.252	192.168.1.250	HTTP	552	HTTP/1.1 404 Not Found (text/html)
10	0.044430	0.093269	192.168.1.250	192.168.1.252	TCP	54	59378 → 80 [ACK] Seq=390 Ack=499 Win=130816 Len=0
11	4.960207	5.053476	192.168.1.252	192.168.1.250	TCP	54	80 → 59378 [FIN, ACK] Seq=499 Ack=390 Win=64128 Len=0
12	0.045583	5.099059	192.168.1.250	192.168.1.252	TCP	54	59378 → 80 [ACK] Seq=390 Ack=500 Win=130816 Len=0

## Forwarder



test2fwd.pcap

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter: <Ctrl-F>

No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.000000	192.168.1.253	192.168.1.250	TCP	66	59378 → 1002 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2	0.000040	0.000040	192.168.1.253	192.168.1.250	TCP	66	59379 → 1002 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
3	0.030016	0.030056	192.168.1.250	192.168.1.253	TCP	66	1002 → 59378 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
4	0.000038	0.030094	192.168.1.250	192.168.1.253	TCP	66	1002 → 59379 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
5	0.015116	0.046010	192.168.1.253	192.168.1.250	TCP	60	59378 → 1002 [ACK] Seq=1 Ack=1 Win=131328 Len=0
6	0.000068	0.046078	192.168.1.253	192.168.1.250	HTTP	443	GET /favicon.ico HTTP/1.1
7	0.000017	0.046095	192.168.1.253	192.168.1.250	TCP	60	59379 → 1002 [ACK] Seq=1 Ack=1 Win=131328 Len=0
8	0.031946	0.078041	192.168.1.250	192.168.1.253	TCP	54	1002 → 59378 [ACK] Seq=1 Ack=390 Win=64128 Len=0
9	0.000032	0.078073	192.168.1.250	192.168.1.253	HTTP	552	HTTP/1.1 404 Not Found (text/html)
10	0.015034	0.093107	192.168.1.253	192.168.1.250	TCP	60	59378 → 1002 [ACK] Seq=390 Ack=499 Win=130816 Len=0
11	4.990404	5.083511	192.168.1.250	192.168.1.253	TCP	54	1002 → 59378 [FIN, ACK] Seq=499 Ack=390 Win=64128 Len=0
12	0.015768	5.099279	192.168.1.253	192.168.1.250	TCP	60	59378 → 1002 [ACK] Seq=390 Ack=500 Win=130816 Len=0

As shown by the packet captures the forwarder is the one responsible for managing communications between both client and server by passing packets to each other

### 7.3 Test 3 Echo Server Client

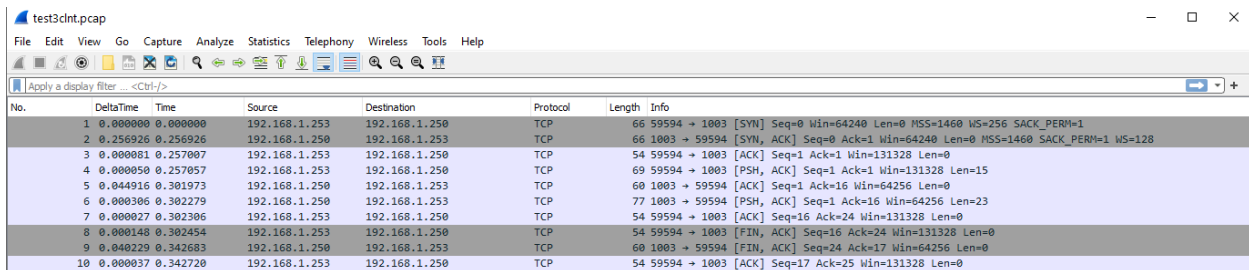
I was able to successfully be forwarded to 192.168.1.252 dport 8000 by HTML 192.168.1.250 dport 1003. The **forward.txt** rule used to do this is **192.168.1.253 1003 192.168.1.252 8000** which means to forward any packets from 192.168.1.253 going to my port forwarder on port 1003 will then be port forwarded to 192.168.1.252 8000. Both client and server will communicate to 192.168.1.250 as the intermediary.

```
E:\Homework\term6\8005\FinalProj\demoecho>python echo-client.py 192.168.1.250
Received From Server: b'Echo => Hello TCP World'
```

```
pi@raspberrypi: ~
root@raspberrypi:/home/pi/Desktop# dir
echo-server.py  epoll_svr.py  test1svr.pcap  test2svr.pcap
root@raspberrypi:/home/pi/Desktop# python echo-server.py

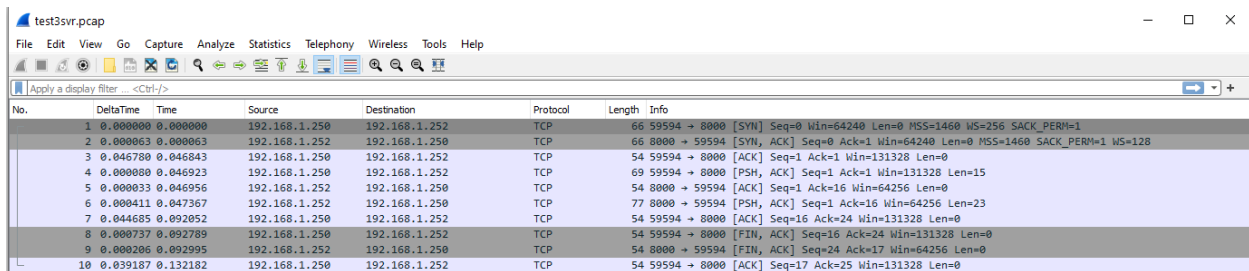
('Client Connection:', ('192.168.1.250', 59594))
```

#### Client



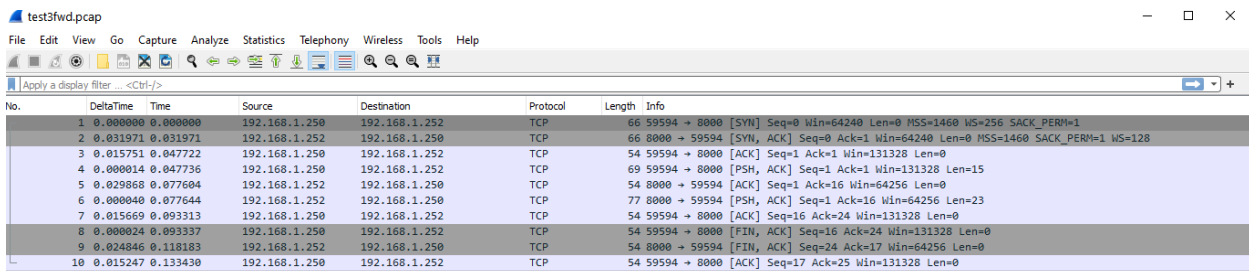
No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.000000	192.168.1.253	192.168.1.250	TCP	66	59594 → 1003 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2	0.256926	0.256926	192.168.1.250	192.168.1.253	TCP	66	1003 → 59594 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
3	0.000081	0.257007	192.168.1.253	192.168.1.250	TCP	54	59594 → 1003 [ACK] Seq=1 Ack=1 Win=131328 Len=0
4	0.000050	0.257057	192.168.1.253	192.168.1.250	TCP	69	59594 → 1003 [PSH, ACK] Seq=1 Ack=1 Win=131328 Len=15
5	0.044916	0.301973	192.168.1.250	192.168.1.253	TCP	60	1003 → 59594 [ACK] Seq=1 Ack=16 Win=64256 Len=0
6	0.000306	0.302279	192.168.1.250	192.168.1.253	TCP	77	1003 → 59594 [PSH, ACK] Seq=1 Ack=16 Win=64256 Len=23
7	0.000027	0.302306	192.168.1.253	192.168.1.250	TCP	54	59594 → 1003 [ACK] Seq=16 Ack=24 Win=131328 Len=0
8	0.000148	0.302454	192.168.1.253	192.168.1.250	TCP	54	59594 → 1003 [FIN, ACK] Seq=16 Ack=24 Win=131328 Len=0
9	0.040229	0.342683	192.168.1.250	192.168.1.253	TCP	60	1003 → 59594 [FIN, ACK] Seq=24 Ack=17 Win=64256 Len=0
10	0.000037	0.342720	192.168.1.253	192.168.1.250	TCP	54	59594 → 1003 [ACK] Seq=17 Ack=25 Win=131328 Len=0

#### Server



No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.000000	192.168.1.250	192.168.1.252	TCP	66	59594 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2	0.000063	0.000063	192.168.1.252	192.168.1.250	TCP	66	8000 → 59594 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
3	0.046780	0.046843	192.168.1.250	192.168.1.252	TCP	54	59594 → 8000 [ACK] Seq=1 Ack=1 Win=131328 Len=0
4	0.000080	0.046923	192.168.1.250	192.168.1.252	TCP	69	59594 → 8000 [PSH, ACK] Seq=1 Ack=1 Win=131328 Len=15
5	0.000033	0.046956	192.168.1.252	192.168.1.250	TCP	54	8000 → 59594 [ACK] Seq=1 Ack=16 Win=64256 Len=0
6	0.000411	0.047367	192.168.1.252	192.168.1.250	TCP	77	8000 → 59594 [PSH, ACK] Seq=1 Ack=16 Win=64256 Len=23
7	0.044685	0.092052	192.168.1.250	192.168.1.252	TCP	54	59594 → 8000 [ACK] Seq=16 Ack=24 Win=131328 Len=0
8	0.000737	0.092789	192.168.1.250	192.168.1.252	TCP	54	59594 → 8000 [FIN, ACK] Seq=16 Ack=24 Win=131328 Len=0
9	0.000206	0.092995	192.168.1.252	192.168.1.250	TCP	54	8000 → 59594 [FIN, ACK] Seq=24 Ack=17 Win=64256 Len=0
10	0.039187	0.132182	192.168.1.250	192.168.1.252	TCP	54	59594 → 8000 [ACK] Seq=17 Ack=25 Win=131328 Len=0

#### Forwarder

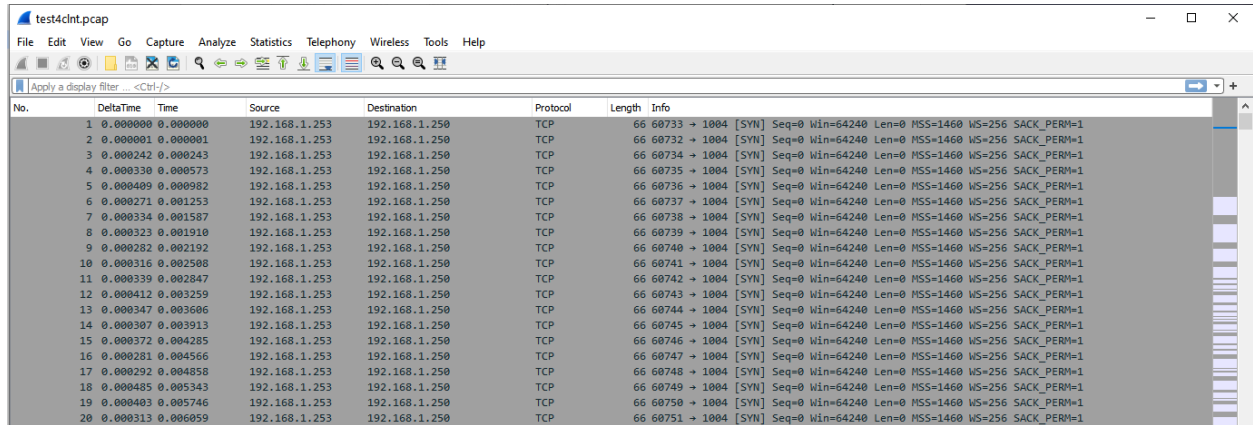


No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.000000	192.168.1.250	192.168.1.252	TCP	66	59594 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2	0.031971	0.031971	192.168.1.252	192.168.1.250	TCP	66	8000 → 59594 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
3	0.015751	0.047722	192.168.1.250	192.168.1.252	TCP	54	59594 → 8000 [ACK] Seq=1 Ack=1 Win=131328 Len=0
4	0.000014	0.047736	192.168.1.250	192.168.1.252	TCP	69	59594 → 8000 [PSH, ACK] Seq=1 Ack=1 Win=131328 Len=15
5	0.029868	0.077604	192.168.1.252	192.168.1.250	TCP	54	8000 → 59594 [ACK] Seq=1 Ack=16 Win=64256 Len=0
6	0.000040	0.077644	192.168.1.252	192.168.1.250	TCP	77	8000 → 59594 [PSH, ACK] Seq=1 Ack=16 Win=64256 Len=23
7	0.015669	0.093313	192.168.1.250	192.168.1.252	TCP	54	59594 → 8000 [ACK] Seq=16 Ack=24 Win=131328 Len=0
8	0.000024	0.093337	192.168.1.250	192.168.1.252	TCP	54	59594 → 8000 [FIN, ACK] Seq=16 Ack=24 Win=131328 Len=0
9	0.024846	0.118183	192.168.1.252	192.168.1.250	TCP	54	8000 → 59594 [FIN, ACK] Seq=24 Ack=17 Win=64256 Len=0
10	0.015247	0.133430	192.168.1.250	192.168.1.252	TCP	54	59594 → 8000 [ACK] Seq=17 Ack=25 Win=131328 Len=0

## 7.4 Test 4 100 Clients

The performance of the port forwarder with 100 clients coming from 192.168.1.253 is relatively quick and successfully completes the test

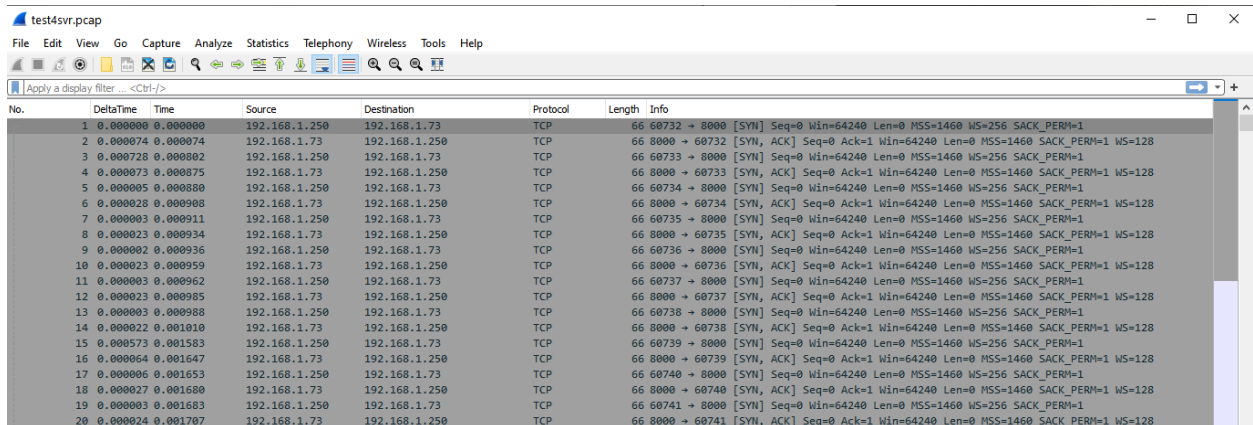
### Client



test4clnt.pcap

No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.000000	192.168.1.253	192.168.1.250	TCP	66	60732 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2	0.000001	0.000001	192.168.1.253	192.168.1.250	TCP	66	60732 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
3	0.000242	0.000243	192.168.1.253	192.168.1.250	TCP	66	60734 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
4	0.000330	0.000573	192.168.1.253	192.168.1.250	TCP	66	60735 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
5	0.000409	0.000992	192.168.1.253	192.168.1.250	TCP	66	60736 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
6	0.000271	0.001253	192.168.1.253	192.168.1.250	TCP	66	60737 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
7	0.000334	0.001587	192.168.1.253	192.168.1.250	TCP	66	60738 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
8	0.000323	0.001910	192.168.1.253	192.168.1.250	TCP	66	60739 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
9	0.000282	0.002192	192.168.1.253	192.168.1.250	TCP	66	60740 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
10	0.000316	0.002508	192.168.1.253	192.168.1.250	TCP	66	60741 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
11	0.000339	0.002847	192.168.1.253	192.168.1.250	TCP	66	60742 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
12	0.000412	0.003259	192.168.1.253	192.168.1.250	TCP	66	60743 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
13	0.000347	0.003606	192.168.1.253	192.168.1.250	TCP	66	60744 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
14	0.000307	0.003913	192.168.1.253	192.168.1.250	TCP	66	60745 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
15	0.000372	0.004285	192.168.1.253	192.168.1.250	TCP	66	60746 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
16	0.000281	0.004566	192.168.1.253	192.168.1.250	TCP	66	60747 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
17	0.000292	0.004858	192.168.1.253	192.168.1.250	TCP	66	60748 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
18	0.000485	0.005343	192.168.1.253	192.168.1.250	TCP	66	60749 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
19	0.000403	0.005746	192.168.1.253	192.168.1.250	TCP	66	60750 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
20	0.000313	0.006059	192.168.1.253	192.168.1.250	TCP	66	60751 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1

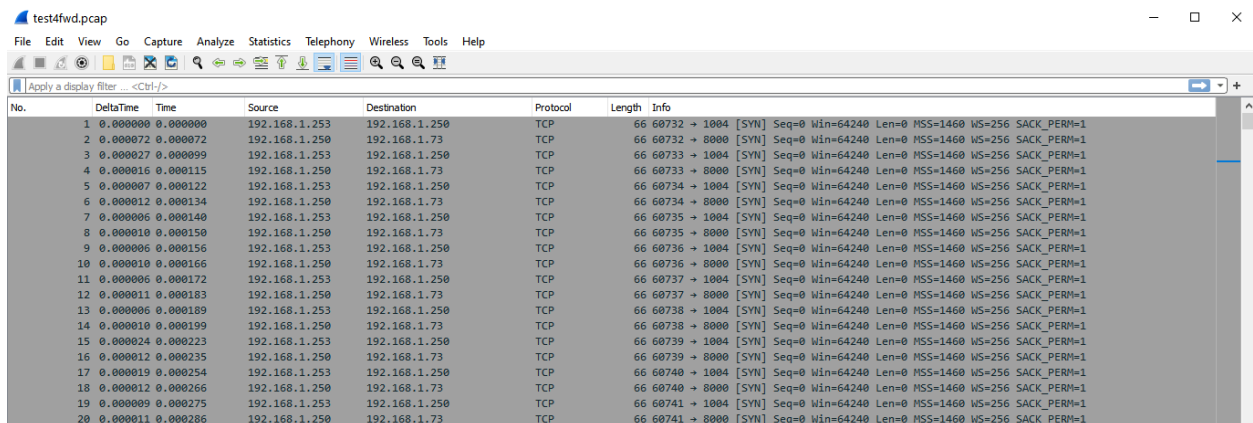
### Server



test4svr.pcap

No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.000000	192.168.1.250	192.168.1.73	TCP	66	60732 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2	0.000074	0.000074	192.168.1.73	192.168.1.250	TCP	66	8000 → 60732 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
3	0.000726	0.000802	192.168.1.250	192.168.1.73	TCP	66	60733 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
4	0.000073	0.000875	192.168.1.73	192.168.1.250	TCP	66	8000 → 60733 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
5	0.000005	0.000880	192.168.1.250	192.168.1.73	TCP	66	60734 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
6	0.000028	0.000908	192.168.1.73	192.168.1.250	TCP	66	8000 → 60734 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
7	0.000003	0.000911	192.168.1.250	192.168.1.73	TCP	66	60735 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
8	0.000023	0.000934	192.168.1.73	192.168.1.250	TCP	66	8000 → 60735 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
9	0.000002	0.000936	192.168.1.250	192.168.1.73	TCP	66	60736 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
10	0.000023	0.000959	192.168.1.73	192.168.1.250	TCP	66	8000 → 60736 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
11	0.000003	0.000962	192.168.1.250	192.168.1.73	TCP	66	60737 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
12	0.000023	0.000985	192.168.1.73	192.168.1.250	TCP	66	8000 → 60737 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
13	0.000003	0.000988	192.168.1.250	192.168.1.73	TCP	66	60738 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
14	0.000022	0.001010	192.168.1.73	192.168.1.250	TCP	66	8000 → 60738 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
15	0.000573	0.001583	192.168.1.250	192.168.1.73	TCP	66	60739 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
16	0.000064	0.001647	192.168.1.73	192.168.1.250	TCP	66	8000 → 60739 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
17	0.000006	0.001653	192.168.1.250	192.168.1.73	TCP	66	60740 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
18	0.000027	0.001680	192.168.1.73	192.168.1.250	TCP	66	8000 → 60740 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
19	0.000003	0.001683	192.168.1.250	192.168.1.73	TCP	66	60741 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
20	0.000024	0.001707	192.168.1.73	192.168.1.250	TCP	66	8000 → 60741 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128

### Forwarder



test4fwd.pcap

No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.000000	192.168.1.253	192.168.1.250	TCP	66	60732 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2	0.000072	0.000072	192.168.1.250	192.168.1.73	TCP	66	60732 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
3	0.000027	0.000099	192.168.1.253	192.168.1.250	TCP	66	60733 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
4	0.000016	0.000115	192.168.1.250	192.168.1.73	TCP	66	60733 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
5	0.000007	0.000122	192.168.1.253	192.168.1.250	TCP	66	60734 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
6	0.000012	0.000134	192.168.1.250	192.168.1.73	TCP	66	60734 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
7	0.000006	0.000140	192.168.1.253	192.168.1.250	TCP	66	60735 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
8	0.000010	0.000150	192.168.1.250	192.168.1.73	TCP	66	60735 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
9	0.000006	0.000156	192.168.1.253	192.168.1.250	TCP	66	60736 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
10	0.000010	0.000166	192.168.1.250	192.168.1.73	TCP	66	60736 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
11	0.000006	0.000172	192.168.1.253	192.168.1.250	TCP	66	60737 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
12	0.000011	0.000183	192.168.1.250	192.168.1.73	TCP	66	60737 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
13	0.000006	0.000189	192.168.1.253	192.168.1.250	TCP	66	60738 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
14	0.000010	0.000199	192.168.1.250	192.168.1.73	TCP	66	60738 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
15	0.000024	0.000223	192.168.1.253	192.168.1.250	TCP	66	60739 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
16	0.000012	0.000235	192.168.1.250	192.168.1.73	TCP	66	60739 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
17	0.000019	0.000254	192.168.1.253	192.168.1.250	TCP	66	60740 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
18	0.000012	0.000266	192.168.1.250	192.168.1.73	TCP	66	60740 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
19	0.000009	0.000275	192.168.1.253	192.168.1.250	TCP	66	60741 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
20	0.000011	0.000286	192.168.1.250	192.168.1.73	TCP	66	60741 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1

AutoSave Off clientstats100.xls - Compatibility Mode - Saved

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Drawing Tools

Draw with Touch

Ink to Shape

Ink to Math

Ink Replay

Touch Convert Replay

Q13

	A	B	C	D	E	F	G	H
1	Thread Num	Requests	Data Trans	Total Dural	Avg Response		Avg Total Duration	Avg Avg Response
2	0	100	6400	9.150835	0.055895		9.089017622	0.055820329
3	1	100	6400	8.994547	0.055863			
4	2	100	6400	8.675776	0.053789			
5	3	100	6400	9.072159	0.055575			
6	4	100	6400	9.021348	0.055714			
7	5	100	6400	8.925167	0.054117			
8	6	100	6400	9.03405	0.056538			
9	7	100	6400	9.126406	0.056009			
10	8	100	6400	8.94471	0.054776			
11	9	100	6400	9.021348	0.055077			

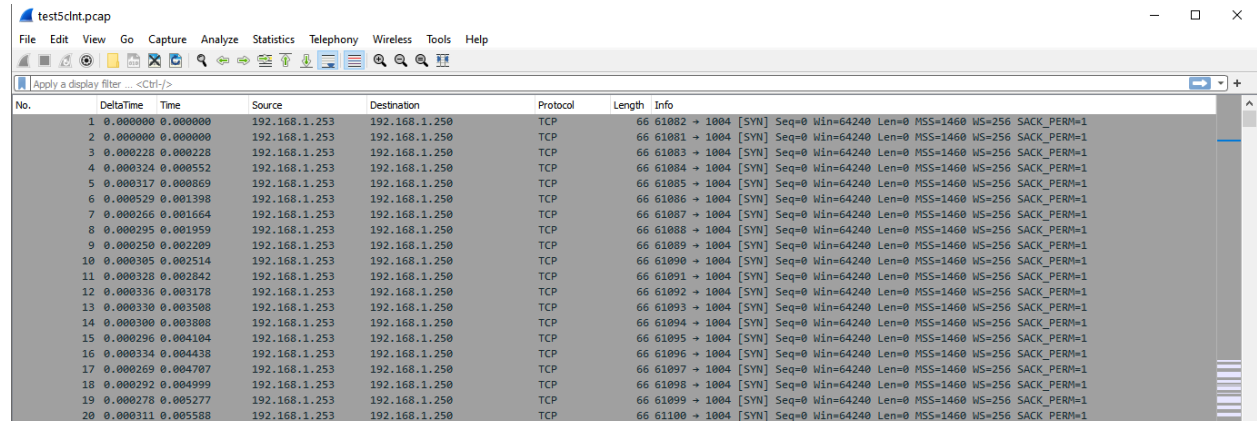
The average total duration and average response time has increased by almost 3x when compared to having no forwarder



## 7.5 Test 5 500 Clients

The performance of the port forwarder with 500 clients coming from 192.168.1.253 is slower and successfully completes the test

### Client



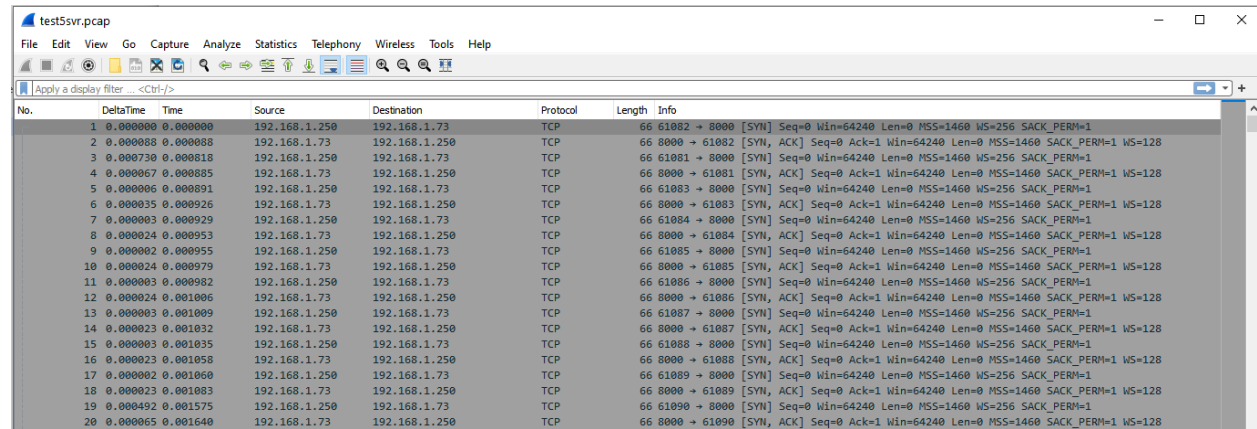
test5clnt.pcap

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter ... <Ctrl-/>

No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.000000	192.168.1.253	192.168.1.250	TCP	66	61082 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2	0.000000	0.000000	192.168.1.253	192.168.1.250	TCP	66	61081 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
3	0.000228	0.000228	192.168.1.253	192.168.1.250	TCP	66	61083 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
4	0.000324	0.000552	192.168.1.253	192.168.1.250	TCP	66	61084 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
5	0.000317	0.000869	192.168.1.253	192.168.1.250	TCP	66	61085 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
6	0.000529	0.001398	192.168.1.253	192.168.1.250	TCP	66	61086 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
7	0.000266	0.001664	192.168.1.253	192.168.1.250	TCP	66	61087 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
8	0.000295	0.001959	192.168.1.253	192.168.1.250	TCP	66	61088 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
9	0.000250	0.002209	192.168.1.253	192.168.1.250	TCP	66	61089 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
10	0.000305	0.002514	192.168.1.253	192.168.1.250	TCP	66	61090 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
11	0.000328	0.002842	192.168.1.253	192.168.1.250	TCP	66	61091 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
12	0.000336	0.003178	192.168.1.253	192.168.1.250	TCP	66	61092 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
13	0.000330	0.003508	192.168.1.253	192.168.1.250	TCP	66	61093 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
14	0.000300	0.003808	192.168.1.253	192.168.1.250	TCP	66	61094 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
15	0.000296	0.004104	192.168.1.253	192.168.1.250	TCP	66	61095 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
16	0.000334	0.004438	192.168.1.253	192.168.1.250	TCP	66	61096 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
17	0.000269	0.004707	192.168.1.253	192.168.1.250	TCP	66	61097 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
18	0.000292	0.004999	192.168.1.253	192.168.1.250	TCP	66	61098 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
19	0.000278	0.005277	192.168.1.253	192.168.1.250	TCP	66	61099 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
20	0.000311	0.005588	192.168.1.253	192.168.1.250	TCP	66	61100 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1

### Server



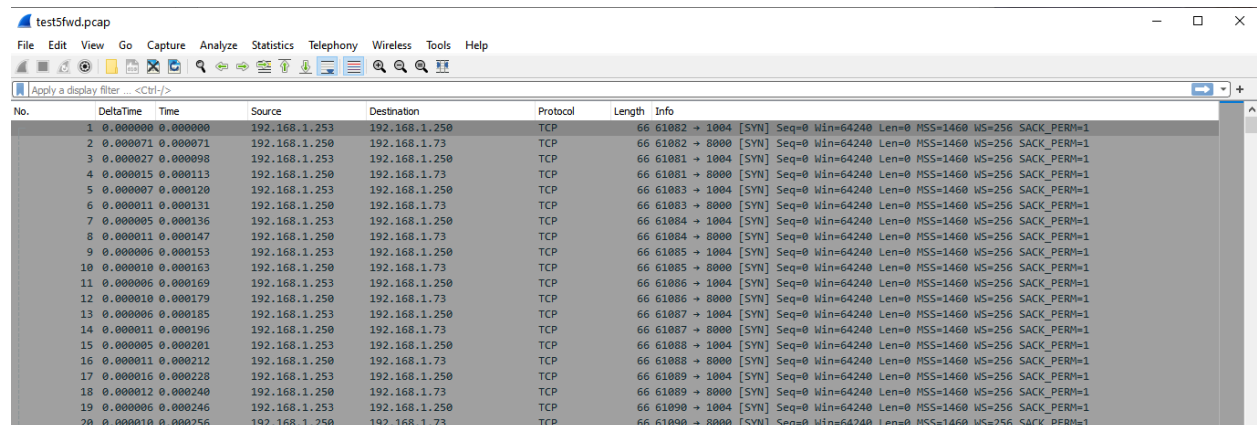
test5svr.pcap

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter ... <Ctrl-/>

No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.000000	192.168.1.250	192.168.1.73	TCP	66	61082 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2	0.000088	0.000088	192.168.1.73	192.168.1.250	TCP	66	8000 → 61082 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
3	0.000730	0.000818	192.168.1.250	192.168.1.73	TCP	66	61081 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
4	0.000067	0.000885	192.168.1.73	192.168.1.250	TCP	66	8000 → 61081 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
5	0.000006	0.000891	192.168.1.250	192.168.1.73	TCP	66	61083 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
6	0.000035	0.000926	192.168.1.73	192.168.1.250	TCP	66	8000 → 61083 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
7	0.000003	0.000929	192.168.1.250	192.168.1.73	TCP	66	61084 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
8	0.000024	0.000953	192.168.1.73	192.168.1.250	TCP	66	8000 → 61084 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
9	0.000002	0.000955	192.168.1.250	192.168.1.73	TCP	66	61085 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
10	0.000024	0.000979	192.168.1.73	192.168.1.250	TCP	66	8000 → 61085 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
11	0.000003	0.000982	192.168.1.250	192.168.1.73	TCP	66	61086 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
12	0.000024	0.001006	192.168.1.73	192.168.1.250	TCP	66	8000 → 61086 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
13	0.000003	0.001009	192.168.1.250	192.168.1.73	TCP	66	61087 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
14	0.000023	0.001032	192.168.1.73	192.168.1.250	TCP	66	8000 → 61087 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
15	0.000003	0.001035	192.168.1.250	192.168.1.73	TCP	66	61088 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
16	0.000023	0.001058	192.168.1.73	192.168.1.250	TCP	66	8000 → 61088 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
17	0.000002	0.001060	192.168.1.250	192.168.1.73	TCP	66	61089 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
18	0.000023	0.001083	192.168.1.73	192.168.1.250	TCP	66	8000 → 61089 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
19	0.000492	0.001575	192.168.1.250	192.168.1.73	TCP	66	61090 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
20	0.000065	0.001640	192.168.1.73	192.168.1.250	TCP	66	8000 → 61090 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128

### Forwarder



test5fwd.pcap

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Apply a display filter ... <Ctrl-/>

No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.000000	192.168.1.253	192.168.1.250	TCP	66	61082 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2	0.000071	0.000071	192.168.1.250	192.168.1.73	TCP	66	61082 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
3	0.000027	0.000098	192.168.1.253	192.168.1.250	TCP	66	61081 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
4	0.000015	0.000113	192.168.1.250	192.168.1.73	TCP	66	61081 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
5	0.000007	0.000120	192.168.1.253	192.168.1.250	TCP	66	61083 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
6	0.000011	0.000131	192.168.1.250	192.168.1.73	TCP	66	61083 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
7	0.000005	0.000136	192.168.1.253	192.168.1.250	TCP	66	61084 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
8	0.000011	0.000147	192.168.1.250	192.168.1.73	TCP	66	61084 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
9	0.000006	0.000153	192.168.1.253	192.168.1.250	TCP	66	61085 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
10	0.000010	0.000163	192.168.1.250	192.168.1.73	TCP	66	61085 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
11	0.000006	0.000169	192.168.1.253	192.168.1.250	TCP	66	61086 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
12	0.000010	0.000179	192.168.1.250	192.168.1.73	TCP	66	61086 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
13	0.000006	0.000185	192.168.1.253	192.168.1.250	TCP	66	61087 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
14	0.000011	0.000196	192.168.1.250	192.168.1.73	TCP	66	61087 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
15	0.000005	0.000201	192.168.1.253	192.168.1.250	TCP	66	61088 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
16	0.000011	0.000212	192.168.1.250	192.168.1.73	TCP	66	61088 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
17	0.000016	0.000228	192.168.1.253	192.168.1.250	TCP	66	61089 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
18	0.000012	0.000240	192.168.1.250	192.168.1.73	TCP	66	61089 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
19	0.000006	0.000246	192.168.1.253	192.168.1.250	TCP	66	61090 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
20	0.000010	0.000256	192.168.1.250	192.168.1.73	TCP	66	61090 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1

AutoSave Off clientstats500.xls - Compatibility Mode - Saved

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Paste Clipboard

Arial 10 Font

**B** *I* U Alignment

General Number

L18

	A	B	C	D	E	F	G	H
1	Thread Num	Requests	Data Trans	Total Durat	Avg Response		Avg Total Duration	Avg Avg Response
2	0	100	6400	28.76823	0.255094		30.78561846	0.275657956
3	1	100	6400	33.57952	0.303825			
4	2	100	6400	33.50519	0.300995			
5	3	100	6400	31.97687	0.287127			
6	4	100	6400	29.20285	0.258505			
7	5	100	6400	33.22632	0.300543			
8	6	100	6400	29.19014	0.257055			
9	7	100	6400	29.02501	0.258116			
10	8	100	6400	33.65437	0.303395			
11	9	100	6400	29.41754	0.26032			

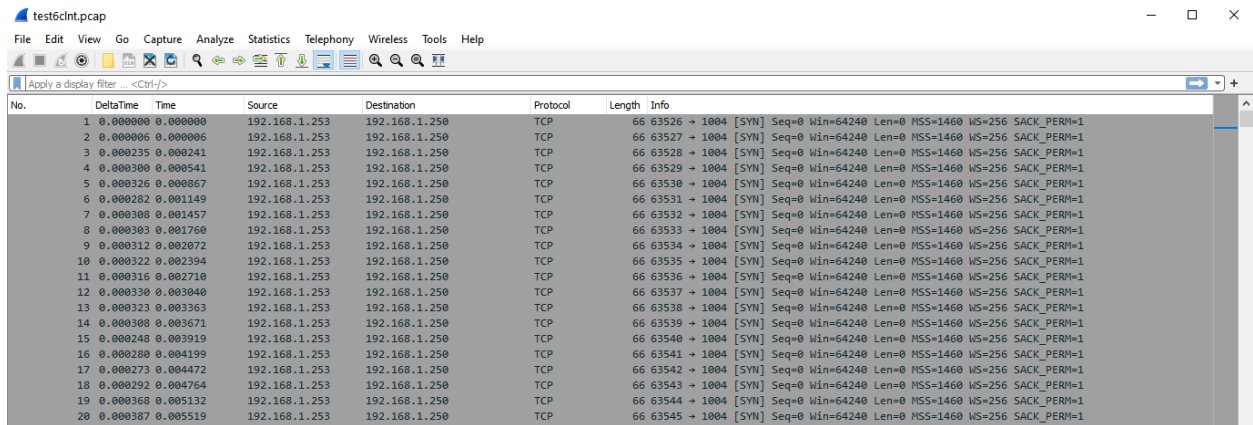
The average total duration and average response time has increased by almost 3x when compared to having no forwarder



## 7.6 Test 6 1000 Clients

The performance of the port forwarder with 1000 clients coming from 192.168.1.253 is very slow and successfully completes the test

### Client



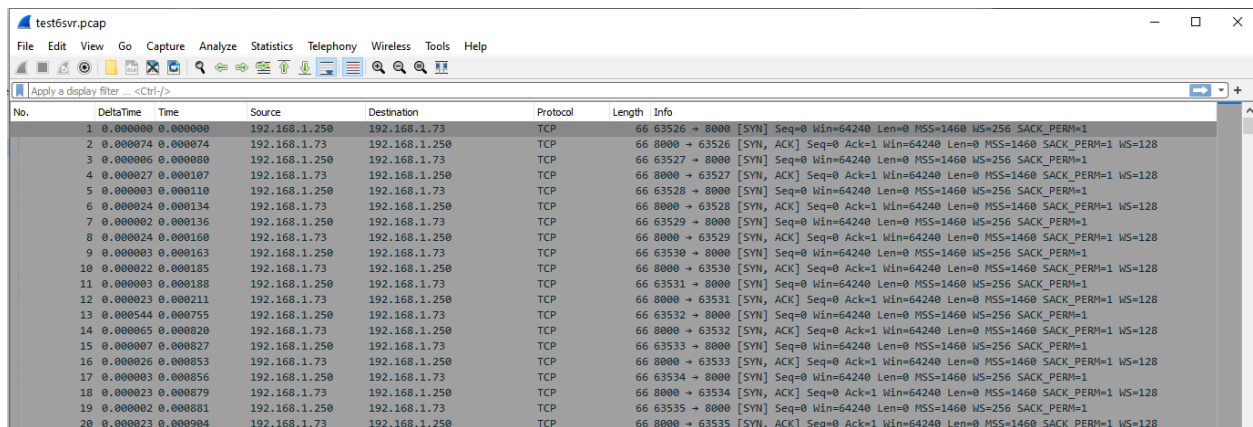
test6clnt.pcap

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter ... <Ctrl-/>

No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.000000	192.168.1.253	192.168.1.250	TCP	66	63526 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2	0.000006	0.000006	192.168.1.253	192.168.1.250	TCP	66	63527 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
3	0.000235	0.000241	192.168.1.253	192.168.1.250	TCP	66	63528 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
4	0.000300	0.000541	192.168.1.253	192.168.1.250	TCP	66	63529 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
5	0.000326	0.000607	192.168.1.253	192.168.1.250	TCP	66	63530 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
6	0.000282	0.001149	192.168.1.253	192.168.1.250	TCP	66	63531 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
7	0.000308	0.001457	192.168.1.253	192.168.1.250	TCP	66	63532 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
8	0.000303	0.001760	192.168.1.253	192.168.1.250	TCP	66	63533 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
9	0.000312	0.002072	192.168.1.253	192.168.1.250	TCP	66	63534 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
10	0.000322	0.002394	192.168.1.253	192.168.1.250	TCP	66	63535 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
11	0.000316	0.002710	192.168.1.253	192.168.1.250	TCP	66	63536 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
12	0.000330	0.003040	192.168.1.253	192.168.1.250	TCP	66	63537 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
13	0.000323	0.003363	192.168.1.253	192.168.1.250	TCP	66	63538 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
14	0.000308	0.003671	192.168.1.253	192.168.1.250	TCP	66	63539 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
15	0.000248	0.003919	192.168.1.253	192.168.1.250	TCP	66	63540 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
16	0.000280	0.004199	192.168.1.253	192.168.1.250	TCP	66	63541 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
17	0.000273	0.004472	192.168.1.253	192.168.1.250	TCP	66	63542 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
18	0.000292	0.004764	192.168.1.253	192.168.1.250	TCP	66	63543 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
19	0.000368	0.005132	192.168.1.253	192.168.1.250	TCP	66	63544 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
20	0.000387	0.005519	192.168.1.253	192.168.1.250	TCP	66	63545 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1

### Server



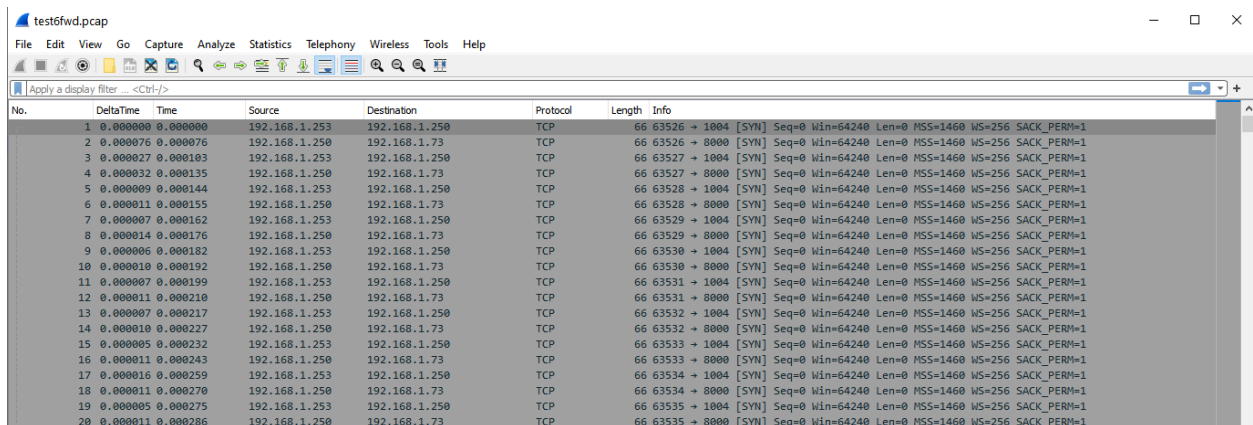
test6svr.pcap

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No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.000000	192.168.1.250	192.168.1.73	TCP	66	63526 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2	0.000074	0.000074	192.168.1.73	192.168.1.250	TCP	66	8000 → 63526 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
3	0.000006	0.000006	192.168.1.250	192.168.1.73	TCP	66	63527 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
4	0.000027	0.000107	192.168.1.73	192.168.1.250	TCP	66	8000 → 63527 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
5	0.000003	0.000110	192.168.1.250	192.168.1.73	TCP	66	63528 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
6	0.000024	0.000134	192.168.1.73	192.168.1.250	TCP	66	8000 → 63528 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
7	0.000002	0.000136	192.168.1.250	192.168.1.73	TCP	66	63529 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
8	0.000024	0.000160	192.168.1.73	192.168.1.250	TCP	66	8000 → 63529 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
9	0.000003	0.000163	192.168.1.250	192.168.1.73	TCP	66	63530 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
10	0.000022	0.000185	192.168.1.73	192.168.1.250	TCP	66	8000 → 63530 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
11	0.000003	0.000188	192.168.1.250	192.168.1.73	TCP	66	63531 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
12	0.000023	0.000211	192.168.1.73	192.168.1.250	TCP	66	8000 → 63531 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
13	0.000544	0.000755	192.168.1.250	192.168.1.73	TCP	66	63532 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
14	0.000065	0.000820	192.168.1.73	192.168.1.250	TCP	66	8000 → 63532 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
15	0.000007	0.000827	192.168.1.250	192.168.1.73	TCP	66	63533 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
16	0.000026	0.000853	192.168.1.73	192.168.1.250	TCP	66	8000 → 63533 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
17	0.000003	0.000856	192.168.1.250	192.168.1.73	TCP	66	63534 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
18	0.000023	0.000879	192.168.1.73	192.168.1.250	TCP	66	8000 → 63534 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128
19	0.000002	0.000881	192.168.1.250	192.168.1.73	TCP	66	63535 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
20	0.000023	0.000904	192.168.1.73	192.168.1.250	TCP	66	8000 → 63535 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM=1 WS=128

### Forwarder



test6fwd.pcap

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No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
1	0.000000	0.000000	192.168.1.253	192.168.1.250	TCP	66	63526 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2	0.000076	0.000076	192.168.1.250	192.168.1.73	TCP	66	63526 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
3	0.000027	0.000103	192.168.1.253	192.168.1.250	TCP	66	63527 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
4	0.000032	0.000135	192.168.1.250	192.168.1.73	TCP	66	63527 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
5	0.000009	0.000144	192.168.1.253	192.168.1.250	TCP	66	63528 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
6	0.000011	0.000155	192.168.1.250	192.168.1.73	TCP	66	63528 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
7	0.000007	0.000162	192.168.1.253	192.168.1.250	TCP	66	63529 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
8	0.000014	0.000176	192.168.1.250	192.168.1.73	TCP	66	63529 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
9	0.000006	0.000182	192.168.1.253	192.168.1.250	TCP	66	63530 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
10	0.000010	0.000192	192.168.1.250	192.168.1.73	TCP	66	63530 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
11	0.000007	0.000199	192.168.1.253	192.168.1.73	TCP	66	63531 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
12	0.000011	0.000210	192.168.1.250	192.168.1.73	TCP	66	63531 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
13	0.000007	0.000217	192.168.1.253	192.168.1.250	TCP	66	63532 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
14	0.000010	0.000227	192.168.1.250	192.168.1.73	TCP	66	63532 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
15	0.000005	0.000232	192.168.1.253	192.168.1.250	TCP	66	63533 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
16	0.000011	0.000243	192.168.1.250	192.168.1.73	TCP	66	63533 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
17	0.000016	0.000259	192.168.1.253	192.168.1.250	TCP	66	63534 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
18	0.000011	0.000270	192.168.1.250	192.168.1.73	TCP	66	63534 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
19	0.000005	0.000275	192.168.1.253	192.168.1.250	TCP	66	63535 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
20	0.000011	0.000286	192.168.1.250	192.168.1.73	TCP	66	63535 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1

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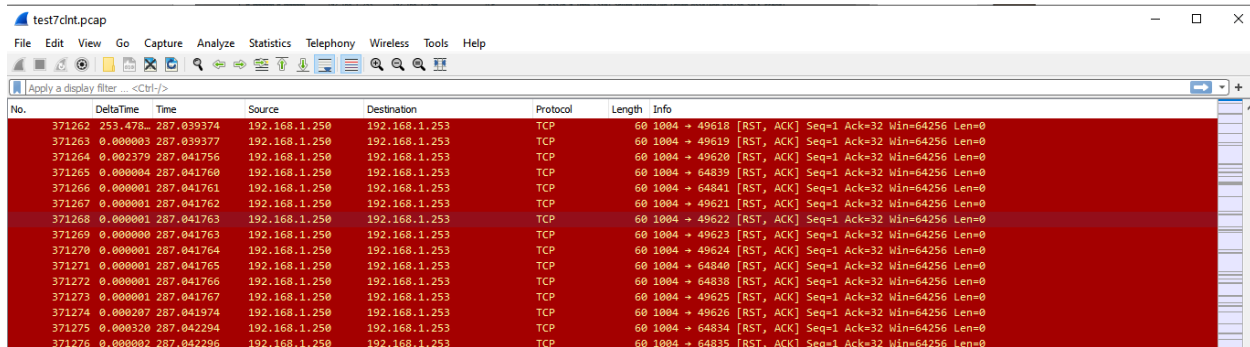
	A	B	C	D	E	F	G	H
1	Thread Num	Requests	Data Trans	Total Durat	Avg Response		Avg Total Duration	Avg Avg Response
2	0	100	6400	41.30432	0.361674		39.37016189	0.345402948
3	1	100	6400	37.10726	0.32035			
4	2	100	6400	36.67537	0.317387			
5	3	100	6400	41.3737	0.361353			
6	4	100	6400	41.27891	0.360817			
7	5	100	6400	38.91668	0.336117			
8	6	100	6400	39.94531	0.348937			
9	7	100	6400	40.15896	0.346812			
10	8	100	6400	36.31408	0.314212			
11	9	100	6400	38.42753	0.335279			

The average total duration and average response time has increased by almost 2.3x when compared to having no forwarder

## 7.7 Test 7 1500 Clients

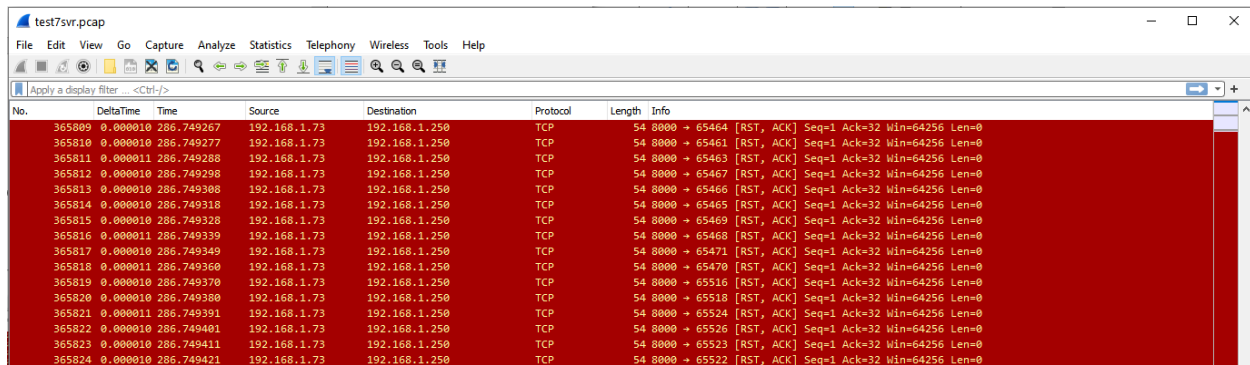
The performance of the port forwarder with 1500 clients coming from 192.168.1.253 locks up for multiple minutes before I decided to end and say the test has failed

### Client



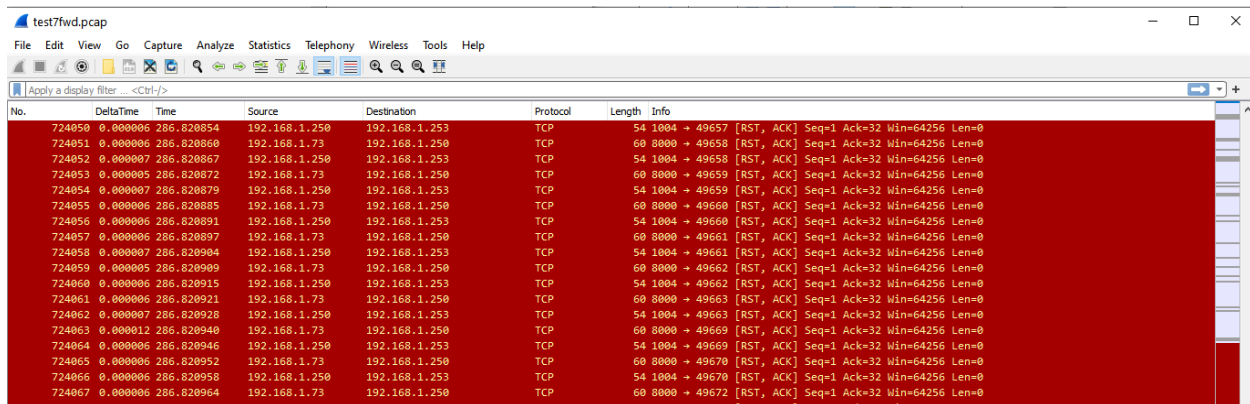
No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
371262	253.478...	287.039374	192.168.1.250	192.168.1.253	TCP	60	1004 → 49618 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
371263	0.000003	287.039377	192.168.1.250	192.168.1.253	TCP	60	1004 → 49619 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
371264	0.002379	287.041756	192.168.1.250	192.168.1.253	TCP	60	1004 → 49620 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
371265	0.000004	287.041760	192.168.1.250	192.168.1.253	TCP	60	1004 → 49621 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
371266	0.000001	287.041761	192.168.1.250	192.168.1.253	TCP	60	1004 → 49622 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
371267	0.000001	287.041762	192.168.1.250	192.168.1.253	TCP	60	1004 → 49623 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
371268	0.000001	287.041763	192.168.1.250	192.168.1.253	TCP	60	1004 → 49624 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
371269	0.000000	287.041763	192.168.1.250	192.168.1.253	TCP	60	1004 → 49625 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
371270	0.000001	287.041764	192.168.1.250	192.168.1.253	TCP	60	1004 → 49626 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
371271	0.000001	287.041765	192.168.1.250	192.168.1.253	TCP	60	1004 → 49627 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
371272	0.000001	287.041765	192.168.1.250	192.168.1.253	TCP	60	1004 → 49628 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
371273	0.000001	287.041767	192.168.1.250	192.168.1.253	TCP	60	1004 → 49629 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
371274	0.000207	287.041974	192.168.1.250	192.168.1.253	TCP	60	1004 → 49630 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
371275	0.000320	287.042294	192.168.1.250	192.168.1.253	TCP	60	1004 → 49631 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
371276	0.000002	287.042296	192.168.1.250	192.168.1.253	TCP	60	1004 → 49632 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0

### Server



No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
365809	0.000010	286.749267	192.168.1.73	192.168.1.250	TCP	54	8000 → 65464 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
365810	0.000010	286.749277	192.168.1.73	192.168.1.250	TCP	54	8000 → 65461 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
365811	0.000011	286.749288	192.168.1.73	192.168.1.250	TCP	54	8000 → 65463 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
365812	0.000010	286.749298	192.168.1.73	192.168.1.250	TCP	54	8000 → 65467 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
365813	0.000010	286.749308	192.168.1.73	192.168.1.250	TCP	54	8000 → 65466 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
365814	0.000010	286.749318	192.168.1.73	192.168.1.250	TCP	54	8000 → 65465 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
365815	0.000010	286.749328	192.168.1.73	192.168.1.250	TCP	54	8000 → 65469 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
365816	0.000011	286.749339	192.168.1.73	192.168.1.250	TCP	54	8000 → 65468 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
365817	0.000010	286.749349	192.168.1.73	192.168.1.250	TCP	54	8000 → 65471 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
365818	0.000011	286.749360	192.168.1.73	192.168.1.250	TCP	54	8000 → 65470 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
365819	0.000010	286.749370	192.168.1.73	192.168.1.250	TCP	54	8000 → 65516 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
365820	0.000010	286.749380	192.168.1.73	192.168.1.250	TCP	54	8000 → 65518 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
365821	0.000011	286.749391	192.168.1.73	192.168.1.250	TCP	54	8000 → 65524 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
365822	0.000010	286.749401	192.168.1.73	192.168.1.250	TCP	54	8000 → 65526 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
365823	0.000010	286.749411	192.168.1.73	192.168.1.250	TCP	54	8000 → 65523 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
365824	0.000010	286.749421	192.168.1.73	192.168.1.250	TCP	54	8000 → 65522 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0

### Forwarder



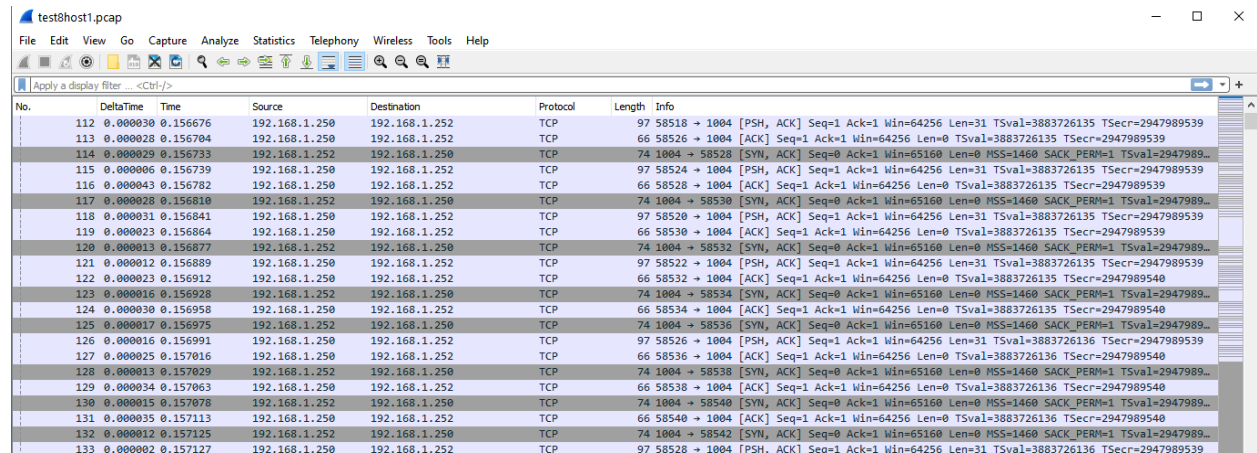
No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
724050	0.000006	286.820854	192.168.1.250	192.168.1.253	TCP	54	1004 → 49657 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
724051	0.000006	286.820860	192.168.1.73	192.168.1.250	TCP	60	8000 → 49658 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
724052	0.000007	286.820867	192.168.1.250	192.168.1.253	TCP	54	1004 → 49658 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
724053	0.000005	286.820872	192.168.1.73	192.168.1.250	TCP	60	8000 → 49659 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
724054	0.000007	286.820879	192.168.1.250	192.168.1.253	TCP	54	1004 → 49659 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
724055	0.000006	286.820885	192.168.1.73	192.168.1.250	TCP	60	8000 → 49660 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
724056	0.000006	286.820891	192.168.1.250	192.168.1.253	TCP	54	1004 → 49660 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
724057	0.000006	286.820897	192.168.1.73	192.168.1.250	TCP	60	8000 → 49661 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
724058	0.000007	286.820904	192.168.1.250	192.168.1.253	TCP	54	1004 → 49661 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
724059	0.000005	286.820909	192.168.1.73	192.168.1.250	TCP	60	8000 → 49662 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
724060	0.000006	286.820915	192.168.1.250	192.168.1.253	TCP	54	1004 → 49662 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
724061	0.000006	286.820921	192.168.1.73	192.168.1.250	TCP	60	8000 → 49663 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
724062	0.000007	286.820928	192.168.1.250	192.168.1.253	TCP	54	1004 → 49663 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
724063	0.000012	286.820940	192.168.1.73	192.168.1.250	TCP	60	8000 → 49669 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
724064	0.000006	286.820946	192.168.1.250	192.168.1.253	TCP	54	1004 → 49669 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
724065	0.000006	286.820952	192.168.1.73	192.168.1.250	TCP	60	8000 → 49670 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
724066	0.000006	286.820958	192.168.1.250	192.168.1.253	TCP	54	1004 → 49670 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0
724067	0.000006	286.820964	192.168.1.73	192.168.1.250	TCP	60	8000 → 49672 [RST, ACK] Seq=1 Ack=32 Win=64256 Len=0

Because the test failed, I am unable to retrieve the excel spreadsheet of the client response times, I only have the server log which shows that about 500 connections did not finish.

## 7.8 Test 8 Simultaneous Two-way Traffic 100+100 Clients

The test of simultaneous two-way traffic between two computers by running both epoll server and echo server on both hosts and having them port forward their packets using the RPI4 as the port forwarder 192.168.1.252 worked successfully.

### Host1



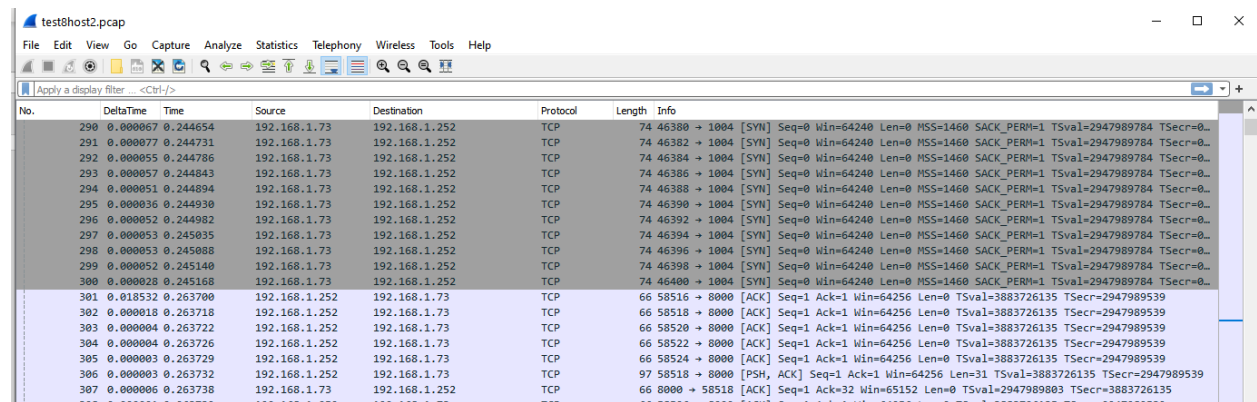
test8host1.pcap

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter ... <Ctrl>/>

No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
112	0.000030	0.156676	192.168.1.250	192.168.1.252	TCP	97	58518 → 1004 [PSH, ACK] Seq=1 Ack=1 Win=64256 Len=31 TSval=3883726135 TSecr=2947989539
113	0.000028	0.156704	192.168.1.250	192.168.1.252	TCP	66	58526 → 1004 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=3883726135 TSecr=2947989539
114	0.000029	0.156733	192.168.1.252	192.168.1.250	TCP	74	1004 → 58528 [SYN, ACK] Seq=0 Ack=1 Win=65160 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989539
115	0.000006	0.156739	192.168.1.250	192.168.1.252	TCP	97	58524 → 1004 [PSH, ACK] Seq=1 Ack=1 Win=64256 Len=31 TSval=3883726135 TSecr=2947989539
116	0.000043	0.156782	192.168.1.250	192.168.1.252	TCP	66	58528 → 1004 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=3883726135 TSecr=2947989539
117	0.000028	0.156810	192.168.1.252	192.168.1.250	TCP	74	1004 → 58530 [SYN, ACK] Seq=0 Ack=1 Win=65160 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989539
118	0.000031	0.156841	192.168.1.250	192.168.1.252	TCP	97	58520 → 1004 [PSH, ACK] Seq=1 Ack=1 Win=64256 Len=31 TSval=3883726135 TSecr=2947989539
119	0.000023	0.156864	192.168.1.250	192.168.1.252	TCP	66	58530 → 1004 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=3883726135 TSecr=2947989539
120	0.000013	0.156877	192.168.1.252	192.168.1.250	TCP	74	1004 → 58532 [SYN, ACK] Seq=0 Ack=1 Win=65160 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989539
121	0.000012	0.156889	192.168.1.250	192.168.1.252	TCP	97	58522 → 1004 [PSH, ACK] Seq=1 Ack=1 Win=64256 Len=31 TSval=3883726135 TSecr=2947989539
122	0.000023	0.156912	192.168.1.250	192.168.1.252	TCP	66	58532 → 1004 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=3883726135 TSecr=2947989540
123	0.000016	0.156928	192.168.1.252	192.168.1.250	TCP	74	1004 → 58534 [SYN, ACK] Seq=0 Ack=1 Win=65160 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989539
124	0.000030	0.156958	192.168.1.250	192.168.1.252	TCP	97	58534 → 1004 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=3883726135 TSecr=2947989540
125	0.000017	0.156975	192.168.1.252	192.168.1.250	TCP	74	1004 → 58536 [SYN, ACK] Seq=0 Ack=1 Win=65160 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989539
126	0.000016	0.156991	192.168.1.250	192.168.1.252	TCP	97	58526 → 1004 [PSH, ACK] Seq=1 Ack=1 Win=64256 Len=31 TSval=3883726136 TSecr=2947989539
127	0.000025	0.157016	192.168.1.250	192.168.1.252	TCP	66	58536 → 1004 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=3883726136 TSecr=2947989540
128	0.000013	0.157029	192.168.1.252	192.168.1.250	TCP	74	1004 → 58538 [SYN, ACK] Seq=0 Ack=1 Win=65160 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989539
129	0.000034	0.157063	192.168.1.250	192.168.1.252	TCP	66	58538 → 1004 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=3883726136 TSecr=2947989540
130	0.000015	0.157078	192.168.1.252	192.168.1.250	TCP	74	1004 → 58540 [SYN, ACK] Seq=0 Ack=1 Win=65160 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989539
131	0.000035	0.157113	192.168.1.250	192.168.1.252	TCP	66	58540 → 1004 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=3883726136 TSecr=2947989540
132	0.000012	0.157125	192.168.1.252	192.168.1.250	TCP	74	1004 → 58542 [SYN, ACK] Seq=0 Ack=1 Win=65160 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989539
133	0.000002	0.157127	192.168.1.250	192.168.1.252	TCP	97	58528 → 1004 [PSH, ACK] Seq=1 Ack=1 Win=64256 Len=31 TSval=3883726136 TSecr=2947989539

### Host2



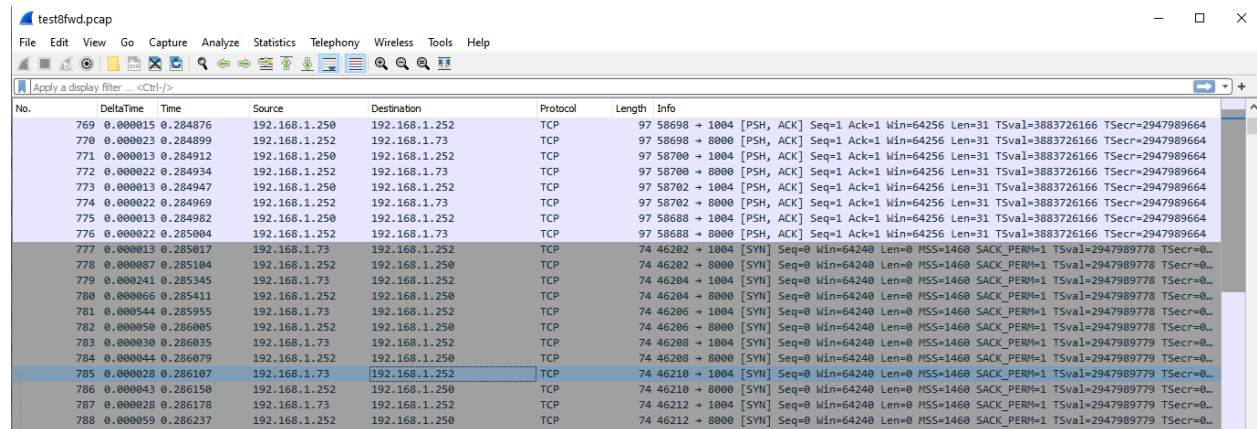
test8host2.pcap

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No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
290	0.000067	0.244654	192.168.1.73	192.168.1.252	TCP	74	46380 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989784 TSecr=0.
291	0.000077	0.244731	192.168.1.73	192.168.1.252	TCP	74	46382 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989784 TSecr=0.
292	0.000055	0.244786	192.168.1.73	192.168.1.252	TCP	74	46384 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989784 TSecr=0.
293	0.000057	0.244843	192.168.1.73	192.168.1.252	TCP	74	46386 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989784 TSecr=0.
294	0.000051	0.244894	192.168.1.73	192.168.1.252	TCP	74	46388 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989784 TSecr=0.
295	0.000036	0.244930	192.168.1.73	192.168.1.252	TCP	74	46390 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989784 TSecr=0.
296	0.000052	0.244982	192.168.1.73	192.168.1.252	TCP	74	46392 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989784 TSecr=0.
297	0.000053	0.245035	192.168.1.73	192.168.1.252	TCP	74	46394 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989784 TSecr=0.
298	0.000053	0.245088	192.168.1.73	192.168.1.252	TCP	74	46396 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989784 TSecr=0.
299	0.000052	0.245140	192.168.1.73	192.168.1.252	TCP	74	46398 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989784 TSecr=0.
300	0.000028	0.245168	192.168.1.73	192.168.1.252	TCP	74	46400 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989784 TSecr=0.
301	0.018532	0.263700	192.168.1.252	192.168.1.73	TCP	66	58516 → 8000 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=3883726135 TSecr=2947989539
302	0.000018	0.263718	192.168.1.252	192.168.1.73	TCP	66	58518 → 8000 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=3883726135 TSecr=2947989539
303	0.000004	0.263722	192.168.1.252	192.168.1.73	TCP	66	58520 → 8000 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=3883726135 TSecr=2947989539
304	0.000004	0.263726	192.168.1.252	192.168.1.73	TCP	66	58522 → 8000 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=3883726135 TSecr=2947989539
305	0.000003	0.263729	192.168.1.252	192.168.1.73	TCP	66	58524 → 8000 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=3883726135 TSecr=2947989539
306	0.000003	0.263732	192.168.1.252	192.168.1.73	TCP	97	58518 → 8000 [PSH, ACK] Seq=1 Ack=1 Win=64256 Len=31 TSval=3883726135 TSecr=2947989539
307	0.000006	0.263735	192.168.1.73	192.168.1.252	TCP	66	8000 → 58518 [ACK] Seq=1 Ack=32 Win=65152 Len=0 TSval=2947989803 TSecr=3883726135
308	0.000001	0.263736	192.168.1.73	192.168.1.252	TCP	66	8000 → 8000 [ACK] Seq=1 Ack=1 Win=65152 Len=0 TSval=2947989803 TSecr=3883726135

### Forwarder



test8fwd.pcap

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No.	DeltaTime	Time	Source	Destination	Protocol	Length	Info
769	0.000015	0.284876	192.168.1.250	192.168.1.252	TCP	97	58698 → 1004 [PSH, ACK] Seq=1 Ack=1 Win=64256 Len=31 TSval=3883726166 TSecr=2947989664
770	0.000023	0.284899	192.168.1.252	192.168.1.73	TCP	97	58690 → 8000 [PSH, ACK] Seq=1 Ack=1 Win=64256 Len=31 TSval=3883726166 TSecr=2947989664
771	0.000013	0.284912	192.168.1.250	192.168.1.252	TCP	97	58700 → 1004 [PSH, ACK] Seq=1 Ack=1 Win=64256 Len=31 TSval=3883726166 TSecr=2947989664
772	0.000022	0.284934	192.168.1.252	192.168.1.73	TCP	97	58700 → 8000 [PSH, ACK] Seq=1 Ack=1 Win=64256 Len=31 TSval=3883726166 TSecr=2947989664
773	0.000013	0.284947	192.168.1.250	192.168.1.252	TCP	97	58702 → 1004 [PSH, ACK] Seq=1 Ack=1 Win=64256 Len=31 TSval=3883726166 TSecr=2947989664
774	0.000022	0.284969	192.168.1.252	192.168.1.73	TCP	97	58702 → 8000 [PSH, ACK] Seq=1 Ack=1 Win=64256 Len=31 TSval=3883726166 TSecr=2947989664
775	0.000013	0.284982	192.168.1.250	192.168.1.252	TCP	97	58688 → 1004 [PSH, ACK] Seq=1 Ack=1 Win=64256 Len=31 TSval=3883726166 TSecr=2947989664
776	0.000022	0.285004	192.168.1.252	192.168.1.73	TCP	97	58688 → 8000 [PSH, ACK] Seq=1 Ack=1 Win=64256 Len=31 TSval=3883726166 TSecr=2947989664
777	0.000013	0.285017	192.168.1.73	192.168.1.252	TCP	74	46202 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989778 TSecr=0.
778	0.000087	0.285104	192.168.1.252	192.168.1.250	TCP	74	46202 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989778 TSecr=0.
779	0.000241	0.285345	192.168.1.73	192.168.1.252	TCP	74	46204 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989778 TSecr=0.
780	0.000066	0.285411	192.168.1.252	192.168.1.250	TCP	74	46204 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989778 TSecr=0.
781	0.000544	0.285955	192.168.1.73	192.168.1.252	TCP	74	46206 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989778 TSecr=0.
782	0.000050	0.286005	192.168.1.252	192.168.1.250	TCP	74	46206 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989778 TSecr=0.
783	0.000030	0.286035	192.168.1.73	192.168.1.252	TCP	74	46208 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989778 TSecr=0.
784	0.000044	0.286079	192.168.1.252	192.168.1.250	TCP	74	46208 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989778 TSecr=0.
785	0.000028	0.286107	192.168.1.73	192.168.1.252	TCP	74	46210 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989779 TSecr=0.
786	0.000043	0.286150	192.168.1.252	192.168.1.250	TCP	74	46210 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989779 TSecr=0.
787	0.000028	0.286178	192.168.1.73	192.168.1.252	TCP	74	46212 → 1004 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989779 TSecr=0.
788	0.000059	0.286237	192.168.1.252	192.168.1.250	TCP	74	46212 → 8000 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=2947989779 TSecr=0.

## 8 Conclusions

Using iptables to do port forwarding is very simplistic and I would very highly recommend it as it is only a few lines of code to get working. The speed difference between having a port forwarder and not having one between the client and epoll server is massive with about a speed penalty on both response and connection durations of about 3x.

### 8.1 Table Comparison between Forwarded and Non Forwarded

Connections	Status	Requests	Total Requests	AvgTotalDuration	AvgResponseTime
100	Success	100	10000	9.089017622	0.055820329
500	Success	100	50000	30.78561846	0.275657956
1000	Success	100	100000	39.37016189	0.345402948
1500	Fail				

Figure 1 Port Forwarded

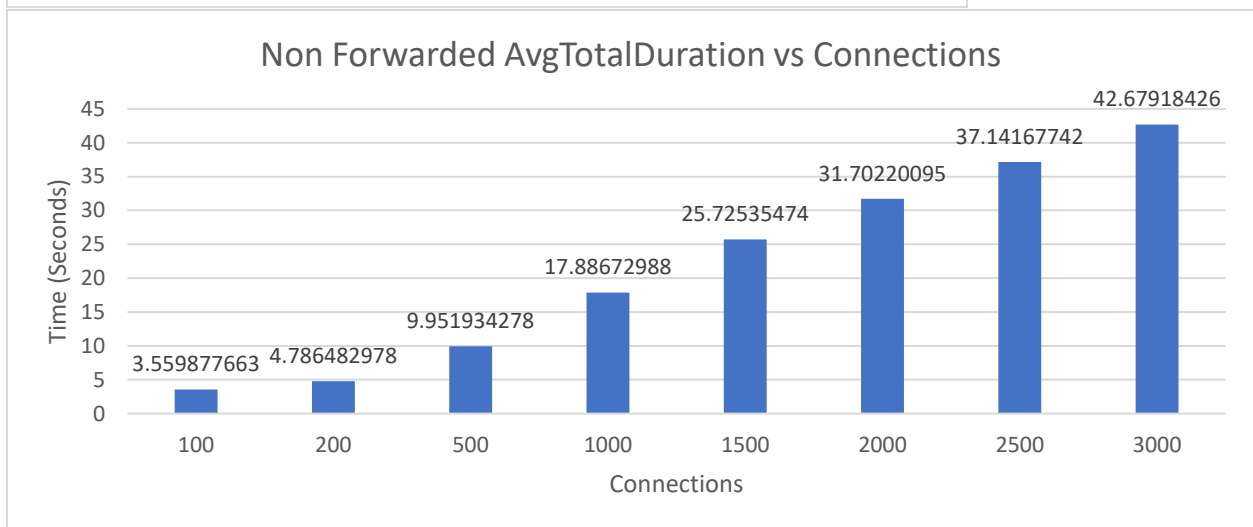
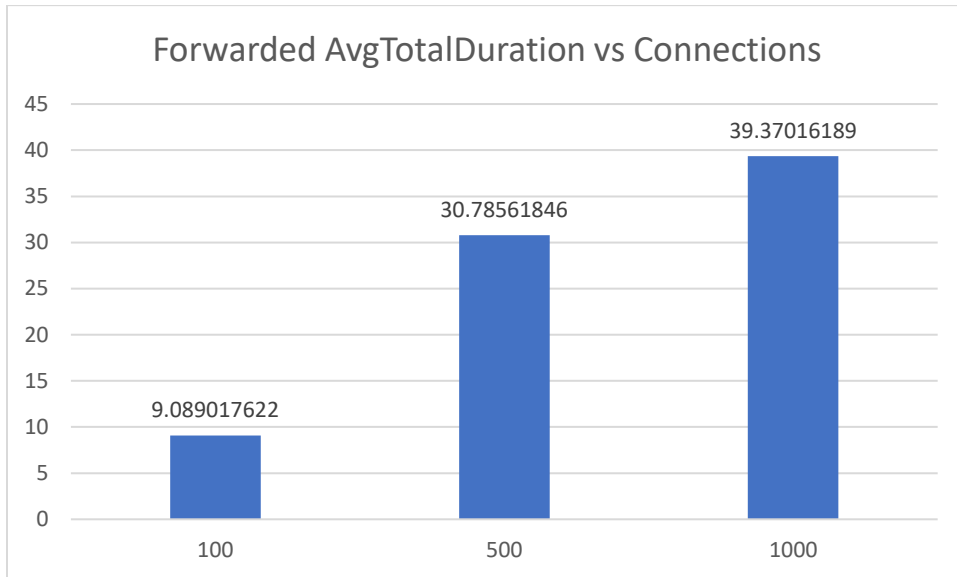
Connections	Status	Requests	Data Transferred(Bytes)	Total Requests	Total Data Transferred(Bytes)	AvgTotalDuration	AvgResponseTime
100	Success	100	6400	10000	64000000	3.559877663	0.016237825
200	Success	100	6400	20000	128000000	4.786482978	0.028205156
500	Success	100	6400	50000	320000000	9.951934278	0.079521272
1000	Success	100	6400	100000	640000000	17.88672988	0.155839739
1500	Success	100	6400	150000	960000000	25.72535474	0.231552899
2000	Success	100	6400	200000	1280000000	31.70220095	0.298103087
2500	Success	100	6400	250000	1600000000	37.14167742	0.354454643
3000	Success	100	6400	300000	1920000000	42.67918426	0.406414569
4000	Fail						

Figure 2 Non Port Forwarded

As shown, the speed differences are huge, 3x is a massive loss. Although its only a few milliseconds when theres few connections, it easily adds up when increasing the number of connections.

## 8.2 Bar Graph Comparison

### 8.2.1 AvgTotalDuration



### 8.2.2 AvgResponseTime

