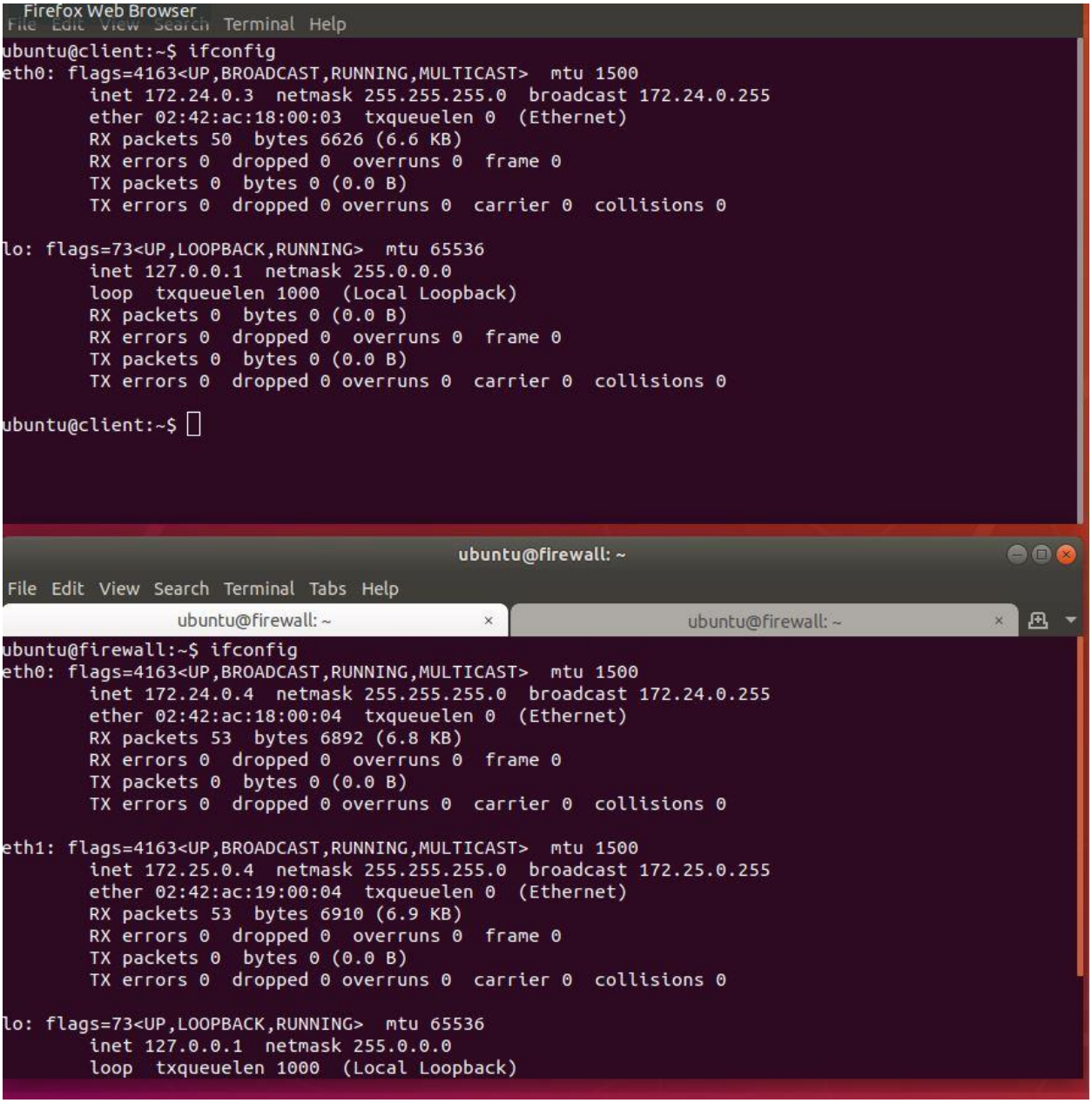
Assignment 4 – Linux Firewall

Task 1. Find IP addresses

a) Find the IP address of the client and the firewall.
b) Show the addresses in screenshots.

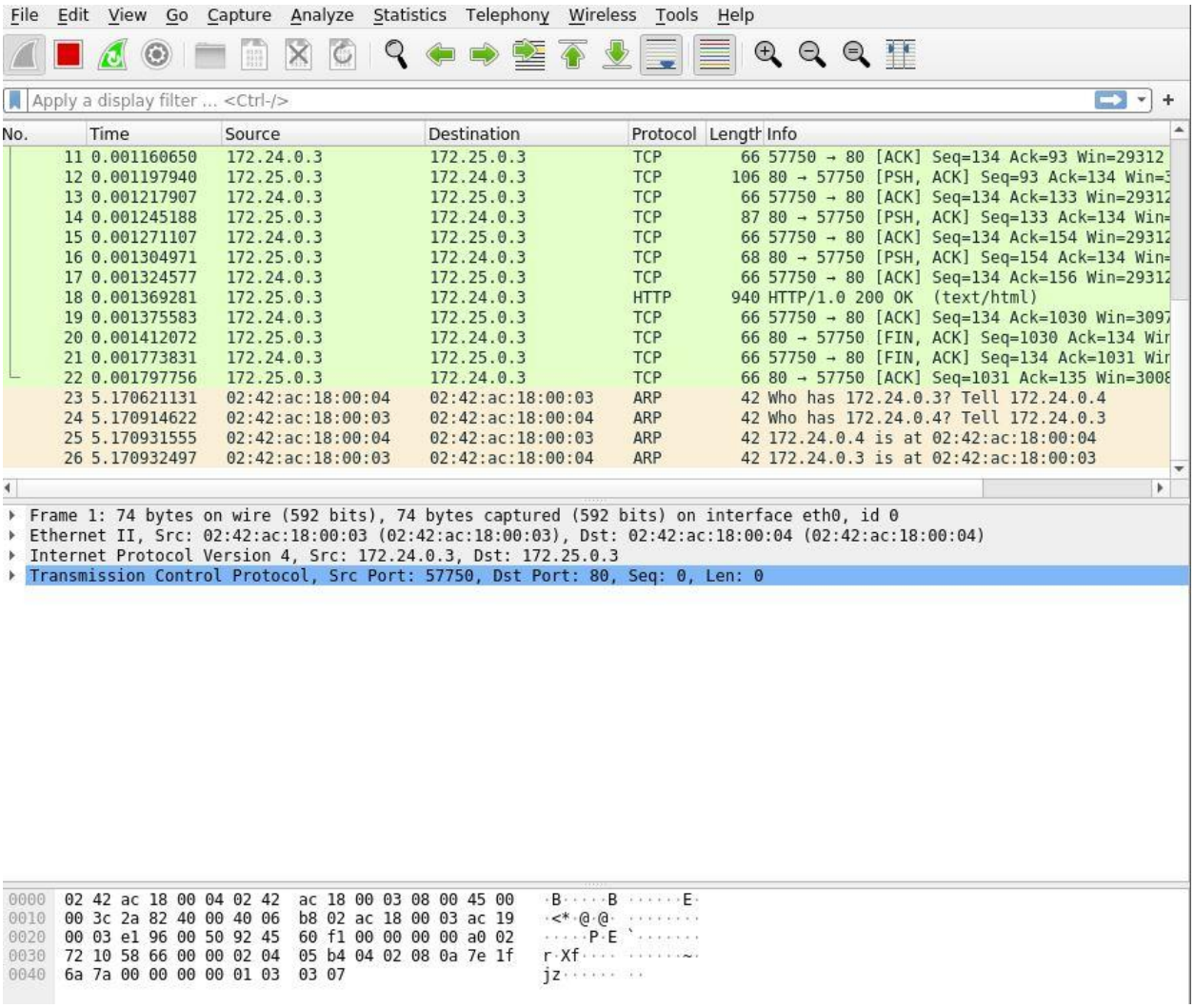


Task 2. Nmap scan

a) Perform a nmap scan on the client for open ports on the server. Show the output in a screenshot.

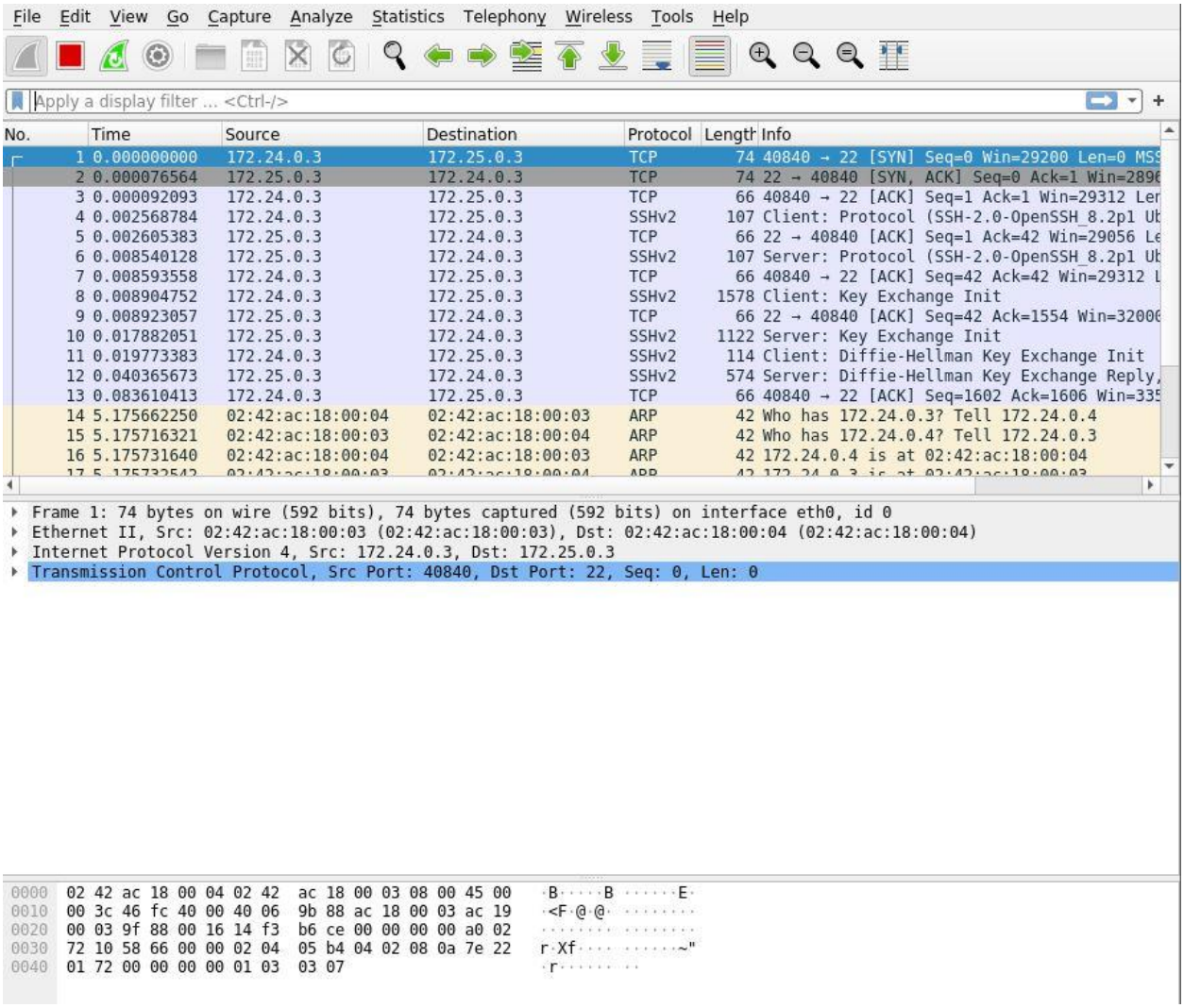
```
ubuntu@client:~$ nmap server
Starting Nmap 7.80 ( https://nmap.org ) at 2023-10-26 19:40 UTC
Nmap scan report for server (172.25.0.3)
Host is up (0.00021s latency).
Not shown: 997 closed ports
PORT   STATE SERVICE
22/tcp open  ssh
23/tcp open  telnet
80/tcp open  http

Nmap done: 1 IP address (1 host up) scanned in 0.07 seconds
ubuntu@client:~$ wget server
--2023-10-26 19:40:40--  http://server/
Resolving server (server)... 172.25.0.3
Connecting to server (server)|172.25.0.3|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 874 [text/html]
Saving to: 'index.html.1'

index.html.1             100%[===============================>]     874  --.-KB/s    in 0s

2023-10-26 19:40:40 (9.96 MB/s) - 'index.html.1' saved [874/874]
```

b) Run *wget* and report captured packets on Wireshark in a screenshot. To capture packets for a new command, you need to stop/start capturing without exiting Wireshark.

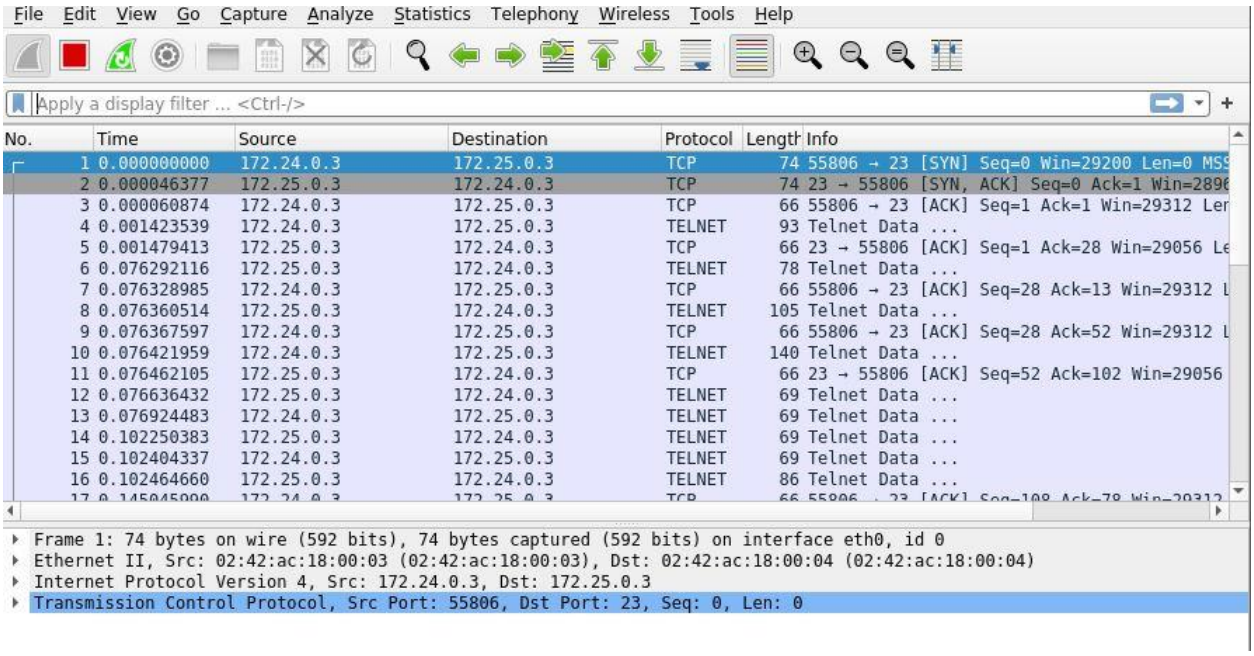


No.	Time	Source	Destination	Protocol	Length	Info
11	0.001160650	172.24.0.3	172.25.0.3	TCP	66	57750 → 80 [ACK] Seq=134 Ack=93 Win=29312
12	0.001197940	172.25.0.3	172.24.0.3	TCP	106	80 → 57750 [PSH, ACK] Seq=93 Ack=134 Win=3
13	0.001217907	172.24.0.3	172.25.0.3	TCP	66	57750 → 80 [ACK] Seq=134 Ack=133 Win=29312
14	0.001245188	172.25.0.3	172.24.0.3	TCP	87	80 → 57750 [PSH, ACK] Seq=133 Ack=134 Win=
15	0.001271107	172.24.0.3	172.25.0.3	TCP	66	57750 → 80 [ACK] Seq=134 Ack=154 Win=29312
16	0.001304971	172.25.0.3	172.24.0.3	TCP	68	80 → 57750 [PSH, ACK] Seq=154 Ack=134 Win=
17	0.001324577	172.24.0.3	172.25.0.3	TCP	66	57750 → 80 [ACK] Seq=134 Ack=156 Win=29312
18	0.001369281	172.25.0.3	172.24.0.3	HTTP	940	HTTP/1.0 200 OK (text/html)
19	0.001375583	172.24.0.3	172.25.0.3	TCP	66	57750 → 80 [ACK] Seq=134 Ack=1030 Win=3097
20	0.001412072	172.25.0.3	172.24.0.3	TCP	66	80 → 57750 [FIN, ACK] Seq=1030 Ack=134 Win
21	0.001773831	172.24.0.3	172.25.0.3	TCP	66	57750 → 80 [FIN, ACK] Seq=134 Ack=1031 Win
22	0.001797756	172.25.0.3	172.24.0.3	TCP	66	80 → 57750 [ACK] Seq=1031 Ack=135 Win=3008
23	5.170621131	02:42:ac:18:00:04	02:42:ac:18:00:03	ARP	42	Who has 172.24.0.3? Tell 172.24.0.4
24	5.170914622	02:42:ac:18:00:03	02:42:ac:18:00:04	ARP	42	Who has 172.24.0.4? Tell 172.24.0.3
25	5.170931555	02:42:ac:18:00:04	02:42:ac:18:00:03	ARP	42	172.24.0.4 is at 02:42:ac:18:00:04
26	5.170932497	02:42:ac:18:00:03	02:42:ac:18:00:04	ARP	42	172.24.0.3 is at 02:42:ac:18:00:03

c) Run *ssh* and report captured packets on Wireshark in a screenshot.



d) Run *telnet* and report captured packets on Wireshark in a screenshot.



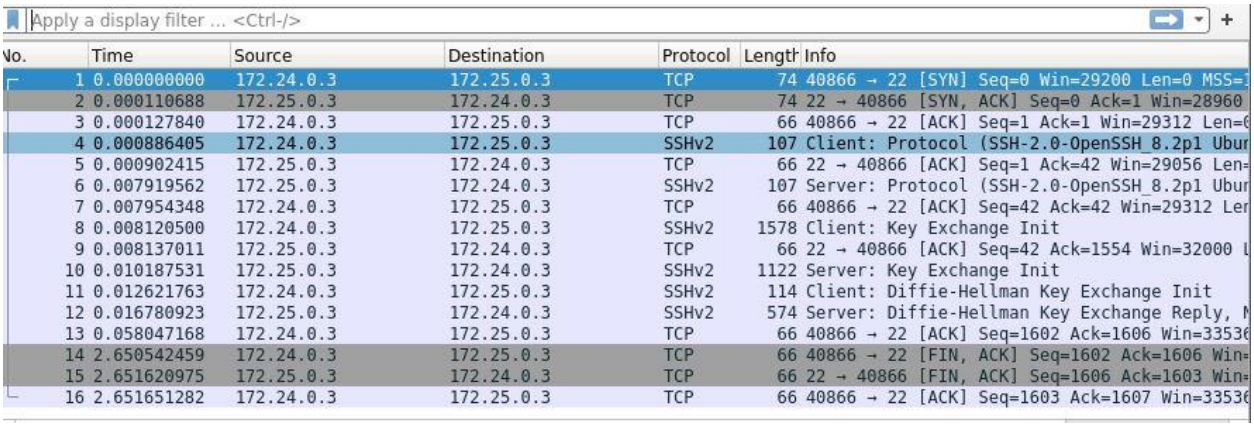
No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	172.24.0.3	172.25.0.3	TCP	74	55806 → 23 [SYN] Seq=0 Win=29200 Len=0 MSS
2	0.000046377	172.25.0.3	172.24.0.3	TCP	74	23 → 55806 [SYN, ACK] Seq=0 Ack=1 Win=2896
3	0.000060874	172.24.0.3	172.25.0.3	TCP	66	55806 → 23 [ACK] Seq=1 Ack=1 Win=29312 Len
4	0.001423539	172.24.0.3	172.25.0.3	TELNET	93	Telnet Data ...
5	0.001479413	172.25.0.3	172.24.0.3	TCP	66	23 → 55806 [ACK] Seq=1 Ack=28 Win=29056 Le
6	0.076292116	172.25.0.3	172.24.0.3	TELNET	78	Telnet Data ...
7	0.076328985	172.24.0.3	172.25.0.3	TCP	66	55806 → 23 [ACK] Seq=28 Ack=13 Win=29312 L
8	0.076360514	172.25.0.3	172.24.0.3	TELNET	105	Telnet Data ...
9	0.076367597	172.24.0.3	172.25.0.3	TCP	66	55806 → 23 [ACK] Seq=28 Ack=52 Win=29312 L
10	0.076421959	172.24.0.3	172.25.0.3	TELNET	140	Telnet Data ...
11	0.076462105	172.25.0.3	172.24.0.3	TCP	66	23 → 55806 [ACK] Seq=52 Ack=102 Win=29056
12	0.076636432	172.25.0.3	172.24.0.3	TELNET	69	Telnet Data ...
13	0.076924483	172.24.0.3	172.25.0.3	TELNET	69	Telnet Data ...
14	0.102250383	172.25.0.3	172.24.0.3	TELNET	69	Telnet Data ...
15	0.102404337	172.24.0.3	172.25.0.3	TELNET	69	Telnet Data ...
16	0.102464660	172.25.0.3	172.24.0.3	TELNET	86	Telnet Data ...

```
Frame 1: 74 bytes on wire (592 bits), 74 bytes captured (592 bits) on interface eth0, id 0
Ethernet II, Src: 02:42:ac:18:00:03 (02:42:ac:18:00:03), Dst: 02:42:ac:18:00:04 (02:42:ac:18:00:04)
Internet Protocol Version 4, Src: 172.24.0.3, Dst: 172.25.0.3
Transmission Control Protocol, Src Port: 55806, Dst Port: 23, Seq: 0, Len: 0
```

Task 3. Use iptables to limit traffic to the server

a) Show that ssh traffic is allowed. On the client, run ssh while capturing traffic on the firewall. Report these two activities in two screenshots. Explain how you know ssh traffic is allowed.

Wireshark view:



No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	172.24.0.3	172.25.0.3	TCP	74	40866 → 22 [SYN] Seq=0 Win=29200 Len=0 MSS=
2	0.000110688	172.25.0.3	172.24.0.3	TCP	74	22 → 40866 [SYN, ACK] Seq=0 Ack=1 Win=28960
3	0.000127840	172.24.0.3	172.25.0.3	TCP	66	40866 → 22 [ACK] Seq=1 Ack=1 Win=29312 Len=0
4	0.000886405	172.24.0.3	172.25.0.3	SSHv2	107	Client: Protocol (SSH-2.0-OpenSSH_8.2p1 Ubur
5	0.000902415	172.25.0.3	172.24.0.3	TCP	66	22 → 40866 [ACK] Seq=1 Ack=42 Win=29056 Len=
6	0.007919562	172.25.0.3	172.24.0.3	SSHv2	107	Server: Protocol (SSH-2.0-OpenSSH_8.2p1 Ubur
7	0.007954348	172.24.0.3	172.25.0.3	TCP	66	40866 → 22 [ACK] Seq=42 Ack=42 Win=29312 Len
8	0.008120500	172.24.0.3	172.25.0.3	SSHv2	1578	Client: Key Exchange Init
9	0.008137011	172.25.0.3	172.24.0.3	TCP	66	22 → 40866 [ACK] Seq=42 Ack=1554 Win=32000 L
10	0.010187531	172.25.0.3	172.24.0.3	SSHv2	1122	Server: Key Exchange Init
11	0.012621763	172.24.0.3	172.25.0.3	SSHv2	114	Client: Diffie-Hellman Key Exchange Init
12	0.016780923	172.25.0.3	172.24.0.3	SSHv2	574	Server: Diffie-Hellman Key Exchange Reply, N
13	0.058047168	172.24.0.3	172.25.0.3	TCP	66	40866 → 22 [ACK] Seq=1602 Ack=1606 Win=33536
14	2.650542459	172.24.0.3	172.25.0.3	TCP	66	40866 → 22 [FIN, ACK] Seq=1602 Ack=1606 Win=
15	2.651620975	172.25.0.3	172.24.0.3	TCP	66	22 → 40866 [FIN, ACK] Seq=1606 Ack=1603 Win=
16	2.651651282	172.24.0.3	172.25.0.3	TCP	66	40866 → 22 [ACK] Seq=1603 Ack=1607 Win=33536

Client View:

```
ubuntu@client:~$ ssh server
The authenticity of host 'server (172.25.0.3)' can't be established.
ECDSA key fingerprint is SHA256:ZtE8xi5Y50aUktZ/XtgjIs1c5jxYQB84Vq5ofmlgGng.
Are you sure you want to continue connecting (yes/no/[fingerprint])?
Host key verification failed.
ubuntu@client:~$
```

Iptables view on the firewall after adding our new rules:

```
Chain INPUT (policy DROP)
target     prot opt source               destination
ACCEPT     all  --  anywhere             anywhere

Chain FORWARD (policy DROP)
target     prot opt source               destination
ACCEPT     all  --  anywhere             anywhere             ctstate RELATED,ESTABLISHED
ACCEPT     tcp  --  anywhere             anywhere             tcp dpt:ssh
ACCEPT     tcp  --  anywhere             anywhere             tcp dpt:http
NFLOG      all  --  anywhere             anywhere             limit: avg 2/min burst 5 nflog-pref
ix  "IPTABLES DROPPED"

Chain OUTPUT (policy DROP)
target     prot opt source               destination
```

Explanation: **We know that ssh traffic is allowed because the rule to allow it is enabled in our iptables configuration as well as the three-way handshake between the client and host being completed.**

b) Show that HTTP traffic is allowed. Report the same as you did for ssh traffic.

Wireshark View:

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	172.24.0.3	172.25.0.3	TCP	74	57974 → 80 [SYN] Seq=0 Win=29200 Len=0 M
2	0.000047720	172.25.0.3	172.24.0.3	TCP	74	80 → 57974 [SYN, ACK] Seq=0 Ack=1 Win=28
3	0.000076895	172.24.0.3	172.25.0.3	TCP	66	57974 → 80 [ACK] Seq=1 Ack=1 Win=29312 L
4	0.000244149	172.24.0.3	172.25.0.3	HTTP	199	GET / HTTP/1.1
5	0.000286719	172.25.0.3	172.24.0.3	TCP	66	80 → 57974 [ACK] Seq=1 Ack=134 Win=30080
6	0.001135403	172.25.0.3	172.24.0.3	TCP	83	80 → 57974 [PSH, ACK] Seq=1 Ack=134 Win=
7	0.001162423	172.24.0.3	172.25.0.3	TCP	66	57974 → 80 [ACK] Seq=134 Ack=18 Win=2931
8	0.001195555	172.25.0.3	172.24.0.3	TCP	104	80 → 57974 [PSH, ACK] Seq=18 Ack=134 Win
9	0.001216264	172.24.0.3	172.25.0.3	TCP	66	57974 → 80 [ACK] Seq=134 Ack=56 Win=2931
10	0.001252011	172.25.0.3	172.24.0.3	TCP	103	80 → 57974 [PSH, ACK] Seq=56 Ack=134 Win
11	0.001271819	172.24.0.3	172.25.0.3	TCP	66	57974 → 80 [ACK] Seq=134 Ack=93 Win=2931
12	0.001299591	172.25.0.3	172.24.0.3	TCP	106	80 → 57974 [PSH, ACK] Seq=93 Ack=134 Win
13	0.001318707	172.24.0.3	172.25.0.3	TCP	66	57974 → 80 [ACK] Seq=134 Ack=133 Win=293
14	0.001343944	172.25.0.3	172.24.0.3	TCP	87	80 → 57974 [PSH, ACK] Seq=133 Ack=134 Wi
15	0.001363280	172.24.0.3	172.25.0.3	TCP	66	57974 → 80 [ACK] Seq=134 Ack=154 Win=293
16	0.001386775	172.25.0.3	172.24.0.3	TCP	68	80 → 57974 [PSH, ACK] Seq=154 Ack=134 Wi
17	0.001405610	172.24.0.3	172.25.0.3	TCP	66	57974 → 80 [ACK] Seq=134 Ack=156 Win=293

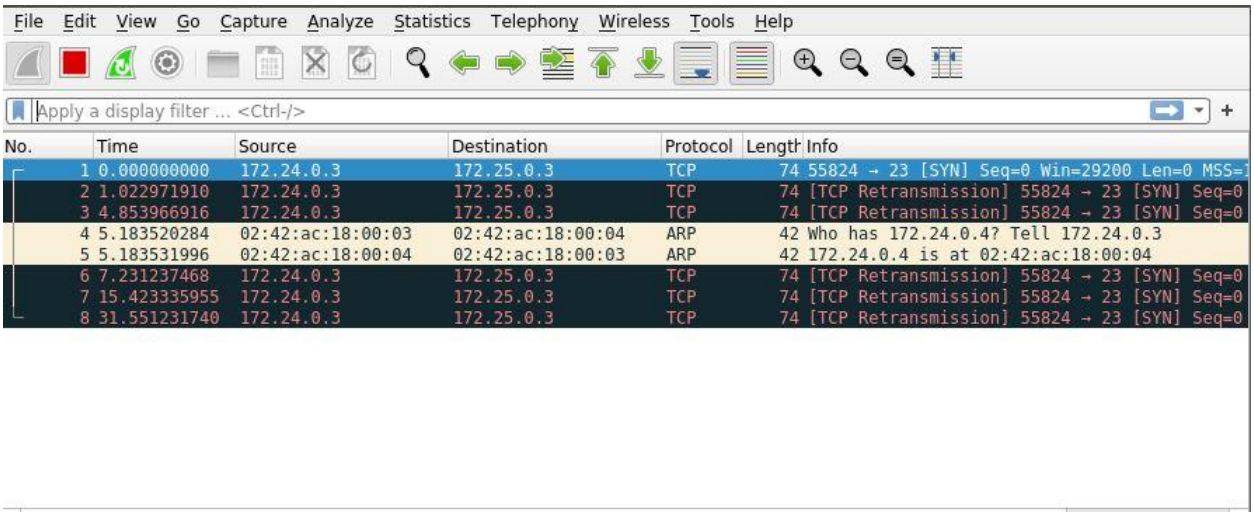
Client View:

```
ubuntu@client:~$ wget server
--2023-10-26 21:05:43--  http://server/
Resolving server (server)... 172.25.0.3
Connecting to server (server)|172.25.0.3|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 874 [text/html]
Saving to: 'index.html.8'

index.html.8            100%[===============================>]     874  --.-KB/s    in 0s

2023-10-26 21:05:43 (262 MB/s) - 'index.html.8' saved [874/874]

ubuntu@client:~$
```

Explanation: **I allowed a rule in the file to accept traffic on port 80 thus allowing http connection to the server. The packet capture proves this because a three-way handshake is established and packets are transferred**

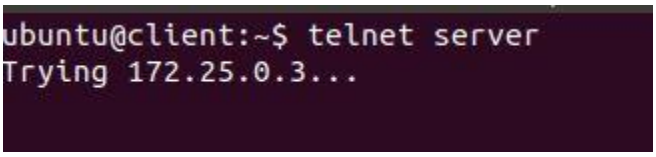
c) Show that telnet traffic is blocked. Report the same as you did for ssh traffic.

Wireshark View:



No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	172.24.0.3	172.25.0.3	TCP	74	55824 → 23 [SYN] Seq=0 Win=29200 Len=0 MSS=1
2	1.022971910	172.24.0.3	172.25.0.3	TCP	74	[TCP Retransmission] 55824 → 23 [SYN] Seq=0
3	4.853966916	172.24.0.3	172.25.0.3	TCP	74	[TCP Retransmission] 55824 → 23 [SYN] Seq=0
4	5.183520284	02:42:ac:18:00:03	02:42:ac:18:00:04	ARP	42	Who has 172.24.0.4? Tell 172.24.0.3
5	5.183531996	02:42:ac:18:00:04	02:42:ac:18:00:03	ARP	42	172.24.0.4 is at 02:42:ac:18:00:04
6	7.231237468	172.24.0.3	172.25.0.3	TCP	74	[TCP Retransmission] 55824 → 23 [SYN] Seq=0
7	15.423335955	172.24.0.3	172.25.0.3	TCP	74	[TCP Retransmission] 55824 → 23 [SYN] Seq=0
8	31.551231740	172.24.0.3	172.25.0.3	TCP	74	[TCP Retransmission] 55824 → 23 [SYN] Seq=0

Client View:



Explanation: **Telnet traffic is blocked because of the rules we've established in our iptables configuration. Only HTTP and SSH traffic is allowed. The packet capture proves this because it is unable to establish a three-way handshake. Syn packets are sent with no ack response.**

d) At the end, perform a nmap scan on the client for open ports on the server. Show the output in a screenshot.

```
ubuntu@client:~$ nmap server
Starting Nmap 7.80 ( https://nmap.org ) at 2023-10-26 21:09 UTC
Nmap scan report for server (172.25.0.3)
Host is up (0.00027s latency).
Not shown: 998 filtered ports
PORT   STATE SERVICE
22/tcp open  ssh
80/tcp open  http

Nmap done: 1 IP address (1 host up) scanned in 6.44 seconds
ubuntu@client:~$
```

Task 4. Open a new service port

a) Show that wizbang traffic is allowed. On the client, run wizbang while capturing traffic on the firewall. Report these two activities in two screenshots. Explain how you know wizbang traffic is allowed.

New iptables config:

```
ubuntu@firewall:~$ sudo iptables -L
Chain INPUT (policy DROP)
target     prot opt source               destination
ACCEPT     all  --  anywhere             anywhere

Chain FORWARD (policy DROP)
target     prot opt source               destination
ACCEPT     all  --  anywhere             anywhere             ctstate RELATED,ESTABLISHED
ACCEPT     tcp  --  anywhere             anywhere             tcp dpt:ssh
ACCEPT     tcp  --  anywhere             anywhere             tcp dpt:http
ACCEPT     tcp  --  anywhere             anywhere             tcp dpt:10013
NFLOG      all  --  anywhere             anywhere             limit: avg 2/min burst 5 nflog-pref
ix  "IPTABLES DROPPED"

Chain OUTPUT (policy DROP)
target     prot opt source               destination
ubuntu@firewall:~$
```

Wireshark View:

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	172.24.0.3	172.25.0.3	TCP	74	47606 → 10013 [SYN] Seq=0 Win=29200 Len=0 MS
2	0.000054262	172.25.0.3	172.24.0.3	TCP	74	10013 → 47606 [SYN, ACK] Seq=0 Ack=1 Win=289
3	0.000072917	172.24.0.3	172.25.0.3	TCP	66	47606 → 10013 [ACK] Seq=1 Ack=1 Win=29312 Le
4	0.000168777	172.24.0.3	172.25.0.3	TCP	73	47606 → 10013 [PSH, ACK] Seq=1 Ack=1 Win=293
5	0.000182232	172.25.0.3	172.24.0.3	TCP	66	10013 → 47606 [ACK] Seq=1 Ack=8 Win=29056 Le
6	0.000212699	172.24.0.3	172.25.0.3	TCP	66	47606 → 10013 [FIN, ACK] Seq=8 Ack=1 Win=293
7	0.010193665	172.25.0.3	172.24.0.3	TCP	66	10013 → 47606 [FIN, ACK] Seq=1 Ack=9 Win=290
8	0.010226346	172.24.0.3	172.25.0.3	TCP	66	47606 → 10013 [ACK] Seq=9 Ack=2 Win=29312 Le
9	5.147277366	02:42:ac:18:00:04	02:42:ac:18:00:03	ARP	42	Who has 172.24.0.3? Tell 172.24.0.4
10	5.147325536	02:42:ac:18:00:03	02:42:ac:18:00:04	ARP	42	Who has 172.24.0.4? Tell 172.24.0.3
11	5.147341276	02:42:ac:18:00:04	02:42:ac:18:00:03	ARP	42	172.24.0.4 is at 02:42:ac:18:00:04
12	5.147342237	02:42:ac:18:00:03	02:42:ac:18:00:04	ARP	42	172.24.0.3 is at 02:42:ac:18:00:03

Client View:

```
ubuntu@client:~$ sudo ./wizbang Hello!
Sending instruction Hello!
bye
ubuntu@client:~$
```

Explanation: **I allowed traffic on port 10013 which is the port wizbang was using to connect to our server. We can see that it works because the three-way handshake is completed.**

b) At the end, perform a nmap scan on the client for open ports on the server. Show the output in a screenshot.

```
ubuntu@client:~$ nmap server
Starting Nmap 7.80 ( https://nmap.org ) at 2023-10-26 21:37 UTC
Nmap scan report for server (172.25.0.3)
Host is up (0.00026s latency).
Not shown: 998 filtered ports
PORT   STATE SERVICE
22/tcp open  ssh
80/tcp open  http

Nmap done: 1 IP address (1 host up) scanned in 4.84 seconds
ubuntu@client:~$
```