

Lachlan Sinclair

11/6/2019

CS 372\_400

Lab 3:

**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.**

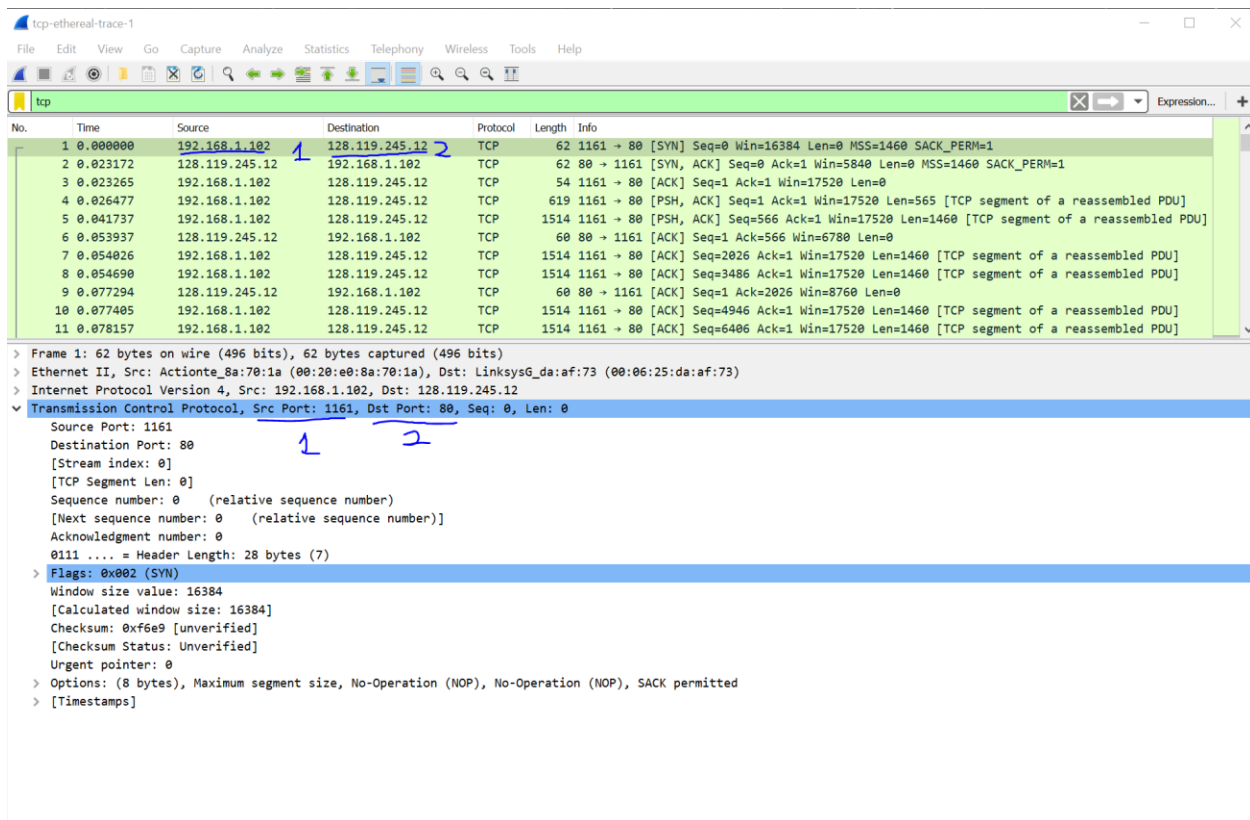
IP addresses of the client: 192.168.1.102

Port number used by the client: 1161

**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?**

IP addresses of gaia.cs.umass.edu: 128.119.245.12

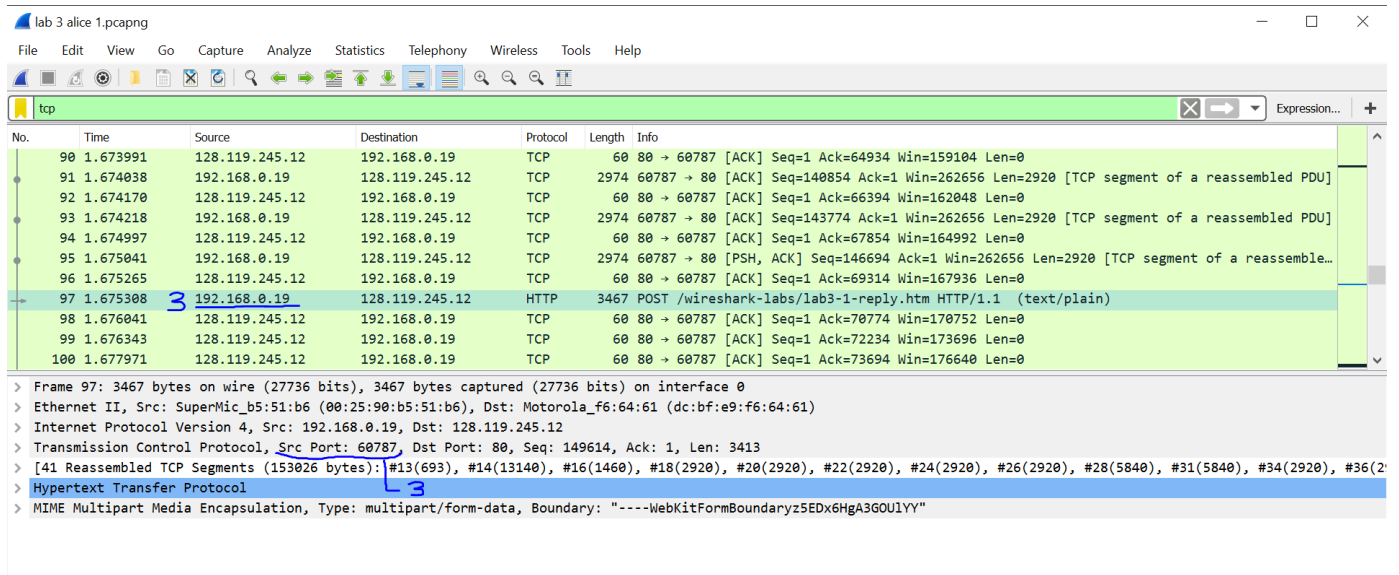
Port number gaia.cs.umass.edu is using: 80



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](http://gaia.cs.umass.edu)?

Client IP address: 192.168.0.19

Client TCP port number: 60787



lab 3 alice 1.pcapng

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tcp

No.	Time	Source	Destination	Protocol	Length	Info
90	1.673991	128.119.245.12	192.168.0.19	TCP	60	80 → 60787 [ACK] Seq=1 Ack=64934 Win=159104 Len=0
91	1.674038	192.168.0.19	128.119.245.12	TCP	2974	60787 → 80 [ACK] Seq=140854 Ack=1 Win=262656 Len=2920 [TCP segment of a reassembled PDU]
92	1.674170	128.119.245.12	192.168.0.19	TCP	60	80 → 60787 [ACK] Seq=1 Ack=66394 Win=162048 Len=0
93	1.674218	192.168.0.19	128.119.245.12	TCP	2974	60787 → 80 [ACK] Seq=143774 Ack=1 Win=262656 Len=2920 [TCP segment of a reassembled PDU]
94	1.674997	128.119.245.12	192.168.0.19	TCP	60	80 → 60787 [ACK] Seq=1 Ack=67854 Win=164992 Len=0
95	1.675041	192.168.0.19	128.119.245.12	TCP	2974	60787 → 80 [PSH, ACK] Seq=146694 Ack=1 Win=262656 Len=2920 [TCP segment of a reassemble...]
96	1.675265	128.119.245.12	192.168.0.19	TCP	60	80 → 60787 [ACK] Seq=1 Ack=69314 Win=167936 Len=0
97	1.675308	192.168.0.19	128.119.245.12	HTTP	3467	POST /wireshark-labs/lab3-1-reply.htm HTTP/1.1 (text/plain)
98	1.676041	128.119.245.12	192.168.0.19	TCP	60	80 → 60787 [ACK] Seq=1 Ack=70774 Win=170752 Len=0
99	1.676343	128.119.245.12	192.168.0.19	TCP	60	80 → 60787 [ACK] Seq=1 Ack=72234 Win=173696 Len=0
100	1.677971	128.119.245.12	192.168.0.19	TCP	60	80 → 60787 [ACK] Seq=1 Ack=73694 Win=176640 Len=0

> Frame 97: 3467 bytes on wire (27736 bits), 3467 bytes captured (27736 bits) on interface 0

> Ethernet II, Src: SuperMic\_b5:51:b6 (00:25:90:b5:51:b6), Dst: Motorola\_f6:64:61 (dc:bf:e9:f6:64:61)

> Internet Protocol Version 4, Src: 192.168.0.19, Dst: 128.119.245.12

> Transmission Control Protocol, Src Port: 60787, Dst Port: 80, Seq: 149614, Ack: 1, Len: 3413

> [41 Reassembled TCP Segments (153026 bytes): #13(693), #14(13140), #16(1460), #18(2920), #20(2920), #22(2920), #24(2920), #26(2920), #28(5840), #31(5840), #34(2920), #36(2920), #38(5840), #40(2920), #42(2920), #44(2920), #46(2920), #48(2920), #50(2920), #52(2920), #54(2920), #56(2920), #58(2920), #60(2920), #62(2920), #64(2920), #66(2920), #68(2920), #70(2920), #72(2920), #74(2920), #76(2920), #78(2920), #80(2920), #82(2920), #84(2920), #86(2920), #88(2920), #90(2920), #92(2920), #94(2920), #96(2920), #98(2920), #100(2920), #102(2920), #104(2920), #106(2920), #108(2920), #110(2920), #112(2920), #114(2920), #116(2920), #118(2920), #120(2920), #122(2920), #124(2920), #126(2920), #128(2920), #130(2920), #132(2920), #134(2920), #136(2920), #138(2920), #140(2920), #142(2920), #144(2920), #146(2920), #148(2920), #150(2920), #152(2920), #154(2920), #156(2920), #158(2920), #160(2920), #162(2920), #164(2920), #166(2920), #168(2920), #170(2920), #172(2920), #174(2920), #176(2920), #178(2920), 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tcp-ethereal-trace-1

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter ... <Ctrl-F> Expression...

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 Win=16384 Len=0 MSS=1460 SACK_PERM=1
2	0.023172	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM=1
3	0.023265	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	0.026477	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565 [TCP segment of a reassembled PDU]
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
6	0.053937	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	0.054026	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
8	0.054690	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
9	0.077294	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	0.077405	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
11	0.078157	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]

> Frame 1: 62 bytes on wire (496 bits), 62 bytes captured (496 bits)

> Ethernet II, Src: Actionte\_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG\_da:af:73 (00:06:25:da:af:73)

> Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12

▼ Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 0, Len: 0

Source Port: 1161

Destination Port: 80

[Stream index: 0]

[TCP Segment Len: 0]

Sequence number: 0 (relative sequence number)

[Next sequence number: 0 (relative sequence number)]

Acknowledgment number: 0

0111 .... = Header Length: 28 bytes (7)

▼ Flags: 0x002 (SYN)

000. .... = Reserved: Not set

...0 .... = Nonce: Not set

...0 .... = Congestion Window Reduced (CWR): Not set

...0 .... = ECN-Echo: Not set

...0 .... = Urgent: Not set

...0 .... = Acknowledgment: Not set

...0 .... = Push: Not set

...0 .... = Reset: Not set

> .... ..1. = Syn: Set

...0 .... = Fin: Not set

[TCP Flags: .....S.]

Window size value: 16384

[Calculated window size: 16384]

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?

The sequence number of the SYNACK segment is 0.

The acknowledgement field is set to 1.

gaia.cs.umass.edu determined that sequence number after successfully receiving the SYN segment, since its sequence number was 0 on the SYN segment it returned 1 since it is the next expected sequence number.

This segment is identified as the SYNACK segment by the SYN and ACK flags being set (0x012)

tcp-ethereal-trace-1

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter ... <Ctrl-F> Expression...

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 Win=16384 Len=0 MSS=1460 SACK_PERM=1
2	0.023172	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM=1
3	0.023265	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	0.026477	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565 [TCP segment of a reassembled PDU]
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
6	0.053937	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	0.054026	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
8	0.054690	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
9	0.077294	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	0.077495	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
11	0.078157	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]

> Frame 2: 62 bytes on wire (496 bits), 62 bytes captured (496 bits)

> Ethernet II, Src: LinksysG\_da:af:73 (00:06:25:da:af:73), Dst: Actionte\_8a:70:1a (00:20:e0:8a:70:1a)

> Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102

▼ Transmission Control Protocol, Src Port: 80, Dst Port: 1161, Seq: 0, Ack: 1, Len: 0

Source Port: 80

Destination Port: 1161

[Stream index: 0]

[TCP Segment Len: 0]

Sequence number: 0 (relative sequence number)

[Next sequence number: 0 (relative sequence number)]

Acknowledgment number: 1 (relative ack number)

0111 .... = Header Length: 28 bytes (7)

▼ 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

.... 0... = Acknowledgment: Set

.... 0... = Push: Not set

.... 0... = Reset: Not set

> .... 0... = Syn: Set

.... 0... = Fin: Not set

[TCP Flags: .....A..S..]

Window size value: 5840

[Calculated window size: 5840]

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.

The sequence number on the TCP segment with the post command is 1.

tcp-ethereal-trace-1

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter ... <Ctrl-F> Expression...

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 Win=16384 Len=0 MSS=1460 SACK_PERM=1
2	0.023172	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM=1
3	0.023265	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	0.026477	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565 [TCP segment of a reassembled PDU]
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
6	0.053937	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	0.054026	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
8	0.054690	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
9	0.077294	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	0.077405	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
11	0.078157	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]

> Frame 4: 619 bytes on wire (4952 bits), 619 bytes captured (4952 bits)

> Ethernet II, Src: Actionte\_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG\_da:af:73 (00:06:25:da:af:73)

> 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)

0101 .... = Header Length: 20 bytes (5)

Flags: 0x018 (PSH, 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

....1. .... = Push: Set

....0. .... = Reset: Not set

....0. .... = Syn: Not set

....0. .... = Fin: Not set

[TCP Flags: .....AP...]

Window size value: 17520

[Calculated window size: 17520]

0000 00 06 25 da af 73 00 20 e0 8a 70 1a 08 00 45 00 ...%s:..:pa:E

0010 02 5d 1e 21 40 00 00 06 a2 e7 c0 a8 01 66 80 77 ...]@:.....f:w

0020 f5 0c 04 09 00 50 0d d6 01 f5 34 a2 74 1a 50 18 ...P:..4:t:P

0030 44 70 1f bd 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 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

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.

All times are in seconds (calculated in excel):

Packet #	1	2	3	4	5	6
Sequence #	1	566	2026	3486	4946	6406
Time Sent	.026477	.041737	.054026	.054690	.077405	.078157
Time the Ack Received	.053937	.077294	.124085	.169118	.217299	.267802
Sample RTT	0.02746	0.035557	0.070059	0.114428	0.139894	0.189645
Estimated RTT	0.02746	0.02847213	0.03367	0.043765	0.055781	0.072514

For segment one, the estimated RTT equal the sample RTT. For the rest I used and alpha value of .125 in the formula estimated RTT = (.875\*estimatedRTT(n-1)) + (.125\*sampleRTT (n))

tcp-ethereal-trace-1

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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 Win=16384 Len=0 MSS=1460 SACK_PERM=1
2	0.023172	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM=1
3	0.023265	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	0.026477	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565 [TCP segment of a reassembled PDU]
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
6	0.053937	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	0.054026	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
8	0.054690	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
9	0.077294	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	0.077405	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
11	0.078157	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]

> Frame 5: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)

> Ethernet II, Src: Actionte\_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG\_da:af:73 (00:06:25:da:af:73)

> Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12

> Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 566, Ack: 1, Len: 1460

- Source Port: 1161
- Destination Port: 80
- [Stream index: 0]
- [TCP Segment Len: 1460]
- Sequence number: 566 (relative sequence number)
- [Next sequence number: 2026 (relative sequence number)]
- Acknowledgment number: 1 (relative ack number)
- 0101 .... = Header Length: 20 bytes (5)
- Flags: 0x018 (PSH, ACK)
- Window size value: 17520
- [Calculated window size: 17520]
- [Window size scaling factor: -2 (no window scaling used)]
- Checksum: 0x3be5 [unverified]
- [Checksum Status: Unverified]
- Urgent pointer: 0
- > [SEQ/ACK analysis]
- > [Timestamps]
- TCP payload (1460 bytes)
- [\[Reassembled PDU in frame: 199\]](#)
- TCP segment data (1460 bytes)

tcp-ethereal-trace-1

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tcp

No.	Time	Source	Destination	Protocol	Length	Info
10	0.077405	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
11	0.078157	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
12	0.124085	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
13	0.124185	192.168.1.102	128.119.245.12	TCP	1201	1161 → 80 [PSH, ACK] Seq=7866 Ack=1 Win=17520 Len=1147 [TCP segment of a reassembled PDU]
14	0.169118	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=4946 Win=14600 Len=0
15	0.217299	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=6406 Win=17520 Len=0
16	0.267802	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=7866 Win=20440 Len=0
17	0.304807	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=9013 Win=23360 Len=0
18	0.305040	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=9013 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
19	0.305813	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=10473 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
20	0.306692	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=11933 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]

> Frame 14: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)

> Ethernet II, Src: Actionte\_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG\_da:af:73 (00:06:25:da:af:73)

> Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12

> Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 566, Ack: 1, Len: 1460

- Source Port: 1161
- Destination Port: 80
- [Stream index: 0]
- [TCP Segment Len: 1460]
- Sequence number: 566 (relative sequence number)
- [Next sequence number: 2026 (relative sequence number)]

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

Segment 1: 565 bytes

Segment 2: 1460 bytes

Segment 3: 1460 bytes

Segment 4: 1460 bytes

Segment 5: 1460 bytes

Segment 6: 1460 bytes

tcp-ethereal-trace-1

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Apply a display filter ... <Ctrl-/> Expression...

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 Win=16384 Len=0 MSS=1460 SACK_PERM=1
2	0.023172	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM=1
3	0.023265	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	0.026477	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565 [TCP segment of a reassembled PDU]
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
6	0.053937	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	0.054026	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
8	0.054690	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
9	0.077294	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	0.077405	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
11	0.078157	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]

> Frame 4: 619 bytes on wire (4952 bits), 619 bytes captured (4952 bits)

> Ethernet II, Src: Actionte\_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG\_da:af:73 (00:06:25:da:af:73)

> 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)
- 0101 .... = Header Length: 20 bytes (5)
- ▼ Flags: 0x018 (PSH, ACK)
- 000. .... = Reserved: Not set
- ...0 .... = Nonce: Not set
- .... 0... = Congestion Window Reduced (CWR): Not set

**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?**

Looking at the first acknowledgement from the server you can see the window size is listed as 5840 bytes.

Looking through the acknowledgements the window size continually increased, and therefore the server was not throttling the sender. See the screen shot below of one of the last acknowledgements, it has a



window size of 17520 bytes.

tcp-ethereal-trace-1

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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 Win=16384 Len=0 MSS=1460 SACK_PERM=1
2	0.023172	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM=1
3	0.023265	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	0.026477	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565 [TCP segment of a reassembled PDU]
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
6	0.053937	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	0.054026	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
8	0.054690	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
9	0.077294	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	0.077405	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
11	0.078157	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]

> Frame 2: 62 bytes on wire (496 bits), 62 bytes captured (496 bits)

> Ethernet II, Src: Linksys\_Gda:af:73 (00:06:25:da:af:73), Dst: Actionte\_8a:70:1a (00:20:e0:8a:70:1a)

> Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102

▼ Transmission Control Protocol, Src Port: 80, Dst Port: 1161, Seq: 0, Ack: 1, Len: 0

Source Port: 80  
Destination Port: 1161  
[Stream index: 0]  
[TCP Segment Len: 0]  
Sequence number: 0 (relative sequence number)  
[Next sequence number: 0 (relative sequence number)]  
Acknowledgment number: 1 (relative ack number)  
0111 .... = Header Length: 28 bytes (7)

> 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]

> [Timestamps]



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tcp

No.	Time	Source	Destination	Protocol	Length	Info
190	5.125019	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=154117 Win=62780 Len=0
191	5.197286	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=156469 Win=62780 Len=0
192	5.197508	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=156469 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
193	5.198388	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=157929 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
194	5.199275	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=159389 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
195	5.200252	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=160849 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
196	5.201150	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=162309 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
197	5.202024	192.168.1.102	128.119.245.12	TCP	326	1161 → 80 [PSH, ACK] Seq=163769 Ack=1 Win=17520 Len=272 [TCP segment of a reassembled PDU]
198	5.297257	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=159389 Win=62780 Len=0
199	5.297341	192.168.1.102	128.119.245.12	HTTP	104	POST /ethereal-labs/lab3-1-reply.htm HTTP/1.1 (text/plain)
200	5.389471	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=162309 Win=62780 Len=0

> Frame 196: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)

> Ethernet II, Src: Actionte\_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG\_da:af:73 (00:06:25:da:af:73)

> Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12

▼ Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 162309, Ack: 1, Len: 1460

Source Port: 1161

Destination Port: 80

[Stream index: 0]

[TCP Segment Len: 1460]

Sequence number: 162309 (relative sequence number)

[Next sequence number: 163769 (relative sequence number)]

Acknowledgment number: 1 (relative ack number)

0101 .... = Header Length: 20 bytes (5)

> Flags: 0x010 (ACK)

Window size value: 17520

[Calculated window size: 17520]

[Window size scaling factor: -2 (no window scaling used)]

Checksum: 0x9567 [unverified]

[Checksum Status: Unverified]

Urgent pointer: 0

> [SEQ/ACK analysis]

> [Timestamps]

TCP payload (1460 bytes)

[\[Reassembled PDU in frame: 199\]](#)

TCP segment data (1460 bytes)

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

There are no retransmissions in the trace files. I checked the sequence numbers used in the sender's packets, the sequence numbers always increased so nothing had to be resent. Also, I have previously used Wireshark and retransmissions show up as super noticeable black entries that are even visible on the scroll bar. The graph in problem 13 also confirms this, since the sequence number always increases.

## 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).

The acks for the most part mirror the 1460 byte size of the segments being sent. In quite a few places there is an ack that is acking every other received segment, there sizes are intervals of 1460 bytes, like in the example below 2920 bytes were acked at the same time.

tcp-ethereal-trace-1

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tcp

No.	Time	Source	Destination	Protocol	Length	Info
88	2.126682	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=64005 Win=62780 Len=0
89	2.203195	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=66357 Win=62780 Len=0
90	2.203411	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=66357 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
91	2.204125	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=67817 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
92	2.204962	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=69277 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
93	2.205836	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=70737 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
94	2.206824	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=72197 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
95	2.207746	192.168.1.102	128.119.245.12	TCP	946	1161 → 80 [PSH, ACK] Seq=73657 Ack=1 Win=17520 Len=892 [TCP segment of a reassembled PDU]
96	2.311413	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=69277 Win=62780 Len=0
97	2.404228	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=72197 Win=62780 Len=0
98	2.476576	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=74549 Win=62780 Len=0

> Frame 96: 60 bytes on wire (480 bits), 60 bytes captured (480 bits)  
 > Ethernet II, Src: LinksysG\_da:af:73 (00:06:25:da:af:73), Dst: Actionte\_8a:70:1a (00:20:e0:8a:70:1a)  
 > 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: 69277, Len: 0

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

The last ack from the server had an ack value of 164091, which means it had received a total of 164091-1=164090 bytes. This last ack was received at time 5.455830. The first packet containing data was sent at time .026477.

Total time of transmission = 5.455830-.026477=5.429353 seconds

Now divide the total number of bytes transferred by the amount of time it took to get the throughput.

Throughput = 164090/5.429353=30222.75398 Bytes/second

tcp-ethereal-trace-1

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Apply a display filter ... <Ctrl-/>

No.	Time	Source	Destination	Protocol	Length	Info
198	5.297257	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=159389 Win=62780 Len=0
199	5.297341	192.168.1.102	128.119.245.12	HTTP	104	POST /ethereal-labs/lab3-1-reply.htm HTTP/1.1 (text/plain)
200	5.389471	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=162309 Win=62780 Len=0
201	5.447887	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=164041 Win=62780 Len=0
202	5.455830	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=164091 Win=62780 Len=0
203	5.461175	128.119.245.12	192.168.1.102	HTTP	784	HTTP/1.1 200 OK (text/html)
204	5.598090	192.168.1.100	192.168.1.1	SSDP	174	M-SEARCH * HTTP/1.1
205	5.599082	192.168.1.100	192.168.1.1	SSDP	175	M-SEARCH * HTTP/1.1
206	5.651141	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=164091 Ack=731 Win=16790 Len=0
207	6.101844	192.168.1.100	192.168.1.1	SSDP	174	M-SEARCH * HTTP/1.1
208	6.102869	192.168.1.100	192.168.1.1	SSDP	175	M-SEARCH * HTTP/1.1

tcp-ethereal-trace-1

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Apply a display filter ... <Ctrl-/>

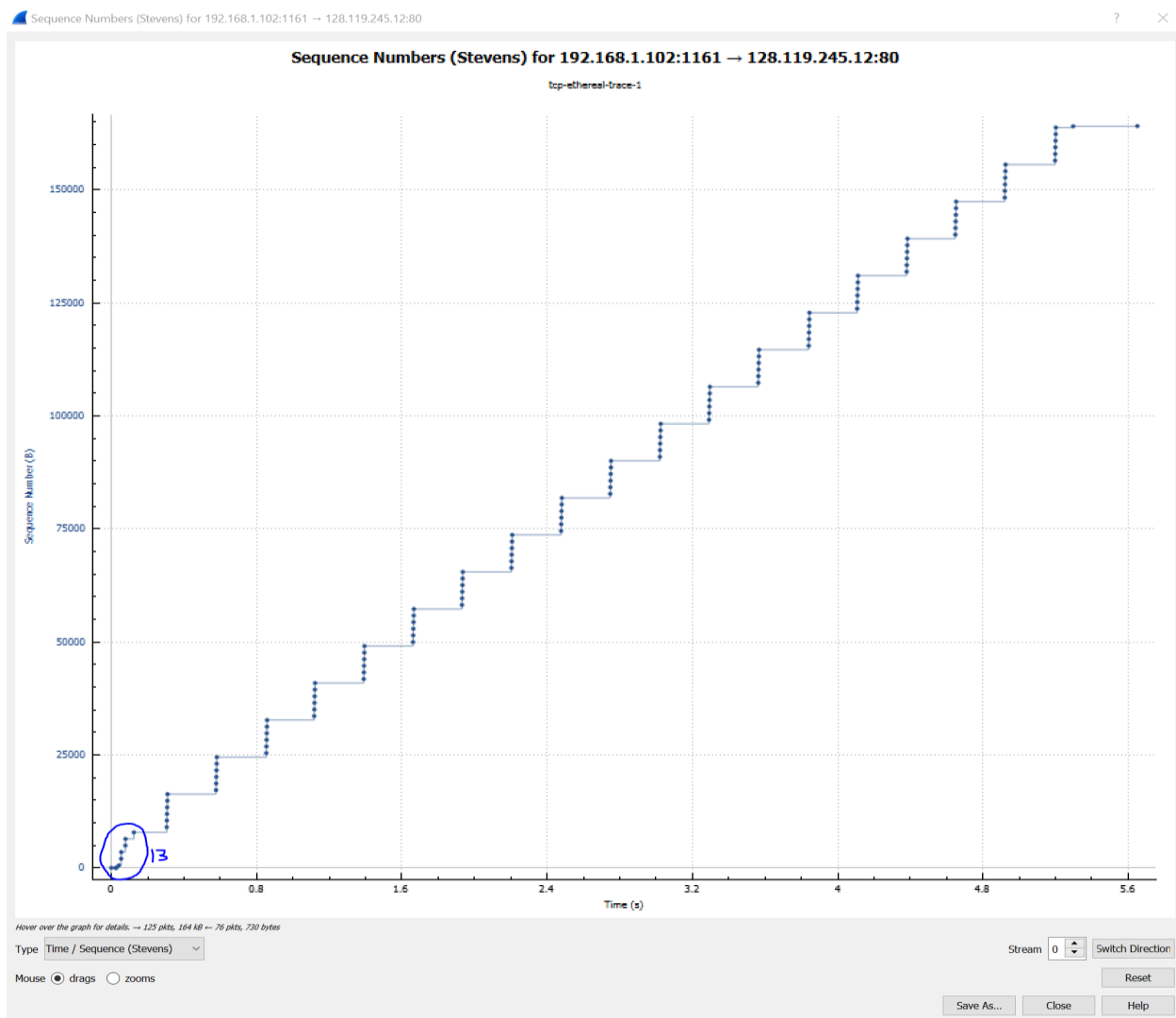
No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.1.102	128.119.245.12	TCP	62	1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1
2	0.023172	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM=1
3	0.023265	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	0.026477	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565 [TCP segment of a reassembled PDU]
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
6	0.053937	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	0.054026	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
8	0.054690	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
9	0.077294	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	0.077405	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
11	0.078157	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]

> Frame 4: 619 bytes on wire (4952 bits), 619 bytes captured (4952 bits)  
 > Ethernet II, Src: Actionte\_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG\_da:af:73 (00:06:25:da:af:73)  
 > 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

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.

By hovering over the values in the graph the slow start begins around .02648 seconds in and ends at .1242 seconds in (exponential growth). At this point congestion avoidance kicks in since the number of bytes waiting to be acked never increases (linear increase).

The idealized version of TCP we have been studying would continue slowstart to use the entire window size the server is advertising rather than keeping it at a steady rate. Which then could be stabilized into a linear growth by congestion control. The congestion avoidance control is the main difference between the graph and the idealized protocol we have been studying.



**14. Answer Question 13 for the trace that you captured when you transferred a file from your own computer to gaia.cs.umass.edu**

The slow start in my graph begins around about .01 seconds (exponential growth). Note, my results matched the issue mentioned earlier in the instructions PDF. My trace recorded the second segment as being over 13 thousand bytes long. The process of continually ramping up the number of bytes sent continues throughout the upload, so the slowstart never really ends. This matches the idealized version of the TCP protocol we have been studying in class since there is no congestion avoidance as seen in problem 13.

