Assignment 1

Computer Networks , CSE232

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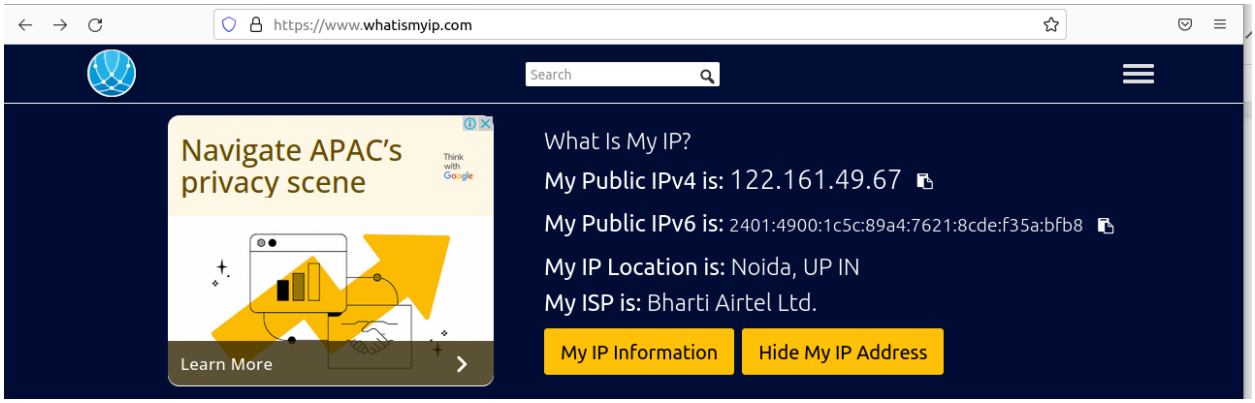
Q1

```
aayush@ubuntu-vm:~$ ifconfig -a
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.0.2.15  netmask 255.255.255.0  broadcast 10.0.2.255
        inet6 fe80::e56b:e644:e9a8:64a3  prefixlen 64  scopeid 0x20<link>
        ether 08:00:27:8e:66:3e  txqueuelen 1000  (Ethernet)
        RX packets 1935  bytes 2508753 (2.5 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 1069  bytes 88402 (88.4 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

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 155  bytes 15344 (15.3 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 155  bytes 15344 (15.3 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```



They are different because on the website it shows the public IP whereas in the screenshot, it is showing my local IP.

Q2

```
aayush@ubuntu-vm:~/Desktop$ nslookup -type=soa yahoo.in
Server:         127.0.0.53
Address:        127.0.0.53#53

Non-authoritative answer:
yahoo.in
        origin = hidden-master.yahoo.com
        mail addr = hostmaster.yahoo-inc.com
        serial = 2022062302
        refresh = 28800
        retry = 3600
        expire = 1814400
        minimum = 600

Authoritative answers can be found from:
yahoo.in        nameserver = ns3.yahoo.com.
yahoo.in        nameserver = ns4.yahoo.com.
yahoo.in        nameserver = ns2.yahoo.com.
yahoo.in        nameserver = ns1.yahoo.com.
yahoo.in        nameserver = ns5.yahoo.com.

aayush@ubuntu-vm:~/Desktop$ nslookup -type=soa yahoo.in ns2.yahoo.com
Server:         ns2.yahoo.com
Address:        2001:4998:1c0::7961:686f:6f21#53

yahoo.in
        origin = hidden-master.yahoo.com
        mail addr = hostmaster.yahoo-inc.com
        serial = 2022062302
        refresh = 28800
        retry = 3600
        expire = 1814400
        minimum = 600
```

i)

We first typed the command nslookup -type=soa yahoo.in. type=soa basically stores all the necessary information about a domain.

After that we got the list of all the servers where authoritative answers can be found. Thereafter using the command nslookup -type=soa yahoo.in <any of the name server>, we got the desired result.

```
aayush@ubuntu-vm:~/Desktop$ dig ns2.yahoo.com a yahoo.in

; <<>> DiG 9.18.1-1ubuntu1.1-Ubuntu <<>> ns2.yahoo.com a yahoo.in
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 43364
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;ns2.yahoo.com.                 IN      A

;; ANSWER SECTION:
ns2.yahoo.com.          859518  IN      A       68.142.255.16

;; Query time: 11 msec
;; SERVER: 127.0.0.53#53(127.0.0.53) (UDP)
;; WHEN: Fri Sep 23 12:45:43 IST 2022
;; MSG SIZE  rcvd: 58

;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 54192
;; flags: qr rd ra; QUERY: 1, ANSWER: 5, AUTHORITY: 5, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;yahoo.in.                      IN      A

;; ANSWER SECTION:
yahoo.in.               300     IN      A       98.136.103.23
yahoo.in.               300     IN      A       106.10.248.150
yahoo.in.               300     IN      A       74.6.136.150
yahoo.in.               300     IN      A       212.82.100.150
yahoo.in.               300     IN      A       124.108.115.100

;; AUTHORITY SECTION:
yahoo.in.               172800  IN      NS      ns2.yahoo.com.
yahoo.in.               172800  IN      NS      ns3.yahoo.com.
yahoo.in.               172800  IN      NS      ns5.yahoo.com.
yahoo.in.               172800  IN      NS      ns1.yahoo.com.
yahoo.in.               172800  IN      NS      ns4.yahoo.com.

;; Query time: 31 msec
;; SERVER: 127.0.0.53#53(127.0.0.53) (UDP)
;; WHEN: Fri Sep 23 12:45:43 IST 2022
;; MSG SIZE  rcvd: 216
```

There are different servers for the website. Each website was live for about 300 units on

the local dns. After 300 units, these entries would expire.

Q3

```
aayush@ubuntu-vm:~/Desktop$ traceroute google.in
traceroute to google.in (142.250.192.132), 30 hops max, 60 byte packets
 1  dsldevice.lan (192.168.1.1)  1.829 ms  2.053 ms  2.116 ms
 2  abts-north-static-068.127.176.122.airtelbroadband.in (122.176.127.68)  6.850 ms  6.961 ms  25.552 ms
 3  182.79.117.225 (182.79.117.225)  5.587 ms 125.17.145.1 (125.17.145.1)  5.479 ms 182.79.117.225 (182.79.117.225)  5.860 ms
 4  74.125.51.184 (74.125.51.184)  25.290 ms 72.14.217.194 (72.14.217.194)  6.775 ms 74.125.51.184 (74.125.51.184)  25.063 ms
 5  * * *
 6  108.170.251.113 (108.170.251.113)  24.874 ms 142.251.52.228 (142.251.52.228)  28.736 ms 72.14.232.56 (72.14.232.56)  10.801 ms
 7  74.125.243.100 (74.125.243.100)  23.588 ms 74.125.244.195 (74.125.244.195)  27.935 ms 108.170.251.119 (108.170.251.119)  23.489 ms
 8  72.14.232.138 (72.14.232.138)  38.697 ms 72.14.233.107 (72.14.233.107)  37.397 ms 72.14.232.138 (72.14.232.138)  31.116 ms
 9  216.239.50.22 (216.239.50.22)  32.842 ms 216.239.54.92 (216.239.54.92)  37.242 ms 108.170.248.177 (108.170.248.177)  37.186 ms
10  142.250.238.81 (142.250.238.81)  32.694 ms 108.170.248.177 (108.170.248.177)  37.088 ms  29.544 ms
11  142.250.238.81 (142.250.238.81)  29.463 ms bom12s18-in-f4.1e100.net (142.250.192.132)  29.344 ms  28.773 ms
```

i) There are 11 intermediate hosts. IP addresses are given in the **above output.**

```
aayush@ubuntu-vm:~/Desktop$ ping -c 100 -q google.in
PING google.in (142.250.199.164) 56(84) bytes of data.

--- google.in ping statistics ---
100 packets transmitted, 100 received, 0% packet loss, time 99420ms
rtt min/avg/max/mdev = 27.172/28.310/32.315/0.935 ms
```

ii) **above output**

```
aayush@ubuntu-vm:~/Desktop$ ping -c 100 -q columbia.edu
PING columbia.edu (128.59.105.24) 56(84) bytes of data.

--- columbia.edu ping statistics ---
100 packets transmitted, 100 received, 0% packet loss, time 104503ms
rtt min/avg/max/mdev = 268.862/271.033/343.025/7.342 ms
```

iii) **above output**

vi)

```
aayush@ubuntu-vm:~$ traceroute columbia.edu
traceroute to columbia.edu (128.59.105.24), 30 hops max, 60 byte packets
 1  dsldevice.lan (192.168.1.1)  3.119 ms  3.023 ms  3.154 ms
 2  abts-north-static-068.127.176.122.airtelbroadband.in (122.176.127.68)  8.060 ms  13.414 ms  13.352 ms
 3  125.19.76.89 (125.19.76.89)  16.236 ms 125.17.145.1 (125.17.145.1)  16.179 ms 125.19.76.89 (125.19.76.89)  16.117 ms
 4  * * 182.79.247.34 (182.79.247.34)  254.796 ms
 5  * * *
 6  be3271.ccr41.lax01.atlas.cogentco.com (154.54.42.101)  267.332 ms  261.707 ms  256.601 ms
 7  be2931.ccr31.phx01.atlas.cogentco.com (154.54.44.85)  266.324 ms  264.469 ms be2932.ccr32.phx01.atlas.cogentco.com (154.54.45.161)  283.632 ms
 8  be2930.ccr21.elp01.atlas.cogentco.com (154.54.42.78)  264.218 ms be2929.ccr21.elp01.atlas.cogentco.com (154.54.42.66)  267.288 ms be2930.ccr21.elp01.atlas.cogentco.com (154.54.42.78)  263.726 ms
 9  be2928.ccr42.iah01.atlas.cogentco.com (154.54.30.161)  263.544 ms *  264.970 ms
10  be2690.ccr42.atl01.atlas.cogentco.com (154.54.28.129)  264.921 ms  264.866 ms  267.213 ms
11  be2113.ccr42.dca01.atlas.cogentco.com (154.54.24.221)  264.754 ms  264.708 ms  257.762 ms
12  be2807.ccr42.jfk02.atlas.cogentco.com (154.54.40.109)  268.779 ms  264.513 ms *
13  be2897.rcr24.jfk01.atlas.cogentco.com (154.54.84.214)  261.594 ms  264.207 ms  264.118 ms
14  38.122.8.210 (38.122.8.210)  266.911 ms  261.936 ms  266.477 ms
15  cc-core-1-x-nyser32-gw-1.net.columbia.edu (128.59.255.5)  279.422 ms  279.301 ms  270.136 ms
16  cc-conc-1-x-cc-core-1.net.columbia.edu (128.59.255.21)  314.652 ms  314.381 ms  314.227 ms
17  128.59.105.24 (128.59.105.24)  269.369 ms  269.251 ms  269.177 ms
```

The number of hops in google.in are 11 and in columbia.edu are 17.

There is a difference because one is a global website and one is an Indian website. For an Indian website, a local cache must be there, that's why it has lesser latency.

Q4

There are two ways of doing so :-

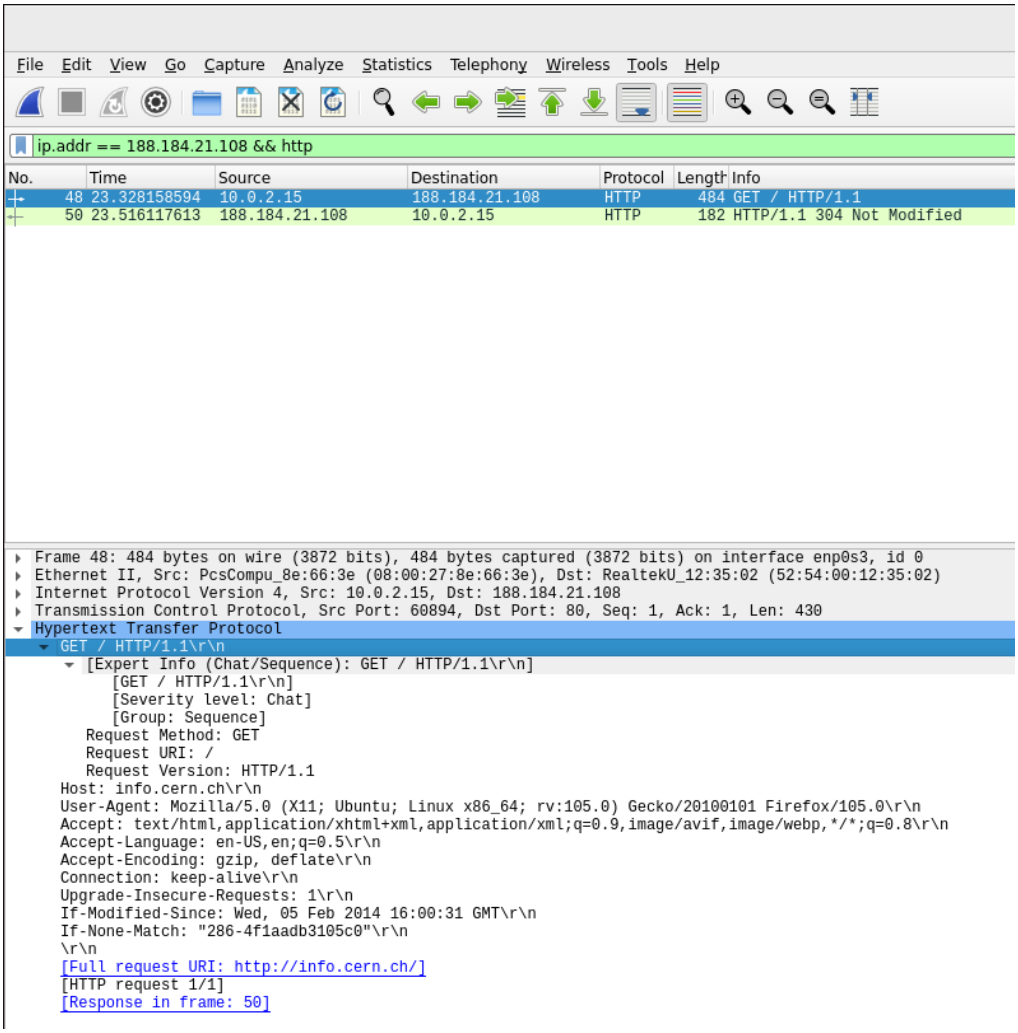
i) take down the local host using command *sudo ifconfig lo down* so that it will wait with 100% packet loss as shown in the output below.

```
aayush@ubuntu-vm:~$ sudo ifconfig lo down
aayush@ubuntu-vm:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.1.11  netmask 255.255.255.0  broadcast 192.168.1.255
        inet6 fe80::e56b:e644:e9a8:64a3  prefixlen 64  scopeid 0x20<link>
        inet6 2401:4900:1c5c:89a4:cb00:a73c:8368:a771  prefixlen 64  scopeid 0x0<global>
        inet6 2401:4900:1c5c:89a4:7621:8cde:f35a:bfb8  prefixlen 64  scopeid 0x0<global>
        ether 08:00:27:8e:66:3e  txqueuelen 1000  (Ethernet)
        RX packets 71235  bytes 60935074 (60.9 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 42190  bytes 18902965 (18.9 MB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

aayush@ubuntu-vm:~$ ping -c1 127.0.0.1
PING 127.0.0.1 (127.0.0.1) 56(84) bytes of data.

--- 127.0.0.1 ping statistics ---
1 packets transmitted, 0 received, 100% packet loss, time 0ms
```

ii) We can increase the size of the packet using command ping -s <packet_size>.

```
aayush@ubuntu-vm:~$ ping -s 100000 google.com
PING google.com(bom07s15-in-x0e.1e100.net (2404:6800:4009:800::200e)) 100000 data bytes
^C
--- google.com ping statistics ---
721 packets transmitted, 0 received, 100% packet loss, time 737284ms
```

Q5

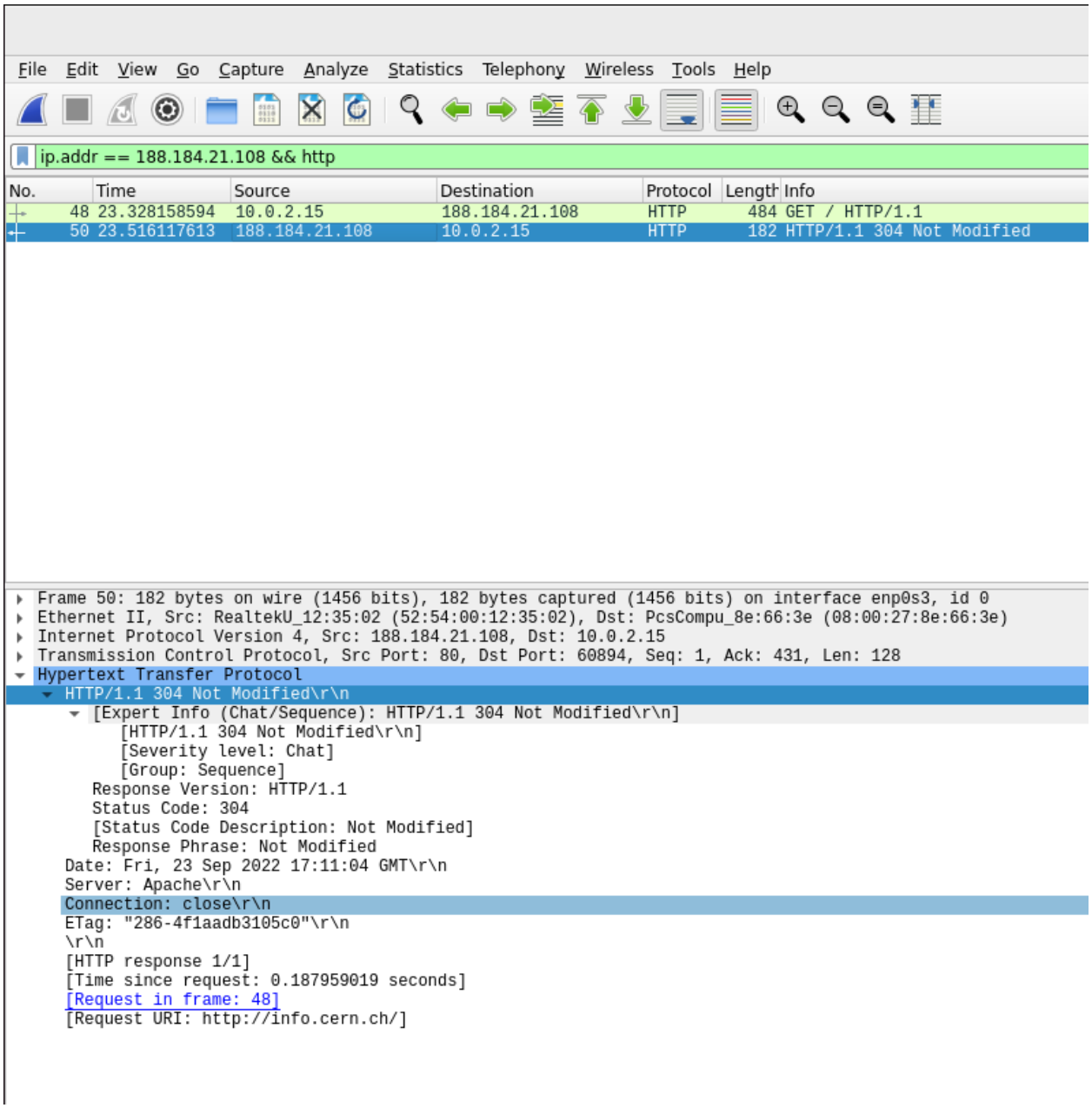


i) For HTTP request packets

HTTP request type:- GET

User-Agent type: Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:105.0) Gecko/20100101 Firefox/105.0\r\n

HTTP request packet URL:- [Full request URI: http://info.cern.ch/]

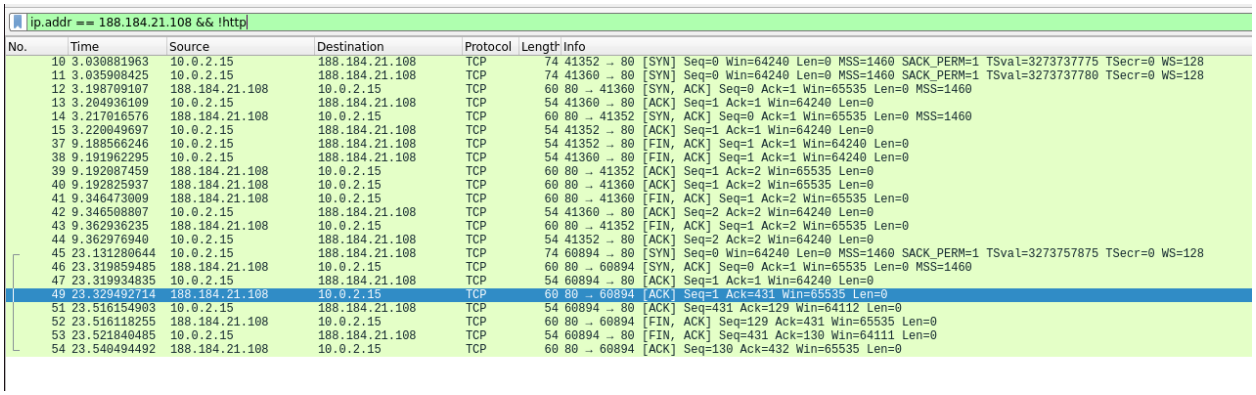


ii) HTTP response packets:

HTTP response code:- 304

HTTP response description:- Not Modified

Name and version of the web server:- Apache



```
ip.addr == 188.184.21.108 && !http
```

No.	Time	Source	Destination	Protocol	Length	Info
10	3.030881963	10.0.2.15	188.184.21.108	TCP	74	41352 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=3273737775 TSecr=0 WS=128
11	3.035908425	10.0.2.15	188.184.21.108	TCP	74	41360 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=3273737780 TSecr=0 WS=128
12	3.198709107	188.184.21.108	10.0.2.15	TCP	60	80 → 41360 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1460
13	3.204936109	10.0.2.15	188.184.21.108	TCP	54	41360 → 80 [ACK] Seq=1 Ack=1 Win=64240 Len=0
14	3.217016576	188.184.21.108	10.0.2.15	TCP	60	80 → 41352 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1460
15	3.220049697	10.0.2.15	188.184.21.108	TCP	54	41352 → 80 [ACK] Seq=1 Ack=1 Win=64240 Len=0
37	9.188566246	10.0.2.15	188.184.21.108	TCP	54	41352 → 80 [FIN, ACK] Seq=1 Ack=1 Win=64240 Len=0
38	9.191962295	10.0.2.15	188.184.21.108	TCP	54	41360 → 80 [FIN, ACK] Seq=1 Ack=1 Win=64240 Len=0
39	9.192087459	188.184.21.108	10.0.2.15	TCP	60	80 → 41352 [ACK] Seq=1 Ack=2 Win=65535 Len=0
40	9.192825937	188.184.21.108	10.0.2.15	TCP	60	80 → 41360 [ACK] Seq=1 Ack=2 Win=65535 Len=0
41	9.346473009	188.184.21.108	10.0.2.15	TCP	60	80 → 41360 [FIN, ACK] Seq=1 Ack=2 Win=65535 Len=0
42	9.346508807	10.0.2.15	188.184.21.108	TCP	54	41360 → 80 [ACK] Seq=2 Ack=2 Win=64240 Len=0
43	9.362936235	188.184.21.108	10.0.2.15	TCP	60	80 → 41352 [FIN, ACK] Seq=1 Ack=2 Win=65535 Len=0
44	9.362976940	10.0.2.15	188.184.21.108	TCP	54	41352 → 80 [ACK] Seq=2 Ack=2 Win=64240 Len=0
45	23.131280644	10.0.2.15	188.184.21.108	TCP	74	60894 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=3273757875 TSecr=0 WS=128
46	23.319859485	188.184.21.108	10.0.2.15	TCP	60	80 → 60894 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1460
47	23.319934835	10.0.2.15	188.184.21.108	TCP	54	60894 → 80 [ACK] Seq=1 Ack=1 Win=64240 Len=0
49	23.329492714	188.184.21.108	10.0.2.15	TCP	60	80 → 60894 [ACK] Seq=1 Ack=431 Win=65535 Len=0
51	23.516154903	10.0.2.15	188.184.21.108	TCP	54	60894 → 80 [ACK] Seq=431 Ack=129 Win=64112 Len=0
52	23.516118255	188.184.21.108	10.0.2.15	TCP	60	80 → 60894 [FIN, ACK] Seq=129 Ack=431 Win=65535 Len=0
53	23.521840485	10.0.2.15	188.184.21.108	TCP	54	60894 → 80 [FIN, ACK] Seq=431 Ack=130 Win=64111 Len=0
54	23.540494492	188.184.21.108	10.0.2.15	TCP	60	80 → 60894 [ACK] Seq=130 Ack=432 Win=65535 Len=0

iii) 8 web objects get downloaded.

They were over different connections.

iv)Persistent connection

Q6

a) command used is:- sudo netstat -p -t

```
aayush@ubuntu-vm:~/Desktop$ sudo netstat -p -t
Active Internet connections (w/o servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State       PID/Program name
tcp        0      0 ubuntu-vm:51798         webafs706.cern.ch:http  TIME_WAIT   -
tcp        0      0 ubuntu-vm:57160         bom12s17-in-f14.1:https TIME_WAIT   -
tcp        0      0 ubuntu-vm:33168         123.208.120.34.bc:https TIME_WAIT   -
tcp        0      0 ubuntu-vm:52182         76.237.120.34.bc.:https TIME_WAIT   -
tcp        0      0 ubuntu-vm:55484         del12s05-in-f3.1e1:http ESTABLISHED 5208/firefox
tcp        0      0 ubuntu-vm:53396         102.115.120.34.bc:https ESTABLISHED 5208/firefox
tcp        0      0 ubuntu-vm:49908         82.221.107.34.bc.g:http ESTABLISHED 5208/firefox
tcp        0      0 ubuntu-vm:40236         a23-55-106-81.depl:http TIME_WAIT   -
tcp        0      0 ubuntu-vm:40744         76.237.120.34.bc.:https TIME_WAIT   -
tcp        0      0 ubuntu-vm:40694         76.237.120.34.bc.:https TIME_WAIT   -
tcp        0      0 ubuntu-vm:40224         a23-55-106-81.depl:http TIME_WAIT   -
tcp        0      0 ubuntu-vm:33170         123.208.120.34.bc:https TIME_WAIT   -
tcp        0      0 ubuntu-vm:35242         a23-55-106-56.depl:http ESTABLISHED 5208/firefox
tcp        0      0 ubuntu-vm:43152         239.237.117.34.bc:https ESTABLISHED 5208/firefox
tcp        0      0 ubuntu-vm:40210         a23-55-106-81.depl:http TIME_WAIT   -
tcp        0      0 ubuntu-vm:47218         123.208.120.34.bc:https TIME_WAIT   -
tcp        0      0 ubuntu-vm:48100         102.115.120.34.bc:https TIME_WAIT   -
tcp        0      0 ubuntu-vm:33180         123.208.120.34.bc:https TIME_WAIT   -
tcp        0      0 ubuntu-vm:40758         76.237.120.34.bc.:https ESTABLISHED 5208/firefox
tcp        0      0 ubuntu-vm:53254         bom07s29-in-f14.1:https TIME_WAIT   -
tcp        0      0 ubuntu-vm:41924         server-18-66-63-1:https ESTABLISHED 5208/firefox
tcp        0      0 ubuntu-vm:51478         server-18-66-78-1:https ESTABLISHED 5208/firefox
tcp        0      0 ubuntu-vm:40208         a23-55-106-81.depl:http TIME_WAIT   -
tcp        0      0 ubuntu-vm:59478         webafs706.cern.ch:http  TIME_WAIT   -
tcp        0      0 ubuntu-vm:43974         117.18.237.29:http      ESTABLISHED 5208/firefox
tcp        0      0 ubuntu-vm:33004         ec2-44-242-3-166.:https ESTABLISHED 5208/firefox
tcp        0      0 ubuntu-vm:59238         del03s16-in-f14.1:https TIME_WAIT   -
tcp        0      0 ubuntu-vm:47204         123.208.120.34.bc:https ESTABLISHED 5208/firefox
tcp        0      0 ubuntu-vm:49902         82.221.107.34.bc.g:http ESTABLISHED 5208/firefox
```

b) TIME_WAIT