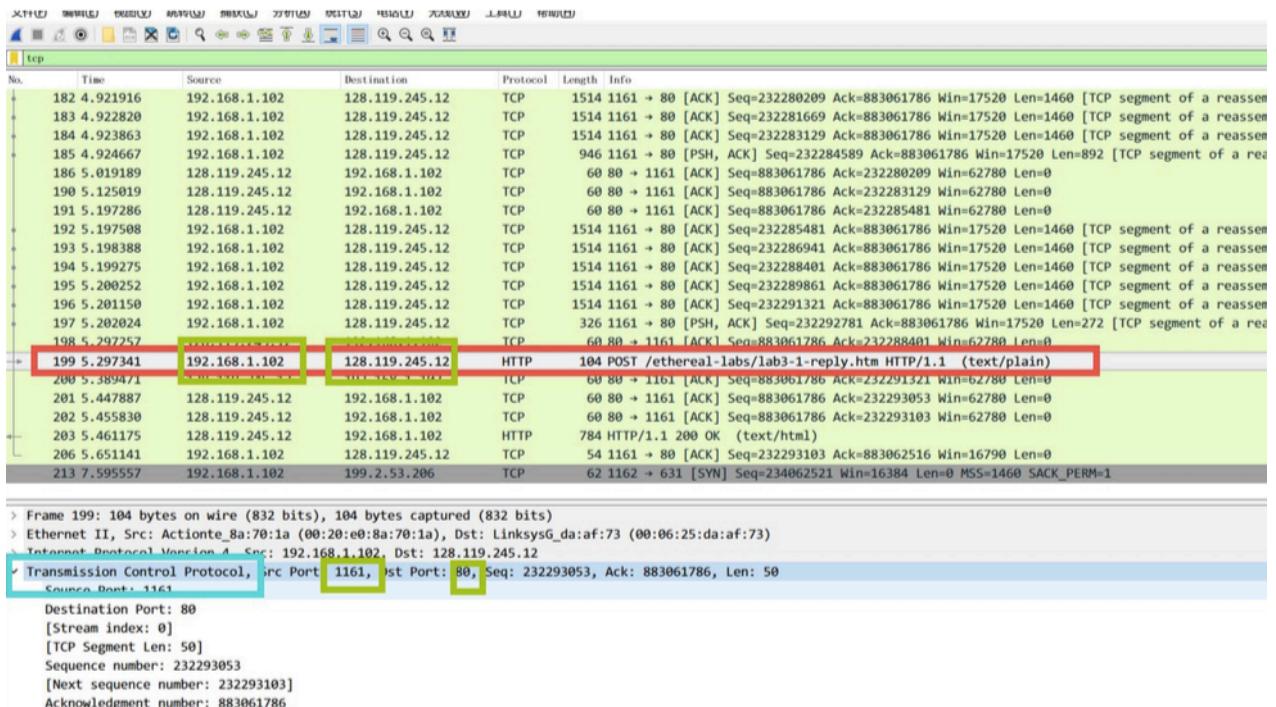


- What is the IP address and TCP port number used by the client computer (source) that is transferring the file to gaia.cs.umass.edu? To answer this question, it's probably easiest to select an HTTP message and explore the details of the TCP packet used to carry this HTTP message, using the "details 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: The IP address 192.168.1.102 TCP port is 1161



- 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:

Sending IP address: 192.168.1.102 TCP port: 1161

Receiving IP address: 128.119.245.12 TCP port: 80

- 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 IP: 172.31.130.217, TCP port: 52836

Server IP: 128.119.245.12, TCP port: 80

No.	Time	Source	Destination	Protocol	Length	Info
127	2.050179	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237835074 Win=0 TStamp=1711729066 TSect=132.2.050487
128	2.050188	172.31.130.217	128.119.245.12	TCP	2962	52836 → 80 [PSH, ACK] Seq=1237913266 Ack=599494355 Win=66560 Len=2896 TStamp=35985345
129	2.050300	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237836522 Win=166656 Len=0 TStamp=1711729066 TSect=130.2.050327
130	2.050327	172.31.130.217	128.119.245.12	TCP	2962	52836 → 80 [ACK] Seq=1237916162 Ack=599494355 Win=66560 Len=2896 TStamp=35985349 TSect=131.2.050479
132	2.050487	172.31.130.217	128.119.245.12	HTTP	1795	POST /wireshark-labs/lab3-1-reply.htm HTTP/1.1 (text/plain)
133	2.050502	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237840866 Win=175360 Len=0 TStamp=1711729066 TSect=134.2.050697
135	2.050831	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237842314 Win=178176 Len=0 TStamp=1711729067 TSect=136.2.050909
						128.119.245.12 → 172.31.130.217 TCP 66 80 → 52836 [ACK] Seq=599494355 Ack=1237843762 Win=181120 Len=0 TStamp=1711729067 TSect=Frame 132: 1795 bytes on wire (14360 bits), 1795 bytes captured (14360 bits) on interface 0
						> Ethernet II, Src: Micro-St_83:61:47 (4c:cc:6a:83:61:47), Dst: Hangzhou_c3:7a:4e (3c:8c:40:c3:7a:4e)
						> Internet Protocol Version 4, Src: 172.3.130.217 Dst: 128.119.245.12
						> Transmission Control Protocol, Src Port: 52836, Dst Port: 80, Seq: 1237919058, Ack: 599494355, Len: 1729
						Source Port: 52836 Destination Port: 80 [Stream index: 5] [TCP Segment Len: 1729] Sequence number: 1237919058 [Next sequence number: 1237920787] Acknowledgment number: 599494355 1000 = Header Length: 32 bytes (8) Flags: 0x018 (PSH, ACK) 000. = Reserved: Not set

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?

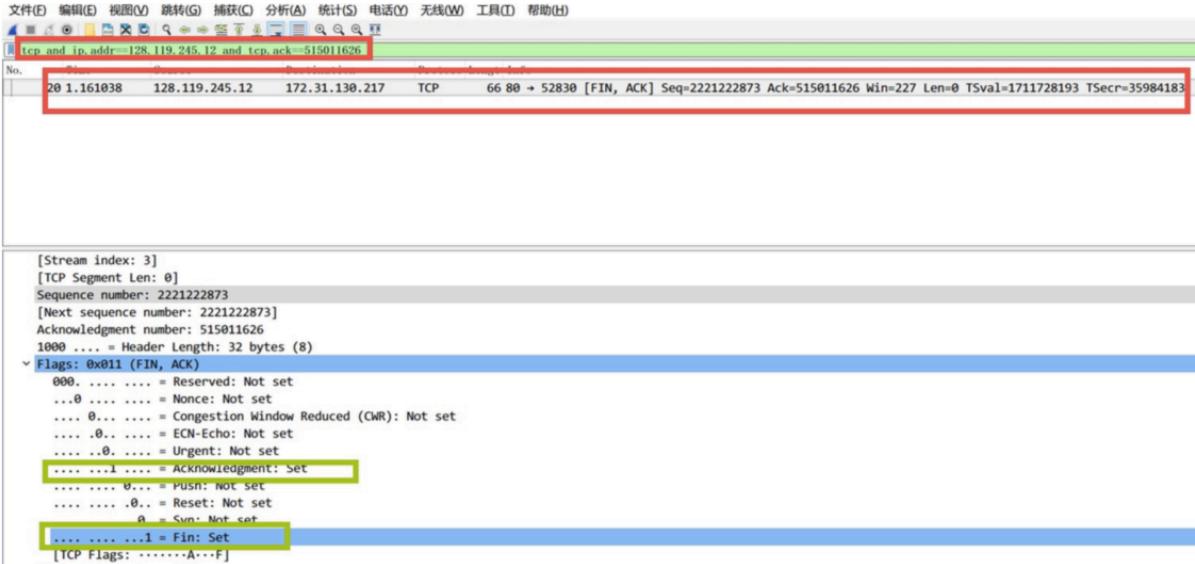
ANS: Client send SYN to start connection. I searched for the first sent request and find the client set SYN as 1 to establish the connection.

SEQ = 515011625, which is a random number. This is the first step of three-way handshake.

tcp and ip.addr==128.119.245.12						
No.	Time	Source	Destination	Protocol	Length	Info
14	0.884320	172.31.130.217	128.119.245.12	TCP	66	52830 → 80 [FIN, ACK] Seq=515011625 Ack=2221222873 Win=260 Len=0 TStamp=15.0.884390
15	0.884390	172.31.130.217	128.119.245.12	TCP	66	52829 → 80 [FIN, ACK] Seq=1213122370 Ack=660518807 Win=260 Len=0 TStamp=16.0.884629
16	0.884629	172.31.130.217	128.119.245.12	TCP	74	52836 → 80 [SYN] Seq=1237767728 Win=64240 Len=0 MSS=1460 WS=256 SACK_P=17.0.884782
17	0.884782	172.31.130.217	128.119.245.12	TCP	74	52837 → 80 [SYN] Seq=908775318 Win=64240 Len=0 MSS=1460 WS=256 SACK_P=19.1.135273
19	1.135273	172.31.130.217	128.119.245.12	TCP	74	52838 → 80 [SYN] Seq=923790985 Win=64240 Len=0 MSS=1460 WS=256 SACK_P=20.1.161038
20	1.161038	128.119.245.12	172.31.130.217	TCP	66	80 → 52830 [FIN, ACK] Seq=2221222873 Ack=515011626 Win=227 Len=0 TStamp=21.1.161086
21	1.161086	172.31.130.217	128.119.245.12	TCP	66	52830 → 80 [ACK] Seq=515011626 Ack=2221222874 Win=260 Len=0 TStamp=3598
22	1.177787	128.119.245.12	172.31.130.217	TCP	74	80 → 52836 [SYN, ACK] Seq=599494354 Ack=1237767729 Win=28960 Len=0 MSS=23.1.177844
23	1.177844	172.31.130.217	128.119.245.12	TCP	66	52836 → 80 [ACK] Seq=1237767729 Ack=599494355 Win=66560 Len=0 TStamp=24.1.178488
						Acknowledgment number: 2221222873 1000 = Header Length: 32 bytes (8) Flags: 0x011 (FIN, ACK) 000. = Reserved: Not set ...0 = Nonce: Not set0.... = Congestion Window Reduced (CWR): Not set0.... = ECN-Echo: Not set0.... = Urgent: Not set0....1.... = Acknowledgment: Set0....0.... = Push: Not set0....0.... = Reset: Not set 0.... = Svn: Not set0....1.... = Fin: Set
						[TCP Flags:] Window size value: 260 [Calculated window size: 260]

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:



According to the sequence number SEQ = client SEQ + 1 of SYN-ACK response value, the SEQ (sequence number) = 515011626 can be used to search.

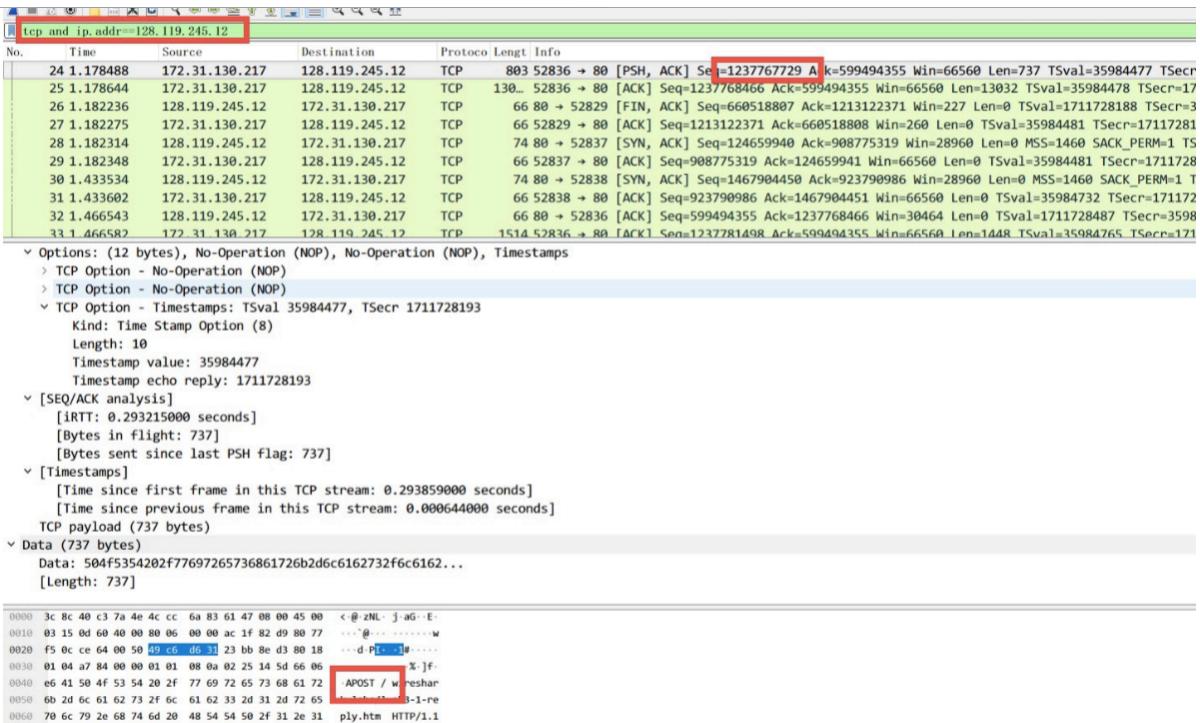
And Ack was set as 1, which means the sever has received the client's connection request and sent SYN-ACK to confirm.

This is the second step of three-way handshake.

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: The sequence number is 1237767729



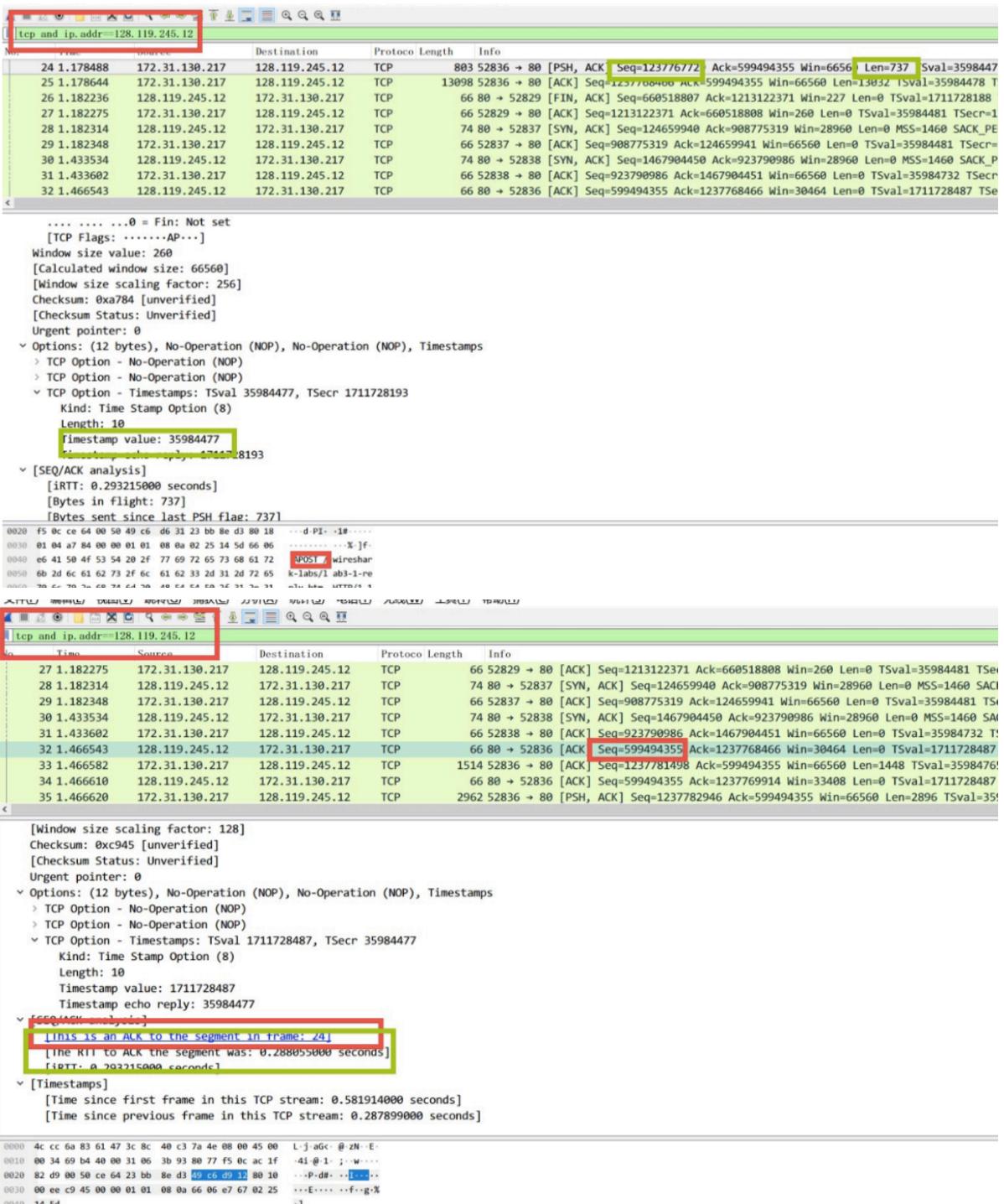
7. Consider the TCP segment containing the HTTP POST as the first segment in the TCP connection. What are the sequence numbers of the first six segments in the TCP connection (including the segment containing the HTTP POST)? At what time was each segment sent? When was the ACK for each segment received? 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 242 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 242 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:

Segment1:



Segment2:

tcp and ip.addr==128.119.245.12

No.	Time	Source	Destination	Protocol	Length	Info
24	1.178488	172.31.130.217	128.119.245.12	TCP	803	52836 → 80 [PSH, ACK] Seq=1237767729 Ack=599494
25	1.178644	172.31.130.217	128.119.245.12	TCP	13098	52836 → 80 [ACK] Seq=1237768466 Ack=599494355 W
26	1.182236	128.119.245.12	172.31.130.217	TCP	66	80 → 52829 [FIN, ACK] Seq=666518807 Ack=1213122
27	1.182275	172.31.130.217	128.119.245.12	TCP	66	52829 → 80 [ACK] Seq=1213122371 Ack=660518808 W
28	1.182314	128.119.245.12	172.31.130.217	TCP	74	80 → 52837 [SYN, ACK] Seq=124659940 Ack=9087753
29	1.182348	172.31.130.217	128.119.245.12	TCP	66	52837 → 80 [ACK] Seq=908775319 Ack=124659941 Wi
30	1.433534	128.119.245.12	172.31.130.217	TCP	74	80 → 52838 [SYN, ACK] Seq=1467904450 Ack=923790
31	1.433602	172.31.130.217	128.119.245.12	TCP	66	52838 → 80 [ACK] Seq=923790986 Ack=1467904451 W
32	1.466543	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237768466 W

Checksum: 0xa483 [unverified]
[Checksum Status: Unverified]
Urgent pointer: 0

- Options: (12 bytes), No-Operation (NOP), No-Operation (NOP), Timestamps
 - > TCP Option - No-Operation (NOP)
 - > TCP Option - No-Operation (NOP)
 - > TCP Option - Timestamps: TStamp 35984478, TSectr 1711728193
 - Kind: Time Stamp Option (8)
 - Length: 10
 - Timestamp value: 35984478
 - Timestamp echo reply: 1711728193

▼ [SEQ/ACK analysis]

- [iRTT: 0.293215000 seconds]
- [Bytes in flight: 13769]
- [Bytes sent since last PSH flag: 13032]

▼ [Timestamps]

tcp and ip.addr==128.119.245.12

No.	Time	Source	Destination	Protocol	Length	Info
42	1.467092	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237775706 Win=44928 Len=0 TStamp=1711
44	1.467239	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=123777154 Win=47872 Len=0 TStamp=1711
46	1.467365	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237778602 Win=50816 Len=0 TStamp=1711
48	1.467403	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237780050 Win=53632 Len=0 TStamp=1711
50	1.467500	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237781498 Win=56576 Len=0 TStamp=1711
53	1.755422	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237782946 Win=59520 Len=0 TStamp=1711
55	1.755478	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237784394 Win=62336 Len=0 TStamp=1711
57	1.755596	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237785842 Win=65286 Len=0 TStamp=1711
59	1.755711	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237787290 Win=68096 Len=0 TStamp=1711

[Calculated window size: 56576]
[Window size scaling factor: 128]
Checksum: 0x958f [unverified]
[Checksum Status: Unverified]
Urgent pointer: 0

- Options: (12 bytes), No-Operation (NOP), No-Operation (NOP), Timestamps
 - > TCP Option - No-Operation (NOP)
 - > TCP Option - No-Operation (NOP)
 - > TCP Option - Timestamps: TStamp 1711728488, TSectr 35984478
 - Kind: Time Stamp Option (8)
 - Length: 10
 - Timestamp value: 1711728488
 - Timestamp echo reply: 35984478

▼ [SEQ/ACK analysis]

- The RTT to ACK the segment was: 0.288896000 seconds
- [iRTT: 0.293215000 seconds]

▼ [Timestamps]

- [Time since first frame in this TCP stream: 0.582911000 seconds]
- [Time since previous frame in this TCP stream: 0.000133000 seconds]

0000 4c cc 6a 83 61 47 3c 8c 40 c3 7a 4e 08 00 45 00 L j aGc @ zN E

Segment3:

33	1.466582	172.31.130.217	128.119.245.12	TCP	1514	52836 → 80 [ACK] Seq=1237781498 Ack=599494355 Win=66560 Len=1448 TStamp=35984765
34	1.466610	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237769914 Win=33408 Len=0 TStamp=1711
35	1.466620	172.31.130.217	128.119.245.12	TCP	2962	52836 → 80 [PSH, ACK] Seq=1237782946 Ack=599494355 Win=66560 Len=2896 TStamp=35984765
36	1.466650	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237771362 Win=36352 Len=0 TStamp=1711

[TCP Flags: -----A---]
Window size value: 260
[Calculated window size: 66560]
[Window size scaling factor: 256]
Checksum: 0xaad9 [unverified]
[Checksum Status: Unverified]
Urgent pointer: 0

- Options: (12 bytes), No-Operation (NOP), No-Operation (NOP), Timestamps
 - > TCP Option - No-Operation (NOP)
 - > TCP Option - No-Operation (NOP)
 - > TCP Option - Timestamps: TStamp 35984765, TSectr 1711728487
 - Kind: Time Stamp Option (8)
 - Length: 10
 - Timestamp value: 35984765
 - Timestamp echo reply: 1711728487

▼ [SEQ/ACK analysis]

- [iRTT: 0.293215000 seconds]
- [Bytes in flight: 14480]
- [Bytes sent since last PSH flag: 14480]

tcp and ip.addr==128.119.245.12

Time	Source	Destination	Protocol	Length	Info
43 1.467104	172.31.130.217	128.119.245.12	TCP	2962	52836 → 88 [ACK] Seq=1237794530 Ack=599494355 Win=66560 Len=2896 Tsvval=35984766
44 1.467239	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=123777154 Win=47872 Len=0 Tsvval=1711728488 T	
45 1.467249	172.31.130.217	128.119.245.12	TCP	2962	52836 → 88 [ACK] Seq=1237797426 Ack=599494355 Win=66560 Len=2896 Tsvval=35984766
46 1.467365	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=123777860 Win=50812 Len=0 Tsvval=1711728488 T	
47 1.467379	172.31.130.217	128.119.245.12	TCP	2962	52836 → 88 [PSH, ACK] Seq=1237800322 Ack=599494355 Win=66560 Len=2896 Tsvval=35984766
48 1.467403	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=1237780050 Win=53632 Len=0 Tsvval=1711728488 T	
49 1.467407	172.31.130.217	128.119.245.12	TCP	2962	52836 → 88 [ACK] Seq=1237803218 Ack=599494355 Win=66560 Len=2896 Tsvval=35984766
50 1.467450	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=1237781499 Win=56576 Len=0 Tsvval=1711728488 T	
51 1.467549	172.31.130.217	128.119.245.12	TCP	2962	52836 → 88 [ACK] Seq=1237806114 Ack=599494355 Win=66560 Len=2896 Tsvval=35984766
53 1.755422	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=1237782946 Win=59520 Len=0 Tsvval=1711728775 T	
54 1.755449	172.31.130.217	128.119.245.12	TCP	2962	52836 → 88 [ACK] Seq=1237806010 Ack=599494355 Win=66560 Len=2896 Tsvval=3598504
55 1.755478	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=1237784394 Win=62336 Len=0 Tsvval=1711728775 T	

<

```

.... .1 .... = Acknowledgment: Set
.... .0... = Push: Not set
.... .0.. = Reset: Not set
.... .0. = Syn: Not set
.... .0 = Fin: Not set
[TCP Flags: .....A....]
Window size value: 465
[Calculated window size: 59520]
[Window size scaling factor: 128]
Checksum: 0x8d92 [unverified]
[Checksum Status: Unverified]
Urgent pointer: 0
` Options: (1 bytes), No-Operation (NOP), No-Operation (NOP), Timestamps
    > TCP Option - No-Operation (NOP)
    > TCP Option - No-Operation (NOP)
    < TCP Option - Timestamps: Tsvval 1711728775, TSecr 35984765
        Kind: Time Stamp Option (8)
        Length: 10
        Timestamp value: 1711728775
        Timestamp echo reply: 35984765
` [SEQ/ACK analysis]
    [THIS IS AN ACK TO THE SEGMENT IN FRAME: 43]
    [The RTT to ACK the segment was: 0.288840000 seconds]
    [RTT: 0.293215000 seconds]
` [Timestampos]

```

Segment4:

tcp and ip.addr==128.119.245.12

Time	Source	Destination	Protocol	Length	Info
30 1.433534	128.119.245.12	172.31.130.217	TCP	74 80 → 52838 [SYN, ACK] Seq=1467904450 Ack=923790986 Win=28960 Len=0 MSS=1460	
31 1.433602	172.31.130.217	128.119.245.12	TCP	66 52838 → 80 [ACK] Seq=923790986 Ack=1467904451 Win=66560 Len=0 Tsvval=3598473	
32 1.466543	128.119.245.12	172.31.130.217	TCP	66 80 → 52838 [ACK] Seq=599494355 Ack=1237768464 Win=30464 Len=0 Tsvval=1711728	
33 1.466582	172.31.130.217	128.119.245.12	TCP	1514 52836 → 80 [ACK] Seq=1237781499 Ack=599494355 Win=66560 Len=1440 Tsvval=3598	
34 1.466610	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=1237769914 Win=33408 Len=0 Tsvval=1711728	
35 1.466620	172.31.130.217	128.119.245.12	TCP	2962 52836 → 80 [PSH, ACK] Seq=1237782946 Ack=599494355 Win=66560 Len=2896 Tsvval=35984766	
36 1.466650	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=123771363 Win=36352 Len=0 Tsvval=1711728	
37 1.466658	172.31.130.217	128.119.245.12	TCP	2962 52836 → 80 [ACK] Seq=1237785842 Ack=599494355 Win=66560 Len=2896 Tsvval=3598	
38 1.466785	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=1237772810 Win=39168 Len=0 Tsvval=1711728	
39 1.466797	172.31.130.217	128.119.245.12	TCP	2962 52836 → 80 [ACK] Seq=1237788738 Ack=599494355 Win=66560 Len=2896 Tsvval=3598	
40 1.466887	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=1237774258 Win=42112 Len=0 Tsvval=1711728	
41 1.466898	172.31.130.217	128.119.245.12	TCP	2962 52836 → 80 [ACK] Seq=1237791634 Ack=599494355 Win=66560 Len=2896 Tsvval=3598	

<

```

.... .1 .... = Acknowledgment: Set
.... .1... = Push: Set
.... .0.. = Reset: Not set
.... .0. = Syn: Not set
.... .0 = Fin: Not set
[TCP Flags: .....AP...]
Window size value: 260
[Calculated window size: 66560]
[Window size scaling factor: 256]
Checksum: 0xa483 [unverified]
[Checksum Status: Unverified]
Urgent pointer: 0
` Options: (12 bytes), No-Operation (NOP), No-Operation (NOP), Timestamps
    > TCP Option - No-Operation (NOP)
    > TCP Option - No-Operation (NOP)
    < TCP Option - Timestamps: Tsvval 35984766, TSecr 1711728487
        Kind: Time Stamp Option (8)
        Length: 10
        Timestamp value: 35984766
        Timestamp echo reply: 35984765
` [SEQ/ACK analysis]
    [iRTT: 0.293215000 seconds]
    [Bytes in flight: 15928]

```

tcp and ip.addr==128.119.245.12						
Time	Source	Destination	Protocol	Length	Info	
51 1.467549	172.31.130.217	128.119.245.12	TCP	2962	52836 → 88 [ACK] Seq=1237806114 Ack=599494355 Win=66560 Len=2896 TSval=65280 Len=0 Tsva	
53 1.755422	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237782946 Win=59520 Len=0 Tsva	
54 1.755449	172.31.130.217	128.119.245.12	TCP	2962	52836 → 88 [ACK] Seq=1237809910 Ack=599494355 Win=66560 Len=2896 TSval=65280 Len=0 Tsva	
55 1.755478	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237784394 Win=62336 Len=0 Tsva	
56 1.755487	172.31.130.217	128.119.245.12	TCP	2962	52836 → 88 [ACK] Seq=1237811906 Ack=599494355 Win=66560 Len=2896 TSval=65280 Len=0 Tsva	
57 1.755596	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237785842 Win=65280 Len=0 Tsva	
58 1.755609	172.31.130.217	128.119.245.12	TCP	2962	52836 → 88 [PSH, ACK] Seq=123778148802 Ack=599494355 Win=66560 Len=2896 TSval=65280 Len=0 Tsva	
59 1.755711	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237787299 Win=68096 Len=0 Tsva	
60 1.755721	172.31.130.217	128.119.245.12	TCP	2962	52836 → 88 [ACK] Seq=1237817698 Ack=599494355 Win=66560 Len=2896 TSval=65280 Len=0 Tsva	
61 1.755924	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237788738 Win=71040 Len=0 Tsva	
62 1.755933	172.31.130.217	128.119.245.12	TCP	2962	52836 → 88 [ACK] Seq=1237820594 Ack=599494355 Win=66560 Len=2896 TSval=65280 Len=0 Tsva	
63 1.756004	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237790186 Win=73984 Len=0 Tsva	
<						
.... 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						
.... 0.... = Syn: Not set						
.... 0.... = Fin: Not set						
[TCP Flags: -----A----]						
Window size value: 510						
[Calculated window size: 65280]						
[Window size scaling factor: 128]						
Checksum: 0x8214 [unverified]						
[Checksum Status: Unverified]						
Urgent pointer: 0						
▼ Options: (12 bytes), No-Operation (NOP), No-Operation (NOP), Timestamps						
> TCP Option - No-Operation (NOP)						
> TCP Option - No-Operation (NOP)						
▼ TCP Option - Timestamps: TSval 1711728775, TSecr 35984766						
Kind: Time Stamp Option (8)						
Length: 10						
Timestamp value: 1711728775						
Timestamp echo reply: 35984766						
▼ [SEQ/ACK analysis]						
[This is an ACK to the segment in frame: 35]						
[The RTT to ACK the segment was: 0.288976000 seconds]						
0000 4c cc 6a 83 61 47 3c 8c 40 c3 7a 4e 08 00 45 00 L-J-aG- @zN- E-						
0010 00 34 69 c0 40 00 31 06 3b 87 00 77 f5 0c ac 1f -41 @ 1 ;w-----						
0020 82 d9 00 50 ce 64 23 bb 8e d7 49 c7 1c f2 80 10 ...P-d#- .I-----						

Segment5:

tcp and ip.addr==128.119.245.12						
	SOURCE	Destination	Protocol	Length	Info	
30 1.433534	128.119.245.12	172.31.130.217	TCP	74	80 → 52838 [SYN, ACK] Seq=1467904450 Ack=923790986 Win=28960 Len=0 MSS	
31 1.433602	172.31.130.217	128.119.245.12	TCP	66	52838 → 80 [ACK] Seq=923790986 Ack=1467904451 Win=66560 Len=0 TSval=35	
32 1.466543	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237768466 Win=30464 Len=0 TSval=17	
33 1.466582	172.31.130.217	128.119.245.12	TCP	1514	52836 → 80 [ACK] Seq=1237781498 Ack=599494355 Win=66560 Len=1448 TSval	
34 1.466610	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237769914 Win=33408 Len=0 TSval=17	
35 1.466620	172.31.130.217	128.119.245.12	TCP	2962	52836 → 80 [PSH, ACK] Seq=1237782946 Ack=599494355 Win=66560 Len=2896	
36 1.466650	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237771362 Win=36352 Len=0 TSval=17	
37 1.466658	172.31.130.217	128.119.245.12	TCP	2962	52836 → 80 [ACK] Seq=123778584 Ack=599494355 Win=66560 Len=2896 TSval	
38 1.466785	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237772810 Win=39168 Len=0 TSval=17	
39 1.466797	172.31.130.217	128.119.245.12	TCP	2962	52836 → 80 [ACK] Seq=1237788738 Ack=599494355 Win=66560 Len=2896 TSval	
40 1.466887	128.119.245.12	172.31.130.217	TCP	66	80 → 52836 [ACK] Seq=599494355 Ack=1237774258 Win=42112 Len=0 TSval=17	
41 1.466898	172.31.130.217	128.119.245.12	TCP	2962	52836 → 80 [ACK] Seq=1237791634 Ack=599494355 Win=66560 Len=2896 TSval	

<

```

.... 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
.... 0... .... = Syn: Not set
.... 0... .... = Fin: Not set
[TCP Flags: ....A....]
Window size value: 260
[Calculated window size: 66560]
[Window size scaling factor: 256]
Checksum: 0xa483 [unverified]
[Checksum Status: Unverified]
Urgent pointer: 0
▼ Options: (12 bytes), No-Operation (NOP), No-Operation (NOP), Timestamps
  > TCP Option - No-Operation (NOP)
  > TCP Option - No-Operation (NOP)
  ▼ TCP Option - Timestamps: TSval 35984766, TSecr 1711728487
    Kind: Time Stamp Option (8)
    Length: 10
    Timestamp value: 35984766
    Timestamp echo reply: 1711728487
▼ [SEQ/ACK analysis]

```

tcp and ip.addr==128.119.245.12

No.	Time	Source	Destination	Protocol	Length	Info
50	1.467540	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=1237781498 Win=5657	
53	1.755422	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=1237782946 Win=5952	
55	1.755478	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=1237784394 Win=6233	
57	1.755596	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=1237785842 Win=6528	
59	1.755711	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=1237787290 Win=6809	
61	1.755922	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=1237788738 Win=7104	
63	1.756004	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=1237790186 Win=7398	
65	1.756102	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=1237791634 Win=7680	
67	1.756261	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=1237793082 Win=794	

[TCP Flags:A.....]
 Window size value: 555
 [Calculated window size: 71040]
 [Window size scaling factor: 128]
 Checksum: 0x7697 [unverified]
 [Checksum Status: Unverified]
 Urgent pointer: 0
 Options: (12 bytes), No-Operation (NOP), No-Operation (NOP), Timestamps
 > TCP Option - No-Operation (NOP)
 > TCP Option - No-Operation (NOP)
 > TCP Option - Timestamps: TSval 1711728775, TSecr 35984766
 Kind: Time Stamp Option (8)
 Length: 10
 Timestamp value: 1711728775
 Timestamp echo reply: 35984766

▼ [SEQ/ACK analysis]
 [This is an ACK to the segment in frame: 37]
 [The RTT to ACK the segment was: 0.289264000 seconds]
 [iRTT: 0.293215000 seconds]

▼ [Timestamps]

Segment6:

tcp and ip.addr==128.119.245.12

No.	Time	Source	Destination	Protocol	Length	Info
35	1.466620	172.31.130.217	128.119.245.12	TCP	2962 52836 → 80 [PSH, ACK] Seq=1237782946 Ack=599494355 Win=66560 Len=2896 TSval=35984766	
36	1.466658	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=1237771362 Win=36352 Len=0 TSval=1711728487 1	
37	1.466658	172.31.130.217	128.119.245.12	TCP	2962 52836 → 80 [ACK] Seq=1237785842 Ack=599494355 Win=66560 Len=2896 TSval=35984766	
38	1.466785	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=1237772810 Win=39168 Len=0 TSval=1711728487 1	
39	1.466797	172.31.130.217	128.119.245.12	TCP	2962 52836 → 80 [ACK] Seq=1237788738 Ack=599494355 Win=66560 Len=2896 TSval=35984766	
40	1.466887	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=1237774258 Win=42112 Len=0 TSval=1711728487 1	
41	1.466898	172.31.130.217	128.119.245.12	TCP	2962 52836 → 80 [ACK] Seq=1237791634 Ack=599494355 Win=66560 Len=2896 TSval=35984766	
42	1.467092	128.119.245.12	172.31.130.217	TCP	66 80 → 52836 [ACK] Seq=599494355 Ack=1237775706 Win=44928 Len=0 TSval=1711728488 1	
43	1.467104	172.31.130.217	128.119.245.12	TCP	2962 52836 → 80 [ACK] Seq=1237794538 Ack=599494355 Win=66560 Len=2896 TSval=35984766	

▼ Options: (12 bytes), No-Operation (NOP), No-Operation (NOP), Timestamps
 > TCP Option - No-Operation (NOP)
 > TCP Option - No-Operation (NOP)
 > TCP Option - Timestamps: TSval 35984766, TSecr 1711728487
 Kind: Time Stamp Option (8)
 Length: 10
 Timestamp value: 35984766
 Timestamp echo reply: 1711728487

▼ [SEQ/ACK analysis]
 [iRTT: 0.293215000 seconds]
 [Bytes in flight: 18824]

63 1.756004 128.119.245.12 172.31.130.217 TCP 66 80 → 52836 [ACK] Seq=599494355 Ack=1237790186 Win=739
 64 1.756026 172.31.130.217 128.119.245.12 TCP 2962 52836 → 80 [ACK] Seq=1237823490 Ack=599494355 Win=665
 65 1.756102 128.119.245.12 172.31.130.217 TCP 66 80 → 52836 [ACK] Seq=599494355 Ack=1237791634 Win=768
 66 1.756108 172.31.130.217 128.119.245.12 TCP 2962 52836 → 80 [ACK] Seq=1237820580 Ack=599494355 Win=665
 67 1.756261 128.119.245.12 172.31.130.217 TCP 66 80 → 52836 [ACK] Seq=599494355 Ack=1237793082 Win=797
 68 1.756266 172.31.130.217 128.119.245.12 TCP 2962 52836 → 80 [ACK] Seq=1237829282 Ack=599494355 Win=665
 69 1.756331 128.119.245.12 172.31.130.217 TCP 66 80 → 52836 [ACK] Seq=599494355 Ack=1237794530 Win=826

[Window size scaling factor: 128]
 Checksum: 0x6b19 [unverified]
 [Checksum Status: Unverified]
 Urgent pointer: 0
 Options: (12 bytes), No-Operation (NOP), No-Operation (NOP), Timestamps
 > TCP Option - No-Operation (NOP)
 > TCP Option - No-Operation (NOP)
 > TCP Option - Timestamps: TSval 1711728776, TSecr 35984766
 Kind: Time Stamp Option (8)
 Length: 10
 Timestamp value: 1711728776
 Timestamp echo reply: 35984766

▼ [SEQ/ACK analysis]
 [This is an ACK to the segment in frame: 39]
 [The RTT to ACK the segment was: 0.289305000 seconds]
 [iRTT: 0.293215000 seconds]

▼ [Timestamps]

segment	send frame	sequence num	Tsval	Len	response frame	RTT	EstimatedRTT
1	24	1237767729	35984477	737		32	0.288055000
2	25	1237768466	35984478	13032		50	0.288896000
3	33	1237781498	35984765	1448		53	0.288840000
4	35	1237782946	35984766	2896		57	0.288976000
5	37	1237785842	35984766	2896		61	0.289264000
6	39	1237788738	35984766	2896		65	0.289305000
							0.289269125

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

ANS see above

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

me as the sender, the window size is 227

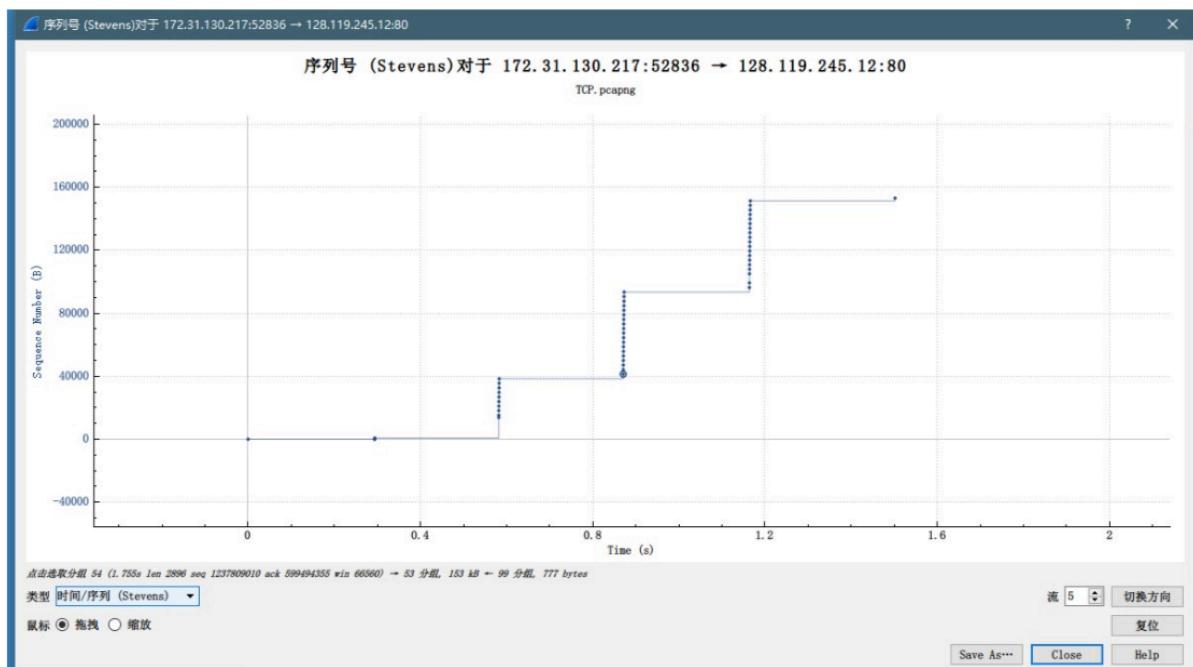
tcp and ip.addr == 128.119.245.12							
No.	Time	Source	Destination	Protocol	Length	Info	
14 0.884320	172.31.130.217	128.119.245.12	TCP	66	52830 → 88	[FIN, ACK] Seq=515011625 Ack=2221222873 Win=260 Len=0 Tsval=35984183 TSecr=1711716357	
15 0.884390	172.31.130.217	128.119.245.12	TCP	66	52830 → 88	[FIN, ACK] Seq=1213122370 Ack=669518807 Win=260 Len=0 Tsval=35984183 TSecr=1711716352	
16 0.884629	172.31.130.217	128.119.245.12	TCP	74	52836 → 88	[SYN] Seq=1237767728 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1 Tsval=35984184 TSecr=0	
17 0.884782	172.31.130.217	128.119.245.12	TCP	74	52837 → 88	[SYN] Seq=988775318 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1 Tsval=35984184 TSecr=0	
19.1.135273	172.31.130.217	128.119.245.12	TCP	74	52839 → 88	[SYN] Seq=9237090985 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1 Tsval=35984184 TSecr=0	
20 1.161038	128.119.245.12	172.31.130.217	TCP	66	80 → 52830	[FIN, ACK] Seq=2221222873 Ack=515011625 Win=227 Len=0 Tsval=1711728193 TSecr=35984183	
22 1.177787	128.119.245.12	172.31.130.217	TCP	74	80 → 52836	[SYN, ACK] Seq=599494354 Ack=1237767729 Win=28960 Len=0 MSS=1460 SACK_PERM=1 Tsval=1711728193 TSecr=1711728193	
23 1.177844	172.31.130.217	128.119.245.12	TCP	66	52836 → 88	[ACK] Seq=1237767729 Ack=599494355 Win=66560 Len=0 Tsval=35984477 TSecr=1711728193	
24 1.178488	172.31.130.217	128.119.245.12	TCP	803	52836 → 88	[PSH, ACK] Seq=1237767729 Ack=599494355 Win=66560 Len=737 Tsval=35984477 TSecr=1711728193	
25 1.178644	172.31.130.217	128.119.245.12	TCP	13098	52836 → 88	[ACK] Seq=1237768466 Ack=599494355 Win=66560 Len=13032 Tsval=35984478 TSecr=1711728193	
26 1.182236	128.119.245.12	172.31.130.217	TCP	66	80 → 52829	[FIN, ACK] Seq=660518807 Ack=1213122371 Win=227 Len=0 Tsval=1711728188 TSecr=35984183	
27 1.182376	172.31.130.217	128.119.245.12	TCP	66	52830 → 88	[ACK] Seq=1213122371 Ack=660518807 Win=100 Len=0 Tsval=1711728188 TSecr=1711728188	
28 1.182314	128.119.245.12	172.31.130.217	TCP	74	80 → 52837	[SYN, ACK] Seq=1246599480 Ack=988775319 Win=28960 Len=0 MSS=1460 SACK_PERM=1 Tsval=1711728193 TSecr=1711728193	
29 1.182348	172.31.130.217	128.119.245.12	TCP	66	52837 → 88	[ACK] Seq=988775319 Ack=1246599481 Win=66560 Len=0 Tsval=35984481 TSecr=1711728193	
30 1.433534	128.119.245.12	172.31.130.217	TCP	74	80 → 52838	[SYN, ACK] Seq=146790450 Ack=9237090986 Win=28960 Len=0 MSS=1460 SACK_PERM=1 Tsval=1711728437 TSecr=1711728437	

No throttle is made due to the lack of buffer space. (window size is not 0)

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

Since the sequence is always going up, no retransmitted segments.



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 250 in the text).

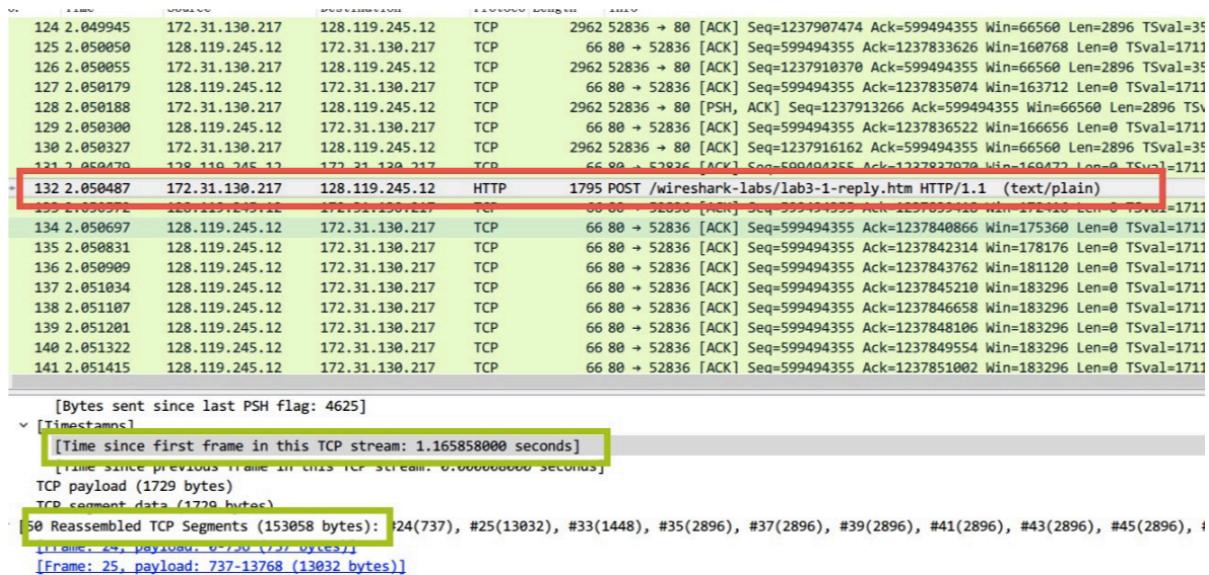
12. What is the throughput (bytes transferred per unit time) for the TCP connection?

Explain how you calculated this value.

ANS

Throughput = (Amount of data transmitted / time incurred)

153058 Bytes / 1.16585800 s = 131283.569697167 Byte/s = 128.206611032 Kb/s



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 slowstart 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.
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