Tyler Cope

CS372 Lab 2

1.

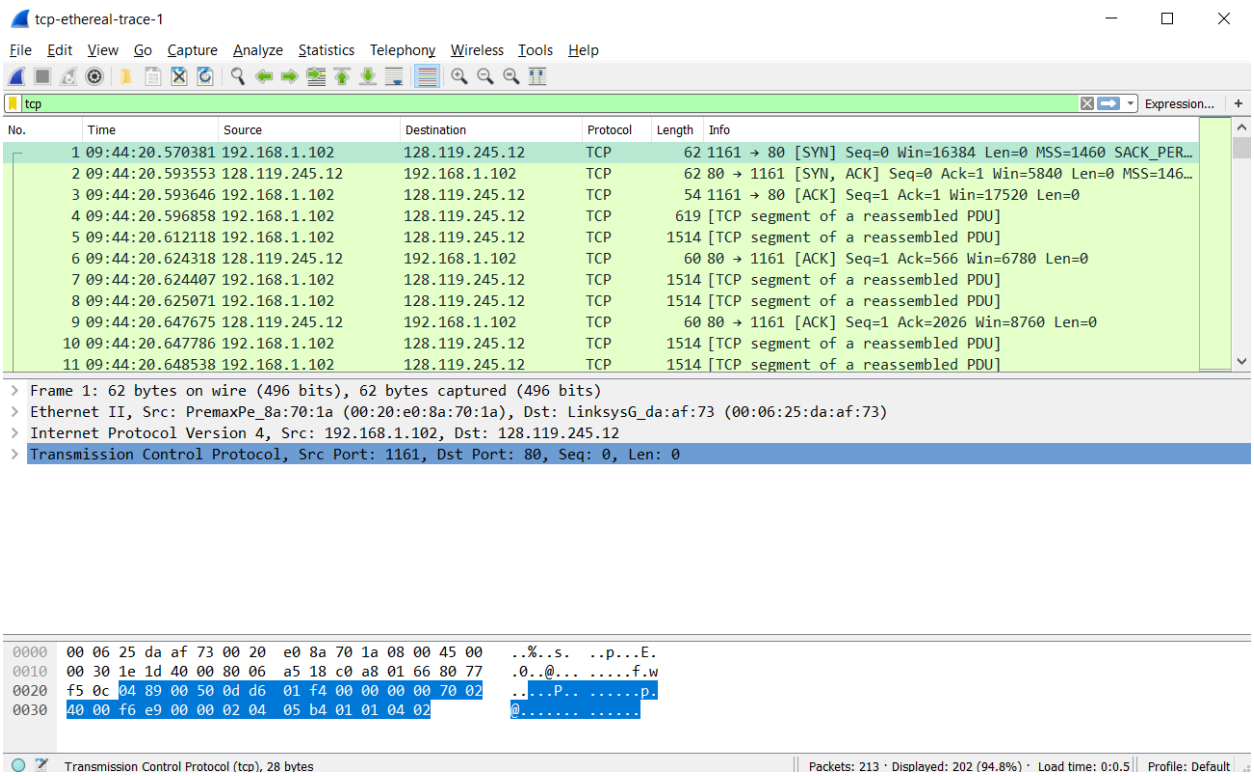
   a. IP address of client: 192.168.1.102

   b. Port number: 1161

2.

   a. IP address of gaia.cs.umass.edu: 128.199.245.12

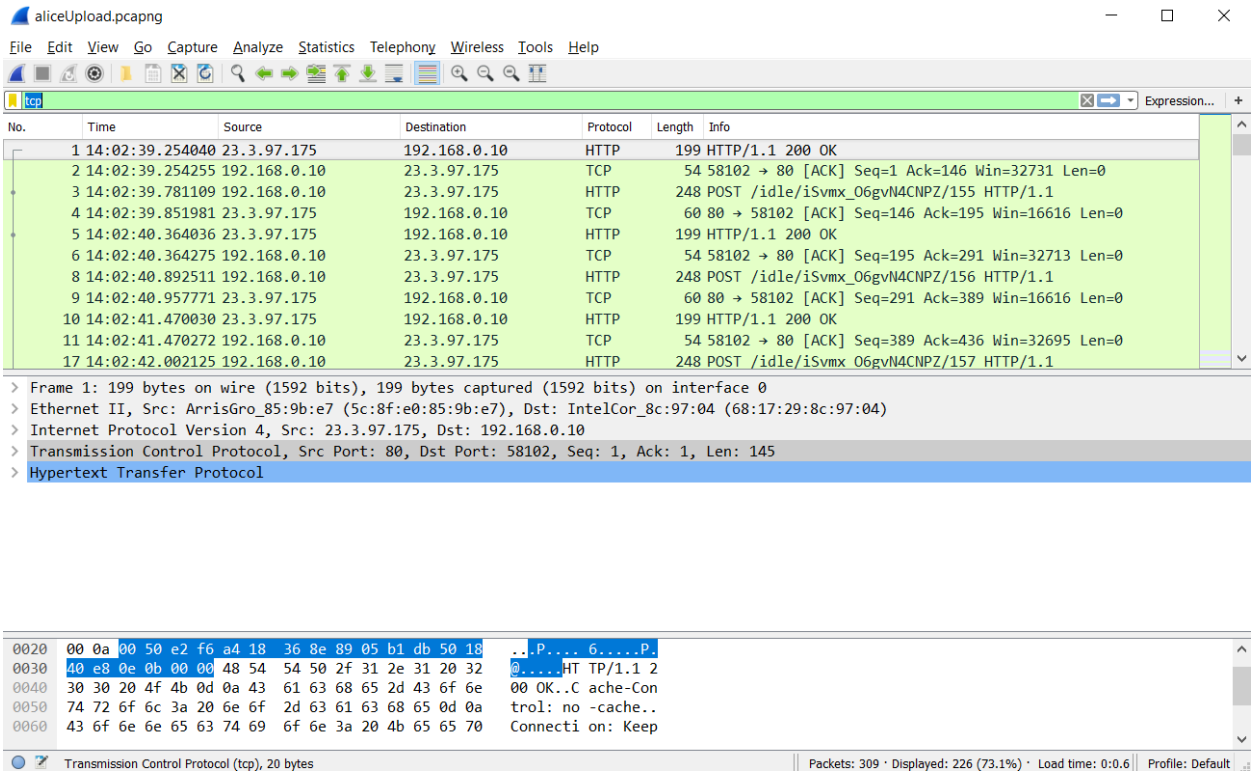
   b. Port of gaia: 80



3.

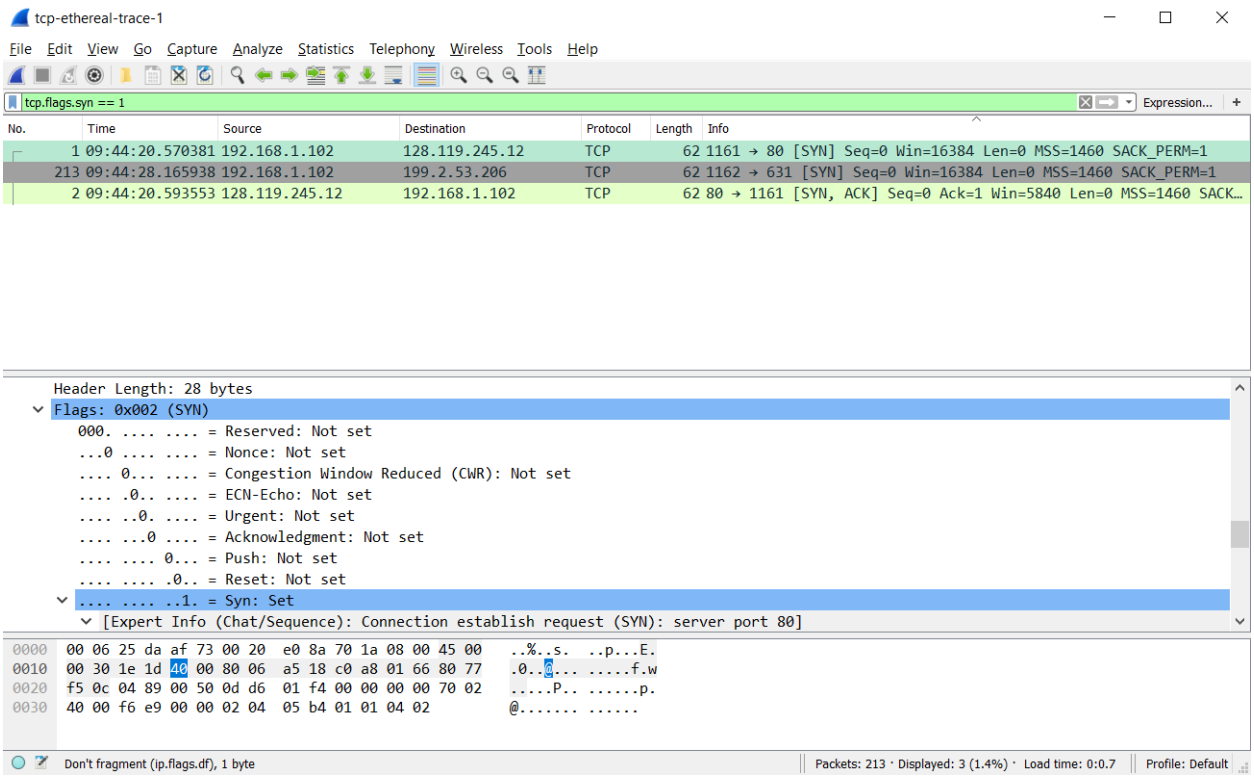
a. IP address of my computer: 23.3.97.175

b. Port of my computer: 58102



4.

The segment of the TCP SYN segment to initiate the connection is 0. I referenced this thread https://ask.wireshark.org/questions/230/displaying-all-tcp-connections-with-syn-packets and this thread https://ask.wireshark.org/questions/10640/how-to-find-syn-not-followed-by-a-synack to answer the second part of the question. I believe what identifies it as SYN segment is that the SYN flag is set to 1.

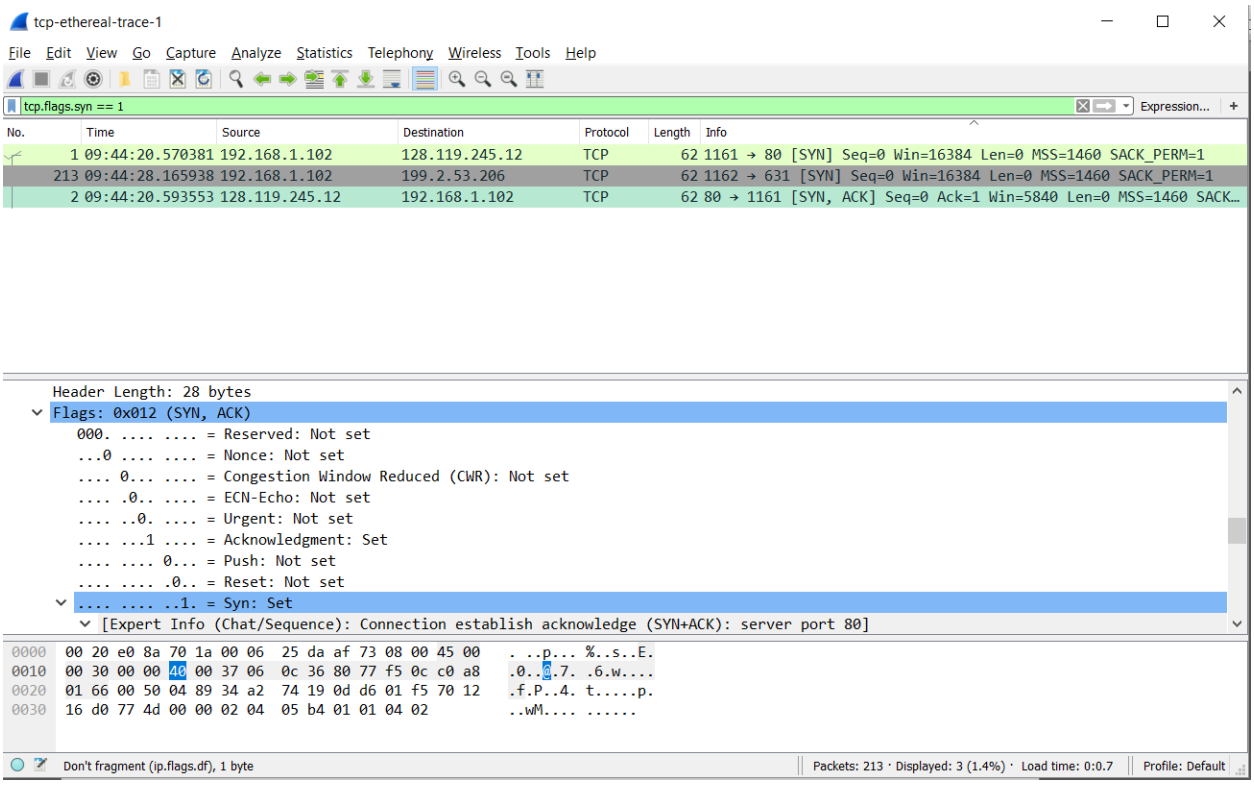


5.

a. The sequence number of the SYNACK segment sent by gaia.cs.umass.edu in reply to the SYN is 0.

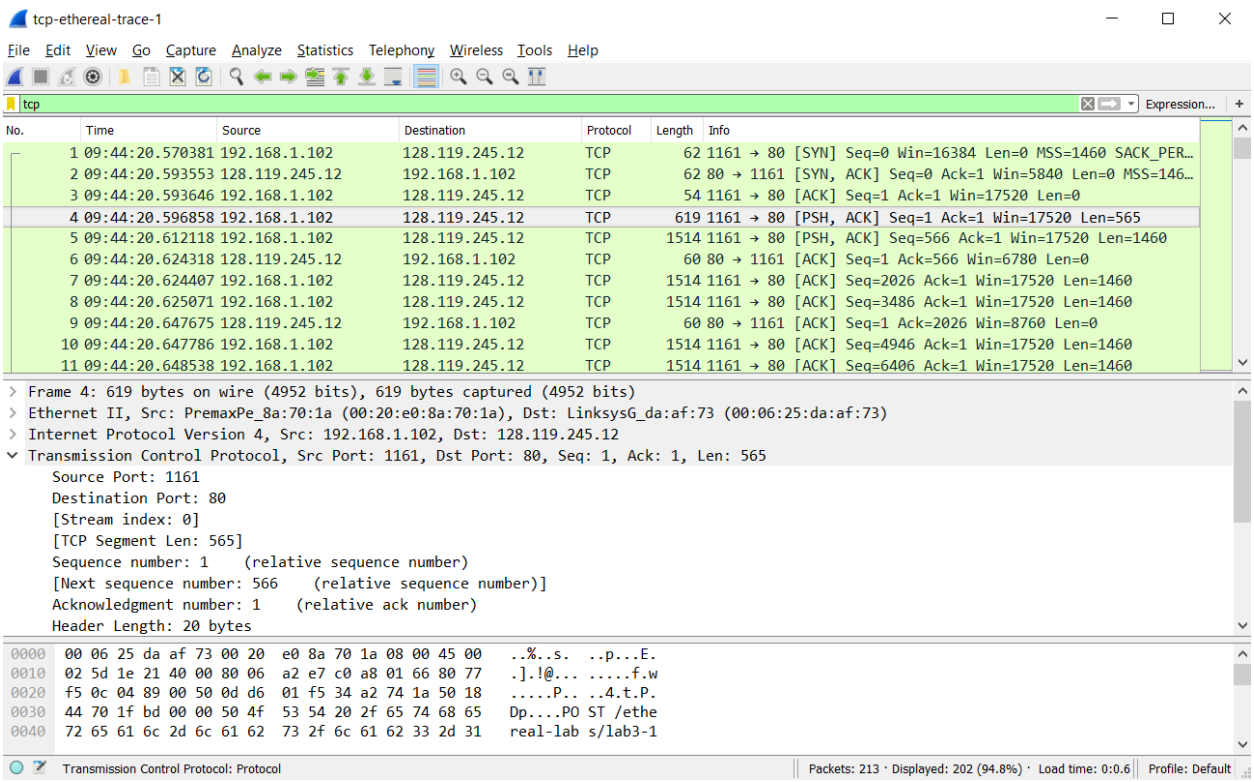
b. The value in the acknowledgment field is 1. gaia.cs.umass.edu determined that value by adding 1 to the sequence number of the SYN segment.

c. It is identified as a SYNACK segment because the Acknowledgment flag is set and the SYN flag is set.



6.

The sequence number of the TCP segment containing the HTTP POST command is 1.



7.

a. The sequence number of the first six segments are: 1, 566, 2026, 3486, 4946, and 6406.

b. All of the segment times that were sent start with 9:44:20, so I will only include the decimal. Just know that each segment is prefaced with 9:44:20 (check next screenshot to verify).

Segment 1: .596858

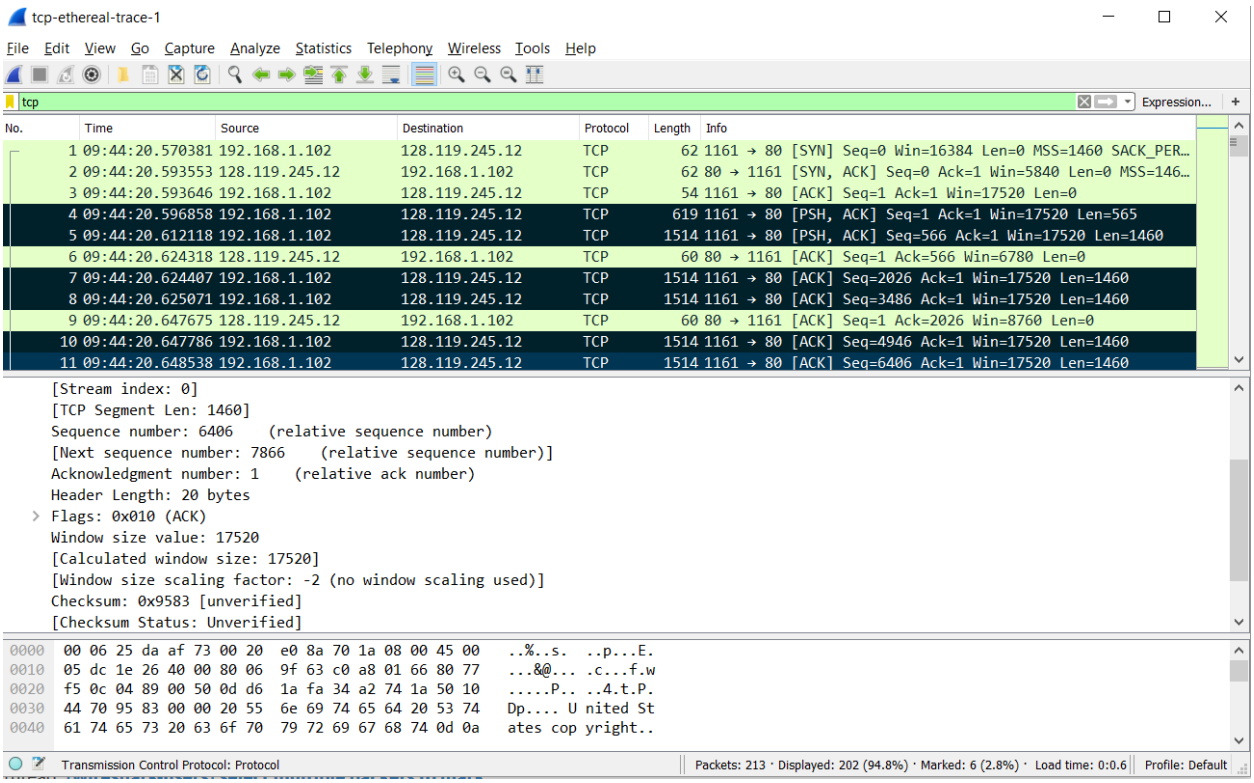
Segment 2: .612118

Segment 3: .624407

Segment 4: .625071

Segment 5: .647786

Segment 6: .648538



c. Similarly, the acknowledgments all start with 9:44:20, so again I'll only include the decimal. The acknowledgments are:

Segment 1: .624318

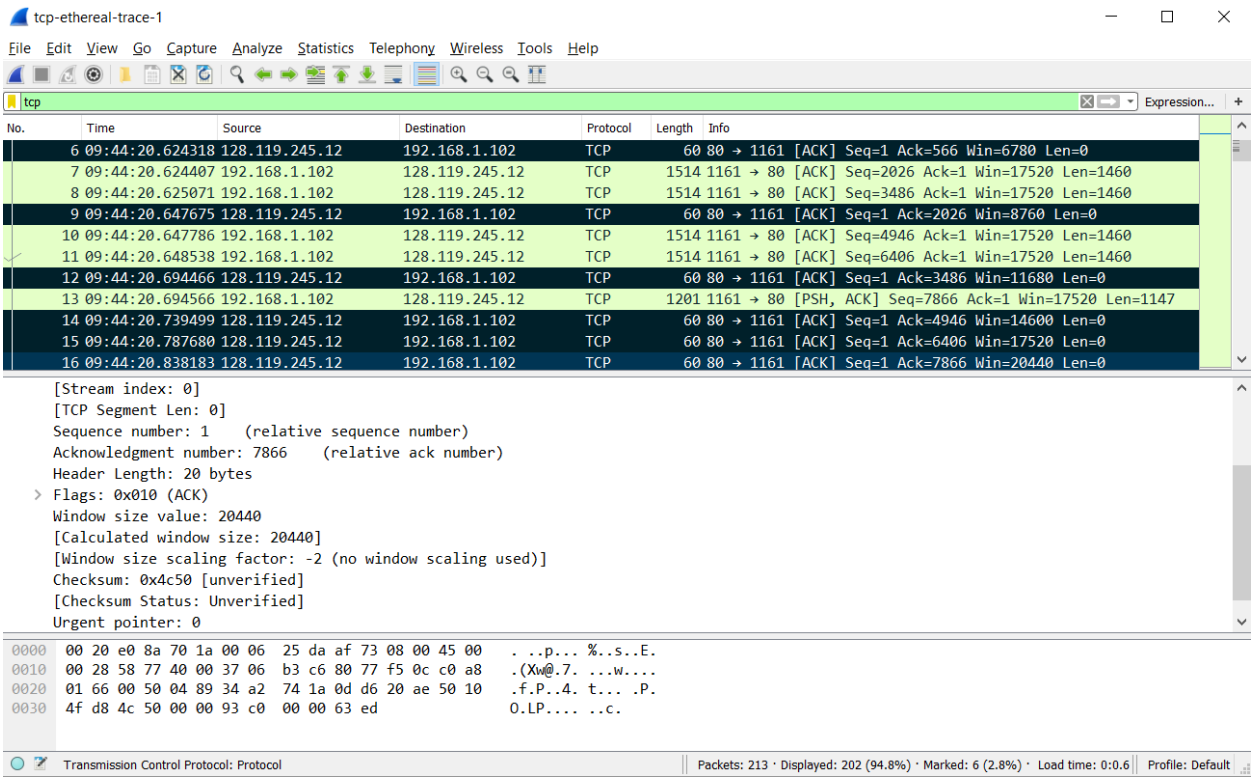
Segment 2: .647675

Segment 3: .694466

Segment 4: .739499

Segment 5: .787680

Segment 6: .838183



d. RTT value for each segment.

Segment 1: .624318 - .596858 = .02746

Segment 2: .647675 - .612118 = .035557

Segment 3: .694466 - .624407 = .070059

Segment 4: .739499 - .625071 = .114428

Segment 5: .787680 - .647786 = .139894

Segment 6: .838183 - .648538 = .189645

e. The formula for Estimated RTT is found on page 242 and is as follows:

EstimatedRTT = 0.875 * EstimatedRTT + 0.125 * SampleRTT

Segment 1: Same as measured RTT which is .02746

Segment 2: 0.875 * .02746 + 0.125 * .03557 = .02847375

Segment 3: 0.875 * .02847375 + 0.125 * .070059 = .0336719063

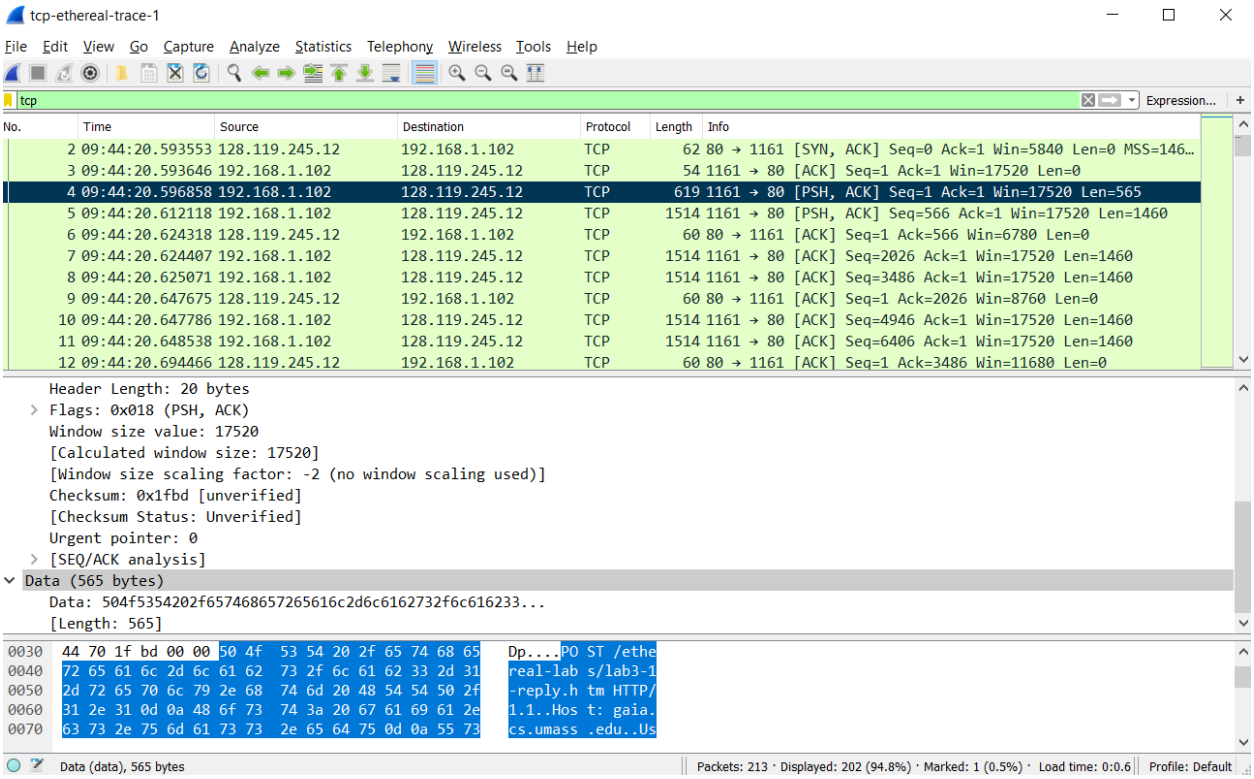
Segment 4: 0.875 * .0336719063 + 0.125 * .114428 = .043766418

Segment 5: 0.875 * .043766418 + 0.125 * .139894 = .0557823658

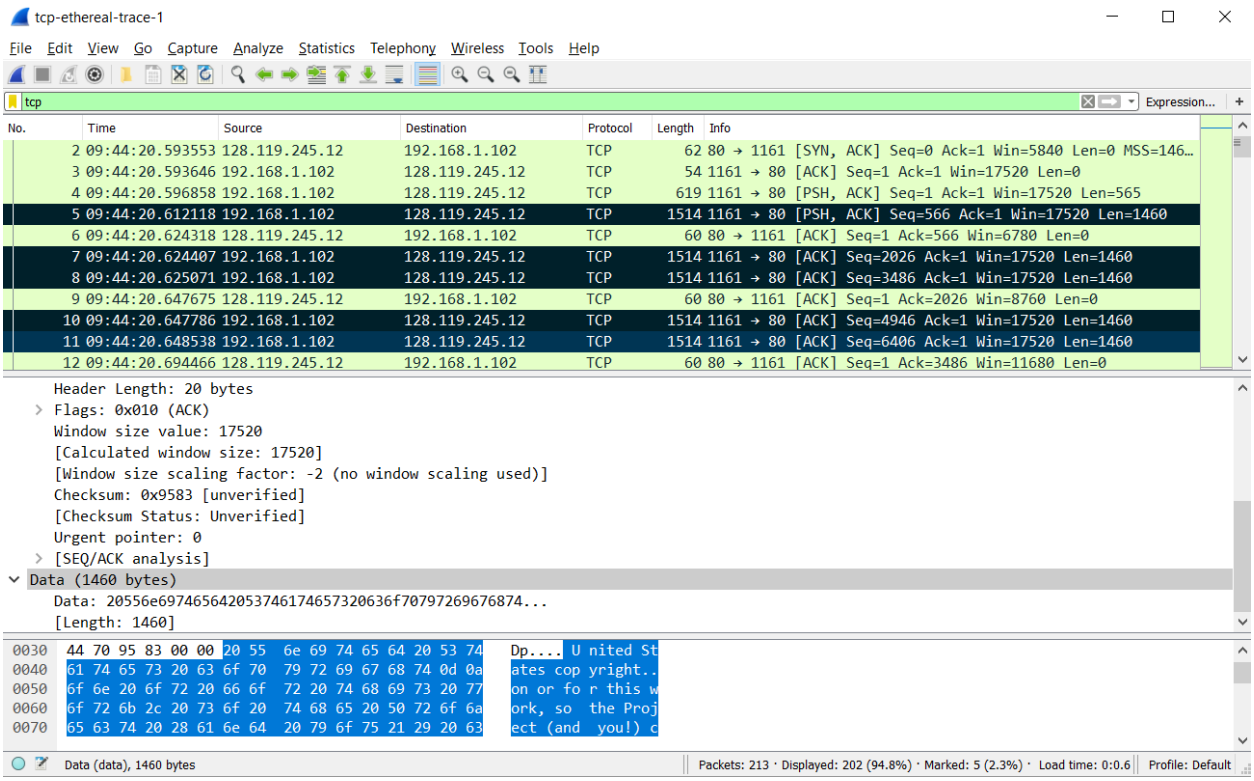
Segment 6: 0.875 * .0557823658 + 0.125 * .189645 = .0725151951

8.

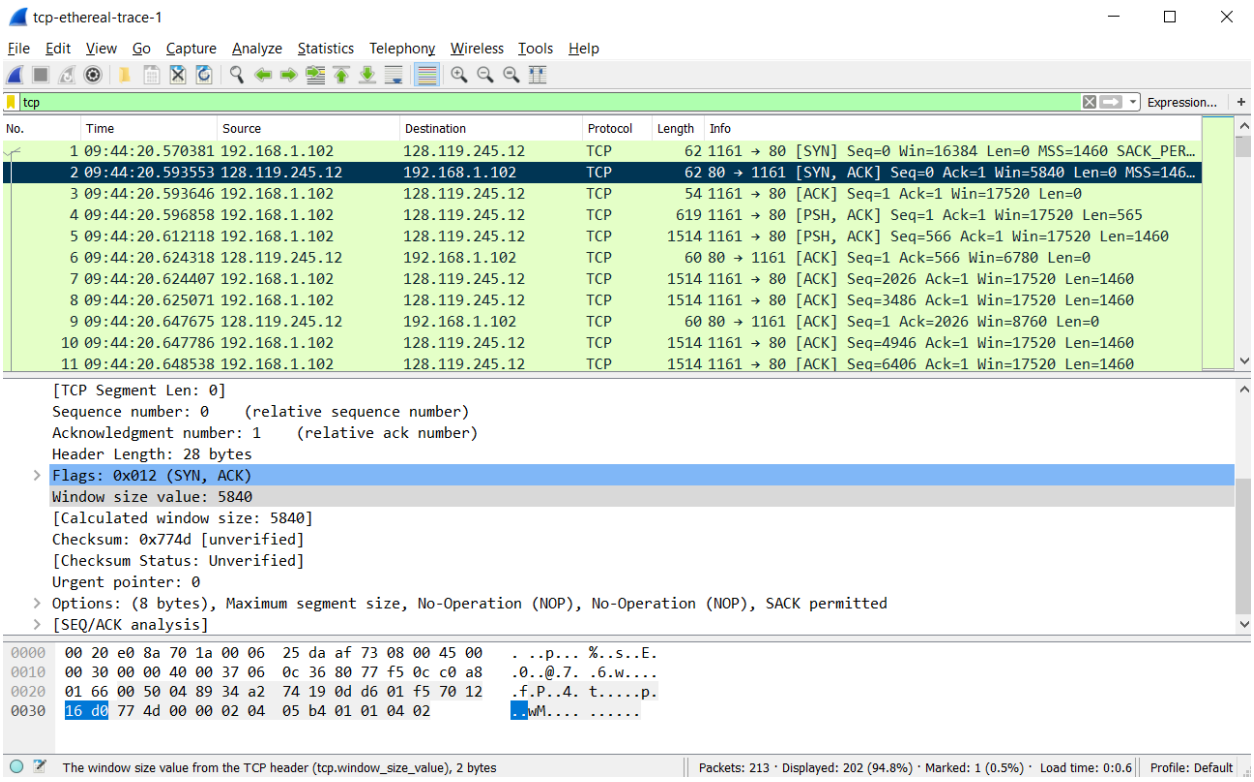
Segment 1: 565 bytes

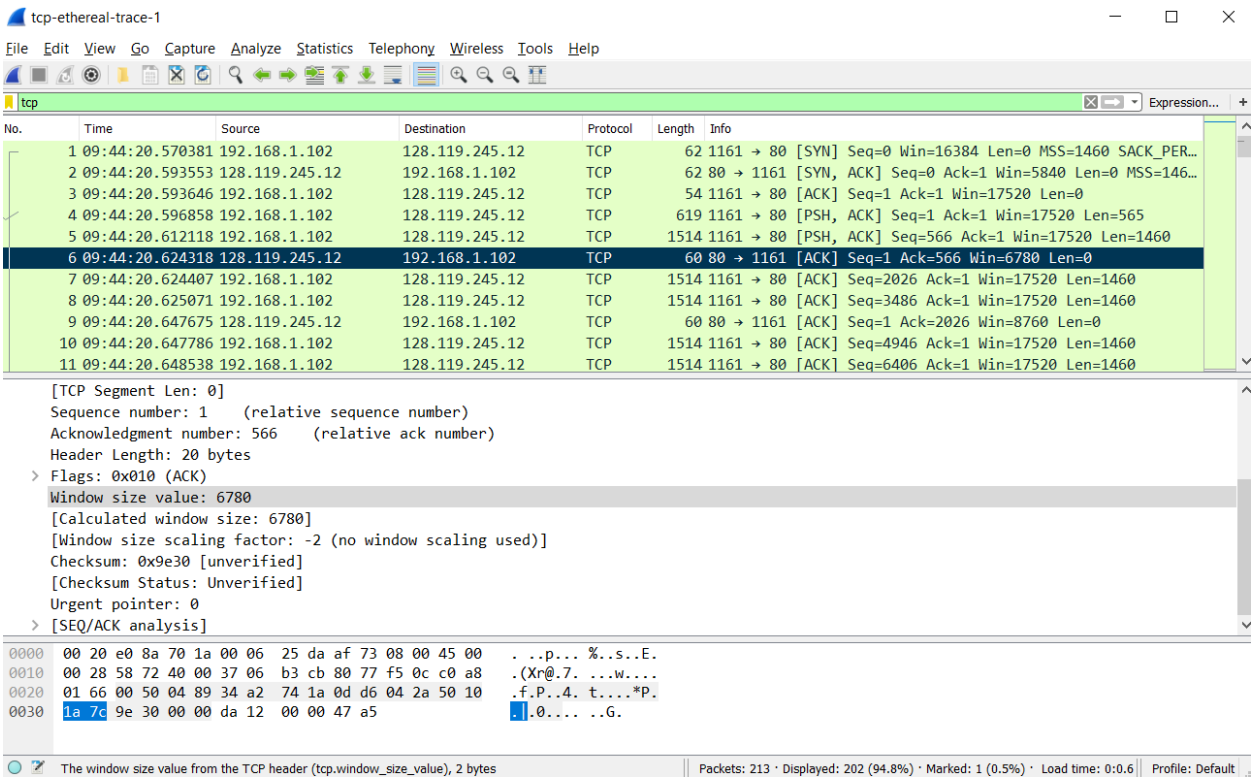


The length of the remaining segments is all 1460 bytes.



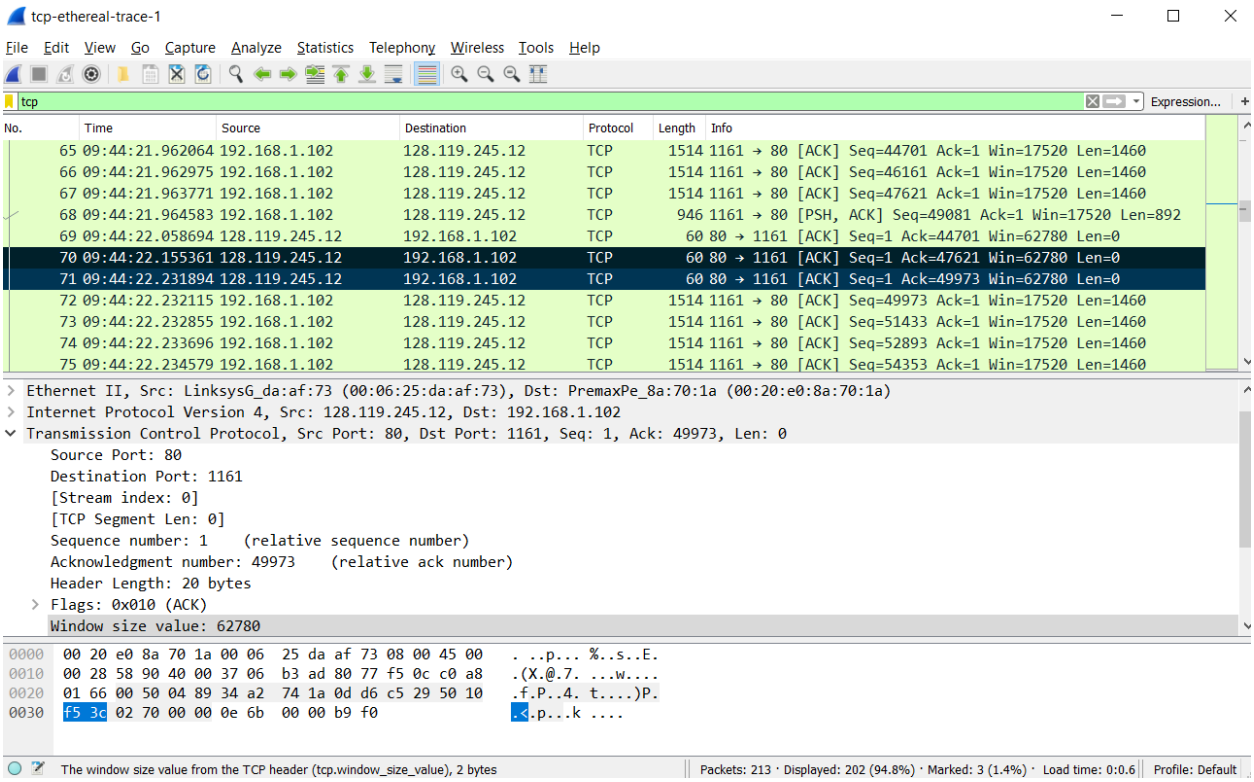
9. The minimum amount of buffer space can be seen in the first acknowledgment from the server. It is 5840 bytes. It does not seem like the lack of receiver buffer space ever throttles the sender because the window grows as needed. In the next two screenshots, see how the first ACK shows 5408 bytes but the next window shows 6780.


tcp-ethereal-trace-1
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
tcp
Expression...
No. Time Source Destination Protocol Length Info
1 09:44:20.570381 192.168.1.102 128.119.245.12 TCP 62 1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PER...
2 09:44:20.593553 128.119.245.12 192.168.1.102 TCP 62 80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=146...
3 09:44:20.593646 192.168.1.102 128.119.245.12 TCP 54 1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4 09:44:20.596858 192.168.1.102 128.119.245.12 TCP 619 1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565
5 09:44:20.612118 192.168.1.102 128.119.245.12 TCP 1514 1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460
6 09:44:20.624318 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7 09:44:20.624407 192.168.1.102 128.119.245.12 TCP 1514 1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460
8 09:44:20.625071 192.168.1.102 128.119.245.12 TCP 1514 1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460
9 09:44:20.647675 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10 09:44:20.647786 192.168.1.102 128.119.245.12 TCP 1514 1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460
11 09:44:20.648538 192.168.1.102 128.119.245.12 TCP 1514 1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460
[TCP Segment Len: 0]
Sequence number: 0 (relative sequence number)
Acknowledgment number: 1 (relative ack number)
Header Length: 28 bytes
Flags: 0x012 (SYN, ACK)
Window size value: 5840
[Calculated window size: 5840]
Checksum: 0x774d [unverified]
[Checksum Status: Unverified]
Urgent pointer: 0
Options: (8 bytes), Maximum segment size, No-Operation (NOP), No-Operation (NOP), SACK permitted
[SEQ/ACK analysis]
0000 00 20 e0 8a 70 1a 00 06 25 da af 73 08 00 45 00 . ..p... %..s..E.
0010 00 30 00 00 40 00 37 06 0c 36 80 77 f5 0c c0 a8 .0..@.7. .6.w....
0020 01 66 00 50 04 89 34 a2 74 19 0d d6 01 f5 70 12 .f.P..4. t.....p.
0030 16 d0 77 4d 00 00 02 04 05 b4 01 01 04 02 ..wM.... ......
The window size value from the TCP header (tcp.window_size_value), 2 bytes
Packets: 213 · Displayed: 202 (94.8%) · Marked: 1 (0.5%) · Load time: 0:0.6
Profile: Default

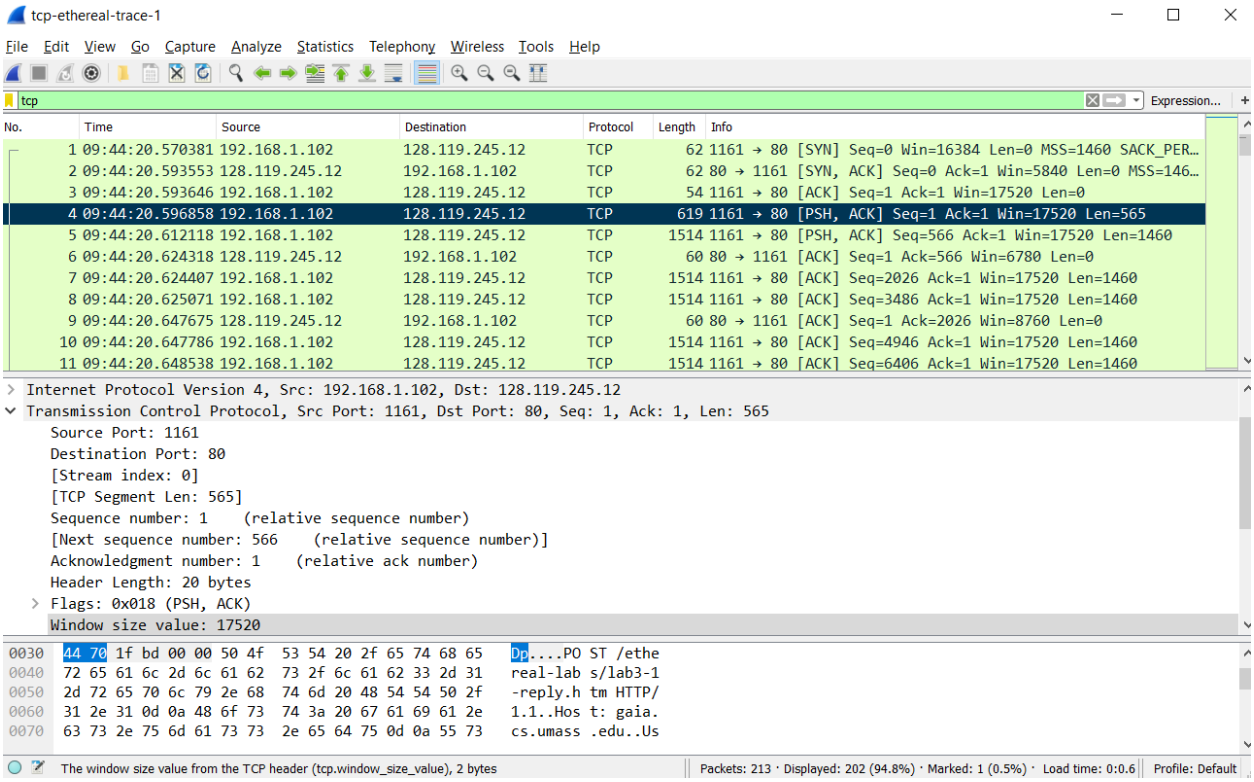

tcp-ethereal-trace-1
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
tcp
Expression...
No. Time Source Destination Protocol Length Info
1 09:44:20.570381 192.168.1.102 128.119.245.12 TCP 62 1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PER...
2 09:44:20.593553 128.119.245.12 192.168.1.102 TCP 62 80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=146...
3 09:44:20.593646 192.168.1.102 128.119.245.12 TCP 54 1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4 09:44:20.596858 192.168.1.102 128.119.245.12 TCP 619 1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565
5 09:44:20.612118 192.168.1.102 128.119.245.12 TCP 1514 1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460
6 09:44:20.624318 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7 09:44:20.624407 192.168.1.102 128.119.245.12 TCP 1514 1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460
8 09:44:20.625071 192.168.1.102 128.119.245.12 TCP 1514 1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460
9 09:44:20.647675 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10 09:44:20.647786 192.168.1.102 128.119.245.12 TCP 1514 1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460
11 09:44:20.648538 192.168.1.102 128.119.245.12 TCP 1514 1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460
[TCP Segment Len: 0]
Sequence number: 1 (relative sequence number)
Acknowledgment number: 566 (relative ack number)
Header Length: 20 bytes
Flags: 0x010 (ACK)
Window size value: 6780
[Calculated window size: 6780]
[Window size scaling factor: -2 (no window scaling used)]
Checksum: 0x9e30 [unverified]
[Checksum Status: Unverified]
Urgent pointer: 0
[SEQ/ACK analysis]
0000 00 20 e0 8a 70 1a 00 06 25 da af 73 08 00 45 00 . ..p... %..s..E.
0010 00 28 58 72 40 00 37 06 b3 cb 80 77 f5 0c c0 a8 .(Xr@.7. ...w....
0020 01 66 00 50 04 89 34 a2 74 1a 0d d6 04 2a 50 10 .f.P..4. t....*P.
0030 1a 7c 9e 30 00 00 da 12 00 00 47 a5 .|.0.... ..G.
The window size value from the TCP header (tcp.window_size_value), 2 bytes
Packets: 213 · Displayed: 202 (94.8%) · Marked: 1 (0.5%) · Load time: 0:0.6
Profile: Default

10. There are no retransmitted segments in the trace. In order to verify this, I looked at the sequence numbers of all the TCP segments. Whenever it got to a new segment, the acknowledgment number always increased, never decreasing.

11. Typically, the receiver is acknowledging 1460 bytes. There are a few times where the receiver is acknowledging every other received segment. I have a screenshot of an example.



12. To get the throughput, we need to calculate the total amount of data transferred divided by the total transmission time. To get the total amount of data that was transferred we just need to go to the first sent packet, get the number of bytes sent, and subtract that from the final value of the last acknowledged segment. At the fourth segment we can see the first data being sent, with acknowledgment number 1. At the last segment for acknowledgment of sent data, segment 202, we can see the number is 164091. So 164091 – 1 = 164090 (the total amount of data that was sent).


tcp-ethereal-trace-1
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
tcp
Expression...
No. Time Source Destination Protocol Length Info
1 09:44:20.570381 192.168.1.102 128.119.245.12 TCP 62 1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PER…
2 09:44:20.593553 128.119.245.12 192.168.1.102 TCP 62 80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=146…
3 09:44:20.593646 192.168.1.102 128.119.245.12 TCP 54 1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4 09:44:20.596858 192.168.1.102 128.119.245.12 TCP 619 1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565
5 09:44:20.612118 192.168.1.102 128.119.245.12 TCP 1514 1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460
6 09:44:20.624318 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
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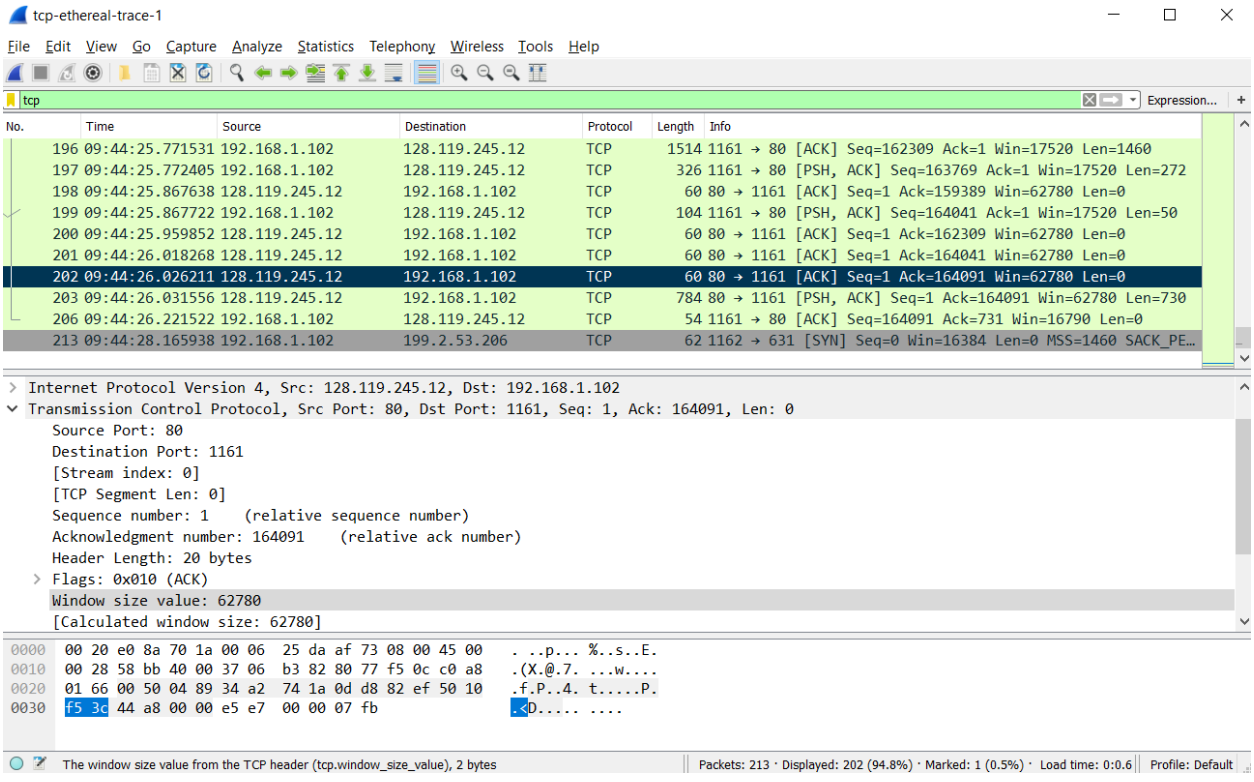
11 09:44:20.648538 192.168.1.102 128.119.245.12 TCP 1514 1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460
Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 1, Ack: 1, Len: 565
Source Port: 1161
Destination Port: 80
[Stream index: 0]
[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
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
The window size value from the TCP header (tcp.window_size_value), 2 bytes
Packets: 213 · Displayed: 202 (94.8%) · Marked: 1 (0.5%) · Load time: 0:0.6
Profile: Default

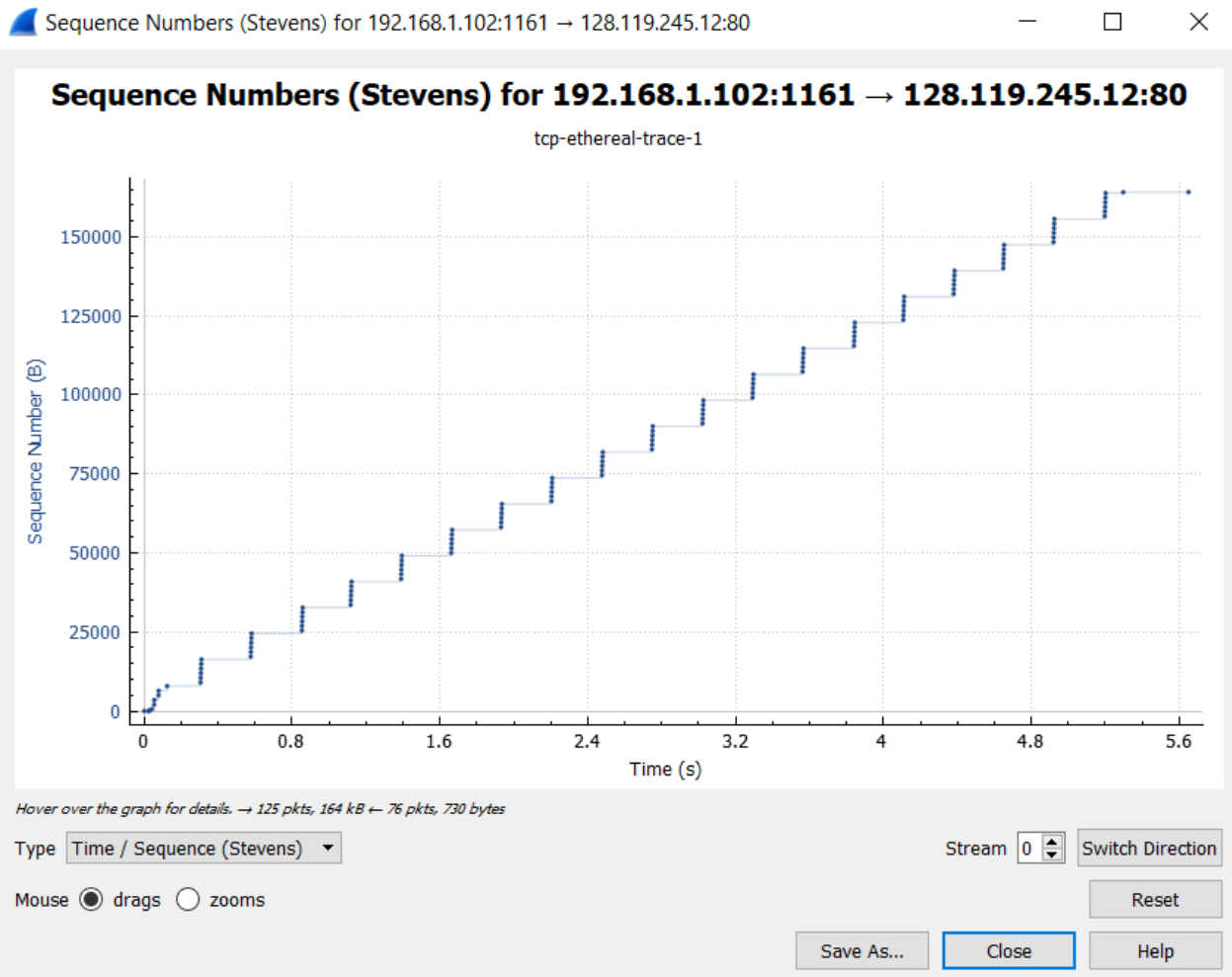

tcp-ethereal-trace-1
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
tcp
Expression...
No. Time Source Destination Protocol Length Info
196 09:44:25.771531 192.168.1.102 128.119.245.12 TCP 1514 1161 → 80 [ACK] Seq=162309 Ack=1 Win=17520 Len=1460
197 09:44:25.772405 192.168.1.102 128.119.245.12 TCP 326 1161 → 80 [PSH, ACK] Seq=163769 Ack=1 Win=17520 Len=272
198 09:44:25.867638 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1 Ack=159389 Win=62780 Len=0
199 09:44:25.867722 192.168.1.102 128.119.245.12 TCP 104 1161 → 80 [PSH, ACK] Seq=164041 Ack=1 Win=17520 Len=50
200 09:44:25.959852 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1 Ack=162309 Win=62780 Len=0
201 09:44:26.018268 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1 Ack=164041 Win=62780 Len=0
202 09:44:26.026211 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1 Ack=164091 Win=62780 Len=0
203 09:44:26.031556 128.119.245.12 192.168.1.102 TCP 784 80 → 1161 [PSH, ACK] Seq=1 Ack=164091 Win=62780 Len=730
206 09:44:26.221522 192.168.1.102 128.119.245.12 TCP 54 1161 → 80 [ACK] Seq=164091 Ack=731 Win=16790 Len=0
213 09:44:28.165938 192.168.1.102 199.2.53.206 TCP 62 1162 → 631 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PE…
Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102
Transmission Control Protocol, Src Port: 80, Dst Port: 1161, Seq: 1, Ack: 164091, Len: 0
Source Port: 80
Destination Port: 1161
[Stream index: 0]
[TCP Segment Len: 0]
Sequence number: 1 (relative sequence number)
Acknowledgment number: 164091 (relative ack number)
Header Length: 20 bytes
Flags: 0x010 (ACK)
Window size value: 62780
[Calculated window size: 62780]
0000 00 20 e0 8a 70 1a 00 06 25 da af 73 08 00 45 00 . ..p... %..s..E.
0010 00 28 58 bb 40 00 37 06 b3 82 80 77 f5 0c c0 a8 .(X.@.7. ...w....
0020 01 66 00 50 04 89 34 a2 74 1a 0d d8 82 ef 50 10 .f.P..4. t.....P.
0030 f5 3c 44 a8 00 00 e5 e7 00 00 07 fb .<D..... ....
The window size value from the TCP header (tcp.window_size_value), 2 bytes
Packets: 213 · Displayed: 202 (94.8%) · Marked: 1 (0.5%) · Load time: 0:0.6
Profile: Default

Next, we need to calculate the total connection time. So, we start at the initial connection and get the time, then subtract that from the ending time (these times are verifiable in the screenshot above). 26.026211 – 20.596858 = 5.429353 seconds. Finally, just divide to get the throughput: 164090/5.429353 = 30,222.75398192 bytest/second.

13.

a. It looks like the slowstart phase begins at the initial TCP connection. After that however, the receiving is fairly smooth and the data coming in is never more than about 8200 bytes before it gets more data. This tells us that the sender is waiting for acknowledgment from the receiver before pushing more data, so I'm not sure there is any congestion avoidance at all.

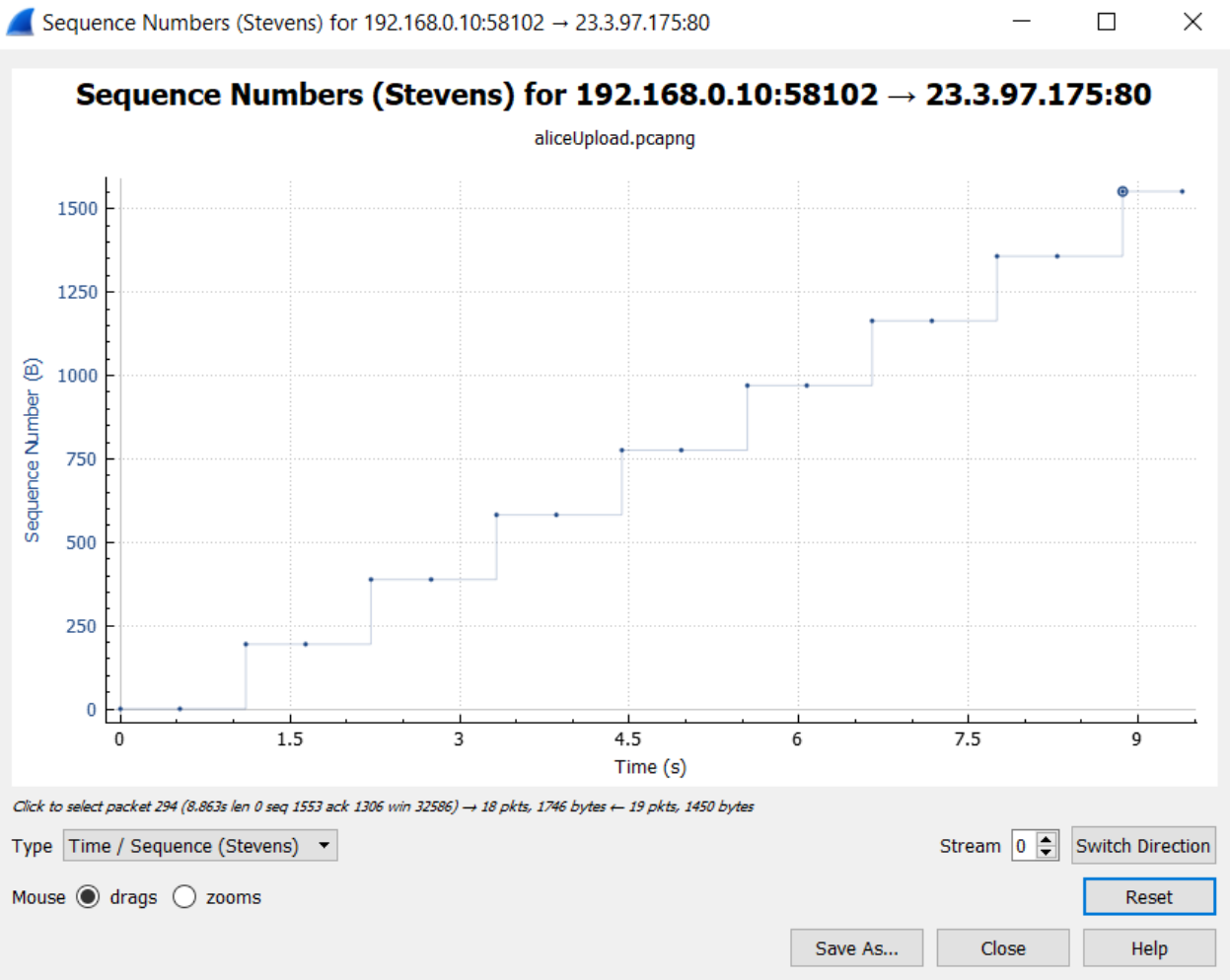
b. Ideally, TCP will send quite a bit of data before waiting for acknowledgment. Here however, only a small amount of data was sent each time so there is never a worry about congestion control.



14.

a. It doesn't look like the slowstart phase ever ends. The window doesn't ever increase by too much.

b. This is similar to the idealized behavior that we have studied for TCP.


Sequence Numbers (Stevens) for 192.168.0.10:58102 → 23.3.97.175:80
Sequence Numbers (Stevens) for 192.168.0.10:58102 → 23.3.97.175:80
aliceUpload.pcapng
Sequence Number (B)
1500
1250
1000
750
500
250
0
0
1.5
3
4.5
6
7.5
9
Time (s)
Click to select packet 294 (8.863s len 0 seq 1553 ack 1306 win 32586) → 18 pkts, 1746 bytes ← 19 pkts, 1450 bytes
Type
Time / Sequence (Stevens)
Stream
0
Switch Direction
Mouse
drags
zooms
Reset
Save As...
Close
Help