

Exercise 1: Understanding TCP using Wireshark

Q1.

IP address of gaia.cs.umass.edu: 128.119.245.12, Port No: 80

IP address of client computer: 192.168.1.102, Port No: 1161

Q2.

Sequence number is 1.

```
[TCP Segment Len: 565]
Sequence number: 1 (relative sequence number)
[Next sequence number: 566 (relative sequence number)]
Acknowledgment number: 1 (relative ack number)
Header Length: 20 bytes
► Flags: 0x018 (PSH, ACK)
Window size value: 17520
[Calculated window size: 17520]
[Window size scaling factor: -2 (no window scaling used)]
Checksum: 0x1fbd [unverified]
[Checksum Status: Unverified]
Urgent pointer: 0
▼ [SEQ/ACK analysis]
  [iRTT: 0.023265000 seconds]
  [Bytes in flight: 565]
  [Bytes sent since last PSH flag: 565]
  [Reassembled PDU in frame: 199]
  TCP segment data (565 bytes)
```

```
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
```

Q3/4.

Segment No	Time Sent (s)	Length	ACK received time (s)	RTT (s)	Estimated RTT (s)
1	0.026477	619	0.053937	0.02746	0.02746
566	0.041737	1514	0.077294	0.03555	0.0285
2026	0.054026	1514	0.124085	0.070059	0.0337
3486	0.054690	1514	0.169118	0.11443	0.0438
4946	0.077405	1514	0.217299	0.13989	0.0558
6406	0.078157	1514	0.267802	0.18964	0.0725

Estimated RTT: $(1-\alpha) * (\text{EstimatedRTT}) + \alpha * (\text{SampleRTT})$
where α is 0.125

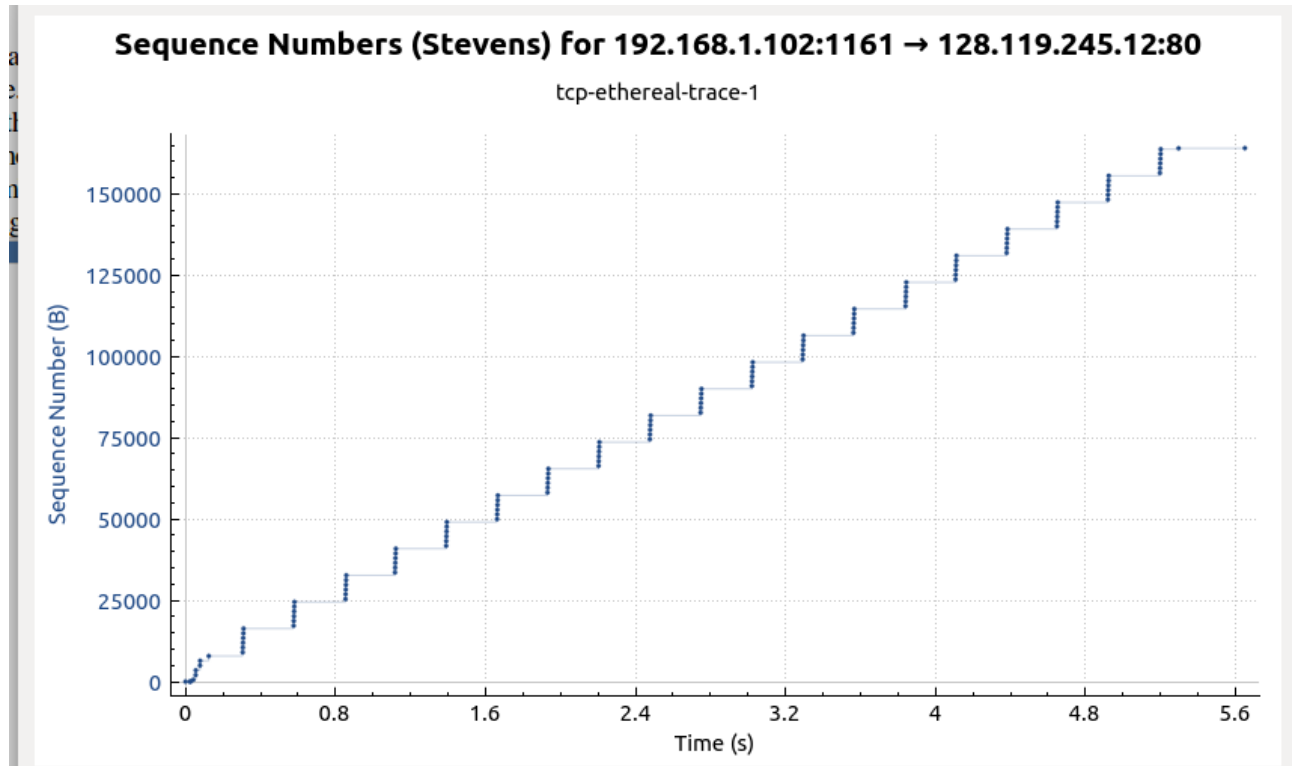
Q5.

17520 bytes throughout all segments.

```
► Flags: 0x018 (PSH, ACK)
Window size value: 17520
[Calculated window size: 17520]
[Window size scaling factor: -2 (no window scaling used)]
```

Q6.

From the graph, we observe that the sequence numbers from client to destination increases monotonically. This indicates that there are no retransmitted segment, as the sequence number of the retransmitted will be smaller than neighbouring segments.



Q7.

ACKs	ACK seq no	ACKed data
1	566	565
2	2026	1460
3	3486	1460
4	4946	1460
5	6406	1460
6	7866	1460
7	9013	1147
8	10473	1460
9	11933	1460
10	13393	1460
11	14853	1460
12	16313	1460

The difference between 2 ACKs' sequence numbers indicates the data size received. This amount acknowledged is not of constant size as it might well be ACK-ing more than one segment size.

Eg.

Segment of No. 78 and No.79:

ACK No.79 – ACK No.78 = 2920 bytes

acknowledged data with 2920 bytes = 1460×2 bytes.

Q8.

Average throughput = ratio between total data size (i) and total transmission time (ii).

(i). difference between seq no of 1st TCP Segment and last ACK seq no.

(ii). Difference between time instant of 1st TCP Segment and time instant of last ACK.

Total data are 164091 (206nd Segment) – 1 (4th Segment) = 164090 bytes

Total transmission time = 5.651141 (206nd Segment) – 0.026477 (4th segment) = 5.624664 seconds

$164090 / 5.4294 = 29.173$ KByte/sec

Exercise 2: TCP Connection Management

Question 1 .

Seq No: 2818463618

Question 2.

Seq No: 1247095790, ACK no: 2818463618 , the starting 1 byte is added to the client sequence number of the data sent after the handshake/initialisation of the connection.

Question 3.

Sequence number of the ACK segment from client responding to SYNACK: 2818463619

Acknowledgement field in this ACK segment: 1247095790

ACK field = sequence number of previous SYNACK plus 1 byte of data that is in the segment.

Question 4 .

The client has done active close as the first [FIN, ACK] is from 10.0.16.201. A 4 Segment (FIN/ACK/FIN/ACK) closure has been conducted as it is a pair of two-way handshakes. Type of closure is simultaneous close as both parties send FINACK simultaneously.

Question 5 .

Total data bytes transferred is 33 bytes, judging by the difference between first and last ACK's sequence number after connection established. $2818463652 - 2818463619 = 33$ bytes. From server to client however is $1247095831 - 1247095791 = 40$ bytes. These numbers represent the size of data transferred during the connection.