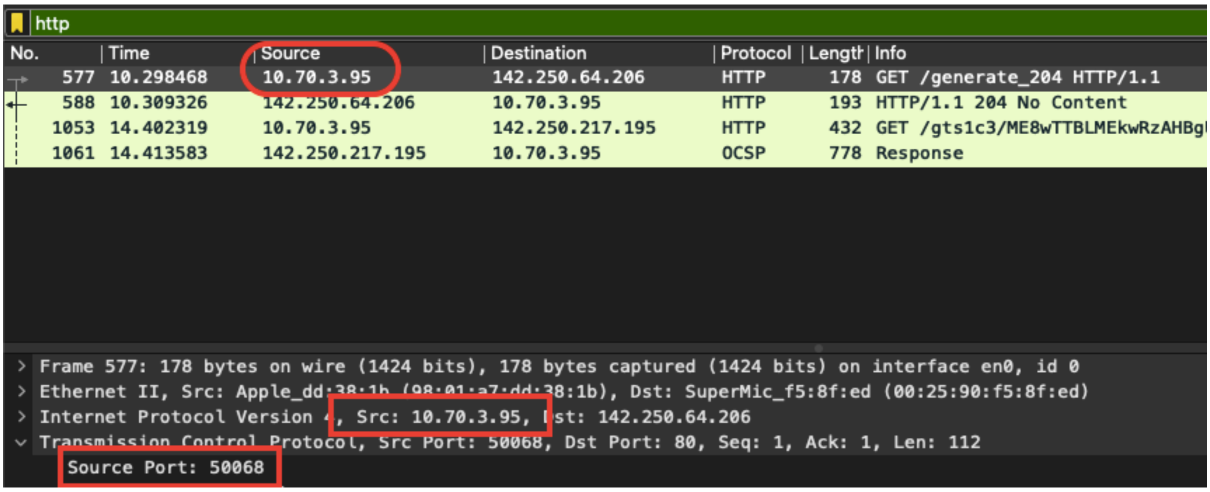
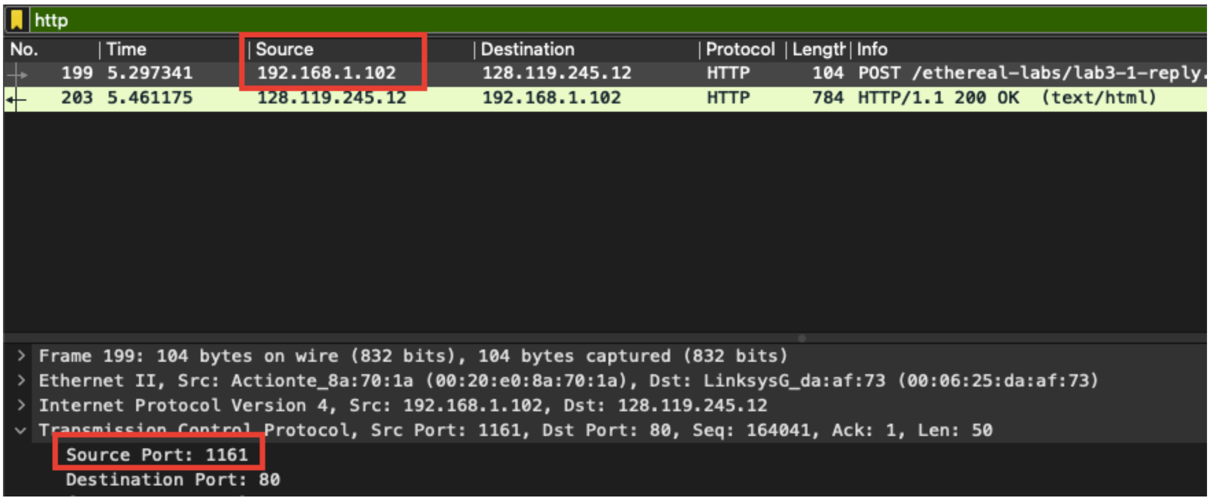
Q1:



```
http
No.     Time        Source            Destination       Protocol  Length  Info
  577   10.298468   10.70.3.95        142.250.64.206    HTTP      178  GET /generate_204 HTTP/1.1
  588   10.309326   142.250.64.206    10.70.3.95        HTTP      193  HTTP/1.1 204 No Content
 1053   14.402319   10.70.3.95        142.250.217.195   HTTP      432  GET /gts1c3/ME8wTTBLMEkwRzAHBg
 1061   14.413583   142.250.217.195   10.70.3.95        OCSP      778  Response

> Frame 577: 178 bytes on wire (1424 bits), 178 bytes captured (1424 bits) on interface en0, id 0
> Ethernet II, Src: Apple_dd:38:1b (98:01:a7:dd:38:1b), Dst: SuperMic_f5:8f:ed (00:25:90:f5:8f:ed)
> Internet Protocol Version 4, Src: 10.70.3.95, Dst: 142.250.64.206
v Transmission Control Protocol, Src Port: 50068, Dst Port: 80, Seq: 1, Ack: 1, Len: 112
    Source Port: 50068
```

Considering the client system as my computer and source IP address as 10.70.3.95 and the port as 50068.

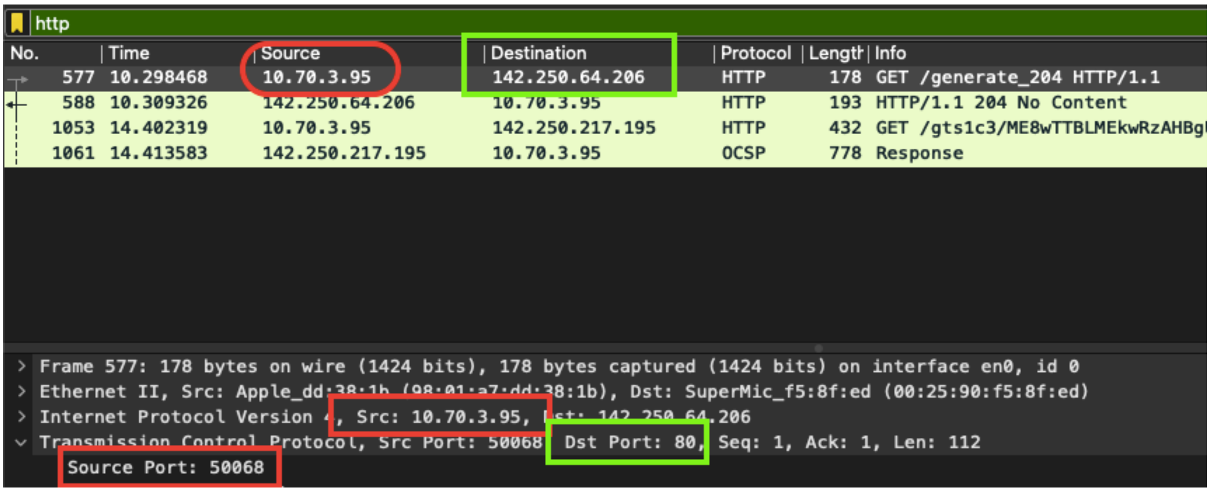


```
http
No.     Time       Source            Destination       Protocol  Length  Info
  199   5.297341   192.168.1.102     128.119.245.12    HTTP      104  POST /ethereal-labs/lab3-1-reply.
  203   5.461175   128.119.245.12    192.168.1.102     HTTP      784  HTTP/1.1 200 OK  (text/html)

> Frame 199: 104 bytes on wire (832 bits), 104 bytes captured (832 bits)
> Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af:73)
> Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
v Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 164041, Ack: 1, Len: 50
    Source Port: 1161
    Destination Port: 80
```

When we have used the trace packet given, we obtained the results as IP 192.168.1.102 and port as 1161.

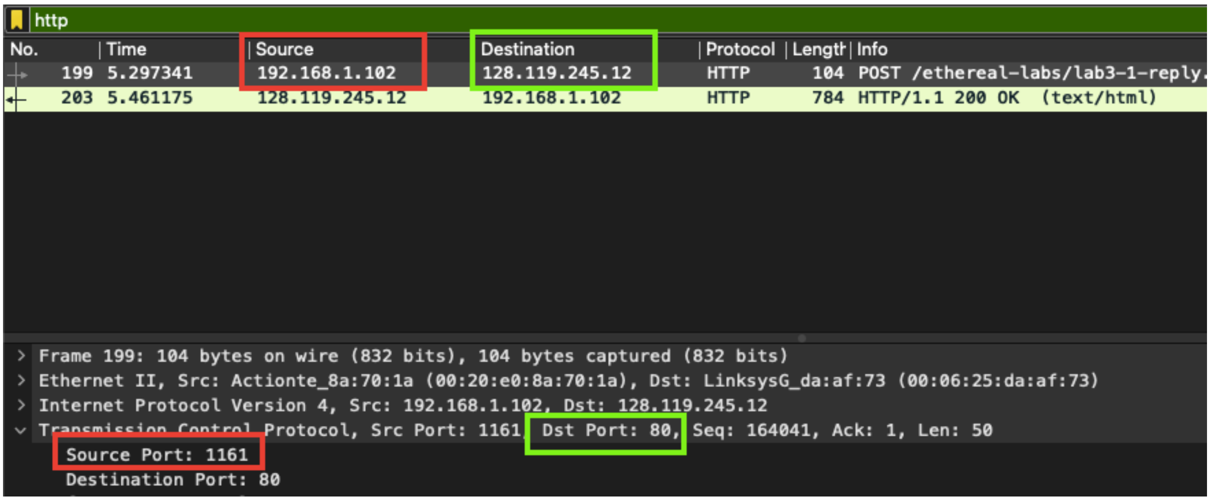
Q2:

Destination details of the server where the request packet is sent as shown in below screenshot as IP 142.250.64.206 and port as 80.



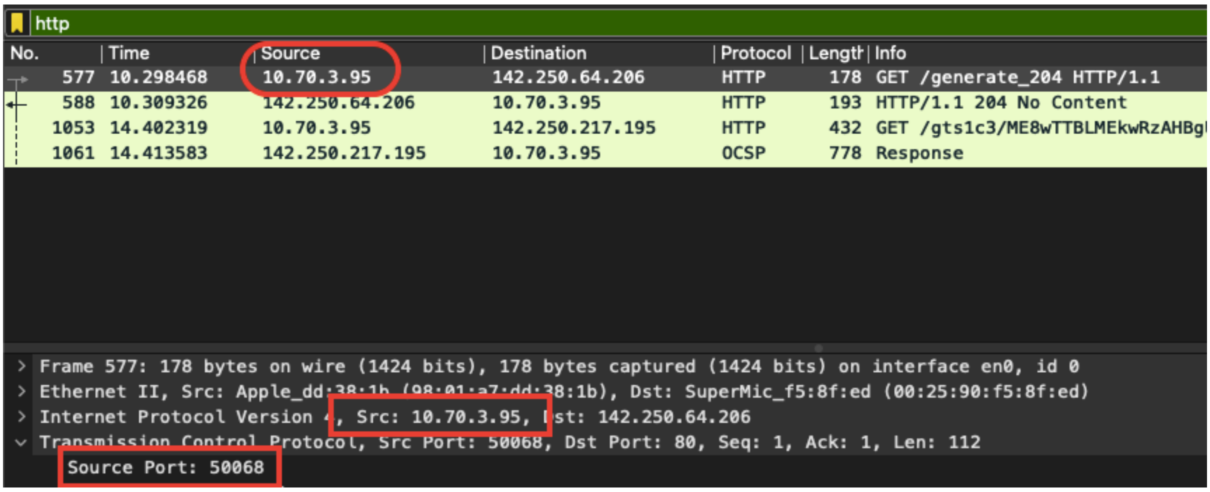
```
http
No.    Time       Source           Destination       Protocol  Length  Info
  577  10.298468  10.70.3.95       142.250.64.206    HTTP       178  GET /generate_204 HTTP/1.1
  588  10.309326  142.250.64.206   10.70.3.95        HTTP       193  HTTP/1.1 204 No Content
 1053  14.402319  10.70.3.95       142.250.217.195   HTTP       432  GET /gts1c3/ME8wTTBLMEkwRzAHBg
 1061  14.413583  142.250.217.195  10.70.3.95        OCSP       778  Response

> Frame 577: 178 bytes on wire (1424 bits), 178 bytes captured (1424 bits) on interface en0, id 0
> Ethernet II, Src: Apple_dd:38:1b (98:01:a7:dd:38:1b), Dst: SuperMic_f5:8f:ed (00:25:90:f5:8f:ed)
> Internet Protocol Version 4, Src: 10.70.3.95, Dst: 142.250.64.206
v Transmission Control Protocol, Src Port: 50068, Dst Port: 80, Seq: 1, Ack: 1, Len: 112
    Source Port: 50068
```

Upon using the trace packet, destination details obtained are IP 128.119.245.12 and port as 80.



```
http
No.    Time      Source          Destination     Protocol  Length  Info
  199  5.297341  192.168.1.102   128.119.245.12  HTTP       104  POST /ethereal-labs/lab3-1-reply.
  203  5.461175  128.119.245.12  192.168.1.102   HTTP       784  HTTP/1.1 200 OK  (text/html)

> Frame 199: 104 bytes on wire (832 bits), 104 bytes captured (832 bits)
> Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af:73)
> Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
v Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 164041, Ack: 1, Len: 50
    Source Port: 1161
    Destination Port: 80
```

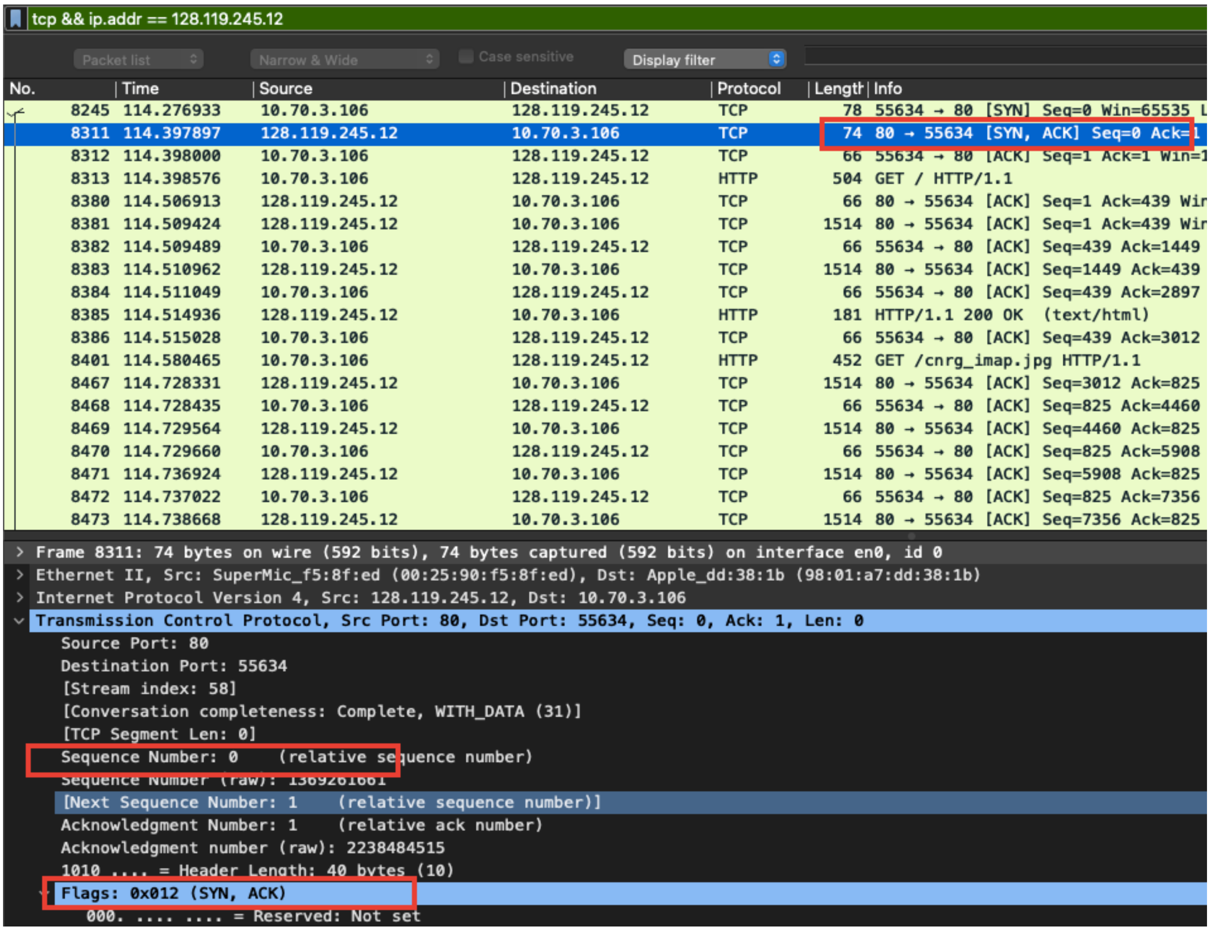
Q3:



```
http
No.    Time       Source           Destination       Protocol  Length  Info
  577  10.298468  10.70.3.95       142.250.64.206    HTTP       178  GET /generate_204 HTTP/1.1
  588  10.309326  142.250.64.206   10.70.3.95        HTTP       193  HTTP/1.1 204 No Content
 1053  14.402319  10.70.3.95       142.250.217.195   HTTP       432  GET /gts1c3/ME8wTTBLMEkwRzAHBg
 1061  14.413583  142.250.217.195  10.70.3.95        OCSP       778  Response

> Frame 577: 178 bytes on wire (1424 bits), 178 bytes captured (1424 bits) on interface en0, id 0
> Ethernet II, Src: Apple_dd:38:1b (98:01:a7:dd:38:1b), Dst: SuperMic_f5:8f:ed (00:25:90:f5:8f:ed)
> Internet Protocol Version 4, Src: 10.70.3.95, Dst: 142.250.64.206
v Transmission Control Protocol, Src Port: 50068, Dst Port: 80, Seq: 1, Ack: 1, Len: 112
    Source Port: 50068
```

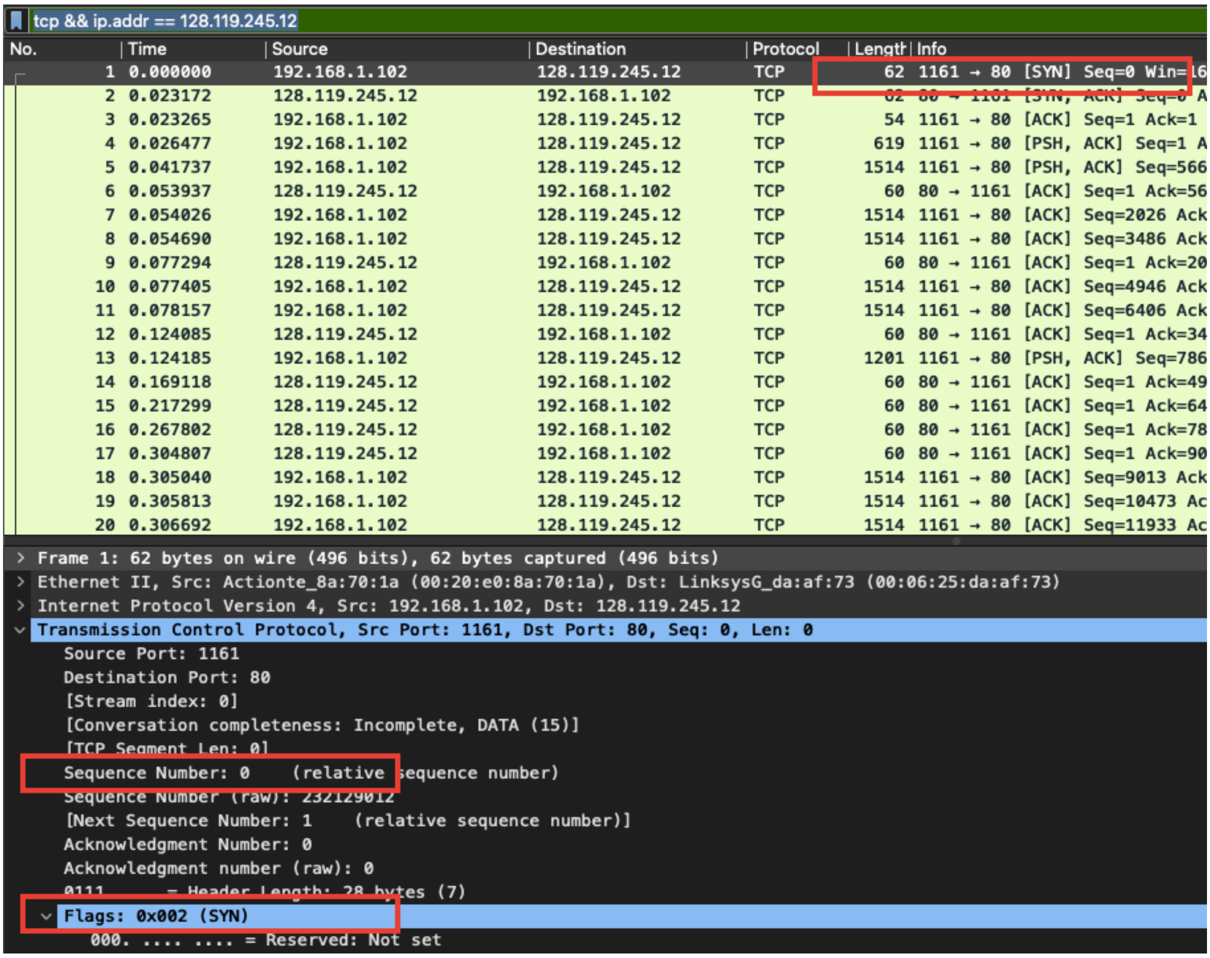
It is same as the results that we obtained in the Q1, with the details as IP 10.70.3.95 and port as 50068

Q4:



```
tcp && ip.addr == 128.119.245.12

No.       Time        Source            Destination       Protocol  Length Info
   8245  114.276933  10.70.3.106       128.119.245.12    TCP         78  55634 → 80 [SYN] Seq=0 Win=65535 L
   8311  114.397897  128.119.245.12    10.70.3.106       TCP         74  80 → 55634 [SYN, ACK] Seq=0 Ack=1
   8312  114.398000  10.70.3.106       128.119.245.12    TCP         66  55634 → 80 [ACK] Seq=1 Ack=1 Win=1
   8313  114.398576  10.70.3.106       128.119.245.12    HTTP       504  GET / HTTP/1.1
   8380  114.506913  128.119.245.12    10.70.3.106       TCP         66  80 → 55634 [ACK] Seq=1 Ack=439 Wir
   8381  114.509424  128.119.245.12    10.70.3.106       TCP       1514  80 → 55634 [ACK] Seq=1 Ack=439 Wir
   8382  114.509489  10.70.3.106       128.119.245.12    TCP         66  55634 → 80 [ACK] Seq=439 Ack=1449
   8383  114.510962  128.119.245.12    10.70.3.106       TCP       1514  80 → 55634 [ACK] Seq=1449 Ack=439
   8384  114.511049  10.70.3.106       128.119.245.12    TCP         66  55634 → 80 [ACK] Seq=439 Ack=2897
   8385  114.514936  128.119.245.12    10.70.3.106       HTTP       181  HTTP/1.1 200 OK  (text/html)
   8386  114.515028  10.70.3.106       128.119.245.12    TCP         66  55634 → 80 [ACK] Seq=439 Ack=3012
   8401  114.580465  10.70.3.106       128.119.245.12    HTTP       452  GET /cnrg_imap.jpg HTTP/1.1
   8467  114.728331  128.119.245.12    10.70.3.106       TCP       1514  80 → 55634 [ACK] Seq=3012 Ack=825
   8468  114.728435  10.70.3.106       128.119.245.12    TCP         66  55634 → 80 [ACK] Seq=825 Ack=4460
   8469  114.729564  128.119.245.12    10.70.3.106       TCP       1514  80 → 55634 [ACK] Seq=4460 Ack=825
   8470  114.729660  10.70.3.106       128.119.245.12    TCP         66  55634 → 80 [ACK] Seq=825 Ack=5908
   8471  114.736924  128.119.245.12    10.70.3.106       TCP       1514  80 → 55634 [ACK] Seq=5908 Ack=825
   8472  114.737022  10.70.3.106       128.119.245.12    TCP         66  55634 → 80 [ACK] Seq=825 Ack=7356
   8473  114.738668  128.119.245.12    10.70.3.106       TCP       1514  80 → 55634 [ACK] Seq=7356 Ack=825

> Frame 8311: 74 bytes on wire (592 bits), 74 bytes captured (592 bits) on interface en0, id 0
> Ethernet II, Src: SuperMic_f5:8f:ed (00:25:90:f5:8f:ed), Dst: Apple_dd:38:1b (98:01:a7:dd:38:1b)
> Internet Protocol Version 4, Src: 128.119.245.12, Dst: 10.70.3.106
v Transmission Control Protocol, Src Port: 80, Dst Port: 55634, Seq: 0, Ack: 1, Len: 0
    Source Port: 80
    Destination Port: 55634
    [Stream index: 58]
    [Conversation completeness: Complete, WITH_DATA (31)]
    [TCP Segment Len: 0]
    Sequence Number: 0    (relative sequence number)
    Sequence Number (raw): 1369261661
    [Next Sequence Number: 1    (relative sequence number)]
    Acknowledgment Number: 1    (relative ack number)
    Acknowledgment number (raw): 2238484515
    1010 .... = Header Length: 40 bytes (10)
  v Flags: 0x012 (SYN, ACK)
      000. .... .... = Reserved: Not set
```

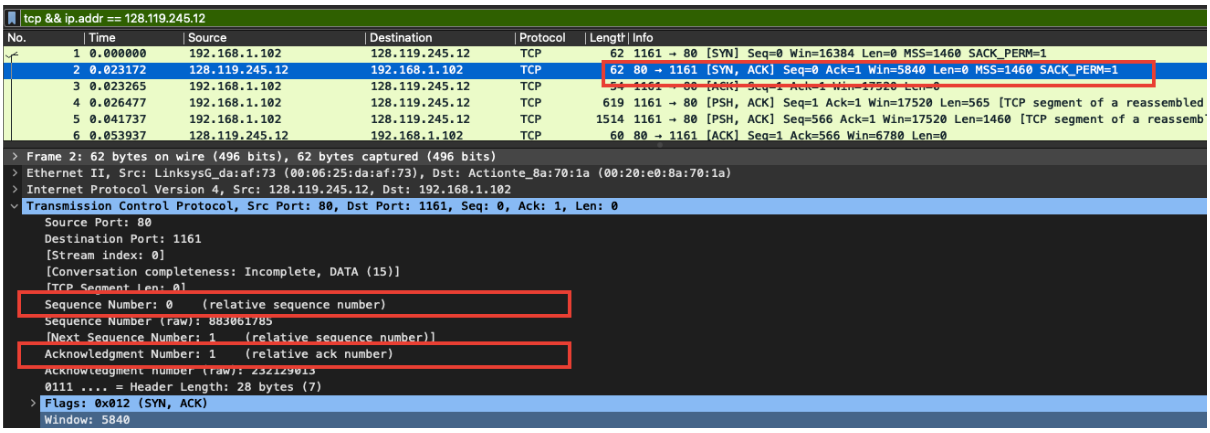
As per ask, for the start of the TCP connection we need to perform the handshake process that start with ta SYN packet. We can observe the same from the above screenshot that the sender had sent out the SYN packet and is flagged below.



```
tcp && ip.addr == 128.119.245.12
No.   Time       Source          Destination     Protocol  Length Info
   1 0.000000    192.168.1.102   128.119.245.12  TCP         62 1161 → 80 [SYN] Seq=0 Win=16
   2 0.023172    128.119.245.12  192.168.1.102   TCP         62 80 → 1161 [SYN, ACK] Seq=0 A
   3 0.023265    192.168.1.102   128.119.245.12  TCP         54 1161 → 80 [ACK] Seq=1 Ack=1
   4 0.026477    192.168.1.102   128.119.245.12  TCP        619 1161 → 80 [PSH, ACK] Seq=1 A
   5 0.041737    192.168.1.102   128.119.245.12  TCP       1514 1161 → 80 [PSH, ACK] Seq=566
   6 0.053937    128.119.245.12  192.168.1.102   TCP         60 80 → 1161 [ACK] Seq=1 Ack=56
   7 0.054026    192.168.1.102   128.119.245.12  TCP       1514 1161 → 80 [ACK] Seq=2026 Ack
   8 0.054690    192.168.1.102   128.119.245.12  TCP       1514 1161 → 80 [ACK] Seq=3486 Ack
   9 0.077294    128.119.245.12  192.168.1.102   TCP         60 80 → 1161 [ACK] Seq=1 Ack=20
  10 0.077405    192.168.1.102   128.119.245.12  TCP       1514 1161 → 80 [ACK] Seq=4946 Ack
  11 0.078157    192.168.1.102   128.119.245.12  TCP       1514 1161 → 80 [ACK] Seq=6406 Ack
  12 0.124085    128.119.245.12  192.168.1.102   TCP         60 80 → 1161 [ACK] Seq=1 Ack=34
  13 0.124185    192.168.1.102   128.119.245.12  TCP       1201 1161 → 80 [PSH, ACK] Seq=786
  14 0.169118    128.119.245.12  192.168.1.102   TCP         60 80 → 1161 [ACK] Seq=1 Ack=49
  15 0.217299    128.119.245.12  192.168.1.102   TCP         60 80 → 1161 [ACK] Seq=1 Ack=64
  16 0.267802    128.119.245.12  192.168.1.102   TCP         60 80 → 1161 [ACK] Seq=1 Ack=78
  17 0.304807    128.119.245.12  192.168.1.102   TCP         60 80 → 1161 [ACK] Seq=1 Ack=90
  18 0.305040    192.168.1.102   128.119.245.12  TCP       1514 1161 → 80 [ACK] Seq=9013 Ack
  19 0.305813    192.168.1.102   128.119.245.12  TCP       1514 1161 → 80 [ACK] Seq=10473 Ac
  20 0.306692    192.168.1.102   128.119.245.12  TCP       1514 1161 → 80 [ACK] Seq=11933 Ac

> Frame 1: 62 bytes on wire (496 bits), 62 bytes captured (496 bits)
> Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af:73)
> Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
v Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 0, Len: 0
     Source Port: 1161
     Destination Port: 80
     [Stream index: 0]
     [Conversation completeness: Incomplete, DATA (15)]
     [TCP Segment Len: 0]
     Sequence Number: 0    (relative sequence number)
     Sequence Number (raw): 232129012
     [Next Sequence Number: 1    (relative sequence number)]
     Acknowledgment Number: 0
     Acknowledgment number (raw): 0
     0111 .... = Header Length: 28 bytes (7)
   v Flags: 0x002 (SYN)
       000. .... .... = Reserved: Not set
```

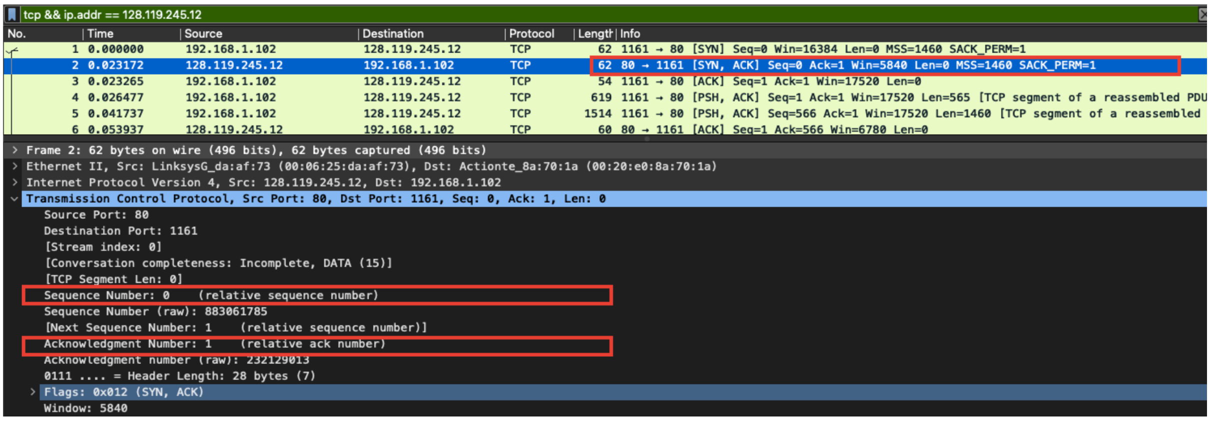
The same is recorded with the tcp-trace packet and we found the SYN flag packet sent from the server to the client for the handshake process.

Q5:



```
tcp && ip.addr == 128.119.245.12
No.   Time       Source          Destination     Protocol  Length Info
   1 0.000000    192.168.1.102   128.119.245.12  TCP         62 1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1
   2 0.023172    128.119.245.12  192.168.1.102   TCP         62 80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM=1
   3 0.023265    192.168.1.102   128.119.245.12  TCP         54 1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
   4 0.026477    192.168.1.102   128.119.245.12  TCP        619 1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565 [TCP segment of a reassembled
   5 0.041737    192.168.1.102   128.119.245.12  TCP       1514 1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP segment of a reassemb
   6 0.053937    128.119.245.12  192.168.1.102   TCP         60 80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0

> Frame 2: 62 bytes on wire (496 bits), 62 bytes captured (496 bits)
> Ethernet II, Src: LinksysG_da:af:73 (00:06:25:da:af:73), Dst: Actionte_8a:70:1a (00:20:e0:8a:70:1a)
> Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102
v Transmission Control Protocol, Src Port: 80, Dst Port: 1161, Seq: 0, Ack: 1, Len: 0
     Source Port: 80
     Destination Port: 1161
     [Stream index: 0]
     [Conversation completeness: Incomplete, DATA (15)]
     [TCP Segment Len: 0]
     Sequence Number: 0    (relative sequence number)
     Sequence Number (raw): 883061785
     [Next Sequence Number: 1    (relative sequence number)]
     Acknowledgment Number: 1    (relative ack number)
     Acknowledgment number (raw): 232129013
     0111 .... = Header Length: 28 bytes (7)
   > Flags: 0x012 (SYN, ACK)
     Window: 5840
```

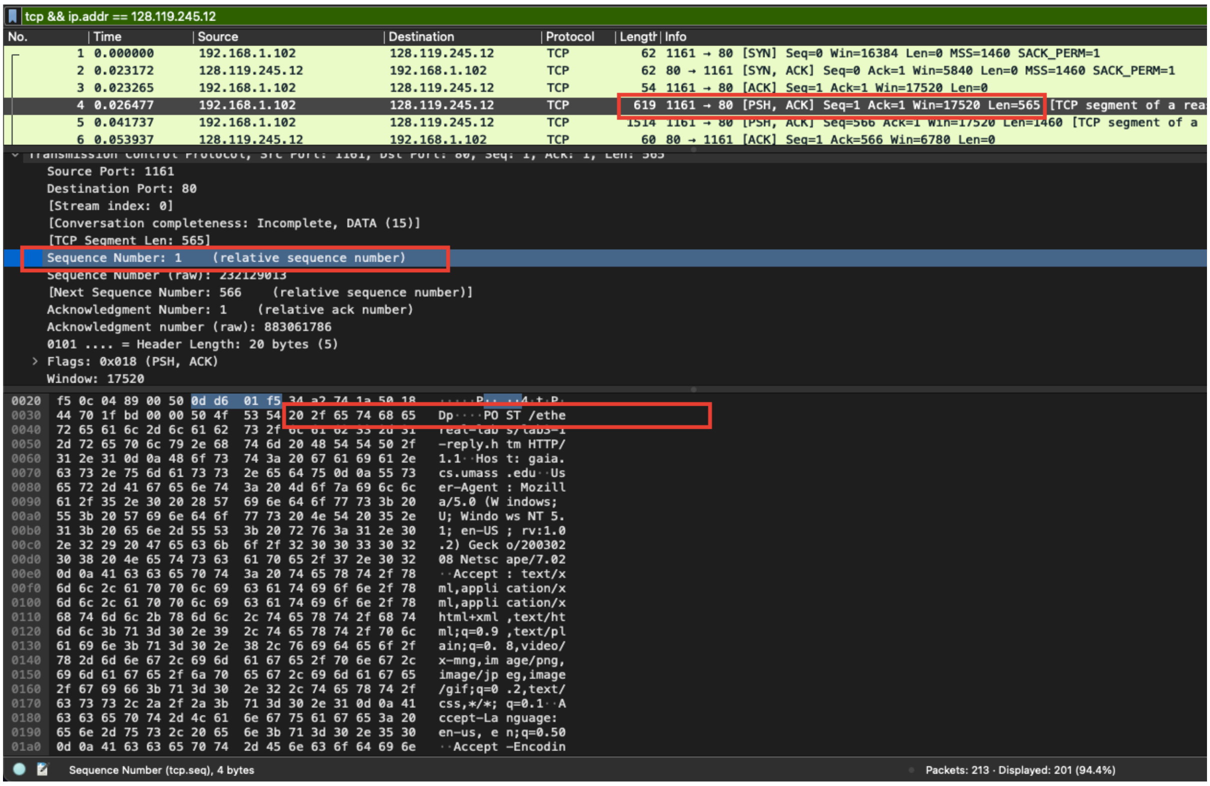
The above screenshot indicates that the flag is set to SYN and the ACK to 1 indicating that it is SYNACK segment that is being sent as a part of response to the SYN packet, i.e., from the client system.



```
tcp && ip.addr == 128.119.245.12
No.   Time      Source          Destination     Protocol Length Info
    1 0.000000  192.168.1.102   128.119.245.12  TCP        62 1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1
    2 0.023172  128.119.245.12  192.168.1.102   TCP        62 80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM=1
    3 0.023265  192.168.1.102   128.119.245.12  TCP        54 1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
    4 0.026477  192.168.1.102   128.119.245.12  TCP       619 1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565 [TCP segment of a reassembled PDU
    5 0.041737  192.168.1.102   128.119.245.12  TCP      1514 1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled
    6 0.053937  128.119.245.12  192.168.1.102   TCP        60 80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0

> Frame 2: 62 bytes on wire (496 bits), 62 bytes captured (496 bits)
> Ethernet II, Src: LinksysG_da:af:73 (00:06:25:da:af:73), Dst: Actionte_8a:70:1a (00:20:e0:8a:70:1a)
> Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102
v Transmission Control Protocol, Src Port: 80, Dst Port: 1161, Seq: 0, Ack: 1, Len: 0
    Source Port: 80
    Destination Port: 1161
    [Stream index: 0]
    [Conversation completeness: Incomplete, DATA (15)]
    [TCP Segment Len: 0]
    Sequence Number: 0    (relative sequence number)
    Sequence Number (raw): 883061785
    [Next Sequence Number: 1    (relative sequence number)]
    Acknowledgment Number: 1    (relative ack number)
    Acknowledgment number (raw): 232129013
    0111 .... = Header Length: 28 bytes (7)
  > Flags: 0x012 (SYN, ACK)
    Window: 5840
```

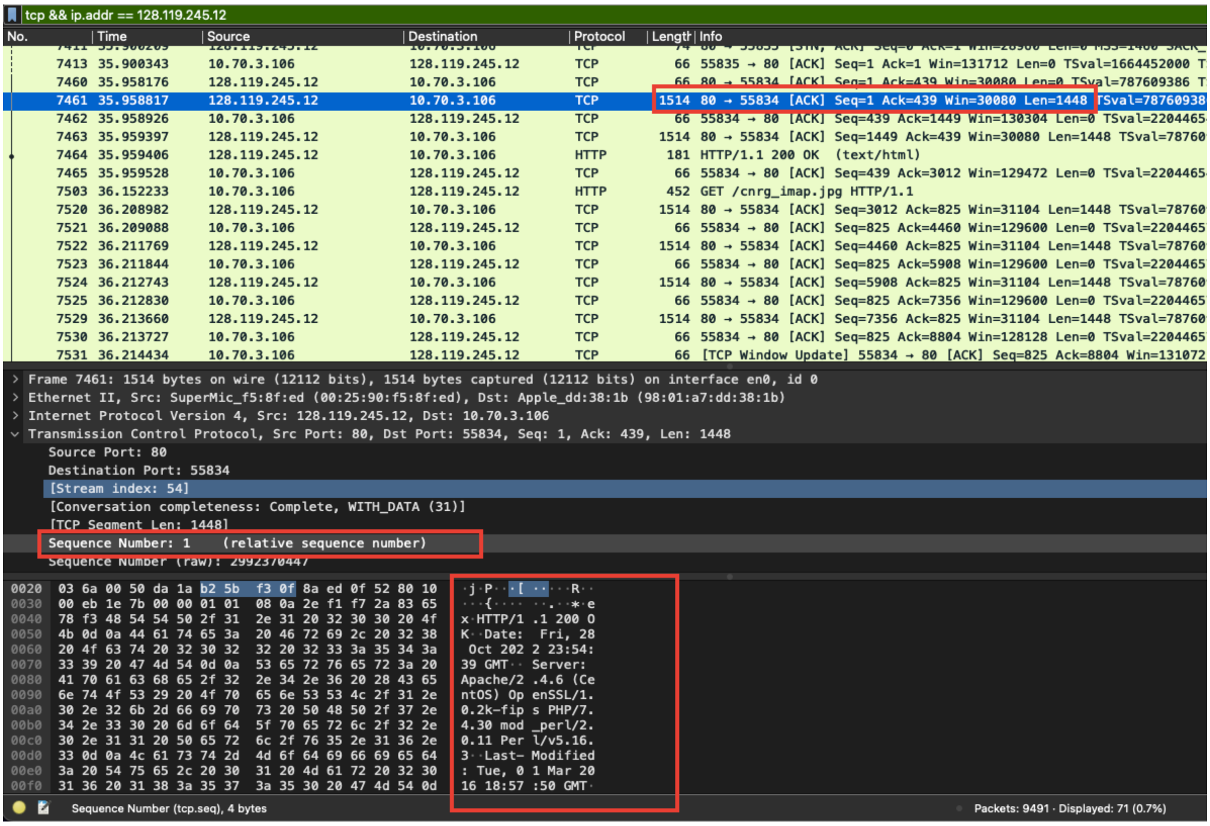
Recording the response with the tcp trace packet – the flag is set to 1 indicating the SYN and the ACK to 1 indicating it is a response for the SYN packet as SYNACK from the server.

Q6:



```
tcp && ip.addr == 128.119.245.12
No.   Time      Source          Destination     Protocol Length Info
    1 0.000000  192.168.1.102   128.119.245.12  TCP        62 1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1
    2 0.023172  128.119.245.12  192.168.1.102   TCP        62 80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM=1
    3 0.023265  192.168.1.102   128.119.245.12  TCP        54 1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
    4 0.026477  192.168.1.102   128.119.245.12  TCP       619 1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565 [TCP segment of a rea
    5 0.041737  192.168.1.102   128.119.245.12  TCP      1514 1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP segment of a
    6 0.053937  128.119.245.12  192.168.1.102   TCP        60 80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
v Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 1, Ack: 1, Len: 565
    Source Port: 1161
    Destination Port: 80
    [Stream index: 0]
    [Conversation completeness: Incomplete, DATA (15)]
    [TCP Segment Len: 565]
    Sequence Number: 1    (relative sequence number)
    Sequence Number (raw): 232129013
    [Next Sequence Number: 566    (relative sequence number)]
    Acknowledgment Number: 1    (relative ack number)
    Acknowledgment number (raw): 883061786
    0101 .... = Header Length: 20 bytes (5)
  > Flags: 0x018 (PSH, ACK)
    Window: 17520

0020  f5 0c 04 89 00 50 0d d6  01 f5 34 a2 74 1a 50 18   .....P.. ..4.t.P.
0030  44 70 1f bd 00 00 50 4f  53 54 20 2f 65 74 68 65   Dp····PO ST /ethe
0040  72 65 61 6c 2d 6c 61 62  73 2f 6c 61 62 33 2d 31   real-lab s/lab3-1
0050  2d 72 65 70 6c 79 2e 68  74 6d 20 48 54 54 50 2f   -reply.h tm HTTP/
0060  31 2e 31 0d 0a 48 6f 73  74 3a 20 67 61 69 61 2e   1.1··Hos t: gaia.
0070  63 73 2e 75 6d 61 73 73  2e 65 64 75 0d 0a 55 73   cs.umass .edu··Us
0080  65 72 2d 41 67 65 6e 74  3a 20 4d 6f 7a 69 6c 6c   er-Agent : Mozill
0090  61 2f 35 2e 30 20 28 57  69 6e 64 6f 77 73 3b 20   a/5.0 (W indows;
00a0  55 3b 20 57 69 6e 64 6f  77 73 20 4e 54 20 35 2e   U; Windo ws NT 5.
00b0  31 3b 20 65 6e 2d 55 53  3b 20 72 76 3a 31 2e 30   1; en-US ; rv:1.0
00c0  2e 32 29 20 47 65 63 6b  6f 2f 32 30 30 33 30 32   .2) Geck o/200302
00d0  30 38 20 4e 65 74 73 63  61 70 65 2f 37 2e 30 32   08 Netsc ape/7.02
00e0  0d 0a 41 63 63 65 70 74  3a 20 74 65 78 74 2f 78   ··Accept : text/x
00f0  6d 6c 2c 61 70 70 6c 69  63 61 74 69 6f 6e 2f 78   ml,appli cation/x
0100  6d 6c 2c 61 70 70 6c 69  63 61 74 69 6f 6e 2f 78   ml,appli cation/x
0110  68 74 6d 6c 2b 78 6d 6c  2c 74 65 78 74 2f 68 74   html+xml ,text/ht
0120  6d 6c 3b 71 3d 30 2e 39  2c 74 65 78 74 2f 70 6c   ml;q=0.9 ,text/pl
0130  61 69 6e 3b 71 3d 30 2e  38 2c 76 69 64 65 6f 2f   ain;q=0. 8,video/
0140  78 2d 6d 6e 67 2c 69 6d  61 67 65 2f 70 6e 67 2c   x-mng,im age/png,
0150  69 6d 61 67 65 2f 6a 70  65 67 2c 69 6d 61 67 65   image/jp eg,image
0160  2f 67 69 66 3b 71 3d 30  2e 32 2c 74 65 78 74 2f   /gif;q=0 .2,text/
0170  63 73 73 2c 2a 2f 2a 3b  71 3d 30 2e 31 0d 0a 41   css,*/*; q=0.1··A
0180  63 63 65 70 74 2d 4c 61  6e 67 75 61 67 65 3a 20   ccept-La nguage:
0190  65 6e 2d 75 73 2c 20 65  6e 3b 71 3d 30 2e 35 30   en-us, e n;q=0.50
01a0  0d 0a 41 63 63 65 70 74  2d 45 6e 63 6f 64 69 6e   ··Accept -Encodin

Sequence Number (tcp.seq), 4 bytes                                   Packets: 213 · Displayed: 201 (94.4%)
```

Sequence number of the tcp segment which has POST command by identifying the POST command in the Data Field for the Seq=1 and Ack=1 .

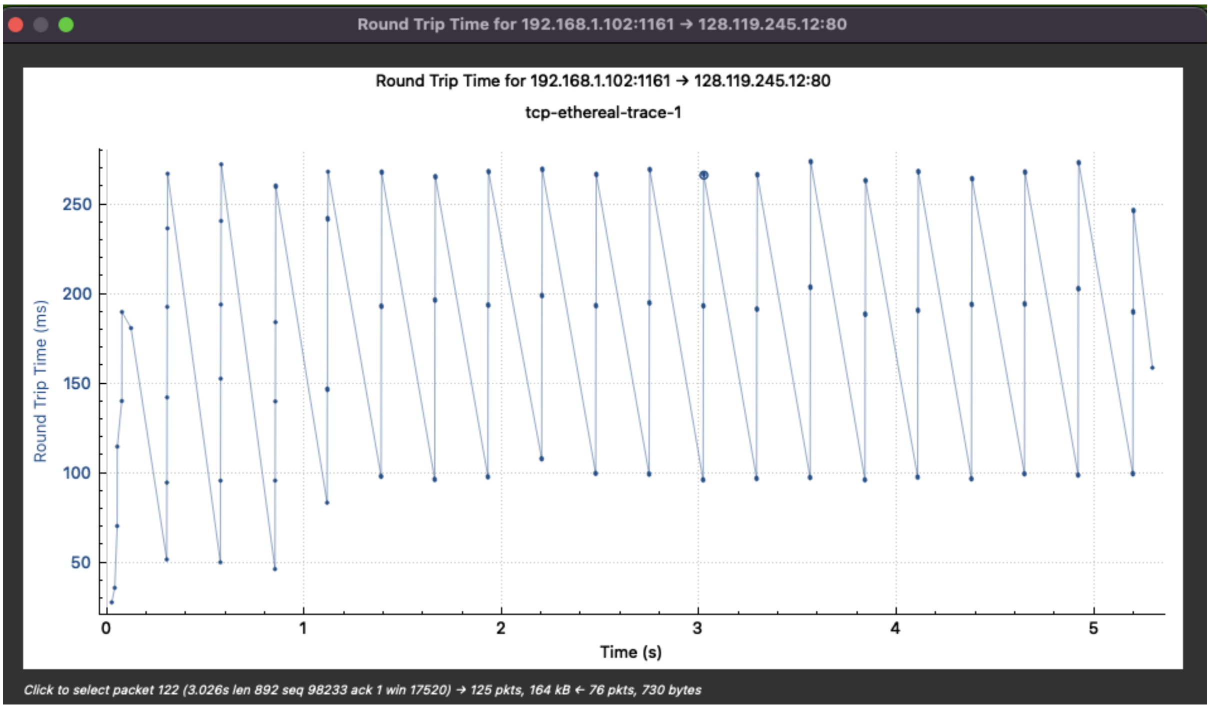


```
tcp && ip.addr == 128.119.245.12
No.    Time       Source           Destination      Protocol  Length Info
7413   35.900343  10.70.3.106      128.119.245.12   TCP         66  55835 → 80 [ACK] Seq=1 Ack=1 Win=131712 Len=0 TSval=1664452000 T
7460   35.958176  128.119.245.12   10.70.3.106      TCP         66  80 → 55834 [ACK] Seq=1 Ack=439 Win=30080 Len=0 TSval=787609386 T
7461   35.958817  128.119.245.12   10.70.3.106      TCP       1514  80 → 55834 [ACK] Seq=1 Ack=439 Win=30080 Len=1448 TSval=78760938
7462   35.958926  10.70.3.106      128.119.245.12   TCP         66  55834 → 80 [ACK] Seq=439 Ack=1449 Win=130304 Len=0 TSval=2204465
7463   35.959397  128.119.245.12   10.70.3.106      TCP       1514  80 → 55834 [ACK] Seq=1449 Ack=439 Win=30080 Len=1448 TSval=78760
7464   35.959406  128.119.245.12   10.70.3.106      HTTP       181  HTTP/1.1 200 OK  (text/html)
7465   35.959528  10.70.3.106      128.119.245.12   TCP         66  55834 → 80 [ACK] Seq=439 Ack=3012 Win=129472 Len=0 TSval=2204465
7503   36.152233  10.70.3.106      128.119.245.12   HTTP       452  GET /cnrg_imap.jpg HTTP/1.1
7520   36.208982  128.119.245.12   10.70.3.106      TCP       1514  80 → 55834 [ACK] Seq=3012 Ack=825 Win=31104 Len=1448 TSval=78760
7521   36.209088  10.70.3.106      128.119.245.12   TCP         66  55834 → 80 [ACK] Seq=825 Ack=4460 Win=129600 Len=0 TSval=2204465
7522   36.211769  128.119.245.12   10.70.3.106      TCP       1514  80 → 55834 [ACK] Seq=4460 Ack=825 Win=31104 Len=1448 TSval=78760
7523   36.211844  10.70.3.106      128.119.245.12   TCP         66  55834 → 80 [ACK] Seq=825 Ack=5908 Win=129600 Len=0 TSval=2204465
7524   36.212743  128.119.245.12   10.70.3.106      TCP       1514  80 → 55834 [ACK] Seq=5908 Ack=825 Win=31104 Len=1448 TSval=78760
7525   36.212830  10.70.3.106      128.119.245.12   TCP         66  55834 → 80 [ACK] Seq=825 Ack=7356 Win=129600 Len=0 TSval=2204465
7529   36.213660  128.119.245.12   10.70.3.106      TCP       1514  80 → 55834 [ACK] Seq=7356 Ack=825 Win=31104 Len=1448 TSval=78760
7530   36.213727  10.70.3.106      128.119.245.12   TCP         66  55834 → 80 [ACK] Seq=825 Ack=8804 Win=128128 Len=0 TSval=2204465
7531   36.214434  10.70.3.106      128.119.245.12   TCP         66  [TCP Window Update] 55834 → 80 [ACK] Seq=825 Ack=8804 Win=131072

> Frame 7461: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface en0, id 0
> Ethernet II, Src: SuperMic_f5:8f:ed (00:25:90:f5:8f:ed), Dst: Apple_dd:38:1b (98:01:a7:dd:38:1b)
> Internet Protocol Version 4, Src: 128.119.245.12, Dst: 10.70.3.106
v Transmission Control Protocol, Src Port: 80, Dst Port: 55834, Seq: 1, Ack: 439, Len: 1448
    Source Port: 80
    Destination Port: 55834
    [Stream index: 54]
    [Conversation completeness: Complete, WITH_DATA (31)]
    [TCP Segment Len: 1448]
    Sequence Number: 1    (relative sequence number)
    Sequence Number (raw): 2992370447

0020  03 6a 00 50 da 1a b2 5b  f3 0f 8a ed 0f 52 80 10   ·j·P···[ ·····R··
0030  00 eb 1e 7b 00 00 01 01  08 0a 2e f1 f7 2a 83 65   ···{···· ··.··*·e
0040  78 f3 48 54 54 50 2f 31  2e 31 20 32 30 30 20 4f   x·HTTP/1 .1 200 O
0050  4b 0d 0a 44 61 74 65 3a  20 46 72 69 2c 20 32 38   K··Date:  Fri, 28
0060  20 4f 63 74 20 32 30 32  32 20 32 33 3a 35 34 3a    Oct 202 2 23:54:
0070  33 39 20 47 4d 54 0d 0a  53 65 72 76 65 72 3a 20   39 GMT·· Server:
0080  41 70 61 63 68 65 2f 32  2e 34 2e 36 20 28 43 65   Apache/2 .4.6 (Ce
0090  6e 74 4f 53 29 20 4f 70  65 6e 53 53 4c 2f 31 2e   ntOS) Op enSSL/1.
00a0  30 2e 32 6b 2d 66 69 70  73 20 50 48 50 2f 37 2e   0.2k-fip s PHP/7.
00b0  34 2e 33 30 20 6d 6f 64  5f 70 65 72 6c 2f 32 2e   4.30 mod _perl/2.
00c0  30 2e 31 31 20 50 65 72  6c 2f 76 35 2e 31 36 2e   0.11 Per l/v5.16.
00d0  33 0d 0a 4c 61 73 74 2d  4d 6f 64 69 66 69 65 64   3··Last- Modified
00e0  3a 20 54 75 65 2c 20 30  31 20 4d 61 72 20 32 30   : Tue, 0 1 Mar 20
00f0  31 36 20 31 38 3a 35 37  3a 35 30 20 47 4d 54 0d   16 18:57 :50 GMT·

Sequence Number (tcp.seq), 4 bytes                          Packets: 9491 · Displayed: 71 (0.7%)
```

The same procedure is followed with the tcp tracer packet and In the data field we identify the response obtained from the server is POST with the Seq=1

Q7:

Below is the statistics for the RTT using the tcp trace packet.

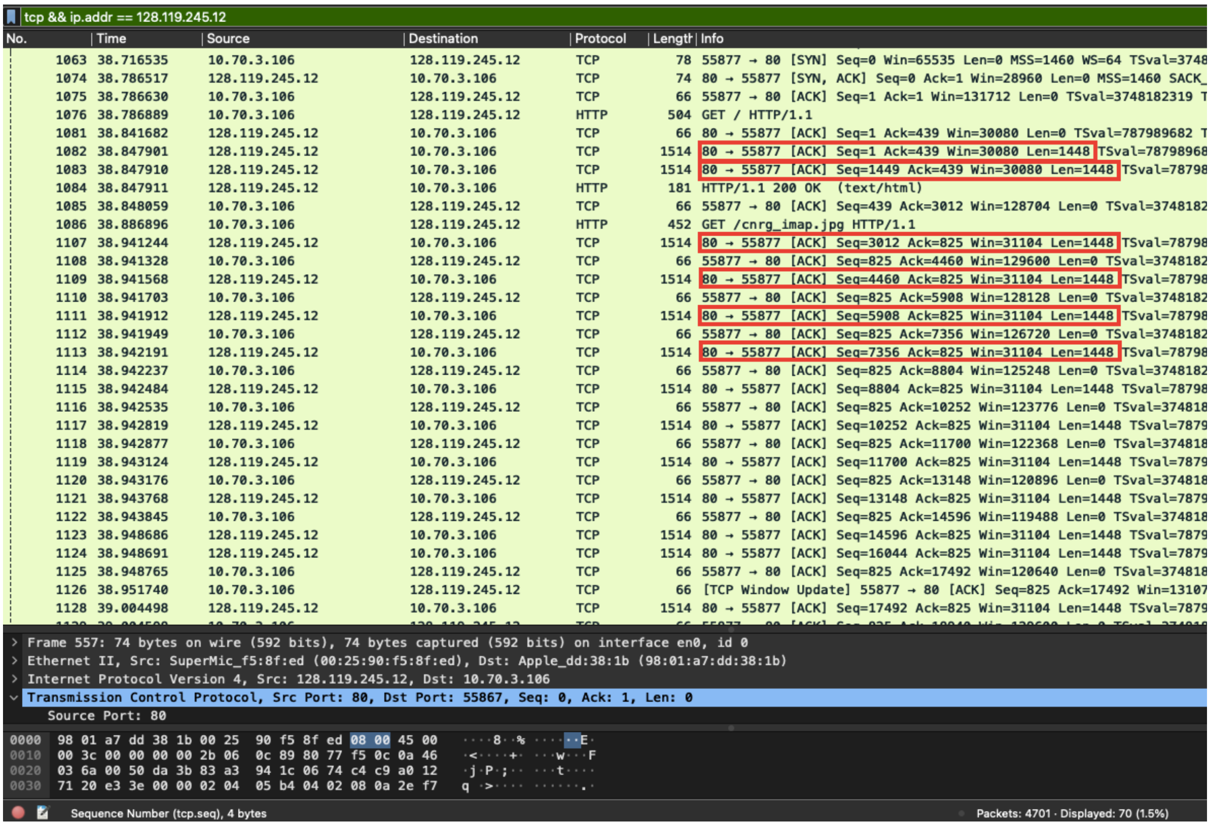


Click to select packet 122 (3.026s len 892 seq 98233 ack 1 win 17520) → 125 pkts, 164 kB ← 76 pkts, 730 bytes

EstimatedRTT = 0.875 * EstimatedRTT + (1-0.875) * SampleRTT
Below table is populated using the above formula and with the sequences obtained.

Sequence Number	Sent Time	ACK Received Time	Round Trip Time (RTT)	Estimated RTT
1	0.026477	0.053937	0.02746	0.02746
566	0.041737	0.077294	0.03557	0.02847
2026	0.054026	0.124085	0.070059	0.03367
3486	0.054069	0.169118	0.114428	0.04376
4946	0.077405	0.217299	0.139894	0.05578
6406	0.078157	0.267802	0.189645	0.07251

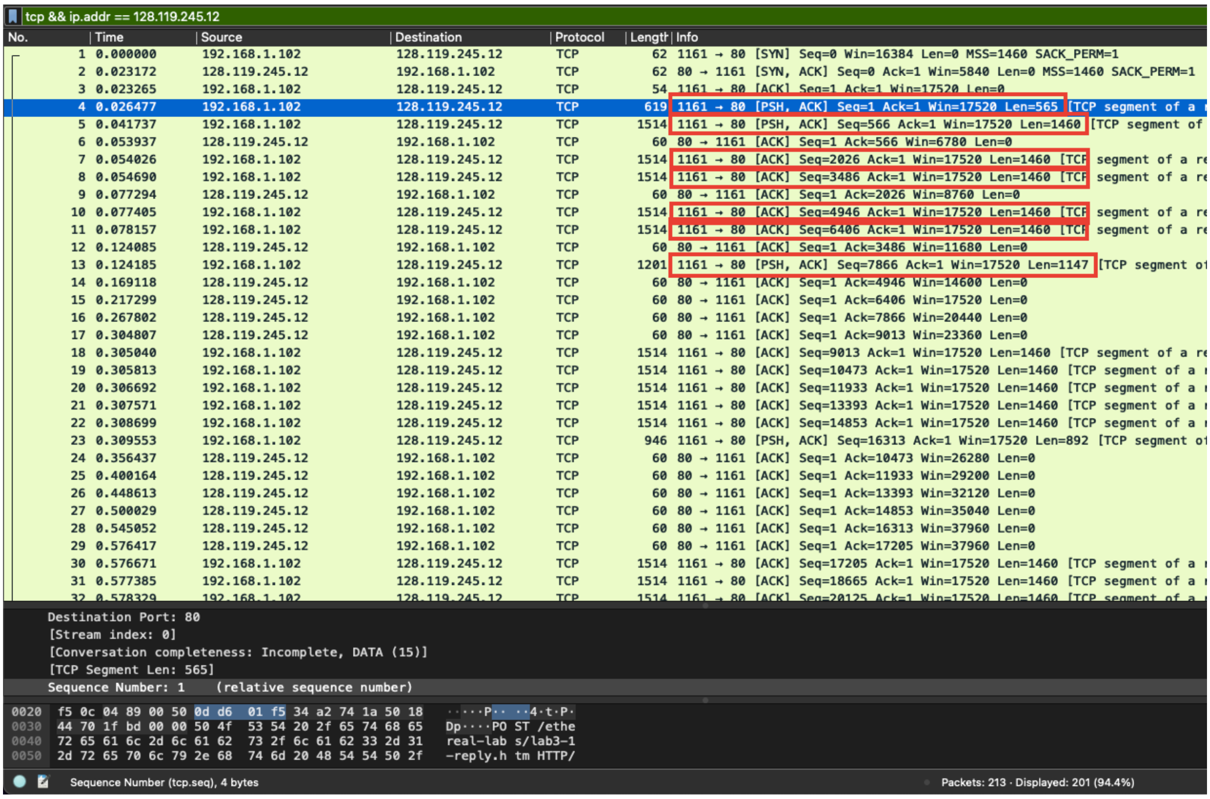
Q8:



```
tcp && ip.addr == 128.119.245.12
No.    Time       Source           Destination      Protocol  Length Info
 1063  38.716535  10.70.3.106      128.119.245.12   TCP         78  55877 → 80 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=64 TSval=3748
 1074  38.786517  128.119.245.12   10.70.3.106      TCP         74  80 → 55877 [SYN, ACK] Seq=0 Ack=1 Win=28960 Len=0 MSS=1460 SACK_
 1075  38.786630  10.70.3.106      128.119.245.12   TCP         66  55877 → 80 [ACK] Seq=1 Ack=1 Win=131712 Len=0 TSval=3748182319 T
 1076  38.786889  10.70.3.106      128.119.245.12   HTTP       504  GET / HTTP/1.1
 1081  38.841682  128.119.245.12   10.70.3.106      TCP         66  80 → 55877 [ACK] Seq=1 Ack=439 Win=30080 Len=0 TSval=787989682 T
 1082  38.847901  128.119.245.12   10.70.3.106      TCP       1514  80 → 55877 [ACK] Seq=1 Ack=439 Win=30080 Len=1448 TSval=78798968
 1083  38.847910  128.119.245.12   10.70.3.106      TCP       1514  80 → 55877 [ACK] Seq=1449 Ack=439 Win=30080 Len=1448 TSval=78798
 1084  38.847911  128.119.245.12   10.70.3.106      HTTP       181  HTTP/1.1 200 OK  (text/html)
 1085  38.848059  10.70.3.106      128.119.245.12   TCP         66  55877 → 80 [ACK] Seq=439 Ack=3012 Win=128704 Len=0 TSval=3748182
 1086  38.886896  10.70.3.106      128.119.245.12   HTTP       452  GET /cnrg_imap.jpg HTTP/1.1
 1107  38.941244  128.119.245.12   10.70.3.106      TCP       1514  80 → 55877 [ACK] Seq=3012 Ack=825 Win=31104 Len=1448 TSval=78798
 1108  38.941328  10.70.3.106      128.119.245.12   TCP         66  55877 → 80 [ACK] Seq=825 Ack=4460 Win=129600 Len=0 TSval=3748182
 1109  38.941568  128.119.245.12   10.70.3.106      TCP       1514  80 → 55877 [ACK] Seq=4460 Ack=825 Win=31104 Len=1448 TSval=78798
 1110  38.941703  10.70.3.106      128.119.245.12   TCP         66  55877 → 80 [ACK] Seq=825 Ack=5908 Win=128128 Len=0 TSval=3748182
 1111  38.941912  128.119.245.12   10.70.3.106      TCP       1514  80 → 55877 [ACK] Seq=5908 Ack=825 Win=31104 Len=1448 TSval=78798
 1112  38.941949  10.70.3.106      128.119.245.12   TCP         66  55877 → 80 [ACK] Seq=825 Ack=7356 Win=126720 Len=0 TSval=3748182
 1113  38.942191  128.119.245.12   10.70.3.106      TCP       1514  80 → 55877 [ACK] Seq=7356 Ack=825 Win=31104 Len=1448 TSval=78798
 1114  38.942237  10.70.3.106      128.119.245.12   TCP         66  55877 → 80 [ACK] Seq=825 Ack=8804 Win=125248 Len=0 TSval=3748182
 1115  38.942484  128.119.245.12   10.70.3.106      TCP       1514  80 → 55877 [ACK] Seq=8804 Ack=825 Win=31104 Len=1448 TSval=78798
 1116  38.942535  10.70.3.106      128.119.245.12   TCP         66  55877 → 80 [ACK] Seq=825 Ack=10252 Win=123776 Len=0 TSval=374818
 1117  38.942819  128.119.245.12   10.70.3.106      TCP       1514  80 → 55877 [ACK] Seq=10252 Ack=825 Win=31104 Len=1448 TSval=7879
 1118  38.942877  10.70.3.106      128.119.245.12   TCP         66  55877 → 80 [ACK] Seq=825 Ack=11700 Win=122368 Len=0 TSval=374818
 1119  38.943124  128.119.245.12   10.70.3.106      TCP       1514  80 → 55877 [ACK] Seq=11700 Ack=825 Win=31104 Len=1448 TSval=7879
 1120  38.943176  10.70.3.106      128.119.245.12   TCP         66  55877 → 80 [ACK] Seq=825 Ack=13148 Win=120896 Len=0 TSval=374818
 1121  38.943768  128.119.245.12   10.70.3.106      TCP       1514  80 → 55877 [ACK] Seq=13148 Ack=825 Win=31104 Len=1448 TSval=7879
 1122  38.943845  10.70.3.106      128.119.245.12   TCP         66  55877 → 80 [ACK] Seq=825 Ack=14596 Win=119488 Len=0 TSval=374818
 1123  38.948686  128.119.245.12   10.70.3.106      TCP       1514  80 → 55877 [ACK] Seq=14596 Ack=825 Win=31104 Len=1448 TSval=7879
 1124  38.948691  128.119.245.12   10.70.3.106      TCP       1514  80 → 55877 [ACK] Seq=16044 Ack=825 Win=31104 Len=1448 TSval=7879
 1125  38.948765  10.70.3.106      128.119.245.12   TCP         66  55877 → 80 [ACK] Seq=825 Ack=17492 Win=120640 Len=0 TSval=374818
 1126  38.951740  10.70.3.106      128.119.245.12   TCP         66  [TCP Window Update] 55877 → 80 [ACK] Seq=825 Ack=17492 Win=13107
 1128  39.004498  128.119.245.12   10.70.3.106      TCP       1514  80 → 55877 [ACK] Seq=17492 Ack=825 Win=31104 Len=1448 TSval=7879

> Frame 557: 74 bytes on wire (592 bits), 74 bytes captured (592 bits) on interface en0, id 0
> Ethernet II, Src: SuperMic_f5:8f:ed (00:25:90:f5:8f:ed), Dst: Apple_dd:38:1b (98:01:a7:dd:38:1b)
> Internet Protocol Version 4, Src: 128.119.245.12, Dst: 10.70.3.106
v Transmission Control Protocol, Src Port: 80, Dst Port: 55867, Seq: 0, Ack: 1, Len: 0
    Source Port: 80

0000  98 01 a7 dd 38 1b 00 25  90 f5 8f ed 08 00 45 00   ····8··%  ······E·
0010  00 3c 00 00 00 00 2b 06  0c 89 80 77 f5 0c 0a 46   ·<····+·  ···w···F
0020  03 6a 00 50 da 3b 83 a3  94 1c 06 74 c4 c9 a0 12   ·j·P·;··  ···t····
0030  71 20 e3 3e 00 00 02 04  05 b4 04 02 08 0a 2e f7   q ·>····  ·······.·

Sequence Number (tcp.seq), 4 bytes                                  Packets: 4701 · Displayed: 70 (1.5%)
```

We are trying to find the length of the first 6 tcp segments for the client system as below:

1st Segment - 1448
2nd Segment – 1448
3rd Segment – 1448
4th Segment – 1448
5th Segment – 1448
6th Segment - 1448



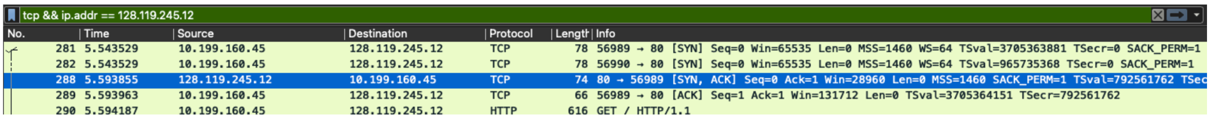
```
tcp && ip.addr == 128.119.245.12
No.      Time      Source          Destination     Protocol  Length Info
      1 0.000000  192.168.1.102   128.119.245.12  TCP         62 1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1
      2 0.023172  128.119.245.12  192.168.1.102   TCP         62 80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM=1
      3 0.023265  192.168.1.102   128.119.245.12  TCP         54 1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
      4 0.026477  192.168.1.102   128.119.245.12  TCP        619 1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565 [TCP segment of a r
      5 0.041737  192.168.1.102   128.119.245.12  TCP       1514 1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP segment of
      6 0.053937  128.119.245.12  192.168.1.102   TCP         60 80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
      7 0.054026  192.168.1.102   128.119.245.12  TCP       1514 1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460 [TCP segment of a re
      8 0.054690  192.168.1.102   128.119.245.12  TCP       1514 1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460 [TCP segment of a re
      9 0.077294  128.119.245.12  192.168.1.102   TCP         60 80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
     10 0.077405  192.168.1.102   128.119.245.12  TCP       1514 1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460 [TCP segment of a re
     11 0.078157  192.168.1.102   128.119.245.12  TCP       1514 1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460 [TCP segment of a re
     12 0.124085  128.119.245.12  192.168.1.102   TCP         60 80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
     13 0.124185  192.168.1.102   128.119.245.12  TCP       1201 1161 → 80 [PSH, ACK] Seq=7866 Ack=1 Win=17520 Len=1147 [TCP segment of
     14 0.169118  128.119.245.12  192.168.1.102   TCP         60 80 → 1161 [ACK] Seq=1 Ack=4946 Win=14600 Len=0
     15 0.217299  128.119.245.12  192.168.1.102   TCP         60 80 → 1161 [ACK] Seq=1 Ack=6406 Win=17520 Len=0
     16 0.267802  128.119.245.12  192.168.1.102   TCP         60 80 → 1161 [ACK] Seq=1 Ack=7866 Win=20440 Len=0
     17 0.304807  128.119.245.12  192.168.1.102   TCP         60 80 → 1161 [ACK] Seq=1 Ack=9013 Win=23360 Len=0
     18 0.305040  192.168.1.102   128.119.245.12  TCP       1514 1161 → 80 [ACK] Seq=9013 Ack=1 Win=17520 Len=1460 [TCP segment of a re
     19 0.305813  192.168.1.102   128.119.245.12  TCP       1514 1161 → 80 [ACK] Seq=10473 Ack=1 Win=17520 Len=1460 [TCP segment of a r
     20 0.306692  192.168.1.102   128.119.245.12  TCP       1514 1161 → 80 [ACK] Seq=11933 Ack=1 Win=17520 Len=1460 [TCP segment of a r
     21 0.307571  192.168.1.102   128.119.245.12  TCP       1514 1161 → 80 [ACK] Seq=13393 Ack=1 Win=17520 Len=1460 [TCP segment of a r
     22 0.308699  192.168.1.102   128.119.245.12  TCP       1514 1161 → 80 [ACK] Seq=14853 Ack=1 Win=17520 Len=1460 [TCP segment of a r
     23 0.309553  192.168.1.102   128.119.245.12  TCP        946 1161 → 80 [PSH, ACK] Seq=16313 Ack=1 Win=17520 Len=892 [TCP segment of
     24 0.356437  128.119.245.12  192.168.1.102   TCP         60 80 → 1161 [ACK] Seq=1 Ack=10473 Win=26280 Len=0
     25 0.400164  128.119.245.12  192.168.1.102   TCP         60 80 → 1161 [ACK] Seq=1 Ack=11933 Win=29200 Len=0
     26 0.448613  128.119.245.12  192.168.1.102   TCP         60 80 → 1161 [ACK] Seq=1 Ack=13393 Win=32120 Len=0
     27 0.500029  128.119.245.12  192.168.1.102   TCP         60 80 → 1161 [ACK] Seq=1 Ack=14853 Win=35040 Len=0
     28 0.545052  128.119.245.12  192.168.1.102   TCP         60 80 → 1161 [ACK] Seq=1 Ack=16313 Win=37960 Len=0
     29 0.576417  128.119.245.12  192.168.1.102   TCP         60 80 → 1161 [ACK] Seq=1 Ack=17205 Win=37960 Len=0
     30 0.576671  192.168.1.102   128.119.245.12  TCP       1514 1161 → 80 [ACK] Seq=17205 Ack=1 Win=17520 Len=1460 [TCP segment of a r
     31 0.577385  192.168.1.102   128.119.245.12  TCP       1514 1161 → 80 [ACK] Seq=18665 Ack=1 Win=17520 Len=1460 [TCP segment of a r
     32 0.578329  192.168.1.102   128.119.245.12  TCP       1514 1161 → 80 [ACK] Seq=20125 Ack=1 Win=17520 Len=1460 [TCP segment of a r

     Destination Port: 80
     [Stream index: 0]
     [Conversation completeness: Incomplete, DATA (15)]
     [TCP Segment Len: 565]
     Sequence Number: 1    (relative sequence number)

0020  f5 0c 04 89 00 50 0d d6  01 f5 34 a2 74 1a 50 18   ·····P·· ··4·t·P·
0030  44 70 1f bd 00 00 50 4f  53 54 20 2f 65 74 68 65   Dp····PO ST /ethe
0040  72 65 61 6c 2d 6c 61 62  73 2f 6c 61 62 33 2d 31   real-lab s/lab3-1
0050  2d 72 65 70 6c 79 2e 68  74 6d 20 48 54 54 50 2f   -reply.h tm HTTP/

Sequence Number (tcp.seq), 4 bytes                                     Packets: 213 · Displayed: 201 (94.4%)
```

We are trying to find the length of the first 6 tcp segments for the tcp tracer packet as below:

1st Segment - 1460
2nd Segment – 1460
3rd Segment – 1460
4th Segment – 1460
5th Segment – 1460
6th Segment - 1147

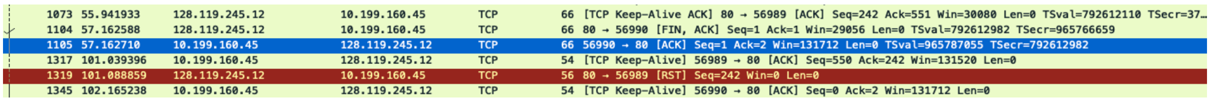
Q9:

Smallest window size of the first transmission at the source using the client's system: 28960



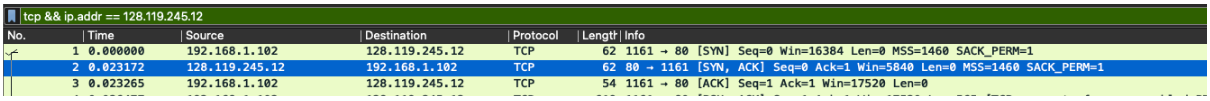
```
tcp && ip.addr == 128.119.245.12
No.      Time      Source          Destination     Protocol  Length Info
    281 5.543529  10.199.160.45   128.119.245.12  TCP         78 56989 → 80 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=64 TSval=3705363881 TSecr=0 SACK_PERM=1
    282 5.543529  10.199.160.45   128.119.245.12  TCP         78 56990 → 80 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=64 TSval=965735368 TSecr=0 SACK_PERM=1
    288 5.593855  128.119.245.12  10.199.160.45   TCP         74 80 → 56989 [SYN, ACK] Seq=0 Ack=1 Win=28960 Len=0 MSS=1460 SACK_PERM=1 TSval=792561762 TSec
    289 5.593963  10.199.160.45   128.119.245.12  TCP         66 56989 → 80 [ACK] Seq=1 Ack=1 Win=131712 Len=0 TSval=3705364151 TSecr=792561762
    290 5.594187  10.199.160.45   128.119.245.12  HTTP       616 GET / HTTP/1.1
```

Smallest window size of the last transmission at the destination using the client's system: 131712



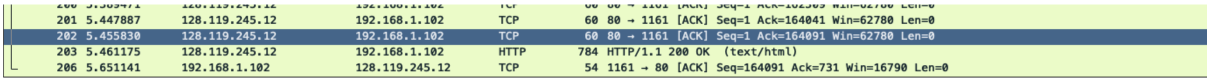
```
   1073 55.941933  128.119.245.12  10.199.160.45   TCP   66 [TCP Keep-Alive ACK] 80 → 56989 [ACK] Seq=242 Ack=551 Win=30080 Len=0 TSval=792612110 TSecr=37…
   1104 57.162588  128.119.245.12  10.199.160.45   TCP   66 80 → 56990 [FIN, ACK] Seq=1 Ack=1 Win=29056 Len=0 TSval=792612982 TSecr=965766659
   1105 57.162710  10.199.160.45   128.119.245.12  TCP   66 56990 → 80 [ACK] Seq=1 Ack=2 Win=131712 Len=0 TSval=965787055 TSecr=792612982
   1317 101.039396 10.199.160.45   128.119.245.12  TCP   54 [TCP Keep-Alive] 56989 → 80 [ACK] Seq=550 Ack=242 Win=131520 Len=0
   1319 101.088859 128.119.245.12  10.199.160.45   TCP   56 80 → 56989 [RST] Seq=242 Win=0 Len=0
   1345 102.165238 10.199.160.45   128.119.245.12  TCP   54 [TCP Keep-Alive] 56990 → 80 [ACK] Seq=0 Ack=2 Win=131712 Len=0
```

Smallest window size of the first transmission at the source using the tcp trace packet: 5840



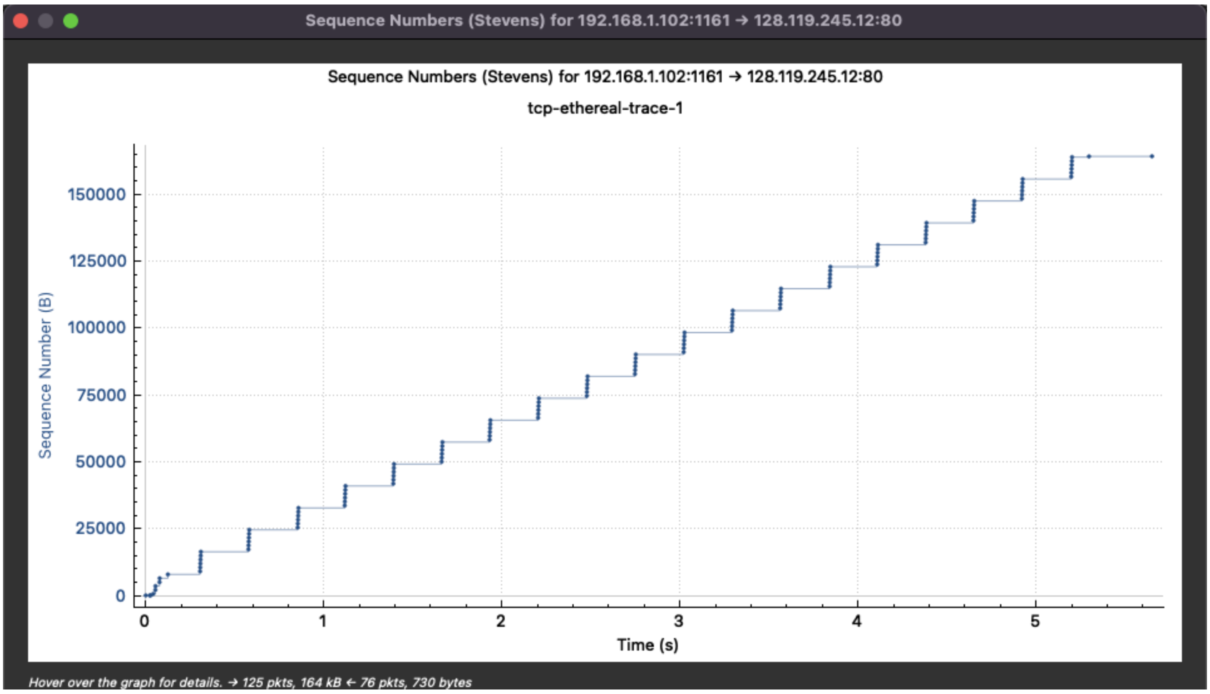
```
tcp && ip.addr == 128.119.245.12
No.      Time       Source           Destination      Protocol  Length Info
       1 0.000000   192.168.1.102    128.119.245.12   TCP       62  1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1
       2 0.023172   128.119.245.12   192.168.1.102    TCP       62  80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM=1
       3 0.023265   192.168.1.102    128.119.245.12   TCP       54  1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
```

Smallest window size of the last transmission at the destination using the tcp trace packet: 62780

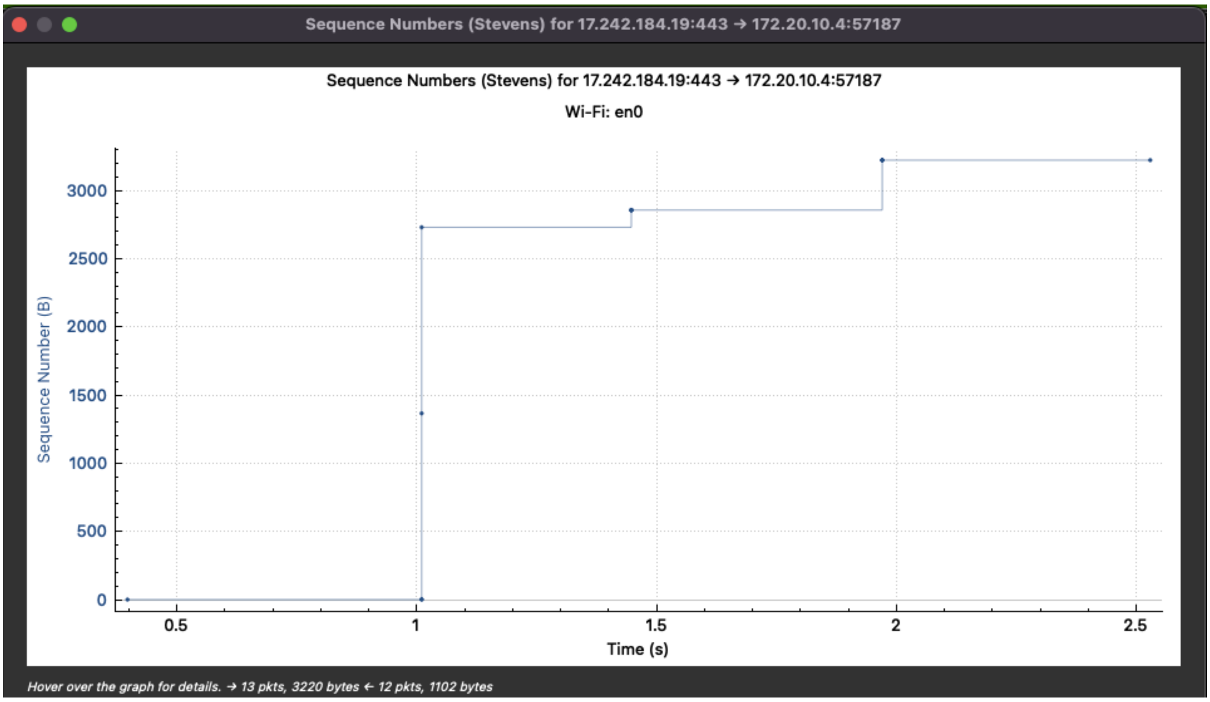


```
     201 5.447887   128.119.245.12   192.168.1.102    TCP       60  80 → 1161 [ACK] Seq=1 Ack=164041 Win=62780 Len=0
     202 5.455830   128.119.245.12   192.168.1.102    TCP       60  80 → 1161 [ACK] Seq=1 Ack=164091 Win=62780 Len=0
     203 5.461175   128.119.245.12   192.168.1.102    HTTP     784  HTTP/1.1 200 OK  (text/html)
     206 5.651141   192.168.1.102    128.119.245.12   TCP       54  1161 → 80 [ACK] Seq=164091 Ack=731 Win=16790 Len=0
```

Q10:



There are no re-transmitted packets in the tracer file. By checking the sequence numbers of the TCP segments, we can conclude that there are no re-transmitted packets, by looking at the Sequence numbers using stevens from source 192.168.1.102 to the destination 128.119.245.12 which is increasing monotonically with the time.



Sequence Numbers (Stevens) for 17.242.184.19:443 → 172.20.10.4:57187
Sequence Numbers (Stevens) for 17.242.184.19:443 → 172.20.10.4:57187
Wi-Fi: en0
Sequence Number (B)
3000
2500
2000
1500
1000
500
0
0.5
1
1.5
2
2.5
Time (s)

Hover over the graph for details. → 13 pkts, 3220 bytes ← 12 pkts, 1102 bytes

Also, with the capture of statistics from my system, we cannot see any of the re-transmissions in the trace file. By looking at the Sequence numbers using stevens from source 17.242.184.19 to the destination 172.20.10.4 which is increasing monotonically with the time.

Q11:

By looking at the length of the tcp segments, we can conclude that:

Received 566 bytes for ACK1: [566 – 0]
Received 1460 bytes for ACK2: [2026 - 566]
Received 1460 bytes for ACK3: [3486 - 2026]
Received 1460 bytes for ACK4: [4946 - 3486]

Q12:

The definition of Average throughput gives us the amount of data sent across the transmission line per unit time.

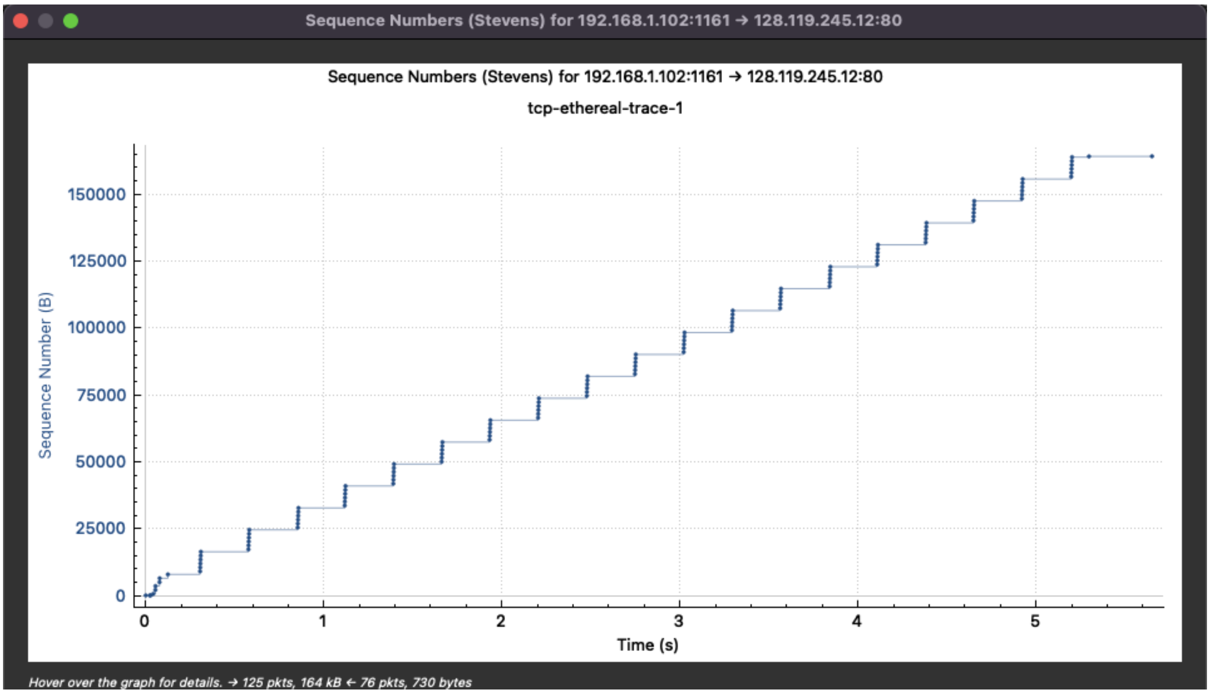
Throughput = Total amount of data / Total transmission time

Time for the last packet to transmit = 5.455830 sec
Time for the last packet to transmit = 0.026477 sec

Transmission duration = (5.455830 - 0.026477) = 5.429353 sec
Total amount of data = [Ack seq # of the last ACK - seq # of the first TCP]
= [164091 – 1] = 164090 bytes

Throughput = (164090 / 5.429353) = 30222.754 bytes/sec

Q13:


Sequence Numbers (Stevens) for 192.168.1.102:1161 → 128.119.245.12:80
Sequence Numbers (Stevens) for 192.168.1.102:1161 → 128.119.245.12:80
tcp-ethereal-trace-1
Sequence Number (B)
150000
125000
100000
75000
50000
25000
0
0
1
2
3
4
5
Time (s)
Hover over the graph for details. → 125 pkts, 164 kB ← 76 pkts, 730 bytes

From the sequence numbers using stevens,TCPs slow start phase start at [0, 0.3] sec, congestion control got initiated at the packet 23rd one. This is where the ack seq number is close to window size of the buffer and no further increase in the size of the of cwned.