COL 334 Assignment - 1

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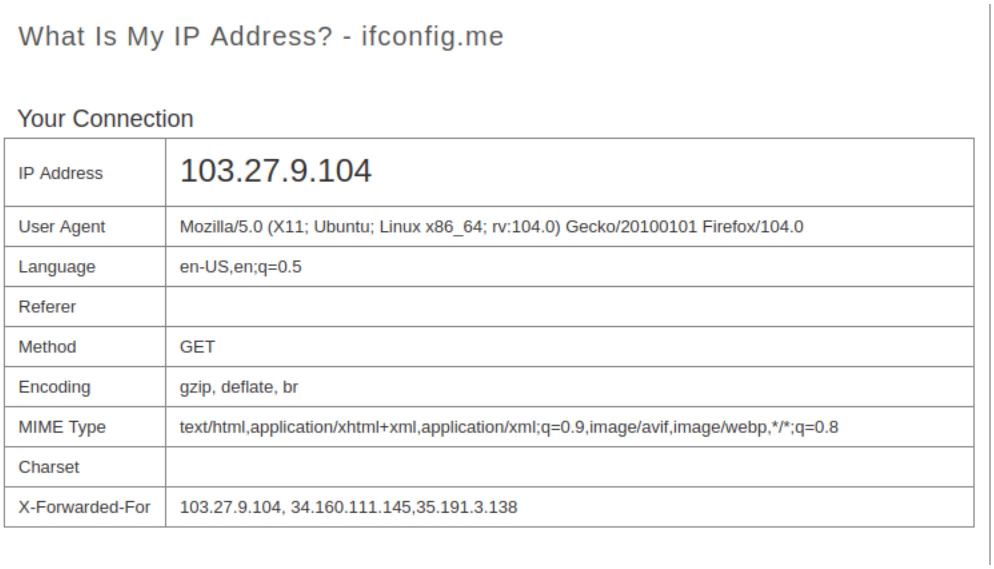
1 Networking Tools

Please note that I have used my mobile hotspot(jio) for all the tasks (unless specified)

1.1 IP address

The IP address of the wifi server is 103.27.9.104 when I am connected to the iitd wifi

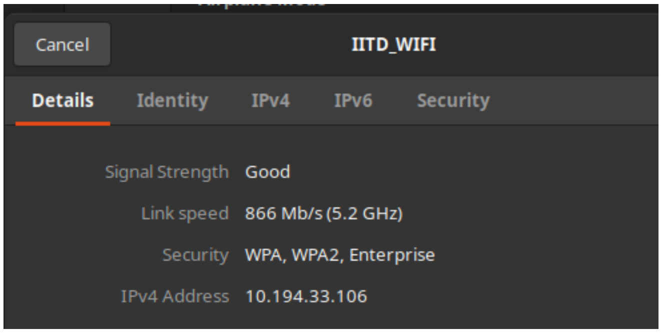


What Is My IP Address? - ifconfig.me

Your Connection

IP Address	103.27.9.104
User Agent	Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:104.0) Gecko/20100101 Firefox/104.0
Language	en-US,en;q=0.5
Referer	
Method	GET
Encoding	gzip, deflate, br
MIME Type	text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Charset	
X-Forwarded-For	103.27.9.104, 34.160.111.145,35.191.3.138

The IP address assigned to my machine via the ISP is 10.194.33.106



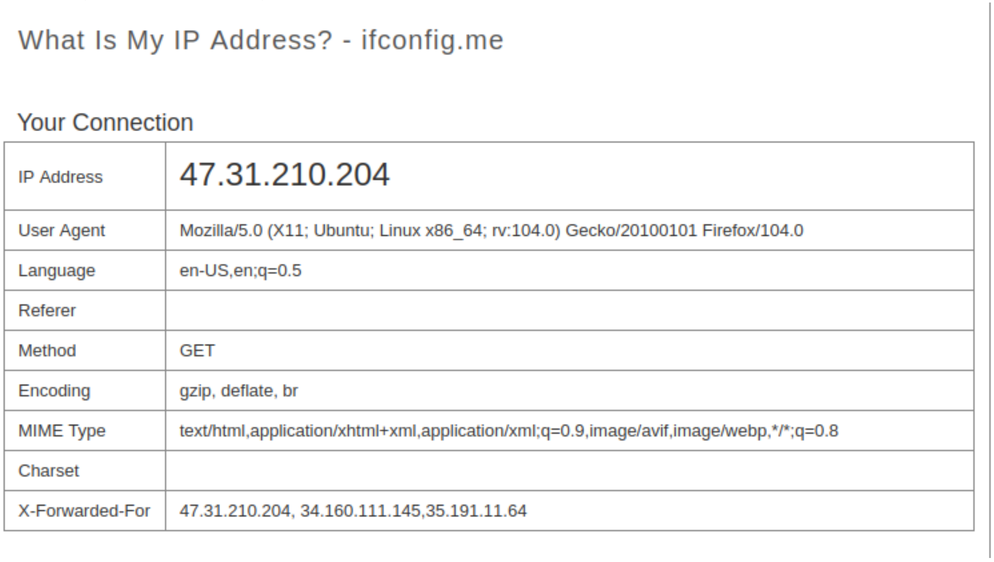
Signal Strength Good

Link speed 866 Mb/s (5.2 GHz)

Security WPA, WPA2, Enterprise

IPv4 Address 10.194.33.106

The IP address of the new isp server is 47.31.210.204 when I am connected to JIO (mobile hotspot)

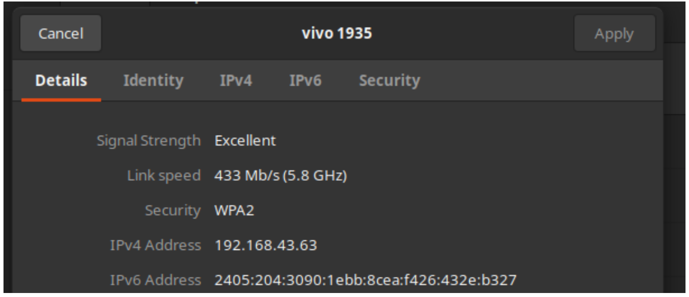


What Is My IP Address? - ifconfig.me

Your Connection

IP Address	47.31.210.204
User Agent	Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:104.0) Gecko/20100101 Firefox/104.0
Language	en-US,en;q=0.5
Referer	
Method	GET
Encoding	gzip, deflate, br
MIME Type	text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Charset	
X-Forwarded-For	47.31.210.204, 34.160.111.145,35.191.11.64

The IP address assigned to my machine via the isp is 192.168.43.63



Signal Strength Excellent

Link speed 433 Mb/s (5.8 GHz)

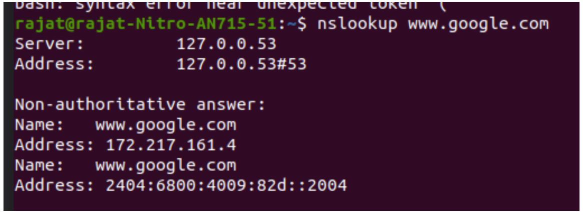
Security WPA2

IPv4 Address 192.168.43.63

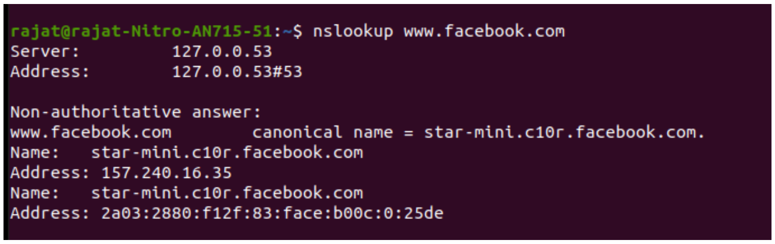
IPv6 Address 2405:204:3090:1ebb:8cea:f426:432e:b327

1.2 nslookup

The IP address of google and facebook are 172.217.161.4 and 157.240.16.35

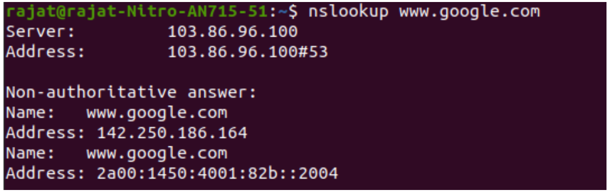


```
bash: syntax error near unexpected token `('
rajat@rajat-Nitro-AN715-51:~$ nslookup www.google.com
Server:         127.0.0.53
Address:        127.0.0.53#53

Non-authoritative answer:
Name:   www.google.com
Address: 172.217.161.4
Name:   www.google.com
Address: 2404:6800:4009:82d::2004
```

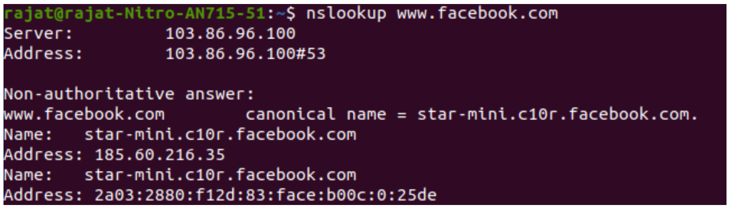


```
rajat@rajat-Nitro-AN715-51:~$ nslookup www.facebook.com
Server:         127.0.0.53
Address:        127.0.0.53#53

Non-authoritative answer:
www.facebook.com        canonical name = star-mini.c10r.facebook.com.
Name:   star-mini.c10r.facebook.com
Address: 157.240.16.35
Name:   star-mini.c10r.facebook.com
Address: 2a03:2880:f12f:83:face:b00c:0:25de
```

After changing the DNS address to 103.86.96.100



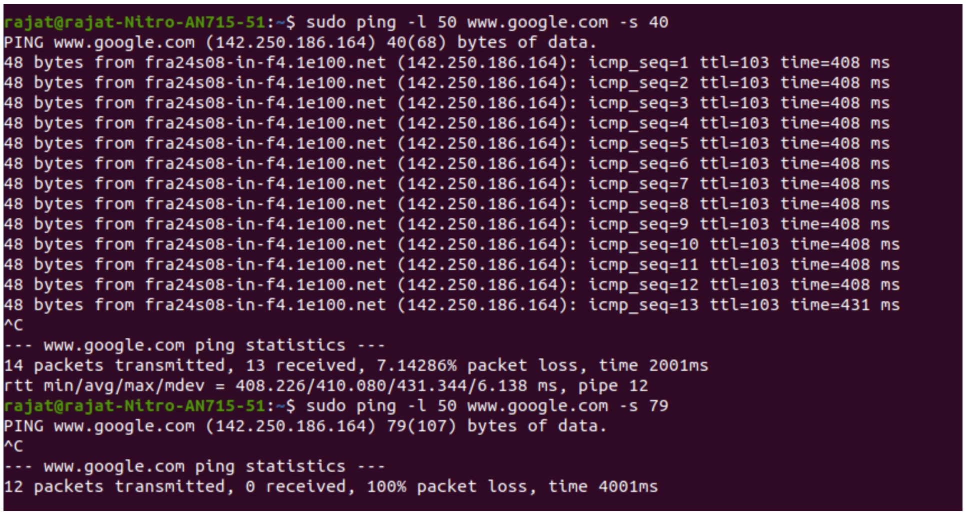
```
rajat@rajat-Nitro-AN715-51:~$ nslookup www.google.com
Server:         103.86.96.100
Address:        103.86.96.100#53

Non-authoritative answer:
Name:   www.google.com
Address: 142.250.186.164
Name:   www.google.com
Address: 2a00:1450:4001:82b::2004
```



```
rajat@rajat-Nitro-AN715-51:~$ nslookup www.facebook.com
Server:         103.86.96.100
Address:        103.86.96.100#53

Non-authoritative answer:
www.facebook.com        canonical name = star-mini.c10r.facebook.com.
Name:   star-mini.c10r.facebook.com
Address: 185.60.216.35
Name:   star-mini.c10r.facebook.com
Address: 2a03:2880:f12d:83:face:b00c:0:25de
```

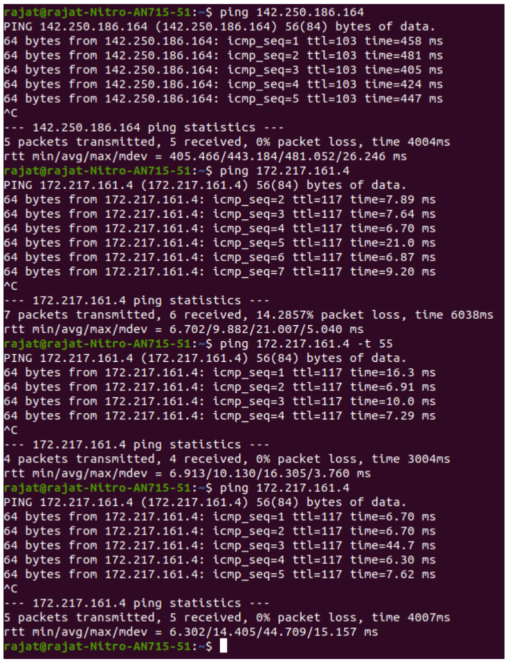
1.3 Ping

First I tried to ping www.google.com with packet size of 40, the packets were successfully transmitted. But then I tried with a packet size of 79, but there was 100 % packet loss



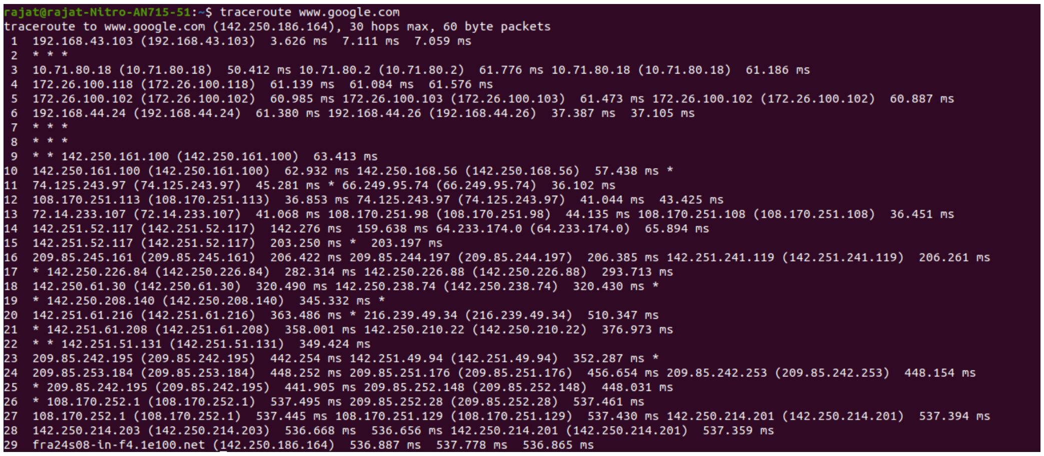
```
rajat@rajat-Nitro-AN715-51:~$ sudo ping -l 50 www.google.com -s 40
PING www.google.com (142.250.186.164) 40(68) bytes of data.
48 bytes from fra24s08-in-f4.1e100.net (142.250.186.164): icmp_seq=1 ttl=103 time=408 ms
48 bytes from fra24s08-in-f4.1e100.net (142.250.186.164): icmp_seq=2 ttl=103 time=408 ms
48 bytes from fra24s08-in-f4.1e100.net (142.250.186.164): icmp_seq=3 ttl=103 time=408 ms
48 bytes from fra24s08-in-f4.1e100.net (142.250.186.164): icmp_seq=4 ttl=103 time=408 ms
48 bytes from fra24s08-in-f4.1e100.net (142.250.186.164): icmp_seq=5 ttl=103 time=408 ms
48 bytes from fra24s08-in-f4.1e100.net (142.250.186.164): icmp_seq=6 ttl=103 time=408 ms
48 bytes from fra24s08-in-f4.1e100.net (142.250.186.164): icmp_seq=7 ttl=103 time=408 ms
48 bytes from fra24s08-in-f4.1e100.net (142.250.186.164): icmp_seq=8 ttl=103 time=408 ms
48 bytes from fra24s08-in-f4.1e100.net (142.250.186.164): icmp_seq=9 ttl=103 time=408 ms
48 bytes from fra24s08-in-f4.1e100.net (142.250.186.164): icmp_seq=10 ttl=103 time=408 ms
48 bytes from fra24s08-in-f4.1e100.net (142.250.186.164): icmp_seq=11 ttl=103 time=408 ms
48 bytes from fra24s08-in-f4.1e100.net (142.250.186.164): icmp_seq=12 ttl=103 time=408 ms
48 bytes from fra24s08-in-f4.1e100.net (142.250.186.164): icmp_seq=13 ttl=103 time=431 ms
^C
--- www.google.com ping statistics ---
14 packets transmitted, 13 received, 7.14286% packet loss, time 2001ms
rtt min/avg/max/mdev = 408.226/410.080/431.344/6.138 ms, pipe 12
rajat@rajat-Nitro-AN715-51:~$ sudo ping -l 50 www.google.com -s 79
PING www.google.com (142.250.186.164) 79(107) bytes of data.
^C
--- www.google.com ping statistics ---
12 packets transmitted, 0 received, 100% packet loss, time 4001ms
```

I tried with different ttl but didn’t notice any change



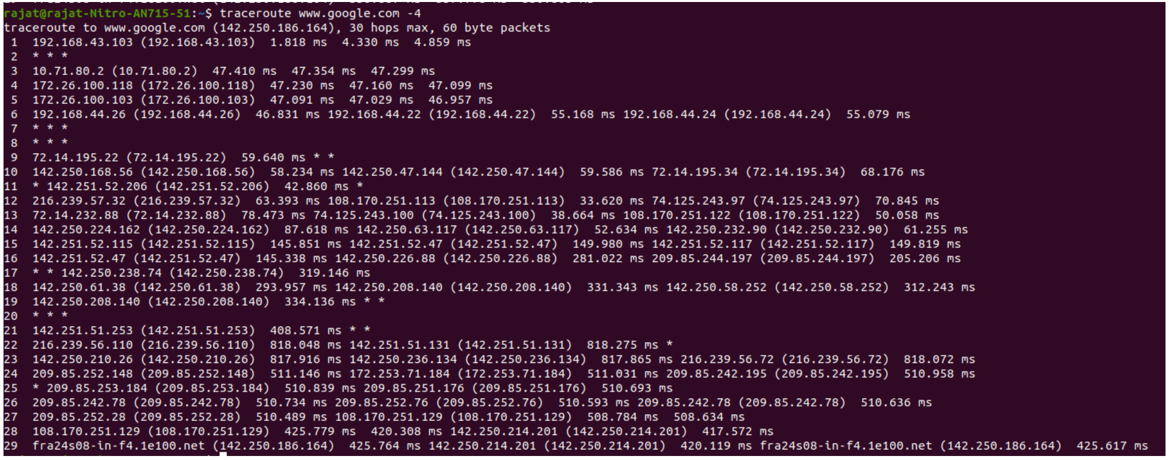
```
rajat@rajat-Nitro-AN715-51:~$ ping 142.250.186.164
PING 142.250.186.164 (142.250.186.164) 56(84) bytes of data.
64 bytes from 142.250.186.164: icmp_seq=1 ttl=103 time=458 ms
64 bytes from 142.250.186.164: icmp_seq=2 ttl=103 time=481 ms
64 bytes from 142.250.186.164: icmp_seq=3 ttl=103 time=405 ms
64 bytes from 142.250.186.164: icmp_seq=4 ttl=103 time=424 ms
64 bytes from 142.250.186.164: icmp_seq=5 ttl=103 time=447 ms
^C
--- 142.250.186.164 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4004ms
rtt min/avg/max/mdev = 405.466/443.184/481.052/26.246 ms
rajat@rajat-Nitro-AN715-51:~$ ping 172.217.161.4
PING 172.217.161.4 (172.217.161.4) 56(84) bytes of data.
64 bytes from 172.217.161.4: icmp_seq=2 ttl=117 time=7.89 ms
64 bytes from 172.217.161.4: icmp_seq=3 ttl=117 time=7.64 ms
64 bytes from 172.217.161.4: icmp_seq=4 ttl=117 time=6.70 ms
64 bytes from 172.217.161.4: icmp_seq=5 ttl=117 time=21.0 ms
64 bytes from 172.217.161.4: icmp_seq=6 ttl=117 time=6.87 ms
64 bytes from 172.217.161.4: icmp_seq=7 ttl=117 time=9.20 ms
^C
--- 172.217.161.4 ping statistics ---
7 packets transmitted, 6 received, 14.2857% packet loss, time 6038ms
rtt min/avg/max/mdev = 6.702/9.882/21.007/5.040 ms
rajat@rajat-Nitro-AN715-51:~$ ping 172.217.161.4 -t 55
PING 172.217.161.4 (172.217.161.4) 56(84) bytes of data.
64 bytes from 172.217.161.4: icmp_seq=1 ttl=117 time=16.3 ms
64 bytes from 172.217.161.4: icmp_seq=2 ttl=117 time=6.91 ms
64 bytes from 172.217.161.4: icmp_seq=3 ttl=117 time=10.0 ms
64 bytes from 172.217.161.4: icmp_seq=4 ttl=117 time=7.29 ms
^C
--- 172.217.161.4 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3004ms
rtt min/avg/max/mdev = 6.913/10.130/16.305/3.760 ms
rajat@rajat-Nitro-AN715-51:~$ ping 172.217.161.4
PING 172.217.161.4 (172.217.161.4) 56(84) bytes of data.
64 bytes from 172.217.161.4: icmp_seq=1 ttl=117 time=6.70 ms
64 bytes from 172.217.161.4: icmp_seq=2 ttl=117 time=6.70 ms
64 bytes from 172.217.161.4: icmp_seq=3 ttl=117 time=44.7 ms
64 bytes from 172.217.161.4: icmp_seq=4 ttl=117 time=6.30 ms
64 bytes from 172.217.161.4: icmp_seq=5 ttl=117 time=7.62 ms
^C
--- 172.217.161.4 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4007ms
rtt min/avg/max/mdev = 6.302/14.405/44.709/15.157 ms
rajat@rajat-Nitro-AN715-51:~$
```

1.4 Traceroute



```
rajat@rajat-Nitro-AN715-51:~$ traceroute www.google.com
traceroute to www.google.com (142.250.186.164), 30 hops max, 60 byte packets
 1  192.168.43.103 (192.168.43.103)  3.626 ms  7.111 ms  7.059 ms
 2  * * *
 3  10.71.80.18 (10.71.80.18)  50.412 ms 10.71.80.2 (10.71.80.2)  61.776 ms 10.71.80.18 (10.71.80.18)  61.186 ms
 4  172.26.100.118 (172.26.100.118)  61.139 ms  61.084 ms  61.576 ms
 5  172.26.100.102 (172.26.100.102)  60.985 ms 172.26.100.103 (172.26.100.103)  61.473 ms 172.26.100.102 (172.26.100.102)  60.887 ms
 6  192.168.44.24 (192.168.44.24)  61.380 ms 192.168.44.26 (192.168.44.26)  37.387 ms  37.105 ms
 7  * * *
 8  * * *
 9  * * 142.250.161.100 (142.250.161.100)  63.413 ms
10  142.250.161.100 (142.250.161.100)  62.932 ms 142.250.168.56 (142.250.168.56)  57.438 ms *
11  74.125.243.97 (74.125.243.97)  45.281 ms * 66.249.95.74 (66.249.95.74)  36.102 ms
12  108.170.251.113 (108.170.251.113)  36.853 ms 74.125.243.97 (74.125.243.97)  41.044 ms  43.425 ms
13  72.14.233.107 (72.14.233.107)  41.068 ms 108.170.251.98 (108.170.251.98)  44.135 ms 108.170.251.108 (108.170.251.108)  36.451 ms
14  142.251.52.117 (142.251.52.117)  142.276 ms  159.638 ms 64.233.174.0 (64.233.174.0)  65.894 ms
15  142.251.52.117 (142.251.52.117)  203.250 ms *  203.197 ms
16  209.85.245.161 (209.85.245.161)  206.422 ms 209.85.244.197 (209.85.244.197)  206.385 ms 142.251.241.119 (142.251.241.119)  206.261 ms
17  * 142.250.226.84 (142.250.226.84)  282.314 ms 142.250.226.88 (142.250.226.88)  293.713 ms
18  142.250.61.30 (142.250.61.30)  320.490 ms 142.250.238.74 (142.250.238.74)  320.430 ms *
19  * 142.250.208.140 (142.250.208.140)  345.332 ms *
20  142.251.61.216 (142.251.61.216)  363.486 ms * 216.239.49.34 (216.239.49.34)  510.347 ms
21  * 142.251.61.208 (142.251.61.208)  358.001 ms 142.250.210.22 (142.250.210.22)  376.973 ms
22  * * 142.251.51.131 (142.251.51.131)  349.424 ms
23  209.85.242.195 (209.85.242.195)  442.254 ms 142.251.49.94 (142.251.49.94)  352.287 ms *
24  209.85.253.184 (209.85.253.184)  448.252 ms 209.85.251.176 (209.85.251.176)  456.654 ms 209.85.242.253 (209.85.242.253)  448.154 ms
25  * 209.85.242.195 (209.85.242.195)  441.905 ms 209.85.252.148 (209.85.252.148)  448.031 ms
26  * 108.170.252.1 (108.170.252.1)  537.495 ms 209.85.252.28 (209.85.252.28)  537.461 ms
27  108.170.252.1 (108.170.252.1)  537.445 ms 108.170.251.129 (108.170.251.129)  537.430 ms 142.250.214.201 (142.250.214.201)  537.394 ms
28  142.250.214.203 (142.250.214.203)  536.668 ms  536.656 ms 142.250.214.201 (142.250.214.201)  537.359 ms
29  fra24s08-in-f4.1e100.net (142.250.186.164)  536.887 ms  537.778 ms  536.865 ms
```

To use IPv4 we can use -4 flag. The results are as follow



```
rajat@rajat-Nitro-AN715-51:~$ traceroute www.google.com -4
traceroute to www.google.com (142.250.186.164), 30 hops max, 60 byte packets
 1  192.168.43.103 (192.168.43.103)  1.818 ms  4.330 ms  4.859 ms
 2  * * *
 3  10.71.80.2 (10.71.80.2)  47.410 ms  47.354 ms  47.299 ms
 4  172.26.100.118 (172.26.100.118)  47.230 ms  47.160 ms  47.099 ms
 5  172.26.100.103 (172.26.100.103)  47.091 ms  47.029 ms  46.957 ms
 6  192.168.44.26 (192.168.44.26)  46.831 ms 192.168.44.22 (192.168.44.22)  55.168 ms 192.168.44.24 (192.168.44.24)  55.079 ms
 7  * * *
 8  * * *
 9  72.14.195.22 (72.14.195.22)  59.640 ms * *
10  142.250.168.56 (142.250.168.56)  58.234 ms 142.250.47.144 (142.250.47.144)  59.586 ms 72.14.195.34 (72.14.195.34)  68.176 ms
11  * 142.251.52.206 (142.251.52.206)  42.860 ms *
12  216.239.57.32 (216.239.57.32)  63.393 ms 108.170.251.113 (108.170.251.113)  33.620 ms 74.125.243.97 (74.125.243.97)  70.845 ms
13  72.14.232.88 (72.14.232.88)  78.473 ms 74.125.243.100 (74.125.243.100)  38.664 ms 108.170.251.122 (108.170.251.122)  50.058 ms
14  142.250.224.162 (142.250.224.162)  87.618 ms 142.250.63.117 (142.250.63.117)  52.634 ms 142.250.232.90 (142.250.232.90)  61.255 ms
15  142.251.52.115 (142.251.52.115)  145.851 ms 142.251.52.47 (142.251.52.47)  149.980 ms 142.251.52.117 (142.251.52.117)  149.819 ms
16  142.251.52.47 (142.251.52.47)  145.338 ms 142.250.226.88 (142.250.226.88)  281.022 ms 209.85.244.197 (209.85.244.197)  205.206 ms
17  * * 142.250.238.74 (142.250.238.74)  319.146 ms
18  142.250.61.38 (142.250.61.38)  293.957 ms 142.250.208.140 (142.250.208.140)  331.343 ms 142.250.58.252 (142.250.58.252)  312.243 ms
19  142.250.208.140 (142.250.208.140)  334.136 ms * *
20  * * *
21  142.251.51.253 (142.251.51.253)  408.571 ms * *
22  216.239.56.110 (216.239.56.110)  818.048 ms 142.251.51.131 (142.251.51.131)  818.275 ms *
23  142.250.210.26 (142.250.210.26)  817.916 ms 142.250.236.134 (142.250.236.134)  817.865 ms 216.239.56.72 (216.239.56.72)  818.072 ms
24  209.85.252.148 (209.85.252.148)  511.146 ms 172.253.71.184 (172.253.71.184)  511.031 ms 209.85.242.195 (209.85.242.195)  510.958 ms
25  * 209.85.253.184 (209.85.253.184)  510.839 ms 209.85.251.176 (209.85.251.176)  510.693 ms
26  209.85.242.78 (209.85.242.78)  510.734 ms 209.85.252.76 (209.85.252.76)  510.593 ms 209.85.242.78 (209.85.242.78)  510.636 ms
27  209.85.252.28 (209.85.252.28)  510.489 ms 108.170.251.129 (108.170.251.129)  508.784 ms  508.634 ms
28  108.170.251.129 (108.170.251.129)  425.779 ms  420.308 ms 142.250.214.201 (142.250.214.201)  417.572 ms
29  fra24s08-in-f4.1e100.net (142.250.186.164)  425.764 ms 142.250.214.201 (142.250.214.201)  420.119 ms fra24s08-in-f4.1e100.net (142.250.186.164)  425.617 ms
```

To make the missing routers reply, We can use the -T flag for tcp protocol as some servers do not respond to the UDP protocols.

We can also use -w flag to increase the waiting time in order to wait for the response of the servers.

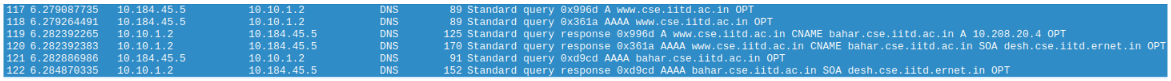
2 DNS Task

2.1 DNS query and response message

The response message is sent over UDP

2.2 Number of DNS queries

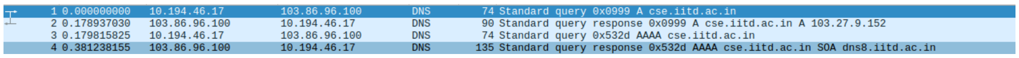
2.2.1 Using Browser



```
117 6.279087735   10.184.45.5         10.10.1.2           DNS       89 Standard query 0x996d A www.cse.iitd.ac.in OPT
118 6.279264491   10.184.45.5         10.10.1.2           DNS       89 Standard query 0x361a AAAA www.cse.iitd.ac.in OPT
119 6.282392265   10.10.1.2           10.184.45.5         DNS      125 Standard query response 0x996d A www.cse.iitd.ac.in CNAME bahar.cse.iitd.ac.in A 10.208.20.4 OPT
120 6.282392383   10.10.1.2           10.184.45.5         DNS      170 Standard query response 0x361a AAAA www.cse.iitd.ac.in CNAME bahar.cse.iitd.ac.in SOA desh.cse.iitd.ernet.in OPT
121 6.282886986   10.184.45.5         10.10.1.2           DNS       91 Standard query 0xd9cd AAAA bahar.cse.iitd.ac.in OPT
122 6.284870335   10.10.1.2           10.184.45.5         DNS      152 Standard query response 0xd9cd AAAA bahar.cse.iitd.ac.in SOA desh.cse.iitd.ernet.in OPT
```

3 DNS queries are sent from my browser (10.184.45.5) to the destination(10.10.1.2)
1 DNS servers is involved

2.2.2 Using nslookup



```
      1 0.000000000   10.194.46.17        103.86.96.100       DNS        74 Standard query 0x0999 A cse.iitd.ac.in
      2 0.178937030   103.86.96.100       10.194.46.17        DNS        90 Standard query response 0x0999 A cse.iitd.ac.in A 103.27.9.152
      3 0.179815825   10.194.46.17        103.86.96.100       DNS        74 Standard query 0x532d AAAA cse.iitd.ac.in
      4 0.381238155   103.86.96.100       10.194.46.17        DNS       135 Standard query response 0x532d AAAA cse.iitd.ac.in SOA dns8.iitd.ac.in
```

2 DNS queries are sent from my browser (10.194.46.17) to the destination(103.86.96.100)

2.3 Number of DNS servers involved

2 DNS servers is involved

2.4 Which DNS server replies with actual IP address?

103.86.96.100 replies with the actual IP address of cse.iitd.ac.in

2.5 Do all servers response?

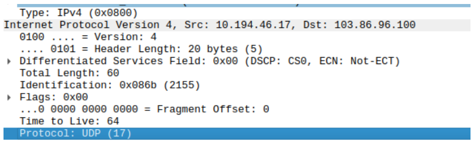
Yes, 1 external server is involved which response

2.6 IP address

1. There are 2 queries and 2 query responses

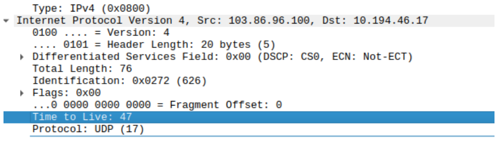
2. Firstly 10.194.46.17 (my browser) sends a query to 103.86.96.100 asking for the IP address of cse.iitd.ac.in

3. The unique ID of the packet is 2155, TTL is 64, Type is IPv4, Protocol is UDP.



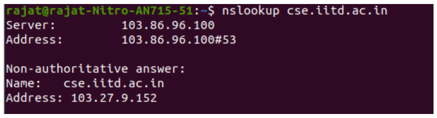
```
   Type: IPv4 (0x0800)
Internet Protocol Version 4, Src: 10.194.46.17, Dst: 103.86.96.100
   0100 .... = Version: 4
   .... 0101 = Header Length: 20 bytes (5)
 ▸ Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
   Total Length: 60
   Identification: 0x086b (2155)
 ▸ Flags: 0x00
   ...0 0000 0000 0000 = Fragment Offset: 0
   Time to Live: 64
   Protocol: UDP (17)
```

4. Then 103.86.96.100 sends a response stating the IP address of cse.iitd.ac.in. unique ID of the packet is 626, TTL is 47, Type is IPv4, Protocol is UDP.



```
    Type: IPv4 (0x0800)
▾ Internet Protocol Version 4, Src: 103.86.96.100, Dst: 10.194.46.17
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  ▸ Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 76
    Identification: 0x0272 (626)
  ▸ Flags: 0x00
    ...0 0000 0000 0000 = Fragment Offset: 0
    Time to Live: 47
    Protocol: UDP (17)
```

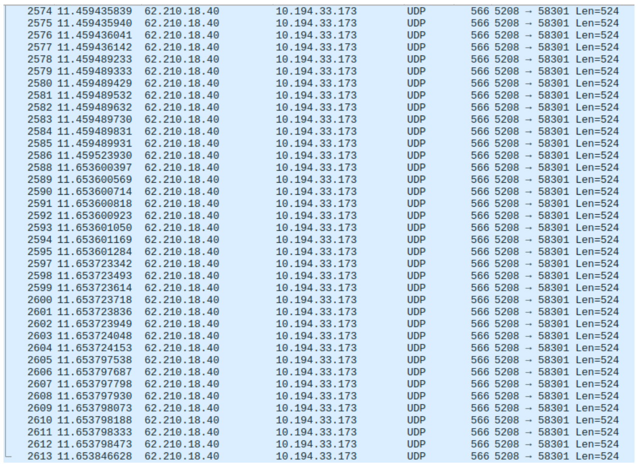
5. There there is another query from 10.194.46.17 and a corresponding response with different IDs(2191 and 665 , TTL (64 and 48 respectively), UDP as their protocol and IPv4 as their type.



```
rajat@rajat-Nitro-AN715-51:~$ nslookup cse.iitd.ac.in
Server:         103.86.96.100
Address:        103.86.96.100#53

Non-authoritative answer:
Name:   cse.iitd.ac.in
Address: 103.27.9.152
```

3 Iperf Task

3.1 Number of UDP packets



```
   2574 11.459435839  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2575 11.459435940  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2576 11.459436041  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2577 11.459436142  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2578 11.459489233  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2579 11.459489333  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2580 11.459489429  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2581 11.459489532  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2582 11.459489632  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2583 11.459489730  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2584 11.459489831  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2585 11.459489931  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2586 11.459523930  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2588 11.653600397  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2589 11.653600569  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2590 11.653600714  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2591 11.653600818  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2592 11.653600923  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2593 11.653601050  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2594 11.653601169  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2595 11.653601284  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2597 11.653723342  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2598 11.653723493  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2599 11.653723614  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2600 11.653723718  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2601 11.653723836  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2602 11.653723949  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2603 11.653724048  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2604 11.653724153  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2605 11.653797538  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2606 11.653797687  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2607 11.653797798  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2608 11.653797930  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2609 11.653798073  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2610 11.653798188  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2611 11.653798333  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2612 11.653798473  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
   2613 11.653846628  62.210.18.40          10.194.33.173       UDP       566 5208 → 58301 Len=524
```

Hence there are 2554 total number of packets that are exchanged between the iperf3 client and the remote server.

3.2 Who is sending the data in bulk

The remote server that is 62.210.18.40 (i.e. ping.online.net) is sending the data in bulk to the iperf3 client (10.194.33.173)

The average size of the packet is 566 bytes.

3.3 Throughput

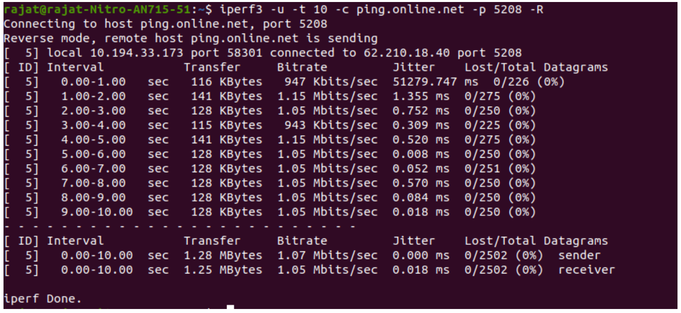
The length of the UDP packet is 566. Now the total number of packets are 2554.

I used select all and then export to see the number of selected packets after applying (((ip.src == 62.210.18.40) (ip.dst == 10.194.33.173)) —— ((ip.src == 10.194.33.173) (ip.dst == 62.210.18.40))) (udp) as the filter.

So we have

$$2554 * 566 = 1445564 bytes = 1.445564 mb$$

The time at which the last packet is sent is 10.4439 seconds as can be seen in the wireshark that the packets are sent continuously without any gap. Thus the throughput is (1.445564*8bits)/10.4439sec = 1.10728762926 bps.
The terminal shows 1.07bps.



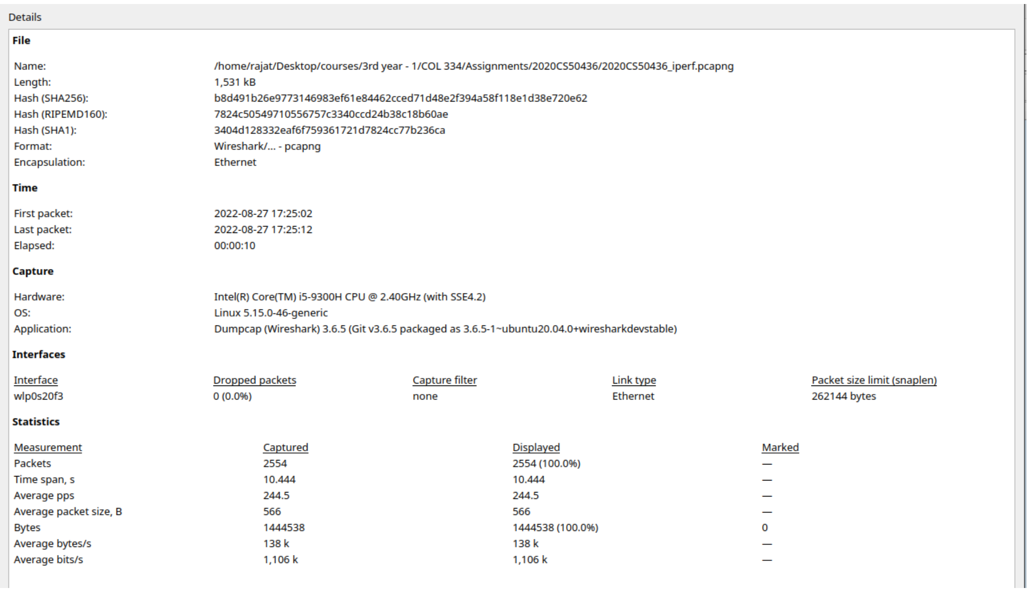
```
rajat@rajat-Nitro-AN715-51:~$ iperf3 -u -t 10 -c ping.online.net -p 5208 -R
Connecting to host ping.online.net, port 5208
Reverse mode, remote host ping.online.net is sending
[  5] local 10.194.33.173 port 58301 connected to 62.210.18.40 port 5208
[ ID] Interval           Transfer     Bitrate         Jitter    Lost/Total Datagrams
[  5]   0.00-1.00   sec   116 KBytes   947 Kbits/sec  51279.747 ms  0/226 (0%)
[  5]   1.00-2.00   sec   141 KBytes  1.15 Mbits/sec  1.355 ms  0/275 (0%)
[  5]   2.00-3.00   sec   128 KBytes  1.05 Mbits/sec  0.752 ms  0/250 (0%)
[  5]   3.00-4.00   sec   115 KBytes   943 Kbits/sec  0.309 ms  0/225 (0%)
[  5]   4.00-5.00   sec   141 KBytes  1.15 Mbits/sec  0.520 ms  0/275 (0%)
[  5]   5.00-6.00   sec   128 KBytes  1.05 Mbits/sec  0.008 ms  0/250 (0%)
[  5]   6.00-7.00   sec   128 KBytes  1.05 Mbits/sec  0.052 ms  0/251 (0%)
[  5]   7.00-8.00   sec   128 KBytes  1.05 Mbits/sec  0.570 ms  0/250 (0%)
[  5]   8.00-9.00   sec   128 KBytes  1.05 Mbits/sec  0.084 ms  0/250 (0%)
[  5]   9.00-10.00  sec   128 KBytes  1.05 Mbits/sec  0.018 ms  0/250 (0%)
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bitrate         Jitter    Lost/Total Datagrams
[  5]   0.00-10.00  sec  1.28 MBytes  1.07 Mbits/sec  0.000 ms  0/2502 (0%)  sender
[  5]   0.00-10.00  sec  1.25 MBytes  1.05 Mbits/sec  0.018 ms  0/2502 (0%)  receiver

iperf Done.
```

The iperf3 terminal shows 1.28 mb of data being transfer. There is a difference of

$$1.445564 - 1.28 = 0.16 mb$$

. This difference may be because the iperf3 terminal only shows the data that is transferred where as the wireshark gives the total size of the packet which includes the headers too. This must not be included in the iperf3 terminal. There may be other differences because of variable packet size which we didn't account for (some packets may be drastically small)

3.4 Capture file properties



Details

File

Name:	/home/rajat/Desktop/courses/3rd year - 1/COL 334/Assignments/2020CS50436/2020CS50436_iperf.pcapng
Length:	1,531 kB
Hash (SHA256):	b8d491b26e9773146983ef61e84462cced71d48e2f394a58f118e1d38e720e62
Hash (RIPEMD160):	7824c50549710556757c3340ccd24b38c18b60ae
Hash (SHA1):	3404d128332eaf6f759361721d7824cc77b236ca
Format:	Wireshark/... - pcapng
Encapsulation:	Ethernet

Time

First packet:	2022-08-27 17:25:02
Last packet:	2022-08-27 17:25:12
Elapsed:	00:00:10

Capture

Hardware:	Intel(R) Core(TM) i5-9300H CPU @ 2.40GHz (with SSE4.2)
OS:	Linux 5.15.0-46-generic
Application:	Dumpcap (Wireshark) 3.6.5 (Git v3.6.5 packaged as 3.6.5-1~ubuntu20.04.0+wiresharkdevstable)

Interfaces

Interface	Dropped packets	Capture filter	Link type	Packet size limit (snaplen)
wlp0s20f3	0 (0.0%)	none	Ethernet	262144 bytes

Statistics

Measurement	Captured	Displayed	Marked
Packets	2554	2554 (100.0%)	—
Time span, s	10.444	10.444	—
Average pps	244.5	244.5	—
Average packet size, B	566	566	—
Bytes	1444538	1444538 (100.0%)	0
Average bytes/s	138 k	138 k	—
Average bits/s	1,106 k	1,106 k	—

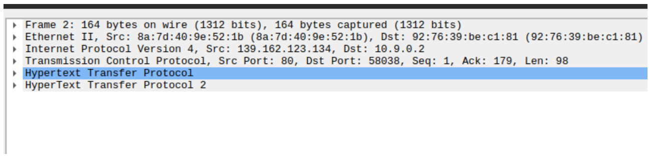
According to capture file properties the average bit size is 566 bytes. And the average speed is 1.106bps. Their isn't major difference between the one that I calculated but the terminal shows 1.07bps, reason being same that terminal only shows the data transfer ignoring the header size.

4 HTTP task

4.1 Numbers of packets present

There are total 10 packets present. On applying the http filter I can see two packets. And on applying http2 filter I can see 9 packets.

So there is one packet with both http and http2 protocol



```
Frame 2: 164 bytes on wire (1312 bits), 164 bytes captured (1312 bits)
Ethernet II, Src: 8a:7d:40:9e:52:1b (8a:7d:40:9e:52:1b), Dst: 92:76:39:be:c1:81 (92:76:39:be:c1:81)
Internet Protocol Version 4, Src: 139.162.123.134, Dst: 10.9.0.2
Transmission Control Protocol, Src Port: 80, Dst Port: 58038, Seq: 1, Ack: 179, Len: 98
Hypertext Transfer Protocol
HyperText Transfer Protocol 2
```

So in total 2 packets with http1 and 9 packets with http2.

4.2 Packets exchanged before getting data

In the first packet the client sends an http handshake with a request to upgrade to http2. In the next packet the server responds with an http protocol confirming the h2c upgrade.

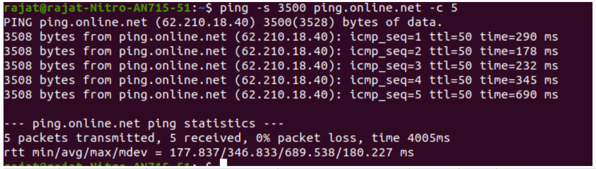
Then a http2 packet(MAGIC) is sent from the client to the server confirming that http2 is being used. Then two more packets stating the settings of the with its requirements for the connection. Then the 4th http2 packet is sent by the server to the client with the data. So 3 http2 packets are exchanged before the before the client receives the data packet.

4.3 Difference between the headers of HTTP2 and HTTP

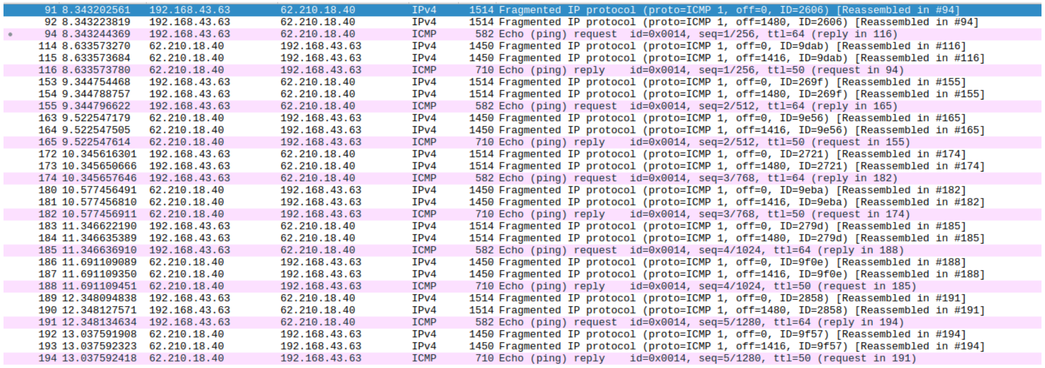
The http1 headers are text-based and they are written in lines. In HTTP2 firstly, the headers are compressed, we have to first decompress it to make it readable also, all the headers have Name length , Name , value , scheme/ path , index etc. In other words, every component of the headers are well defined. The length of every component is present before each header. Where as in HTTP1 every header is just a sentence explaining what that header do, it is more like the part of the data rather than special header.

5 PING task

Please not that I pingged ping.online.net rather than ping-ams1.online.net because the latter was not working and showing 100% data loss



```
rajat@rajat-Nitro-AN715-51:~$ ping -s 3500 ping.online.net -c 5
PING ping.online.net (62.210.18.40) 3500(3528) bytes of data.
3508 bytes from ping.online.net (62.210.18.40): icmp_seq=1 ttl=50 time=290 ms
3508 bytes from ping.online.net (62.210.18.40): icmp_seq=2 ttl=50 time=178 ms
3508 bytes from ping.online.net (62.210.18.40): icmp_seq=3 ttl=50 time=232 ms
3508 bytes from ping.online.net (62.210.18.40): icmp_seq=4 ttl=50 time=345 ms
3508 bytes from ping.online.net (62.210.18.40): icmp_seq=5 ttl=50 time=690 ms

--- ping.online.net ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4005ms
rtt min/avg/max/mdev = 177.837/346.833/689.538/180.227 ms
```



```
 91 8.343202561   192.168.43.63   62.210.18.40    IPv4   1514 Fragmented IP protocol (proto=ICMP 1, off=0, ID=2606) [Reassembled in #94]
 92 8.343223819   192.168.43.63   62.210.18.40    IPv4   1514 Fragmented IP protocol (proto=ICMP 1, off=1480, ID=2606) [Reassembled in #94]
 94 8.343244369   192.168.43.63   62.210.18.40    ICMP    582 Echo (ping) request  id=0x0014, seq=1/256, ttl=64 (reply in 116)
114 8.633573270   62.210.18.40    192.168.43.63   IPv4   1450 Fragmented IP protocol (proto=ICMP 1, off=0, ID=9dab) [Reassembled in #116]
115 8.633573684   62.210.18.40    192.168.43.63   IPv4   1450 Fragmented IP protocol (proto=ICMP 1, off=1416, ID=9dab) [Reassembled in #116]
116 8.633573780   62.210.18.40    192.168.43.63   ICMP    710 Echo (ping) reply    id=0x0014, seq=1/256, ttl=50 (request in 94)
153 9.344754468   192.168.43.63   62.210.18.40    IPv4   1514 Fragmented IP protocol (proto=ICMP 1, off=0, ID=269f) [Reassembled in #155]
154 9.344788757   192.168.43.63   62.210.18.40    IPv4   1514 Fragmented IP protocol (proto=ICMP 1, off=1480, ID=269f) [Reassembled in #155]
155 9.344796622   192.168.43.63   62.210.18.40    ICMP    582 Echo (ping) request  id=0x0014, seq=2/512, ttl=64 (reply in 165)
163 9.522547179   62.210.18.40    192.168.43.63   IPv4   1450 Fragmented IP protocol (proto=ICMP 1, off=0, ID=9e56) [Reassembled in #165]
164 9.522547505   62.210.18.40    192.168.43.63   IPv4   1450 Fragmented IP protocol (proto=ICMP 1, off=1416, ID=9e56) [Reassembled in #165]
165 9.522547614   62.210.18.40    192.168.43.63   ICMP    710 Echo (ping) reply    id=0x0014, seq=2/512, ttl=50 (request in 155)
172 10.345616301  192.168.43.63   62.210.18.40    IPv4   1514 Fragmented IP protocol (proto=ICMP 1, off=0, ID=2721) [Reassembled in #174]
173 10.345650666  192.168.43.63   62.210.18.40    IPv4   1514 Fragmented IP protocol (proto=ICMP 1, off=1480, ID=2721) [Reassembled in #174]
174 10.345657646  192.168.43.63   62.210.18.40    ICMP    582 Echo (ping) request  id=0x0014, seq=3/768, ttl=64 (reply in 182)
180 10.577456491  62.210.18.40    192.168.43.63   IPv4   1450 Fragmented IP protocol (proto=ICMP 1, off=0, ID=9eba) [Reassembled in #182]
181 10.577456810  62.210.18.40    192.168.43.63   IPv4   1450 Fragmented IP protocol (proto=ICMP 1, off=1416, ID=9eba) [Reassembled in #182]
182 10.577456911  62.210.18.40    192.168.43.63   ICMP    710 Echo (ping) reply    id=0x0014, seq=3/768, ttl=50 (request in 174)
183 11.346622190  192.168.43.63   62.210.18.40    IPv4   1514 Fragmented IP protocol (proto=ICMP 1, off=0, ID=279d) [Reassembled in #185]
184 11.346635389  192.168.43.63   62.210.18.40    IPv4   1514 Fragmented IP protocol (proto=ICMP 1, off=1480, ID=279d) [Reassembled in #185]
185 11.346636910  192.168.43.63   62.210.18.40    ICMP    582 Echo (ping) request  id=0x0014, seq=4/1024, ttl=64 (reply in 188)
186 11.691109089  62.210.18.40    192.168.43.63   IPv4   1450 Fragmented IP protocol (proto=ICMP 1, off=0, ID=9f0e) [Reassembled in #188]
187 11.691109350  62.210.18.40    192.168.43.63   IPv4   1450 Fragmented IP protocol (proto=ICMP 1, off=1416, ID=9f0e) [Reassembled in #188]
188 11.691109451  62.210.18.40    192.168.43.63   ICMP    710 Echo (ping) reply    id=0x0014, seq=4/1024, ttl=50 (request in 185)
189 12.348094838  192.168.43.63   62.210.18.40    IPv4   1514 Fragmented IP protocol (proto=ICMP 1, off=0, ID=2858) [Reassembled in #191]
190 12.348127571  192.168.43.63   62.210.18.40    IPv4   1514 Fragmented IP protocol (proto=ICMP 1, off=1480, ID=2858) [Reassembled in #191]
191 12.348134634  192.168.43.63   62.210.18.40    ICMP    582 Echo (ping) request  id=0x0014, seq=5/1280, ttl=64 (reply in 194)
192 13.037591908  62.210.18.40    192.168.43.63   IPv4   1450 Fragmented IP protocol (proto=ICMP 1, off=0, ID=9f57) [Reassembled in #194]
193 13.037592323  62.210.18.40    192.168.43.63   IPv4   1450 Fragmented IP protocol (proto=ICMP 1, off=1416, ID=9f57) [Reassembled in #194]
194 13.037592418  62.210.18.40    192.168.43.63   ICMP    710 Echo (ping) reply    id=0x0014, seq=5/1280, ttl=50 (request in 191)
```

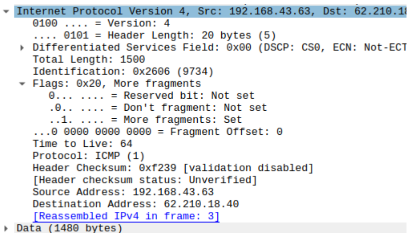
5.1 Number of packets

As we can see from the screenshot, 30 packets are being exchanged between the the host and the remote server.

5.2 Size of ping requests

Each ping request is of 3492 bytes of data excluding the header) and 3528 including the header files.

5.2.1 Ping packet no. 1



```
▾ Internet Protocol Version 4, Src: 192.168.43.63, Dst: 62.210.1
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  ▸ Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT
    Total Length: 1500
    Identification: 0x2606 (9734)
  ▾ Flags: 0x20, More fragments
      0... .... = Reserved bit: Not set
      .0.. .... = Don't fragment: Not set
      ..1. .... = More fragments: Set
    ...0 0000 0000 0000 = Fragment Offset: 0
    Time to Live: 64
    Protocol: ICMP (1)
    Header Checksum: 0xf239 [validation disabled]
    [Header checksum status: Unverified]
    Source Address: 192.168.43.63
    Destination Address: 62.210.18.40
    [Reassembled IPv4 in frame: 3]
▸ Data (1480 bytes)
```

As we can see the fragment flag is set to 1. Its identification is 9734. The time to send this packet is 0.000021258 sec.

Request packets

Name of Packet	ID	Fragment	size(bytes)	data size (bytes)	time sent	response
Packet 1	0x2606 (9734)	YES	1500	1480	0sec	0.29sec
Packet 2	0x2606 (9734)	YES	1500	1480	0.000021sec	0.29sec
Packet 3	0x2606 (9734)	NO	568	548	0.000041sec	0.29sec
Packet 7	0x269f (9887)	YES	1500	1480	1.001551sec	1.1793sec
Packet 8	0x269f (9887)	YES	1500	1480	1.001586sec	1.1793sec
Packet 9	0x269f (9887)	NO	568	548	1.001594sec	1.1793sec
Packet 13	0x2721 (10017)	YES	1500	1480	2.002413sec	2.2342sec
Packet 14	0x2721 (10017)	YES	1500	1480	2.002448sec	2.2342sec
Packet 15	0x2721 (10017)	NO	568	548	2.002455sec	2.2342sec
Packet 19	0x279d (10141)	YES	1500	1480	3.003419sec	3.3479sec
Packet 20	0x279d (10141)	YES	1500	1480	3.003432sec	3.3479sec
Packet 21	0x279d (10141)	NO	568	548	3.003434sec	3.3479sec
Packet 25	0x2858 (10328)	YES	1500	1480	4.004892sec	4.6943sec
Packet 26	0x2858 (10328)	YES	1500	1480	4.004925sec	4.6943sec
Packet 27	0x2858 (10328)	NO	568	548	4.004932sec	4.6943sec

Every packet is fragmented to 3 packets.

Reply packets

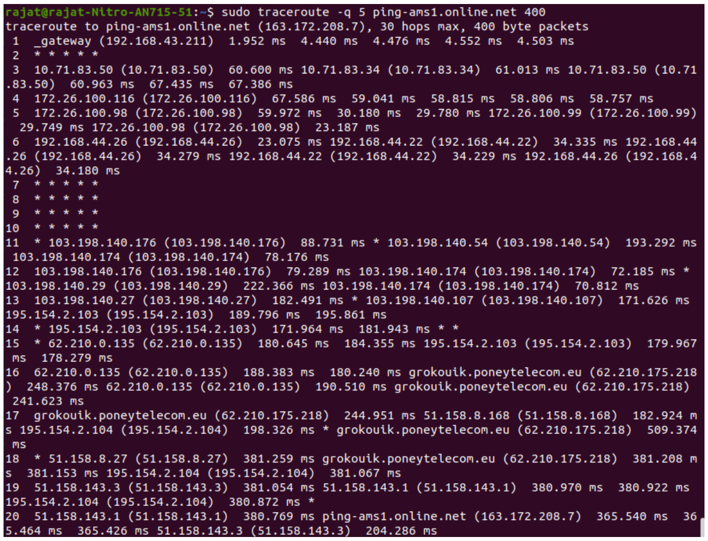
(on next page)

6 Traceroute

If I use traceroute -q 5 ping-ams1.online.net 3500 then many routers fails to response therefore I reduced the size of the packets to 400

Name of Packet	ID	Fragment	size(bytes)	data size (bytes)	time sent
Packet 4	0x9dab (40363)	YES	1436	1416	0.290371123
Packet 5	0x9dab (40363)	YES	1436	1416	0.290371219
Packet 6	0x9dab (40363)	NO	696	676	1.001551907
Packet 10	0x9e56 (40534)	YES	1436	1416	1.179344944
Packet 11	0x9e56 (40534)	YES	1436	1416	1.179345053
Packet 12	0x9e56 (40534)	NO	696	676	2.00241374
Packet 16	0x9eba (40634)	YES	1436	1416	2.234254249
Packet 17	0x9eba (40634)	YES	1436	1416	2.23425435
Packet 18	0x9eba (40634)	NO	696	676	3.003419629
Packet 22	0x9eba (40634)	YES	1436	1416	3.347906789
Packet 23	0x9eba (40634)	YES	1436	1416	3.34790689
Packet 24	0x9eba (40634)	NO	696	676	4.004892277
Packet 28	0x9f57 (40791)	YES	1436	1416	4.694389347
Packet 29	0x9f57 (40791)	YES	1436	1416	4.694389762
Packet 30	0x9f57 (40791)	NO	696	676	4.694389857

6.1 Number of hops involved



```
rajat@rajat-Nitro-AN715-51:~$ sudo traceroute -q 5 ping-ams1.online.net 400
traceroute to ping-ams1.online.net (163.172.208.7), 30 hops max, 400 byte packets
 1  _gateway (192.168.43.211)  1.952 ms  4.440 ms  4.476 ms  4.552 ms  4.503 ms
 2  * * * * *
 3  10.71.83.50 (10.71.83.50)  60.600 ms 10.71.83.34 (10.71.83.34)  61.013 ms 10.71.83.50 (10.71
.83.50)  60.963 ms  67.435 ms  67.386 ms
 4  172.26.100.116 (172.26.100.116)  67.586 ms  59.041 ms  58.815 ms  58.806 ms  58.757 ms
 5  172.26.100.98 (172.26.100.98)  59.972 ms  30.180 ms  29.780 ms 172.26.100.99 (172.26.100.99)
  29.749 ms 172.26.100.98 (172.26.100.98)  23.187 ms
 6  192.168.44.26 (192.168.44.26)  23.075 ms 192.168.44.22 (192.168.44.22)  34.335 ms 192.168.44
.26 (192.168.44.26)  34.279 ms 192.168.44.22 (192.168.44.22)  34.229 ms 192.168.44.26 (192.168.4
4.26)  34.180 ms
 7  * * * * *
 8  * * * * *
 9  * * * * *
10  * * * * *
11  * 103.198.140.176 (103.198.140.176)  88.731 ms * 103.198.140.54 (103.198.140.54)  193.292 ms
 103.198.140.174 (103.198.140.174)  78.176 ms
12  103.198.140.176 (103.198.140.176)  79.289 ms 103.198.140.174 (103.198.140.174)  72.185 ms *
103.198.140.29 (103.198.140.29)  222.366 ms 103.198.140.174 (103.198.140.174)  70.812 ms
13  103.198.140.27 (103.198.140.27)  182.491 ms * 103.198.140.107 (103.198.140.107)  171.626 ms
195.154.2.103 (195.154.2.103)  189.796 ms  195.861 ms
14  * 195.154.2.103 (195.154.2.103)  171.964 ms  181.943 ms * *
15  * 62.210.0.135 (62.210.0.135)  180.645 ms  184.355 ms 195.154.2.103 (195.154.2.103)  179.967
 ms  178.279 ms
16  62.210.0.135 (62.210.0.135)  188.383 ms  180.240 ms grokouik.poneytelecom.eu (62.210.175.218
)  248.376 ms 62.210.0.135 (62.210.0.135)  190.510 ms grokouik.poneytelecom.eu (62.210.175.218)
 241.623 ms
17  grokouik.poneytelecom.eu (62.210.175.218)  244.951 ms 51.158.8.168 (51.158.8.168)  182.924 m
s 195.154.2.104 (195.154.2.104)  198.326 ms * grokouik.poneytelecom.eu (62.210.175.218)  509.374
 ms
18  * 51.158.8.27 (51.158.8.27)  381.259 ms grokouik.poneytelecom.eu (62.210.175.218)  381.208 m
s  381.153 ms 195.154.2.104 (195.154.2.104)  381.067 ms
19  51.158.143.3 (51.158.143.3)  381.054 ms 51.158.143.1 (51.158.143.1)  380.970 ms  380.922 ms
195.154.2.104 (195.154.2.104)  380.872 ms *
20  51.158.143.1 (51.158.143.1)  380.769 ms ping-ams1.online.net (163.172.208.7)  365.540 ms  36
5.464 ms  365.426 ms 51.158.143.3 (51.158.143.3)  204.286 ms
```

There are 20 hops involved in the route. That the packet reaches the destination in the 20th hop.

6.2 Total packets

A total of 164 packets are involved in traceroute. There are 100 request packets. Which are sent from the client to remote machines. 64 Packets are sent from the remote machine to the client.

source	destination	number of packets
192.168.43.63	163.172.208.7	100
192.168.43.211	192.168.43.63	5
10.71.83.50	192.168.43.63	4
10.71.83.34	192.168.43.63	2
172.26.100.116	192.168.43.63	5
172.26.100.98	192.168.43.63	4
192.168.44.26	192.168.43.63	3
172.26.100.99	192.168.43.63	1
192.168.44.22	192.168.43.63	2
103.198.140.174	192.168.43.63	4
103.198.140.176	192.168.43.63	3
103.198.140.54	192.168.43.63	1
103.198.140.107	192.168.43.63	1
103.198.140.27	192.168.43.63	1
195.154.2.103	192.168.43.63	5
62.210.0.135	192.168.43.63	5
103.198.140.29	192.168.43.63	1
62.210.175.218	192.168.43.63	5
51.158.8.168	192.168.43.63	1
195.154.2.104	192.168.43.63	3
163.172.208.7	192.168.43.63	4
51.158.8.27	192.168.43.63	1
51.158.143.1	192.168.43.63	3
51.158.143.3	192.168.43.63	2
		164

6.3 Fields remaining same or changing

The fields that remain same are, the size of the packet and the waiting time for each packet and the type of each packet.

Every packets that is sent has different ID. Each packet is sent as a sequence of 5 packets. Each group of 5 packets have same ttl. The next 5 packets have one more ttl so that they can do one more hop and find the next router and so on until the destination server is reached. Thus the last packet has 20 ttl (some extra packets are also observed which had ttl of more than 20).

The fields that must stay constant are the size of each packet as the size will determine the throughput of the network.

The fields that must change are the ttl because we need to find the route of the packet. When ever the ttl become zero (decrement by 1 after each hop) we get a response back from that router thus finding out information about the path the packets have to travel to reach the destination.