

Computer Networks

Lab 4 - TCP

By:

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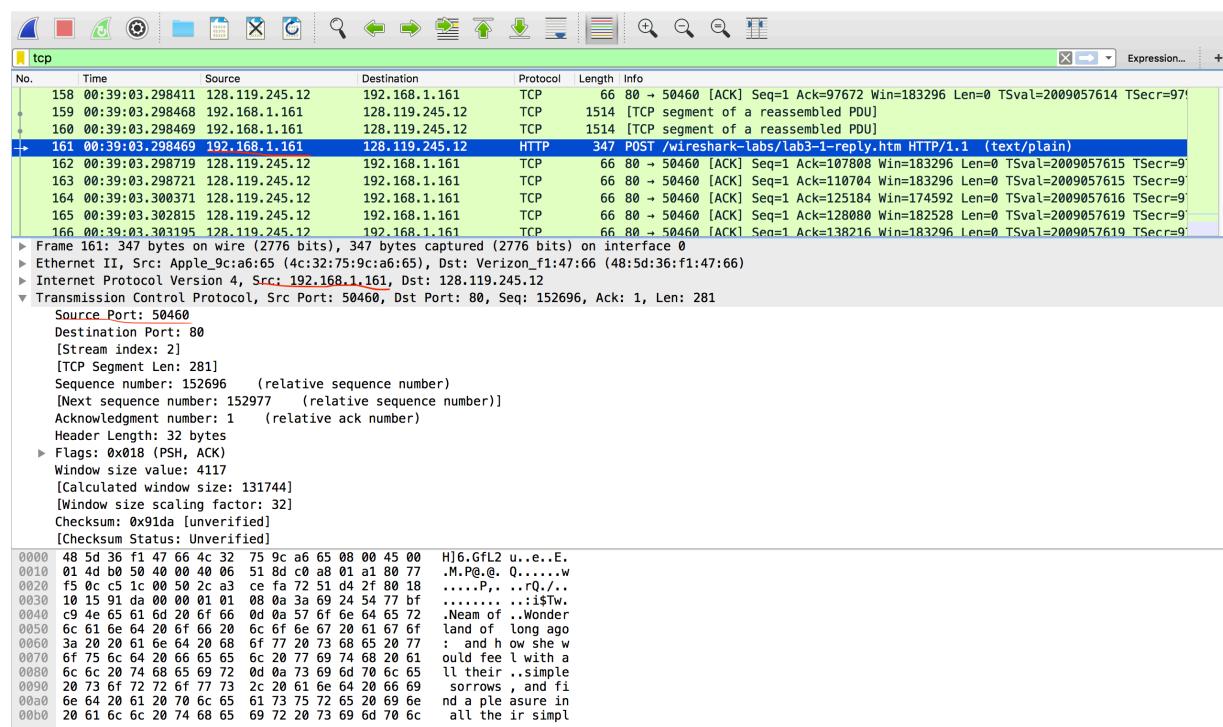
mds747

1) What is the IP address and TCP port number used by the client computer (source) that is transferring the file to gaia.cs.umass.edu? To answer this question, it's probably easiest to select an HTTP message and explore the details of the TCP packet used to carry this HTTP message, using the "details of the selected packet header window" (refer to Figure 2 in the "Getting Started with Wireshark" Lab if you're uncertain about the Wireshark windows.

Ans.) Client Computer:

IP address: 192.168.1.161

Source Port: 50460

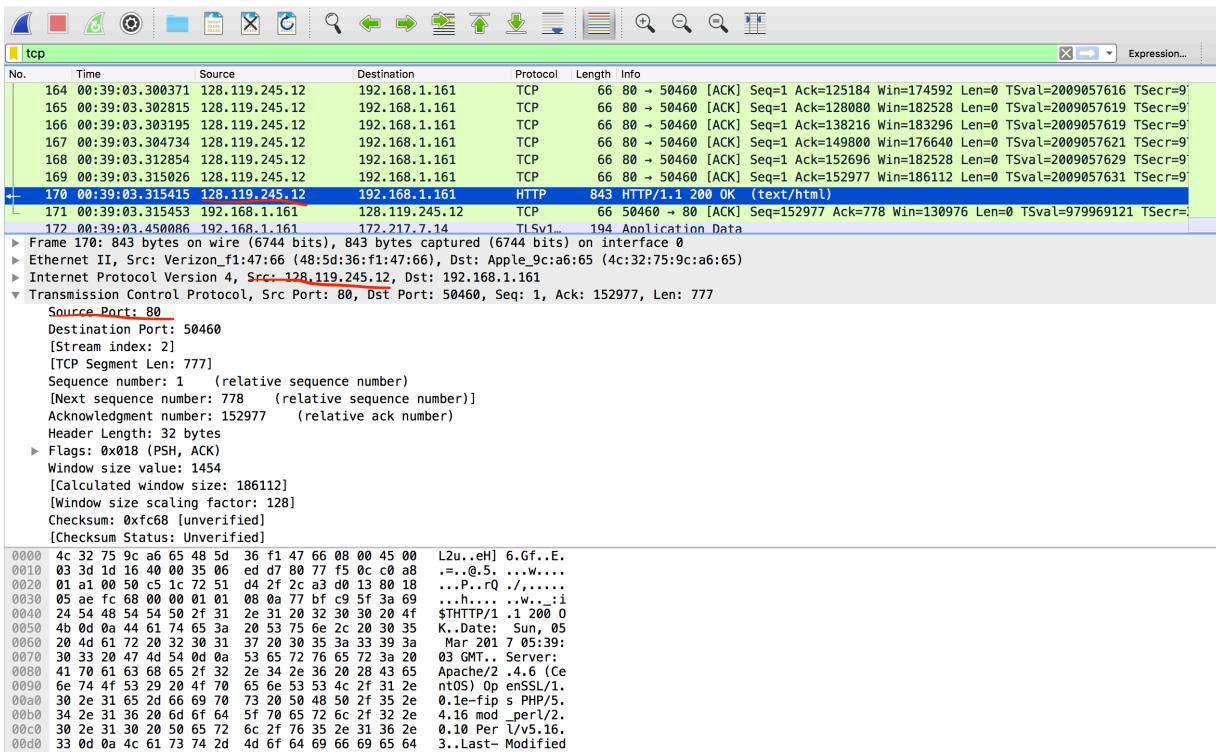


2) What is the IP address of gaia.cs.umass.edu? On what port number is it sending and receiving TCP segments for this connection?

Ans.) Server Computer(gaia.cs.umass.edu):

IP address: 128.119.245.12

Source Port: 80

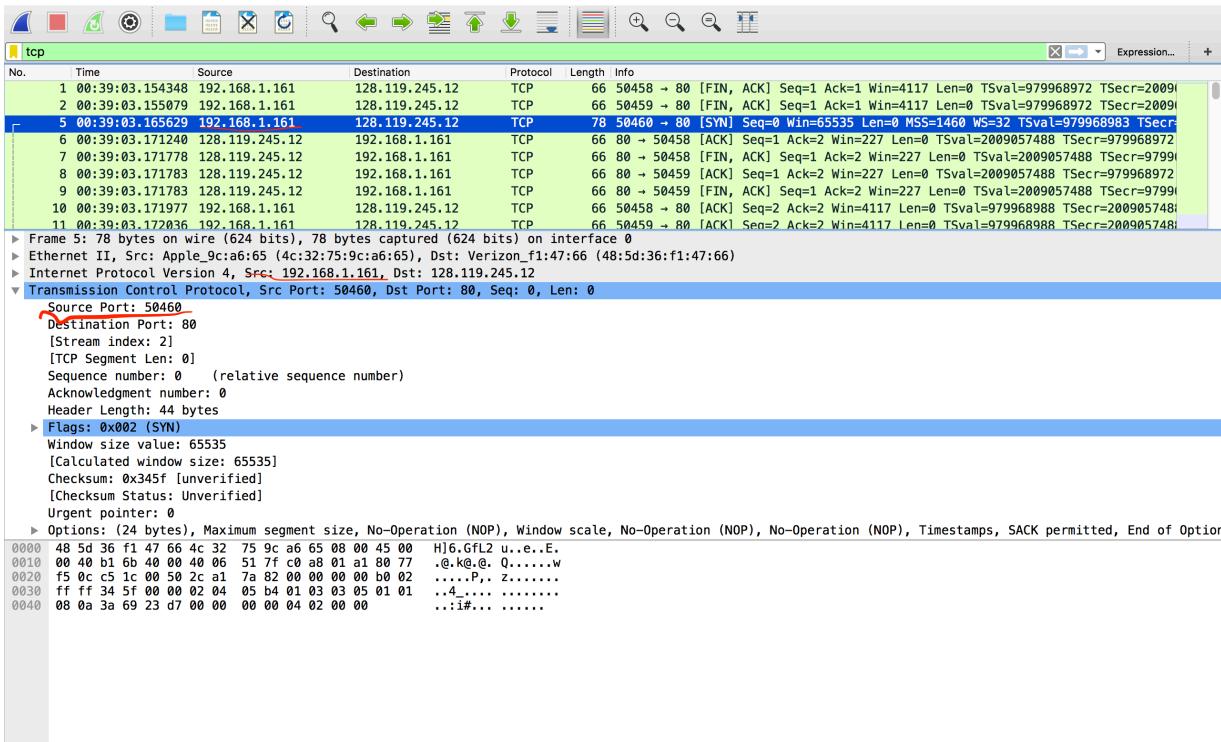


3) What is the IP address and TCP port number used by your client computer (source) to transfer the file to gaia.cs.umass.edu?

Ans.) Client Computer(Source):

IP address: 192.168.1.161

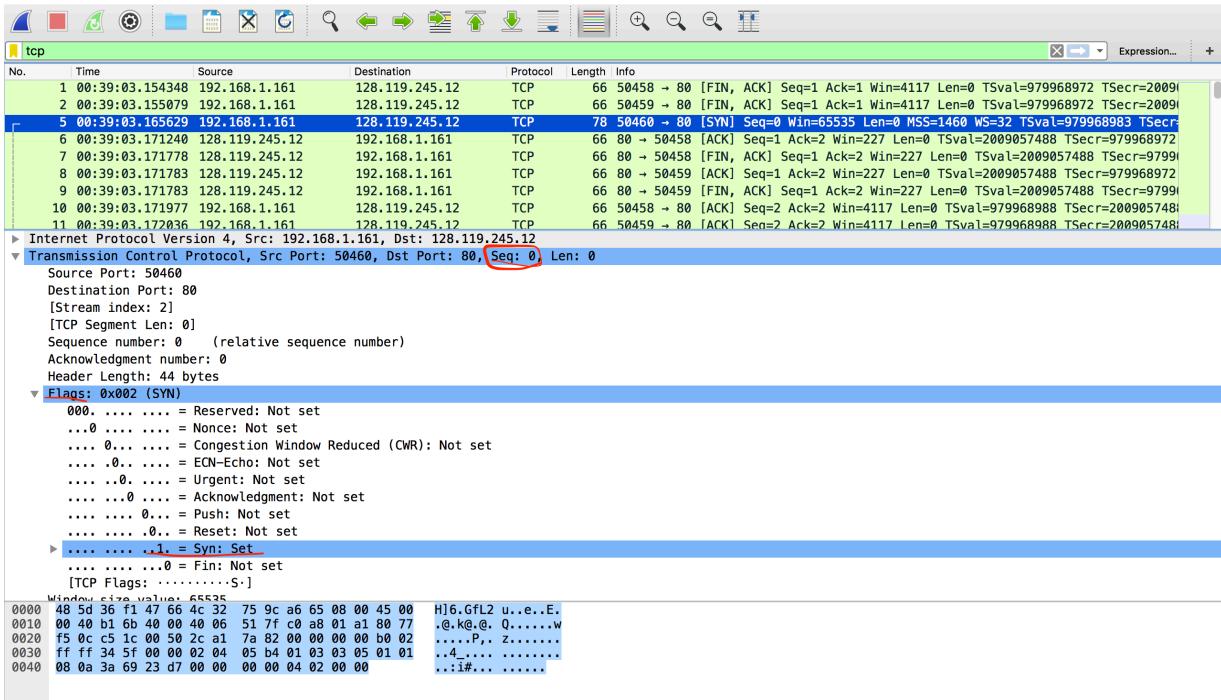
TCP Port: 50460



4) What is the sequence number of the TCP SYN segment that is used to initiate the TCP connection between the client computer and gaia.cs.umass.edu? What is it in the segment that identifies the segment as a SYN segment?

Ans.) The sequence number of the TCP SYN segment that is used to initiate the TCP connection between the client computer and gaia.cs.umass.edu is 0.

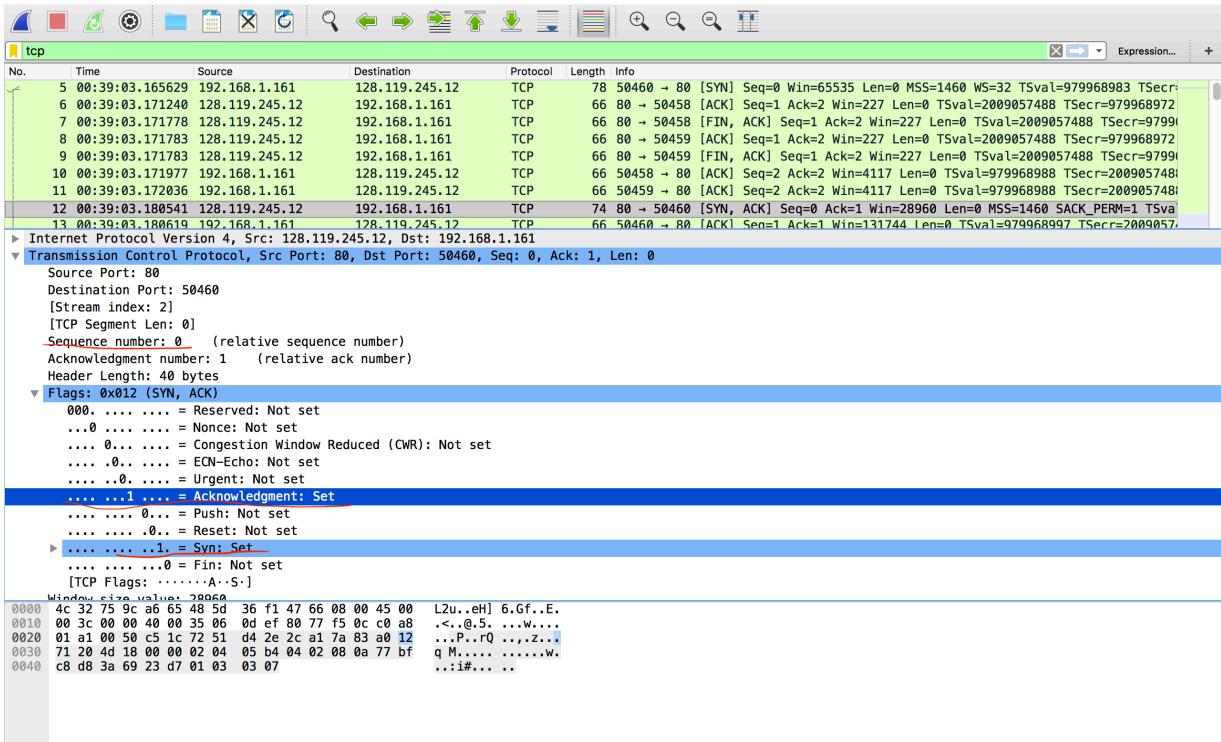
As shown in figure below, “Flags” section identifies the segment as a SYN segment. The Syn flag is set to 1.



5) What is the sequence number of the SYNACK segment sent by gaia.cs.umass.edu to the client computer in reply to the SYN? What is the value of the Acknowledgement field in the SYNACK segment? How did gaia.cs.umass.edu determine that value? What is it in the segment that identifies the segment as a SYNACK segment?

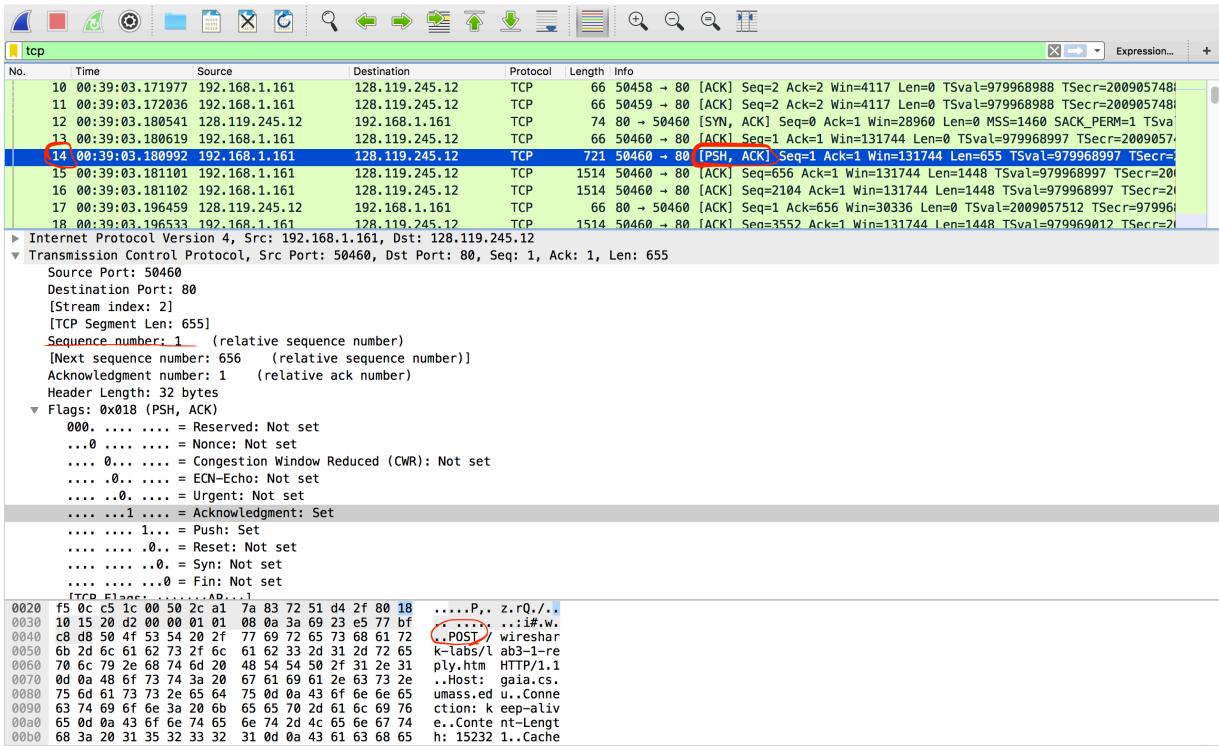
Ans.) The sequence number of the SYNACK segment sent by gaia.cs.umass.edu to the client computer in reply to the SYN is 0. The value of the Acknowledgement field in the SYNACK segment is 1. To determine the value of ACK field in the SYNACK segment, the server adds 1 to the initial sequence number of SYN segment from the client computer. The initial sequence number of SYN segment from the client computer is 0, thus the value of the ACK field in the SYNACK segment is 1.

The segment is identified as SYNACK segment if it has both SYN and ACK flags set to 1.



6) What is the sequence number of the TCP segment containing the HTTP POST command? Note that in order to find the POST command, you'll need to dig into the packet content field at the bottom of the Wireshark window, looking for a segment with a “POST” within its DATA field.

Ans.) As shown in figure below, Sequence number of TCP segment containing HTTP POST command is 1. Segment 14 contains HTTP POST .



7) Consider the TCP segment containing the HTTP POST as the first segment in the TCP connection. What are the sequence numbers of the first six segments in the TCP connection (including the segment containing the HTTP POST)? At what time was each segment sent? When was the ACK for each segment received? Given the difference between when each TCP segment was sent, and when its acknowledgement was received, what is the RTT value for each of the six segments? What is the EstimatedRTT value (see Section 3.5.3, page 239 in text) after the receipt of each ACK? Assume that the value of the EstimatedRTT is equal to the measured RTT for the first segment, and then is computed using the EstimatedRTT equation on page 239 for all subsequent segments. Note: Wireshark has a nice feature that allows you to plot the RTT for each of the TCP segments sent. Select a TCP segment in the “listing of captured packets” window that is being sent from the client to the gaia.cs.umass.edu server. Then select: Statistics->TCP Stream Graph- >Round Trip Time Graph.

Ans.) According to figures below, The Segment numbers 1-6 are 14,15,16,18,20,21 and their ACK are numbers: 17,19,22,25,28,31

Segment No.	Sequence Number	Sent Time	ACK Received Time	RTT
1	1	0.180992	0.196459	0.015467
2	656	0.181101	0.197500	0.016399
3	2104	0.181102	0.197836	0.016734
4	3552	0.196553	0.211130	0.014577
5	5000	0.197575	0.213564	0.015989
6	6448	0.197836	0.213918	0.016082

EstimatedRTT = $(1-\alpha) * \text{EstimatedRTT} + \alpha * \text{SampleRTT}$, where
 $\alpha = 0.125$

For Segment 1, EstimatedRTT = 0.015467 ms

For Segment 2, Estimated RTT = $0.875 * 0.015467 + 0.125 * 0.016399 = 0.015549$ ms

For Segment 3, Estimated RTT = $0.875 * 0.015549 + 0.125 * 0.016734 = 0.015625$ ms

For Segment 4, Estimated RTT = $0.875 * 0.015625 + 0.125 * 0.014577 = 0.015493$ ms

For Segment 5, Estimated RTT = $0.875 * 0.015493 + 0.125 * 0.015989 = 0.015557$ ms

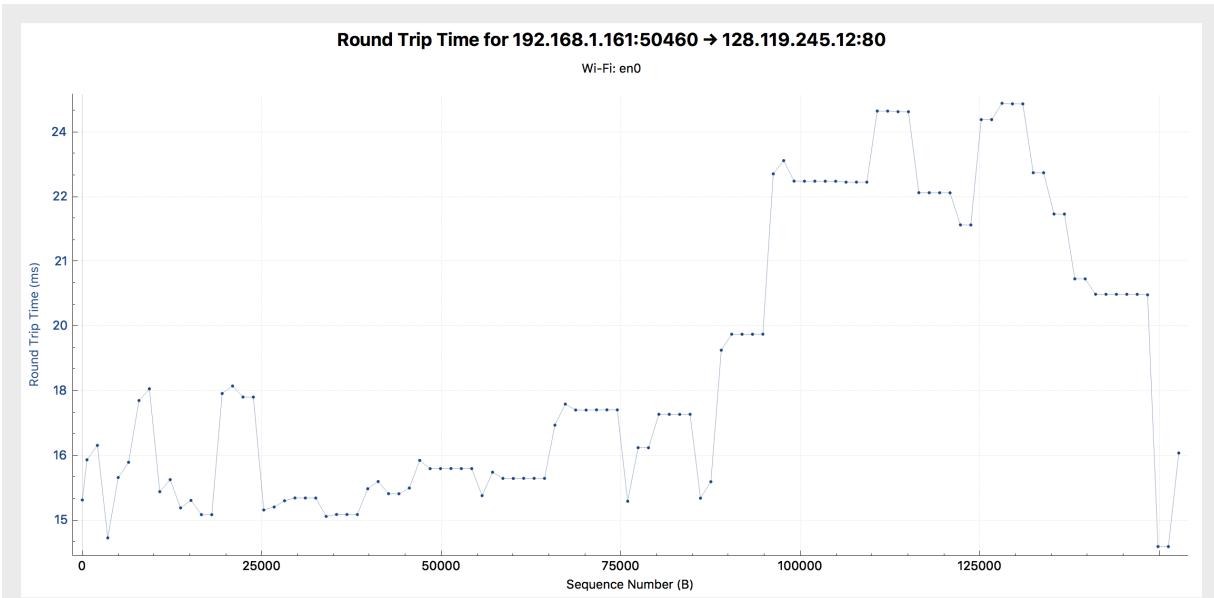
For Segment 6, Estimated RTT = $0.875 * 0.015557 + 0.125 * 0.016082 = 0.015622$ ms

No.	Time	Source	Destination	Protocol	Length	Info
14	00:39:03.180992	192.168.1.161	128.119.245.12	TCP	721	50460 → 80 [PSH, ACK] Seq=1 Ack=1 Win=131744 Len=655 TSval=979968997 TSecr=20
15	00:39:03.181010	192.168.1.161	128.119.245.12	TCP	1514	50460 → 80 [ACK] Seq=656 Ack=1 Win=131744 Len=1448 TSval=979968997 TSecr=20
16	00:39:03.181102	192.168.1.161	128.119.245.12	TCP	1514	50460 → 80 [ACK] Seq=2104 Ack=1 Win=131744 Len=1448 TSval=979968997 TSecr=20
17	00:39:03.196459	128.119.245.12	192.168.1.161	TCP	66	80 → 50460 [ACK] Seq=1 Ack=656 Win=30336 Len=0 TSval=2009057512 TSecr=979968997
18	00:39:03.196533	192.168.1.161	128.119.245.12	TCP	1514	50460 → 80 [ACK] Seq=3552 Ack=1 Win=131744 Len=1448 TSval=979969012 TSecr=20
19	00:39:03.197500	128.119.245.12	192.168.1.161	TCP	66	80 → 50460 [ACK] Seq=1 Ack=2104 Win=33280 Len=0 TSval=2009057512 TSecr=979968997
20	00:39:03.197575	192.168.1.161	128.119.245.12	TCP	1514	50460 → 80 [ACK] Seq=5000 Ack=1 Win=131744 Len=1448 TSval=979969013 TSecr=20
21	00:39:03.197577	192.168.1.161	128.119.245.12	TCP	1514	50460 → 80 [ACK] Seq=6448 Ack=1 Win=131744 Len=1448 TSval=979969013 TSecr=20
22	00:39:03.197836	128.119.245.12	192.168.1.161	TCP	66	80 → 50460 [ACK] Seq=1 Ack=3552 Win=36096 Len=0 TSval=2009057512 TSecr=979968997
► Internet Protocol Version 4, Src: 192.168.1.161, Dst: 128.119.245.12						
▼ Transmission Control Protocol, Src Port: 50460, Dst Port: 80, Seq: 1, Ack: 1, Len: 655						
Source Port: 50460 Destination Port: 80 [Stream index: 2] [TCP Segment Len: 655] Sequence number: 1 (relative sequence number) [Next sequence number: 656 (relative sequence number)] Acknowledgment number: 1 (relative ack number) Header Length: 32 bytes Flags: 0x018 (PSH, ACK) 000..... = Reserved: Not set ...0..... = Nonce: Not set0... = Congestion Window Reduced (CWR): Not set0... = ECN-Echo: Not set0... = Urgent: Not set1... = Acknowledgment: Set1... = Push: Set0... = Reset: Not set0... = Syn: Not set0... = Fin: Not set [TCP Flags]						
0020	f5 0c c5 1c 00 50 2c a1 7a 83 72 51 d4 2f 80 18P.. z.r0./..				
0030	00 15 20 d2 00 00 01 01 08 0a 3a 69 23 e5 77 bf;#.w.				
0040	c8 d8 50 4f 53 54 20 2f 77 69 72 65 73 68 61 72	.POST / wireshar				
0050	6b 2d 60 61 62 73 2f 6c 61 62 33 2d 31 2d 72 65	k-labs/l ab3-1-re				
0060	70 6c 79 2e 68 74 6d 20 48 54 54 50 2f 31 2e 31	ply.htm HTTP/1.1				
0070	0d 0a 48 6f 73 74 3a 20 67 61 69 61 2e 63 73 2e	..Host: gaia.cs.				
0080	75 6d 61 73 73 2e 65 64 75 0d 0a 43 6f 6e 66 65	umass.ed u.Conne				
0090	63 74 69 6f 6e 3a 20 6b 65 65 70 2d 61 6c 69 76	ction: k eep-aliv				
00a0	65 0d 0a 43 6f 6e 74 65 6e 74 2d 4c 65 6e 67 74	e..Conte nt-Lengt				
00b0	68 3a 20 31 35 32 33 32 31 0d 0a 43 61 63 68 65	h: 15232 1..Cache				

Fig: Segments 1-6

No.	Time	Source	Destination	Protocol	Length	Info
17	00:39:03.196459	128.119.245.12	192.168.1.161	TCP	66	80 → 50460 [ACK] Seq=1 Ack=656 Win=30336 Len=0 TSval=2009057512 TSecr=979968997
18	00:39:03.196533	192.168.1.161	128.119.245.12	TCP	1514	50460 → 80 [ACK] Seq=3552 Ack=1 Win=131744 Len=1448 TSval=979969012 TSecr=20
19	00:39:03.197500	128.119.245.12	192.168.1.161	TCP	66	80 → 50460 [ACK] Seq=1 Ack=2104 Win=33280 Len=0 TSval=2009057512 TSecr=979968997
20	00:39:03.197575	192.168.1.161	128.119.245.12	TCP	1514	50460 → 80 [ACK] Seq=5000 Ack=1 Win=131744 Len=1448 TSval=979969013 TSecr=20
21	00:39:03.197836	128.119.245.12	192.168.1.161	TCP	1514	50460 → 80 [ACK] Seq=6448 Ack=1 Win=131744 Len=1448 TSval=979969013 TSecr=20
22	00:39:03.197880	192.168.1.161	128.119.245.12	TCP	66	80 → 50460 [ACK] Seq=1 Ack=3552 Win=36096 Len=0 TSval=2009057512 TSecr=979968997
23	00:39:03.197880	192.168.1.161	128.119.245.12	TCP	1514	50460 → 80 [ACK] Seq=7896 Ack=1 Win=131744 Len=1448 TSval=979969013 TSecr=20
24	00:39:03.197880	192.168.1.161	128.119.245.12	TCP	1514	50460 → 80 [ACK] Seq=9344 Ack=1 Win=131744 Len=1448 TSval=979969013 TSecr=20
25	00:39:03.211120	128.119.245.12	192.168.1.161	TCP	66	80 → 50460 [ACK] Seq=1 Ack=5000 Win=39040 Len=0 TSval=2009057527 TSecr=979968997
26	00:39:03.211192	192.168.1.161	128.119.245.12	TCP	1514	50460 → 80 [ACK] Seq=10792 Ack=1 Win=131744 Len=1448 TSval=979969026 TSecr=979968997
27	00:39:03.211196	192.168.1.161	128.119.245.12	TCP	1514	50460 → 80 [ACK] Seq=12240 Ack=1 Win=131744 Len=1448 TSval=979969026 TSecr=979968997
28	00:39:03.213564	128.119.245.12	192.168.1.161	TCP	66	80 → 50460 [ACK] Seq=1 Ack=6448 Win=41856 Len=0 TSval=2009057530 TSecr=979968997
29	00:39:03.213644	192.168.1.161	128.119.245.12	TCP	1514	50460 → 80 [ACK] Seq=13688 Ack=1 Win=131744 Len=1448 TSval=979969028 TSecr=979968997
30	00:39:03.213644	192.168.1.161	128.119.245.12	TCP	1514	50460 → 80 [ACK] Seq=15136 Ack=1 Win=131744 Len=1448 TSval=979969028 TSecr=979968997
31	00:39:03.213918	128.119.245.12	192.168.1.161	TCP	66	80 → 50460 [ACK] Seq=1 Ack=7896 Win=44800 Len=0 TSval=2009057530 TSecr=979968997
► Internet Protocol Version 4, Src: 192.168.1.161, Dst: 128.119.245.12						
▼ Transmission Control Protocol, Src Port: 50460, Dst Port: 80, Seq: 1, Ack: 1, Len: 655						
Source Port: 50460 Destination Port: 80 [Stream index: 2] [TCP Segment Len: 655] Sequence number: 1 (relative sequence number) [Next sequence number: 656 (relative sequence number)] Acknowledgment number: 1 (relative ack number) Header Length: 32 bytes Flags: 0x018 (PSH, ACK) 000..... = Reserved: Not set ...0..... = Nonce: Not set0... = Congestion Window Reduced (CWR): Not set0... = ECN-Echo: Not set						
0020	f5 0c c5 1c 00 50 2c a1 7a 83 72 51 d4 2f 80 18P.. z.r0./..				
0030	00 15 20 d2 00 00 01 01 08 0a 3a 69 23 e5 77 bf;#.w.				
0040	c8 d8 50 4f 53 54 20 2f 77 69 72 65 73 68 61 72	.POST / wireshar				
0050	6b 2d 60 61 62 73 2f 6c 61 62 33 2d 31 2d 72 65	k-labs/l ab3-1-re				
0060	70 6c 79 2e 68 74 6d 20 48 54 54 50 2f 31 2e 31	ply.htm HTTP/1.1				
0070	0d 0a 48 6f 73 74 3a 20 67 61 69 61 2e 63 73 2e	..Host: gaia.cs.				
0080	75 6d 61 73 73 2e 65 64 75 0d 0a 43 6f 6e 66 65	umass.ed u.Conne				
0090	63 74 69 6f 6e 3a 20 6b 65 65 70 2d 61 6c 69 76	ction: k eep-aliv				
00a0	65 0d 0a 43 6f 6e 74 65 6e 74 2d 4c 65 6e 67 74	e..Conte nt-Lengt				
00b0	68 3a 20 31 35 32 33 32 31 0d 0a 43 61 63 68 65	h: 15232 1..Cache				

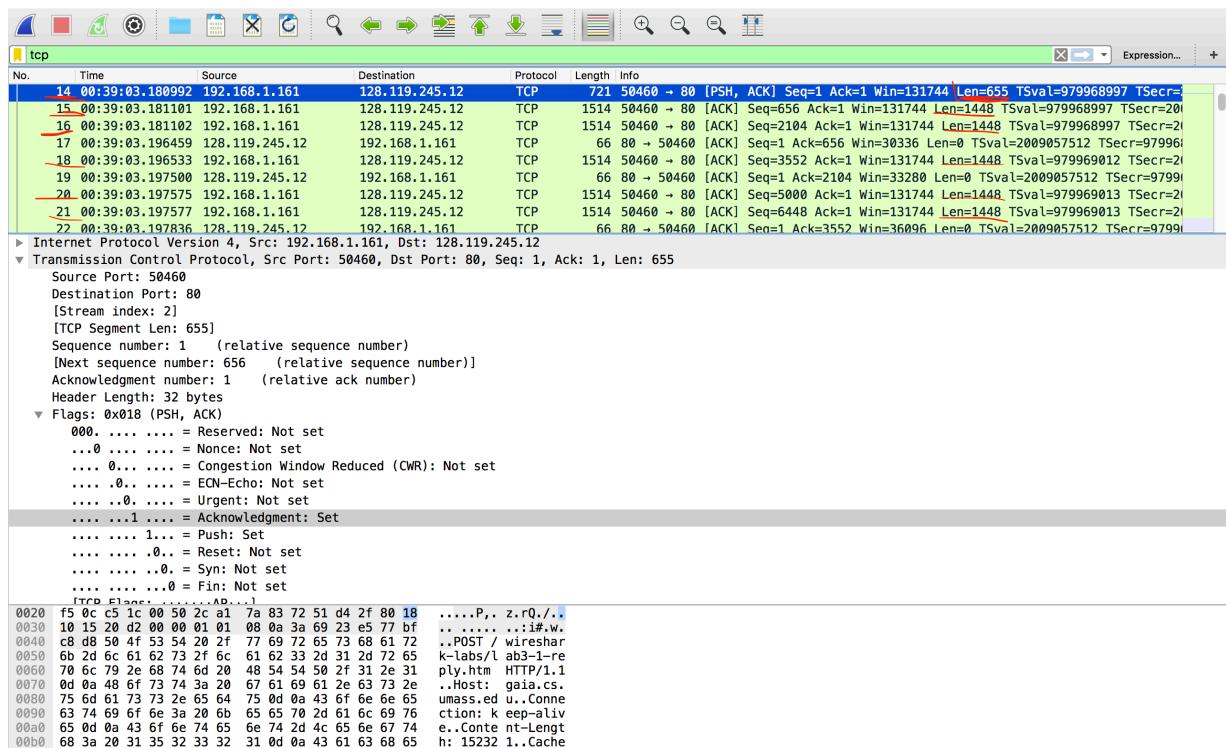
Fig: ACK of 1-6



8) What is the length of each of the first six TCP segments?

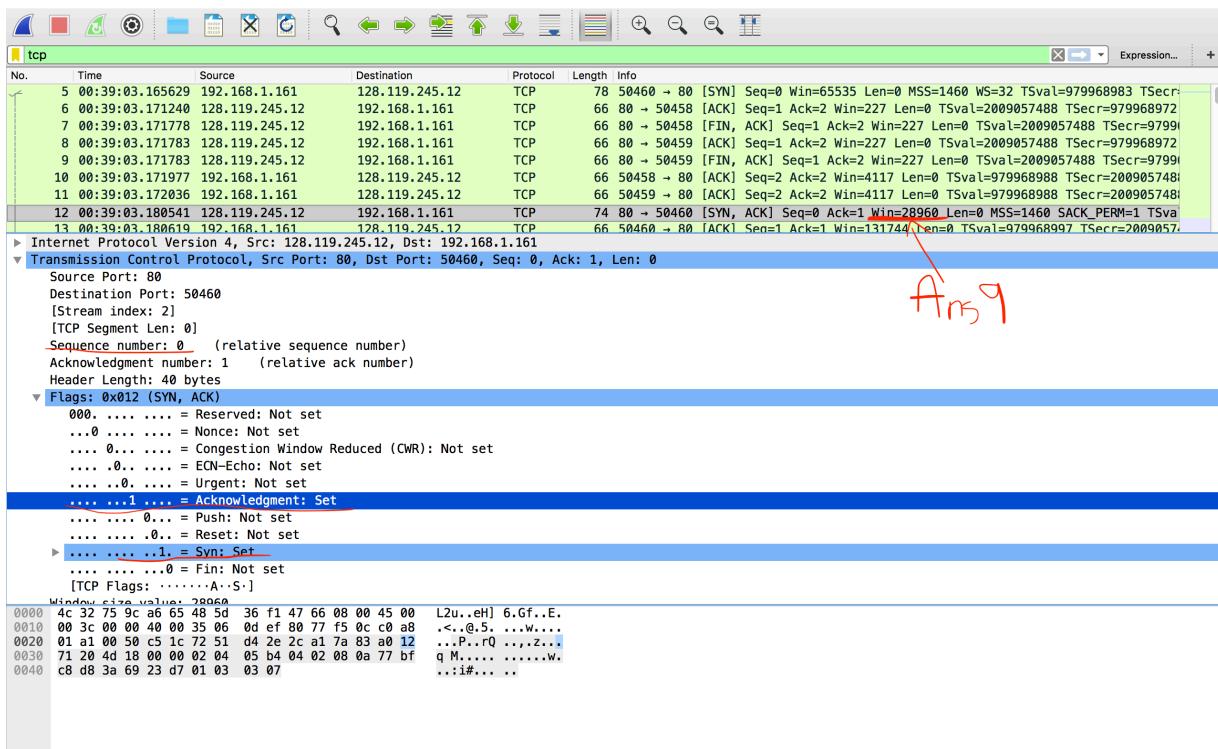
Ans.) The length of first TCP segment is: 655 bytes.

The length of next 5 TCP segments is: 1448 bytes.



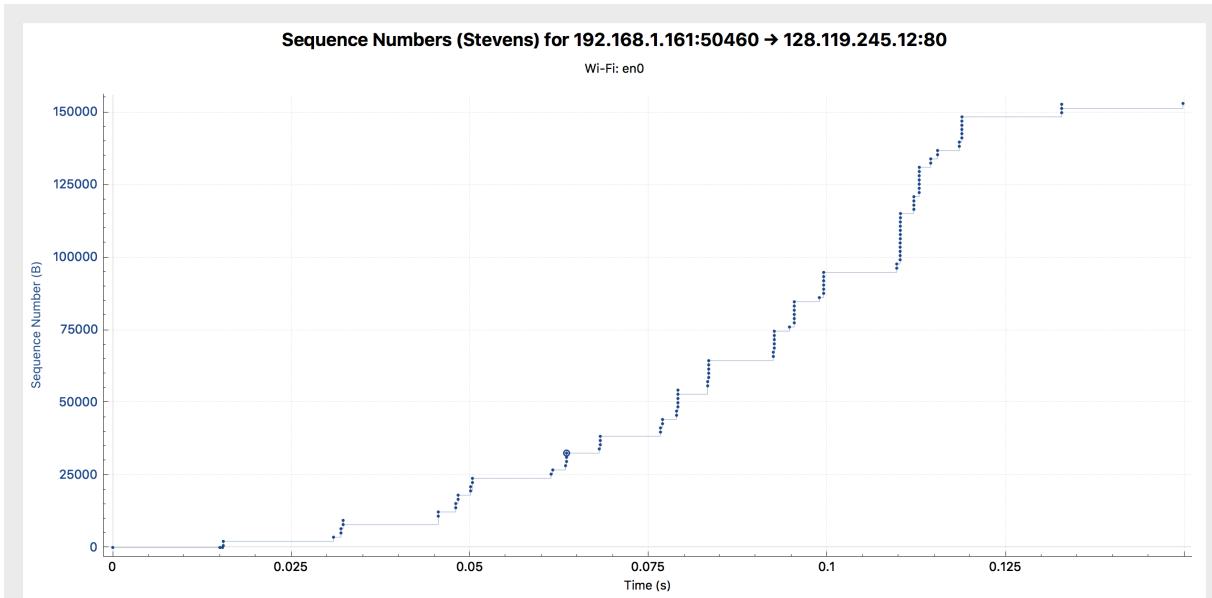
9) What is the minimum amount of available buffer space advertised at the received for the entire trace? Does the lack of receiver buffer space ever throttle the sender?

Ans.) The minimum amount of available buffer space advertised at the received for the entire trace is the value of first ACK from the server i.e. 28960 bytes. The reviver windows grows upto size of 62780 bytes, hence the sender is never throttled due to lack of receiver buffer space.



10) Are there any retransmitted segments in the trace file? What did you check for (in the trace) in order to answer this question?

Ans.) There is no retransmitted segments in the trace file. In the time sequence graph (Stevens), all sequence numbers are monotonically increasing as shown in figure below.



11) How much data does the receiver typically acknowledge in an ACK? Can you identify cases where the receiver is ACKing every other received segment (see Table 3.2 on page 247 in the text).

Ans.) Data acknowledged in an ACK = The difference between the acknowledged sequence numbers of two consecutive ACKs . For Example No 17 and 19 have ACK sequence numbers 656 and 2104 respectively.

So $2104 - 656 = 1448$ bytes.

The receiver is ACKing every other segment as shown in figure.

No.	Time	Source	Destination	Protocol	Length	Info
17	00:39:03.196459	128.119.245.12	192.168.1.161	TCP	66	80 → 50460 [ACK] Seq=1 Ack=656 Win=30336 Len=0 TSval=2009057512 TSecr=97996
18	00:39:03.196533	192.168.1.161	128.119.245.12	TCP	1514	50460 → 80 [ACK] Seq=3552 Ack=1 Win=131744 Len=1448 TSval=979969012 TSecr=21
19	00:39:03.197500	128.119.245.12	192.168.1.161	TCP	66	80 → 50460 [ACK] Seq=1 Ack=2104 Win=33280 Len=0 TSval=2009057512 TSecr=97996
20	00:39:03.197575	192.168.1.161	128.119.245.12	TCP	1514	50460 → 80 [ACK] Seq=5000 Ack=1 Win=131744 Len=1448 TSval=979969013 TSecr=21
21	00:39:03.197577	192.168.1.161	128.119.245.12	TCP	1514	50460 → 80 [ACK] Seq=6448 Ack=1 Win=131744 Len=1448 TSval=979969013 TSecr=21
22	00:39:03.197836	128.119.245.12	192.168.1.161	TCP	66	80 → 50460 [ACK] Seq=1 Ack=3552 Win=36096 Len=0 TSval=2009057512 TSecr=97996
23	00:39:03.197880	192.168.1.161	128.119.245.12	TCP	1514	50460 → 80 [ACK] Seq=7896 Ack=1 Win=131744 Len=1448 TSval=979969013 TSecr=21
24	00:39:03.197880	192.168.1.161	128.119.245.12	TCP	1514	50460 → 80 [ACK] Seq=9344 Ack=1 Win=131744 Len=1448 TSval=979969013 TSecr=21
25	00:39:03.211120	128.119.245.12	192.168.1.161	TCP	66	80 → 50460 [ACK] Seq=1 Ack=5008 Win=39040 Len=0 TSval=2009057527 TSecr=97996
26	00:39:03.211195	192.168.1.161	128.119.245.12	TCP	1514	50460 → 80 [ACK] Seq=10792 Ack=1 Win=131744 Len=1448 TSval=979969026 TSecr=21
27	00:39:03.211196	192.168.1.161	128.119.245.12	TCP	1514	50460 → 80 [ACK] Seq=12240 Ack=1 Win=131744 Len=1448 TSval=979969026 TSecr=21
28	00:39:03.213564	128.119.245.12	192.168.1.161	TCP	66	80 → 50460 [ACK] Seq=1 Ack=6448 Win=41856 Len=0 TSval=2009057530 TSecr=97996
29	00:39:03.213642	192.168.1.161	128.119.245.12	TCP	1514	50460 → 80 [ACK] Seq=13688 Ack=1 Win=131744 Len=1448 TSval=979969028 TSecr=21
30	00:39:03.213644	192.168.1.161	128.119.245.12	TCP	1514	50460 → 80 [ACK] Seq=15136 Ack=1 Win=131744 Len=1448 TSval=979969028 TSecr=21
31	00:39:03.213918	128.119.245.12	192.168.1.161	TCP	66	80 → 50460 [ACK] Seq=1 Ack=7896 Win=44800 Len=0 TSval=2009057530 TSecr=97996

12) What is the throughput (bytes transferred per unit time) for the TCP connection? Explain how you calculated this value.

Ans.) The size of alice.txt is 152,138 bytes. The time difference between first TCP

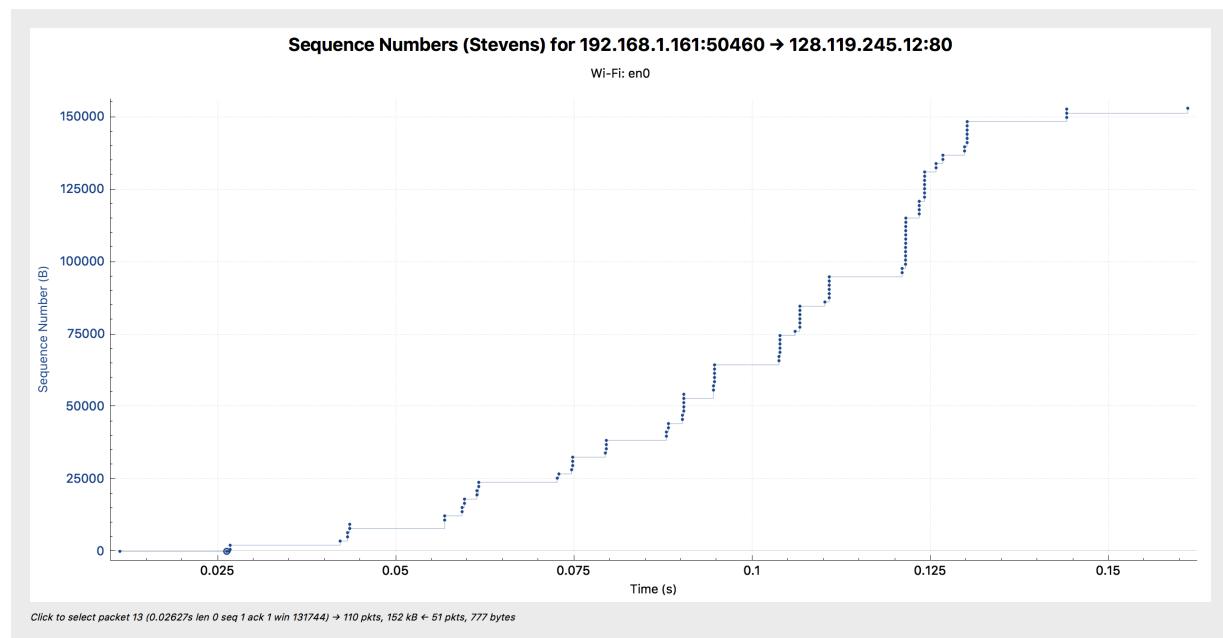
segment and the last ACK segment is 0.03926.

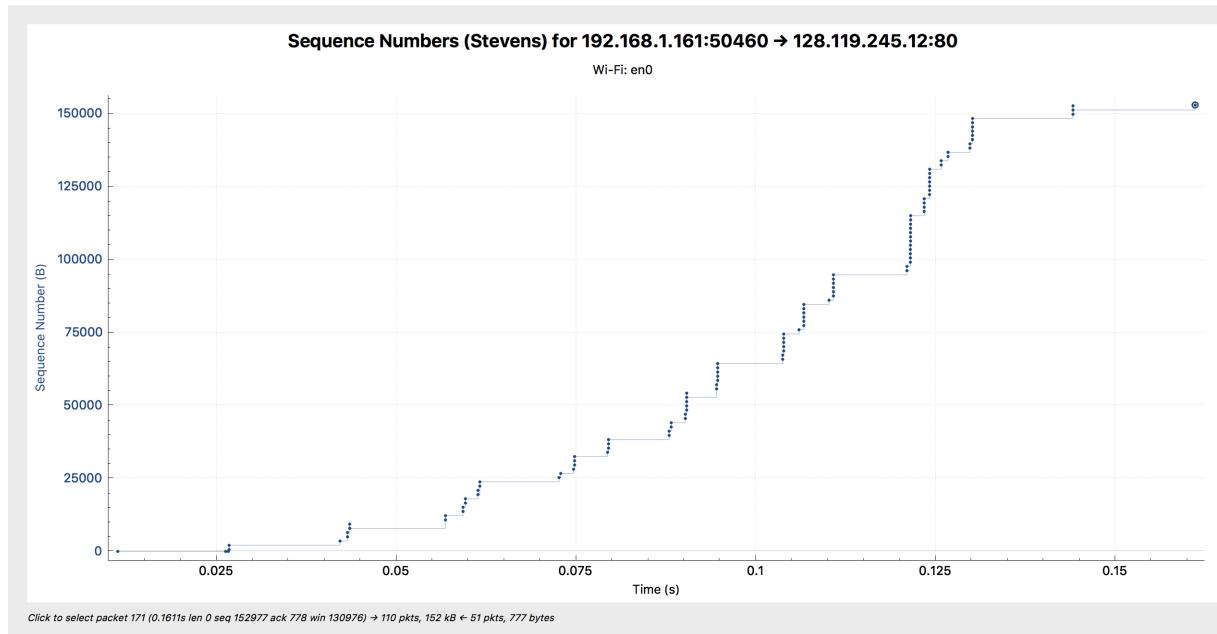
$$\text{Therefore, Throughput} = 152138 / 0.03926 = 3875.14 \text{ KB/sec}$$

13) Use the Time-Sequence-Graph(Stevens) plotting tool to view the sequence number versus time plot of segments being sent from the client to the gaia.cs.umass.edu server. Can you identify where TCP's slow start phase begins and ends, and where congestion avoidance takes over? Comment on ways in which the measured data differs from the idealized behavior of TCP that we've studied in the text.

Ans.) The slow start of the TCP seems to begin at about 0.02627 seconds and then ends at about 0.1611 seconds. Congestion avoidance takes over at about 0.13 seconds because it cut down the amount being sent.

The idealized behavior of TCP in the text assumes that TCP senders are aggressive in sending data. Too much traffic may congest the network; therefore, TCP senders should follow the AIMD algorithm so that when they detect network congestion (i.e., packet loss), their sending window size should drop down.





- 14) Answer each of two questions above for the trace that you have gathered when you transferred a file from your computer to gaia.cs.umass.edu

Ans.) The answer is same as above.