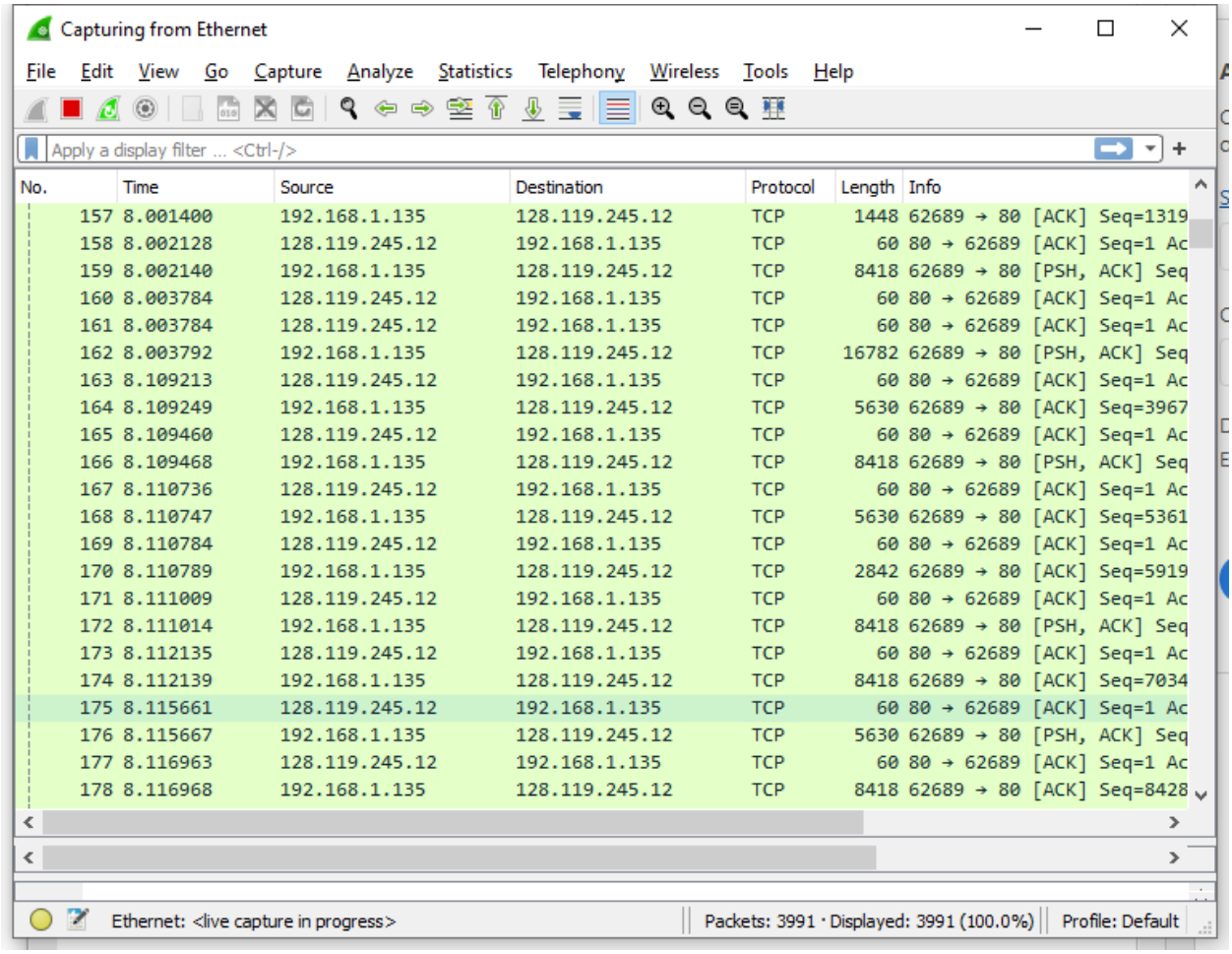
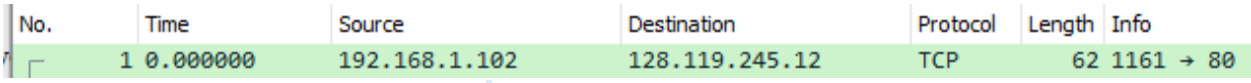
Haorui Zhang

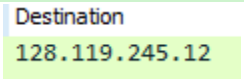
10/30/2021

CS 455

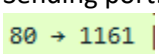
1. 

2.
   a. IP address: Source address: 192.169.1.102 Port Number: 1161 Destination Port number: 80



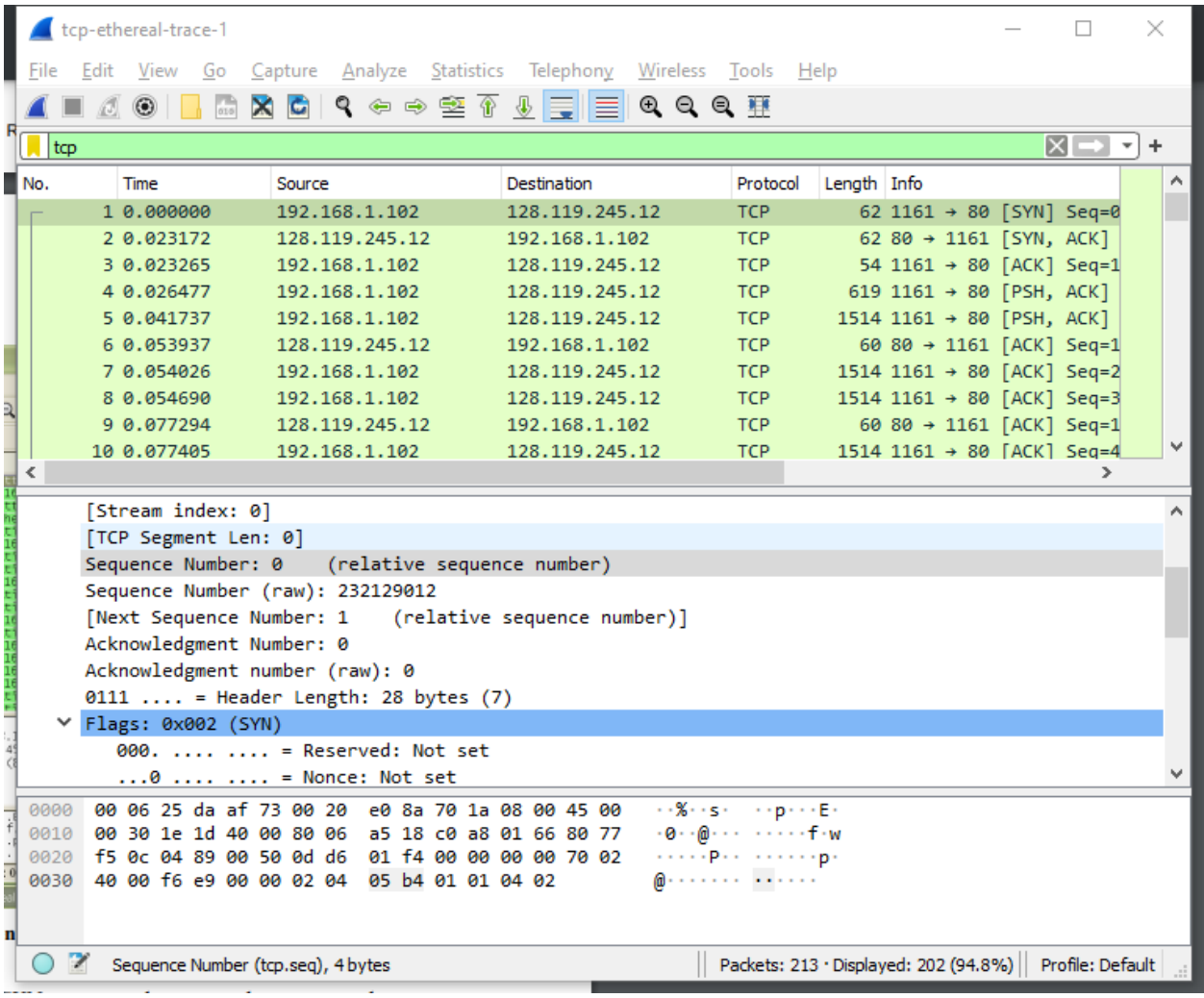


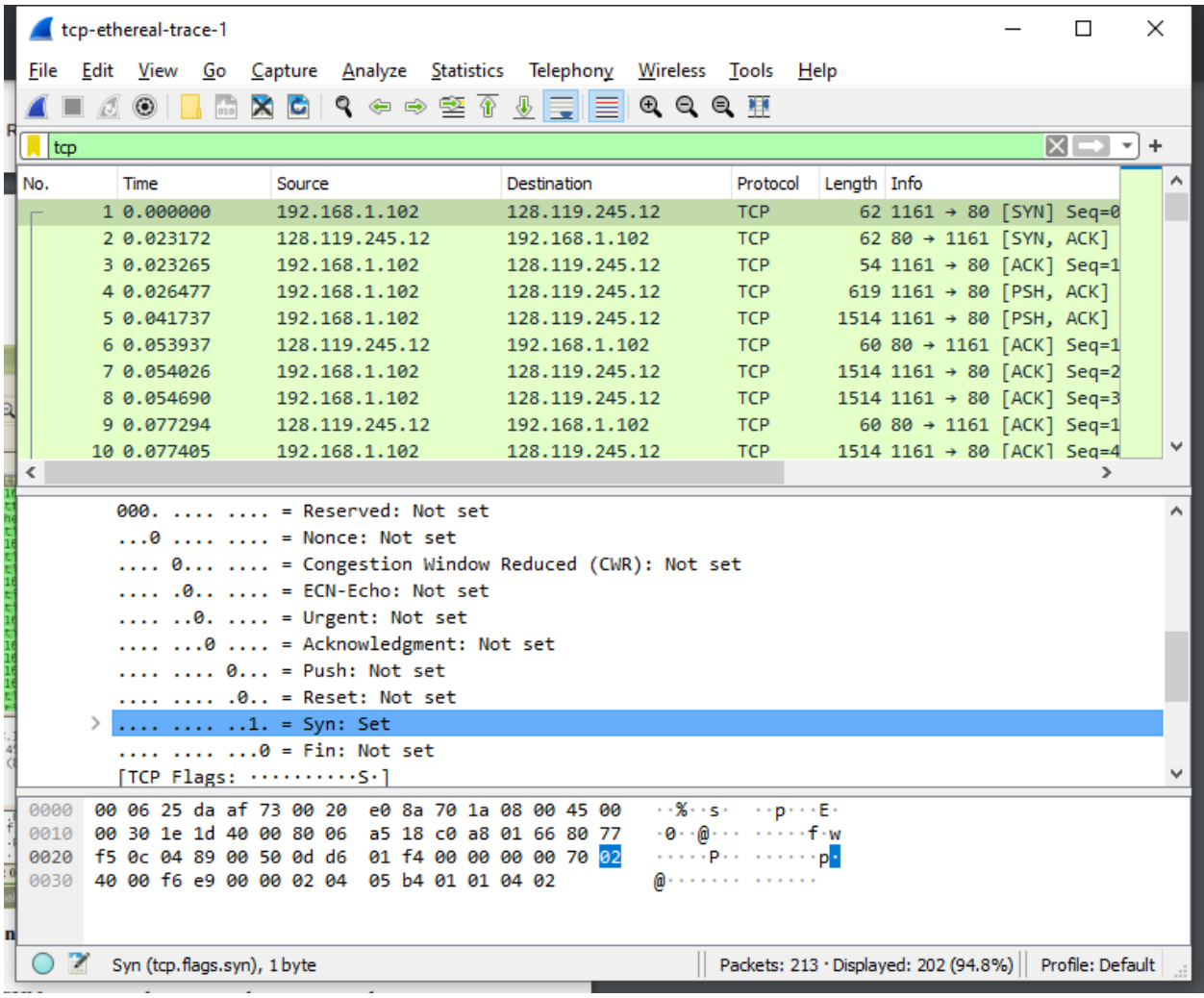
   b. IP of gaia.cs.umass.edu: 128.119.245.12
   Receiving port: 80
   Sending port: 1161



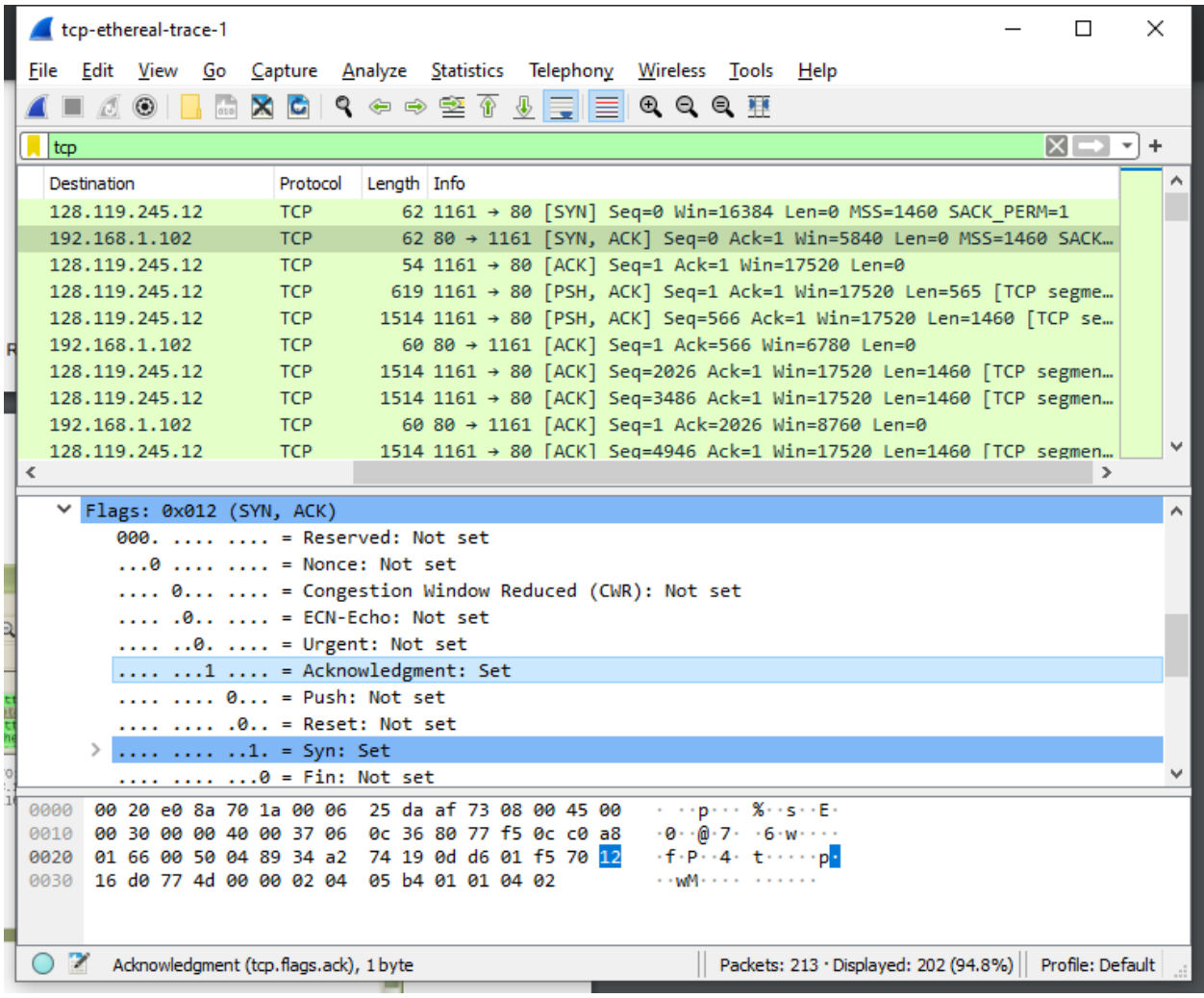
   c. My client IP: 192.168.1.135
   TCP port: 62689
3.

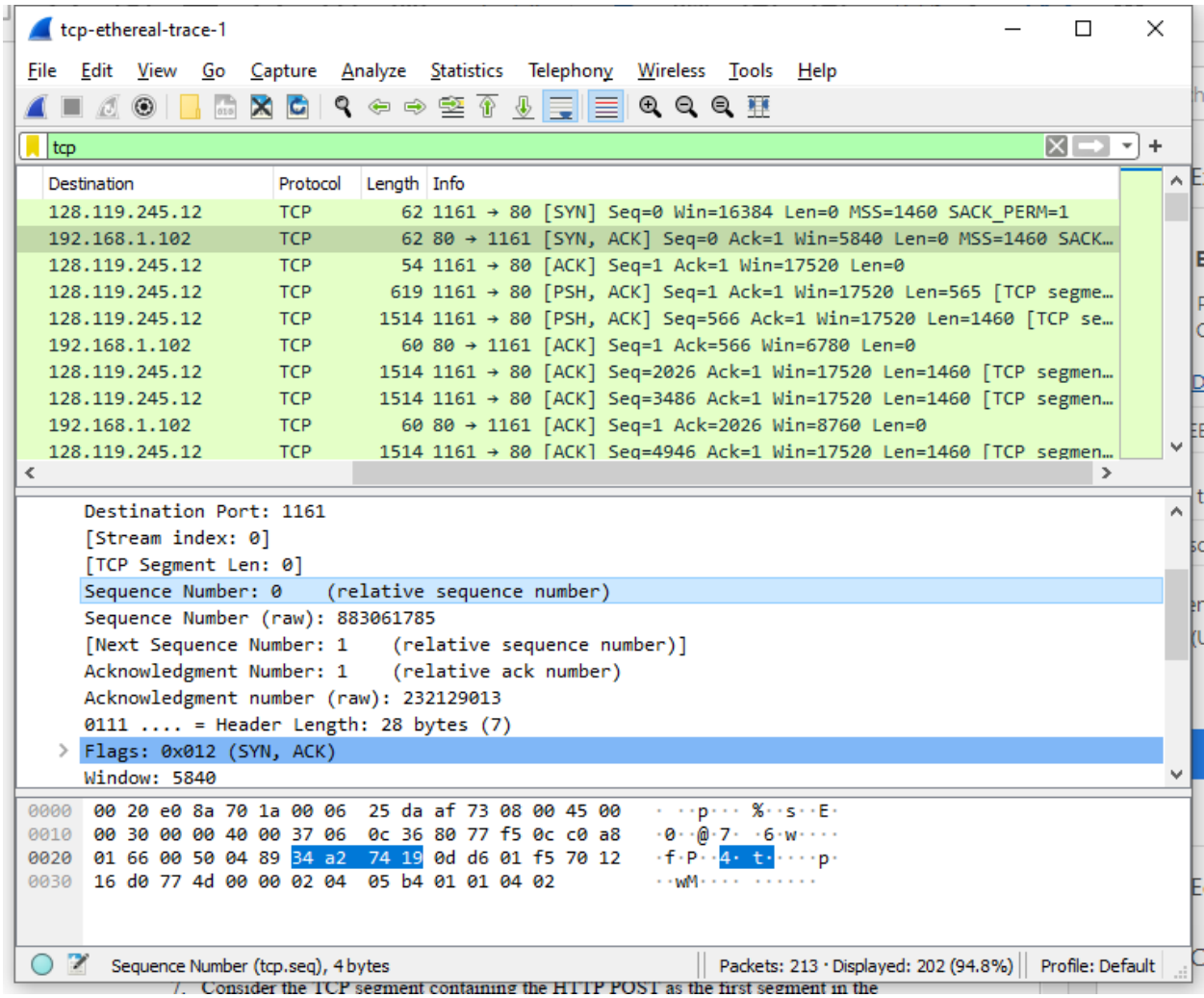
a. The sequence number counts the bytes of data into byte stream. It's 0 in this case. The SYN flag is set to 1


tcp-ethereal-trace-1
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
tcp
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
2 0.023172 128.119.245.12 192.168.1.102 TCP 62 80 → 1161 [SYN, ACK]
3 0.023265 192.168.1.102 128.119.245.12 TCP 54 1161 → 80 [ACK] Seq=1
4 0.026477 192.168.1.102 128.119.245.12 TCP 619 1161 → 80 [PSH, ACK]
5 0.041737 192.168.1.102 128.119.245.12 TCP 1514 1161 → 80 [PSH, ACK]
6 0.053937 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1
7 0.054026 192.168.1.102 128.119.245.12 TCP 1514 1161 → 80 [ACK] Seq=2
8 0.054690 192.168.1.102 128.119.245.12 TCP 1514 1161 → 80 [ACK] Seq=3
9 0.077294 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1
10 0.077405 192.168.1.102 128.119.245.12 TCP 1514 1161 → 80 [ACK] Seq=4
[Stream index: 0]
[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)
Flags: 0x002 (SYN)
000. .... = Reserved: Not set
...0 .... = Nonce: Not set
0000 00 06 25 da af 73 00 20 e0 8a 70 1a 08 00 45 00
0010 00 30 1e 1d 40 00 80 06 a5 18 c0 a8 01 66 80 77
0020 f5 0c 04 89 00 50 0d d6 01 f4 00 00 00 00 70 02
0030 40 00 f6 e9 00 00 02 04 05 b4 01 01 04 02
Sequence Number (tcp.seq), 4 bytes
Packets: 213 · Displayed: 202 (94.8%)
Profile: Default



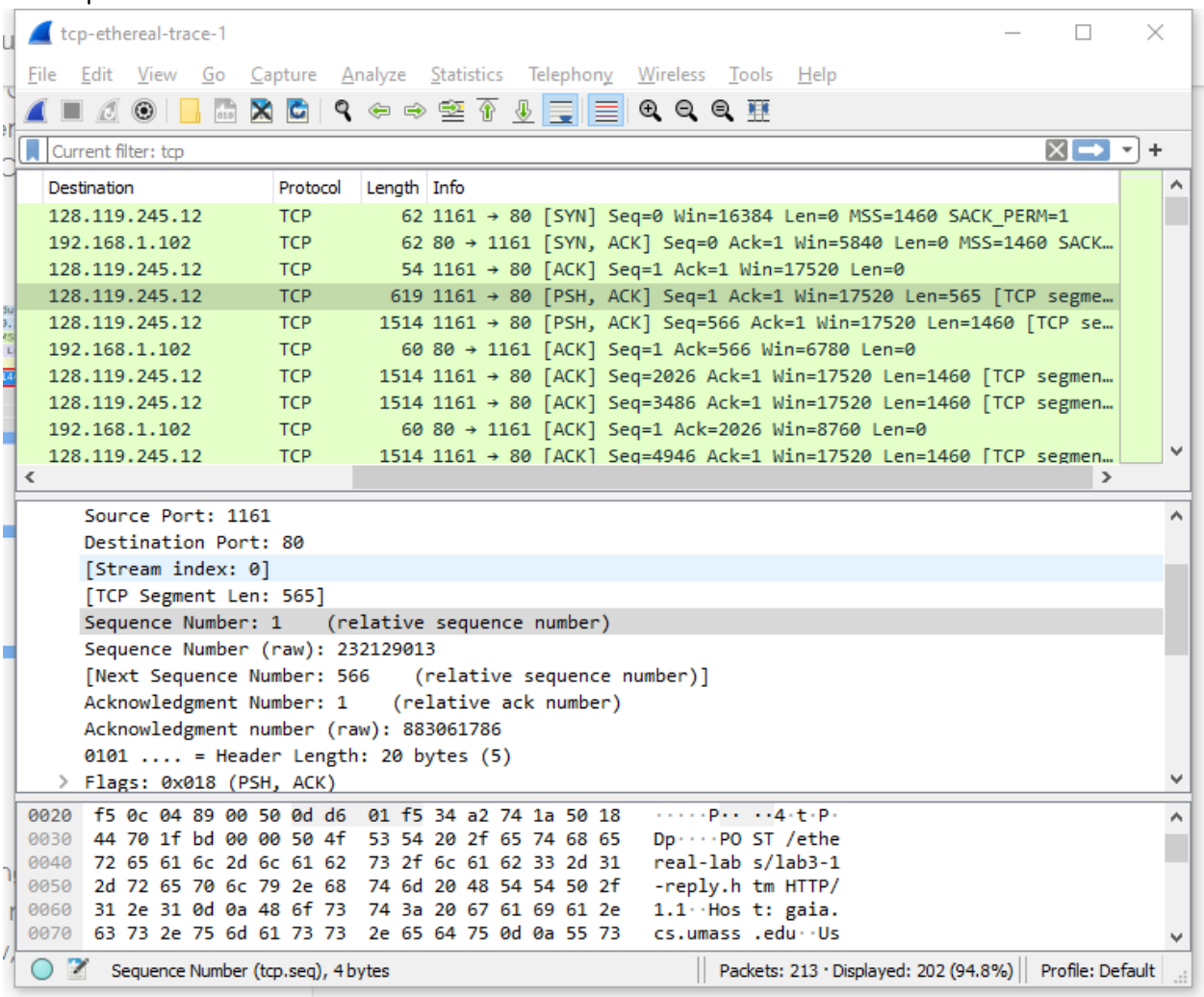
b. The sequence number is 0.
The value of the ACK in the SYNACK segment is 1. Gaia server determines this value by adding 1 to the SYN segment's sequence number, which is 0. SYNACK is determined by ACK and SYN flags. Both are set to 1.


tcp-ethereal-trace-1
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
tcp
Destination Protocol Length Info
128.119.245.12 TCP 62 1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1
192.168.1.102 TCP 62 80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK…
128.119.245.12 TCP 54 1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
128.119.245.12 TCP 619 1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565 [TCP segme…
128.119.245.12 TCP 1514 1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP se…
192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
128.119.245.12 TCP 1514 1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460 [TCP segmen…
128.119.245.12 TCP 1514 1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460 [TCP segmen…
192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
128.119.245.12 TCP 1514 1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460 [TCP segmen…
Flags: 0x012 (SYN, ACK)
000. .... = Reserved: Not set
...0 .... = Nonce: Not set
.... 0... .... = Congestion Window Reduced (CWR): Not set
.... .0.. .... = ECN-Echo: Not set
.... ..0. .... = Urgent: Not set
....1 .... = Acknowledgment: Set
.... 0... = Push: Not set
.... .0.. = Reset: Not set
....1. = Syn: Set
....0 = Fin: Not set
0000 00 20 e0 8a 70 1a 00 06 25 da af 73 08 00 45 00
0010 00 30 00 00 40 00 37 06 0c 36 80 77 f5 0c c0 a8
0020 01 66 00 50 04 89 34 a2 74 19 0d d6 01 f5 70 12
0030 16 d0 77 4d 00 00 02 04 05 b4 01 01 04 02
Acknowledgment (tcp.flags.ack), 1 byte
Packets: 213 · Displayed: 202 (94.8%)
Profile: Default



7. Consider the TCP segment containing the HTTP POST as the first segment in the

c. The sequence number is 1.



d. From the first to the sixth segment, the sequence numbers are: 1→566→2026→3486 →4946→6406.

# Segment	Sent Time	Received Time	RTT
1	0.026477	0.053937	0.02746
2	0.041737	0.077294	0.035557
3	0.054026	0.124085	0.070059
4	0.054690	0.169118	0.114428
5	0.077405	0.217299	0.139894
6	0.078157	0.267802	0.189645

EstimatedRTT = 0.875*EstimatedRTT+0.125*SampleRTT

Estimated RTT for 1st segment: 0.02746

Estimated RTT for 2nd segment: 0.875*0.02746+0.125*0.035557 = 0.02847

Estimated RTT for 3rd segment: 0.875*0.02847+0.125*0.070059=0.0327775

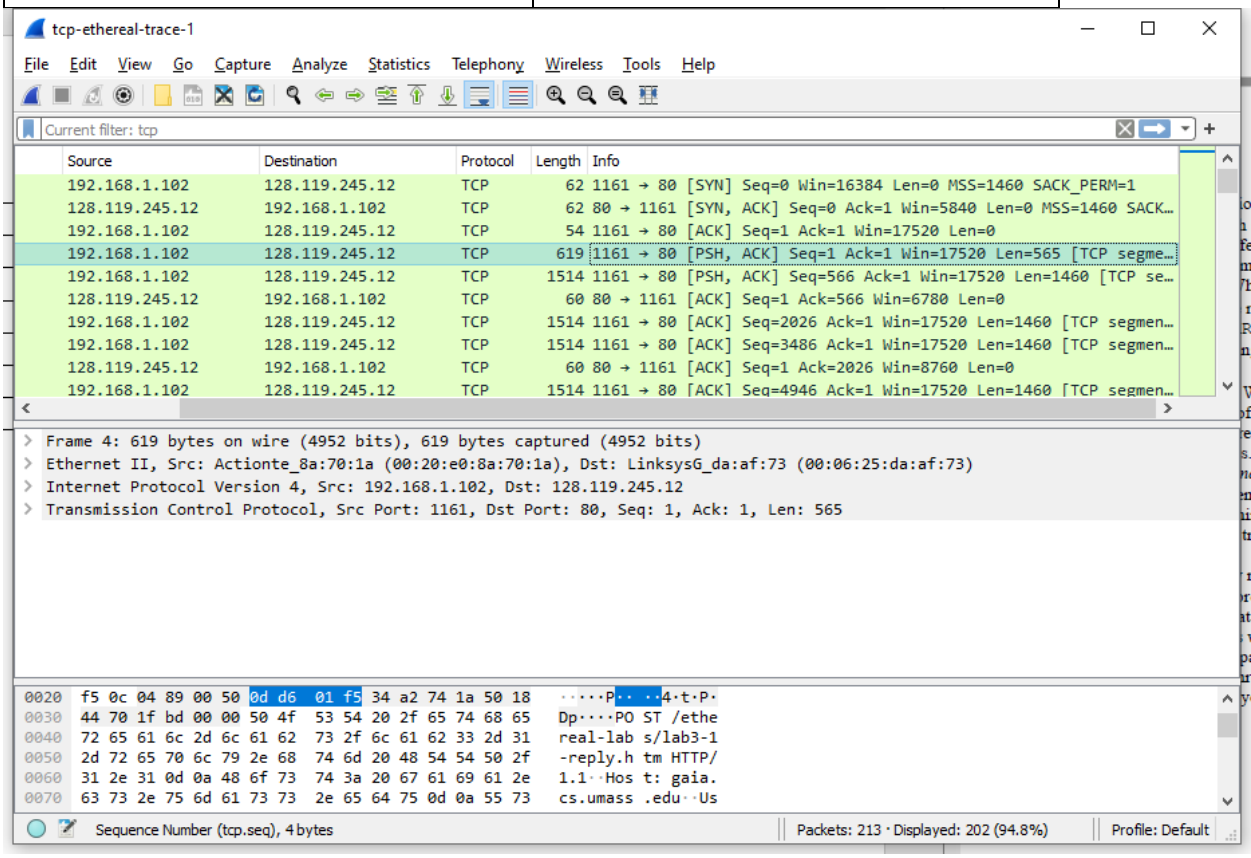
Estimated RTT for 4th segment: 0.875*0.0327775+0.125*0.114428 = 0.0429838125

Estimated RTT for 5th segment: 0.875*0.0429838125+0.125*0.139894 = 0.05509

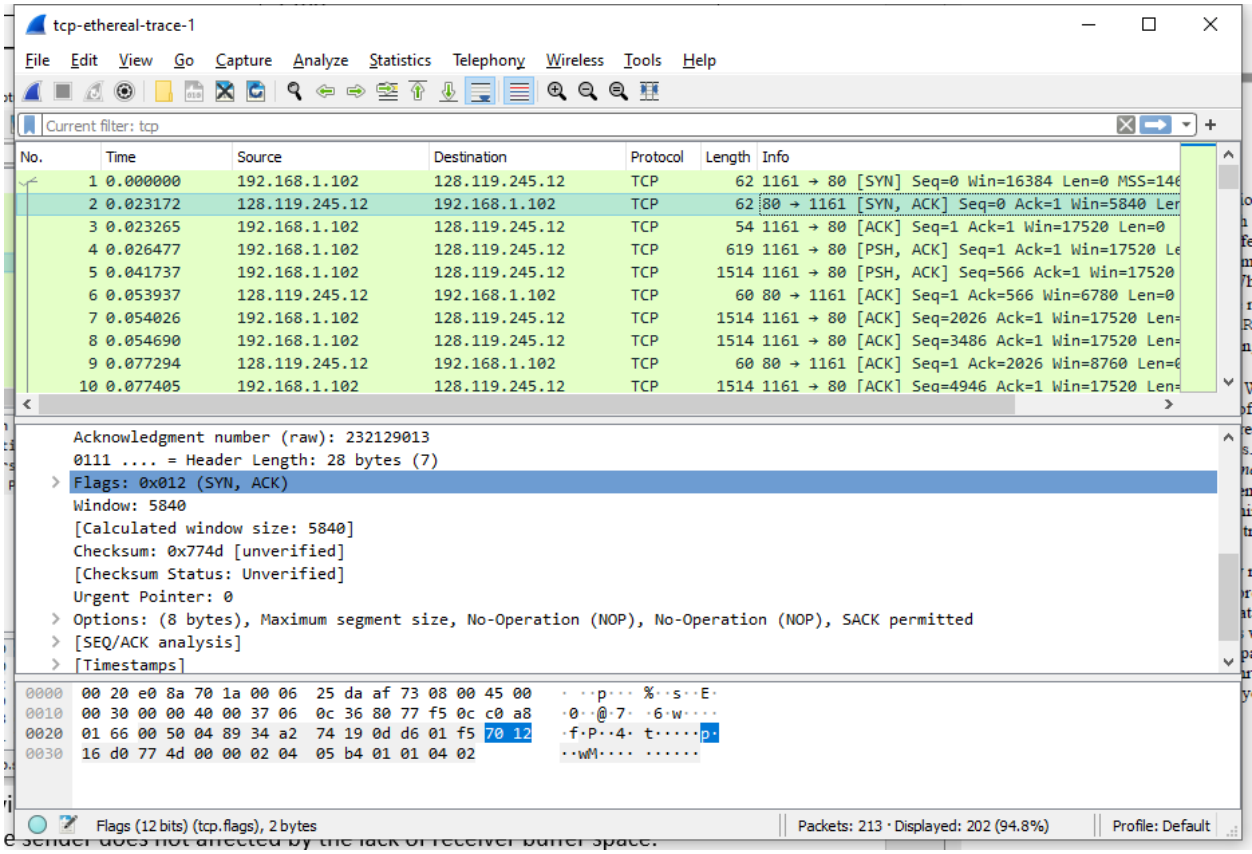
Estimated RTT for 6th segment: 0.875*0.05509 + 0.125*0.189645 = 0.071916

e. Length:

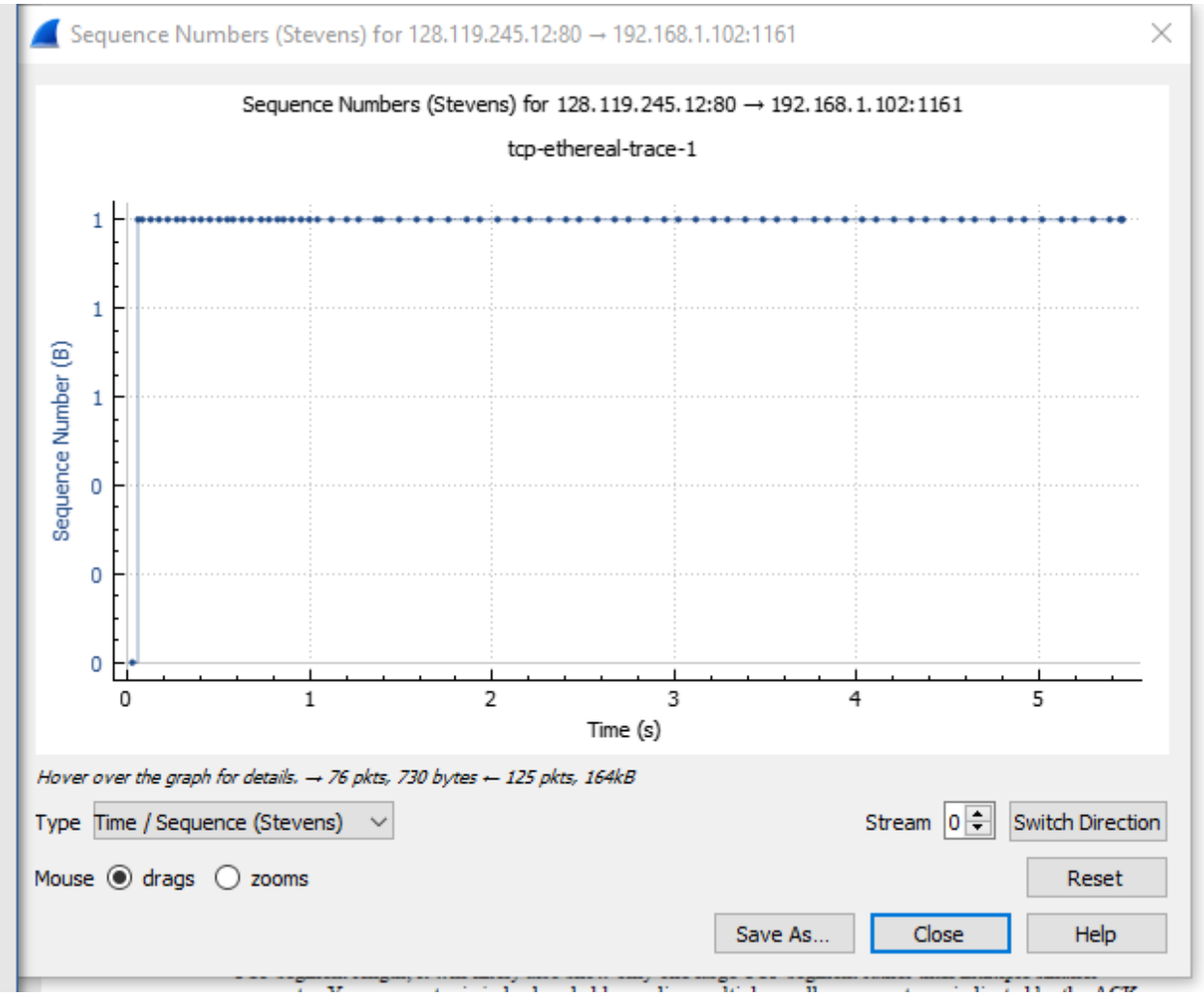
# Segment	Length (byte)
1	565
2	1460
3	1460
4	1460
5	1460
6	1460



f. Min buffer space (window size) is 5840 bytes. Since the window size increase to 62780 bytes eventually, the sender does not affected by the lack of receiver buffer space.



g. No, based on the sequence numbers graph, the transmission is stable and show no change, which means there is no retransmission.

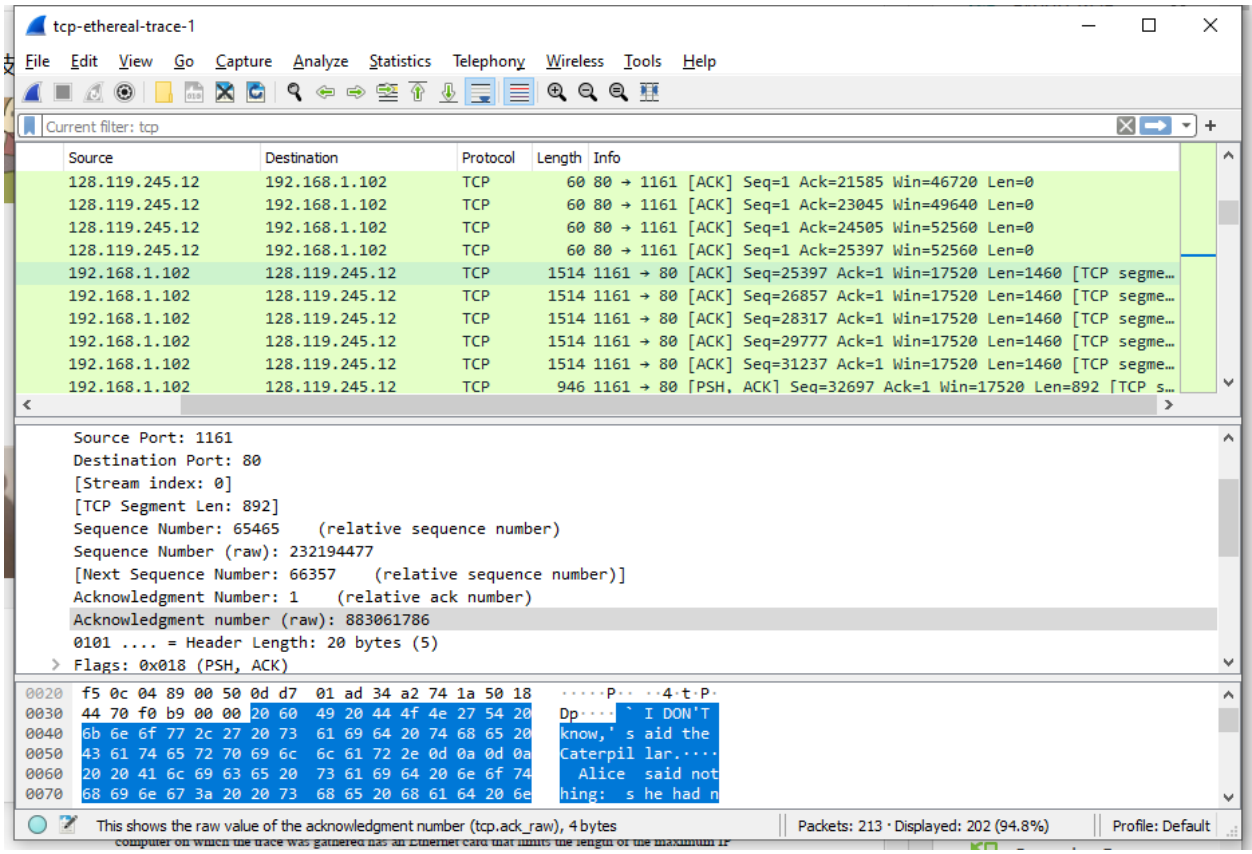


h. We can calculate data size in an ACK by compare difference between this ACK seq number and next ACK sequence number.

# ACK	Cur sequence number	Data size
1	566	566
2	2026	1460
3	3486	1460
4	4946	1460
5	6406	1460

…

We can identify cases where the receiver is ACKing every other received segment based on data size. If the data size is different from others except the first one, then the receiver is ACKing every other received segment.



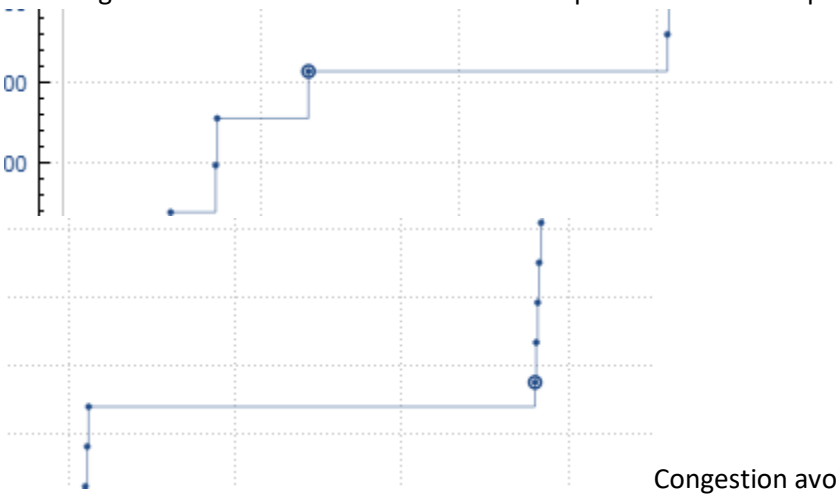
i. The throughput of TCP is the amount of data being sent/received in a unit of time. To calculate the throughput, the total amount of data and the total time for the transmission need to be known. In this case, the total amount of data is determined by the difference between the final sequence number and the first sequence number, which is 164091-1 = 164090 bytes. The amount of time is determined by the difference between the first segment time and the final segment time, which is 5.461175-0.026477 = 5.434698s. The total throughput is 164090 bytes/5.434698s = 30193bytes/second

4.

a. The slowstart phases starts as beginning and ends where the second phases of segments transmission start. Starts at 0.0 sec and ends by 0.1242 secs.

Slow start phases

The congestion avoidance takes over slow start phase as slow start phase ends:



Congestion avoidance phase.

Ideally TCP has the transmit as fast as possible as long as there is no congestion, and the window size after congestion is the half of the one before. But in this case, it's much less than the half of the threshold.

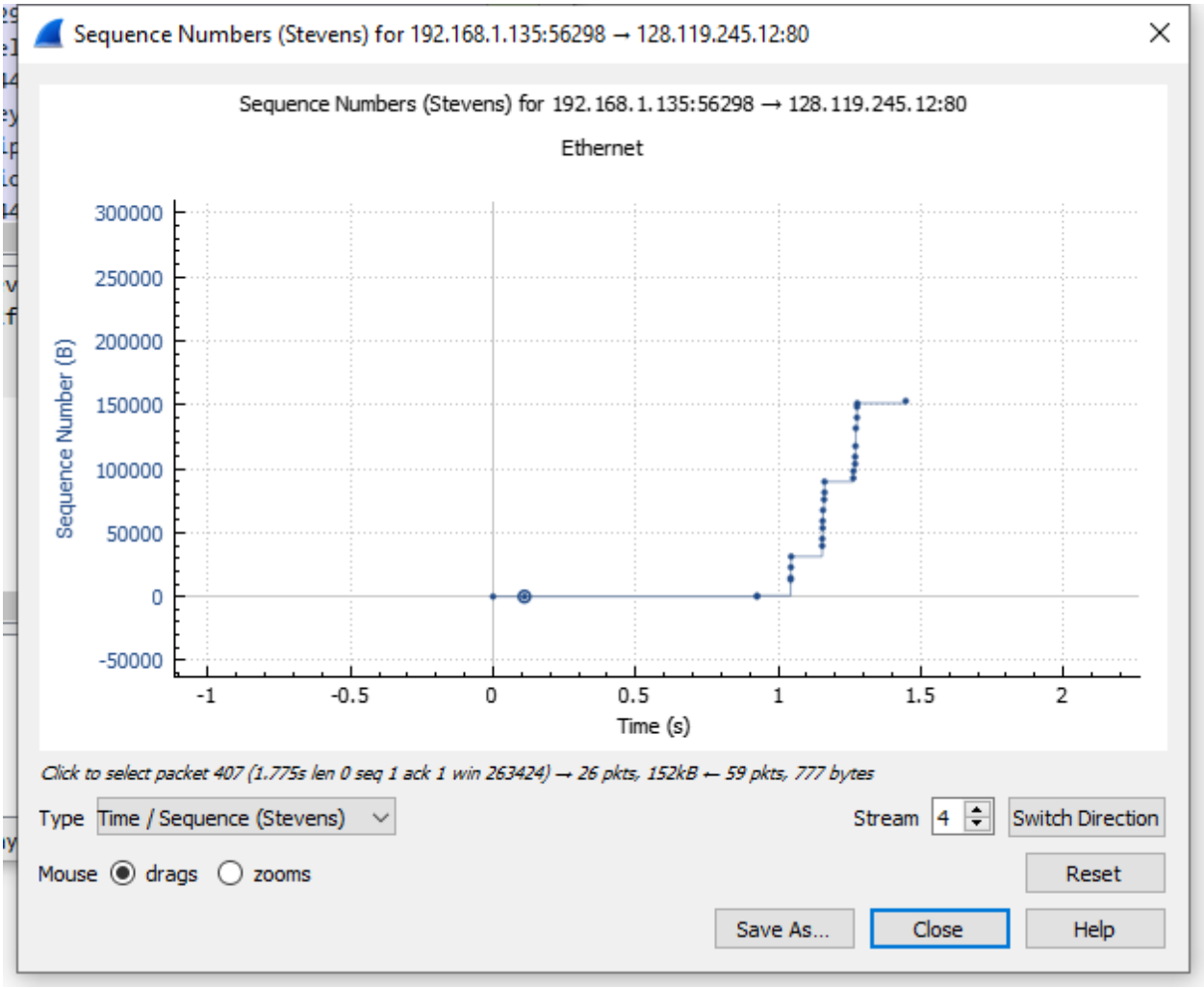
128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=25397 Win=52560 Len=0
192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=25397 Ack=1 Win=17520 Len=1460 [TCP segme…
192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=26857 Ack=1 Win=17520 Len=1460 [TCP segme…
192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=28317 Ack=1 Win=17520 Len=1460 [TCP segme…
192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=29777 Ack=1 Win=17520 Len=1460 [TCP segme…
192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=31237 Ack=1 Win=17520 Len=1460 [TCP segme…
192.168.1.102	128.119.245.12	TCP	946	1161 → 80 [PSH, ACK] Seq=32697 Ack=1 Win=17520 Len=892 [TCP s…

The threshold is 52560 and the ideal window size should be 26280 but the actual one is only 17520

b. My graph:

Slow starts begins at 2.7s and ends at around 2.71s. After that the congestion phases start. Compare to ideal one, the window size is close to ideal case.

128.119.245.12	192.168.1.135	TCP	60	80 → 56298 [ACK] Seq=1 Ack=42465 Win=114432 Len=0
192.168.1.135	128.119.245.12	TCP	5630	56298 → 80 [ACK] Seq=92649 Ack=1 Win=263424 Len=5576 [TCP seg…
128.119.245.12	192.168.1.135	TCP	60	80 → 56298 [ACK] Seq=1 Ack=45253 Win=120064 Len=0


Sequence Numbers (Stevens) for 192.168.1.135:56298 → 128.119.245.12:80
Sequence Numbers (Stevens) for 192.168.1.135:56298 → 128.119.245.12:80
Ethernet
Sequence Number (B)
300000
250000
200000
150000
100000
50000
0
-50000
-1
-0.5
0
0.5
1
1.5
2
Time (s)
Click to select packet 407 (1.775s len 0 seq 1 ack 1 win 263424) → 26 pkts, 152kB ← 59 pkts, 777 bytes
Type
Time / Sequence (Stevens)
Stream
4
Switch Direction
Mouse
drags
zooms
Reset
Save As...
Close
Help