

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).

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
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
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=619
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1514
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=1514
8	0.054690	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1514
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=1514
11	0.078157	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1514

< Frame 4: 619 bytes on wire (4952 bits), 619 bytes captured (4952 bits) on interface 0
 > 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
 > Data (565 bytes)

Using the `tcpethereal-trace-1` file, the IP address is **192.168.1.102** and TCP port number is **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?

No.	Time	Source	Destination	Protocol	Length	Info
149	3.992224	192.168.0.14	128.119.245.12	HTTP	375	POST /wireshark-labs/lab3-1-reply.htm HTTP/1.1
162	4.102804	128.119.245.12	192.168.0.14	HTTP	831	HTTP/1.1 200 OK (text/html)

< Frame 162: 831 bytes on wire (6648 bits), 831 bytes captured (6648 bits) on interface 0
 > Ethernet II, Src: HitronTe_6b:e6:92 (a8:4e:3f:6b:e6:92), Dst: IntelCor_e6:d4:9e (18:5e:0f:e6:d4:9e)
 > Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.0.14
 > Transmission Control Protocol, Src Port: 80, Dst Port: 50425, Seq: 1, Ack: 131447, Len: 777
 Source Port: 80
 Destination Port: 50425
 [Stream index: 5]
 [TCP Segment Len: 777]

Using the trace I captured, the IP address of `gaia.cs.umass.edu` is **128.119.245.12**. On port number **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?

No.	Time	Source	Destination	Protocol	Length	Info
149	3.992224	192.168.0.14	128.119.245.12	HTTP	375	POST /wireshark-labs/lab3-1-reply.htm H
162	4.102804	128.119.245.12	192.168.0.14	HTTP	831	HTTP/1.1 200 OK (text/html)

> Frame 149: 375 bytes on wire (3000 bits), 375 bytes captured (3000 bits) on interface 0
 > Ethernet II, Src: IntelCor_e6:d4:9e (18:5e:0f:e6:d4:9e), Dst: HitronTe_6b:e6:92 (a8:4e:3f:6b:e6:92)
 > Internet Protocol Version 4, Src: 192.168.0.14, Dst: 128.119.245.12
 > Transmission Control Protocol, Src Port: 50425, Dst Port: 80, Seq: 131126, Ack: 1, Len: 321
 Source Port: 50425
 Destination Port: 80
 [Stream index: 5]

My IP address is **192.168.0.14** and TCP port number is **50425**.

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?

No.	Time	Source	Destination	Protocol	Length	Info
23	3.578999	192.168.0.1	192.168.0.14	DNS	93	Standard query response 0xcba0 A gai
24	3.580187	192.168.0.14	128.119.245.12	TCP	66	50425 → 80 [SYN] Seq=0 Win=64240 Len
25	3.667531	128.119.245.12	192.168.0.14	TCP	66	80 → 50425 [SYN, ACK] Seq=0 Ack=1 Wi
26	3.667885	192.168.0.14	128.119.245.12	TCP	54	50425 → 80 [ACK] Seq=1 Ack=1 Win=655
27	3.672115	192.168.0.14	128.119.245.12	TCP	755	50425 → 80 [PSH, ACK] Seq=1 Ack=1 Wi
28	3.674143	192.168.0.14	128.119.245.12	TCP	1514	50425 → 80 [ACK] Seq=702 Ack=1 Win=6

.... 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: 64240

The sequence number of the TCP SYN segment is **0**. The SYN flag is set to **1**, therefore a SYN segment.

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?

No.	Time	Source	Destination	Protocol	Length	Info
23	3.578999	192.168.0.1	192.168.0.14	DNS	93	Standard query response 0xcba0 A gai
24	3.580187	192.168.0.14	128.119.245.12	TCP	66	50425 → 80 [SYN] Seq=0 Win=64240 Len
25	3.667531	128.119.245.12	192.168.0.14	TCP	66	80 → 50425 [SYN, ACK] Seq=0 Ack=1 Wi
26	3.667885	192.168.0.14	128.119.245.12	TCP	54	50425 → 80 [ACK] Seq=1 Ack=1 Win=655
27	3.672115	192.168.0.14	128.119.245.12	TCP	755	50425 → 80 [PSH, ACK] Seq=1 Ack=1 Wi
28	3.674143	192.168.0.14	128.119.245.12	TCP	1514	50425 → 80 [ACK] Seq=702 Ack=1 Win=6

.... 0... .. = Congestion Window Reduced (CWR): Not set
.... .0.. = ECN-Echo: Not set
.... ..0. = Urgent: Not set
.... ...1 = Acknowledgment: Set
.... 0... = Push: Not set
....0.. = Reset: Not set
>1. = Syn: Set

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 and is determined by the gaia.cs.umass.edu (host) server. When the first segment is received, the host (gaia.cs.umass.edu) puts the sequence number of the next byte that the host expects to receive. As a result, since the SYN segment had an initial sequence number 0, the SYNACK segment is numbered 1.

The parts of the segment that identifies the segment as a SYNACK segment are the SYN and Acknowledgement flags. In the SYNACK segment, both flags should be 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.

No.	Time	Source	Destination	Protocol	Length	Info
26	3.667885	192.168.0.14	128.119.245.12	TCP	54	50425 → 80 [ACK] Seq=1 Ack=1 Win=655
27	3.672115	192.168.0.14	128.119.245.12	TCP	755	50425 → 80 [PSH, ACK] Seq=1 Ack=1 Wi
28	3.674143	192.168.0.14	128.119.245.12	TCP	1514	50425 → 80 [ACK] Seq=702 Ack=1 Win=6
29	3.674145	192.168.0.14	128.119.245.12	TCP	1514	50425 → 80 [ACK] Seq=2162 Ack=1 Win=
30	3.674146	192.168.0.14	128.119.245.12	TCP	1514	50425 → 80 [ACK] Seq=3622 Ack=1 Win=
31	3.674153	192.168.0.14	128.119.245.12	TCP	1514	50425 → 80 [ACK] Seq=5082 Ack=1 Win=

Destination Port: 80
[Stream index: 5]
[TCP Segment Len: 701]
Sequence number: 1 (relative sequence number)
[Next sequence number: 702 (relative sequence number)]
Acknowledgment number: 1 (relative ack number)
0101 = Header Length: 20 bytes (5)
▼ Flags: 0x018 (PSH, ACK)

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

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.

No.	Time	Source	Destination	Protocol	Length	Info
4	0.026477	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 L
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=1
8	0.054690	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1
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=1
11	0.078157	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1
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
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=1
19	0.305813	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=10473 Ack=1 Win=17520 Len=
20	0.306692	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=11933 Ack=1 Win=17520 Len=
21	0.307571	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=13393 Ack=1 Win=17520 Len=
22	0.308699	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=14853 Ack=1 Win=17520 Len=
23	0.309552	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=16313 Ack=1 Win=17520 Len=

Note that I used the trace from the *tcpethereal-trace-1* file to answer this question. The sequence numbers of the first six segments are **1, 566, 2026, 3486, 4946, 6406** and were sent at times **0.026477, 0.041737, 0.054026, 0.054690, 0.077405, 0.078157** respectively.

The ACKs for the first six segments were received at times **0.053937, 0.077294, 0.124085, 0.169118, 0.217299, 0.267802** respectively.

Segment 1 RTT = 0.053937 - 0.026477 = **0.02746**

Segment 2 RTT = 0.077294 - 0.041737 = **0.035557**

Segment 3 RTT = 0.124085 - 0.054026 = **0.070059**

Segment 4 RTT = 0.169118 - 0.054690 = **0.11443**

Segment 5 RTT = 0.217299 - 0.077405 = **0.13989**

Segment 6 RTT = 0.267802 - 0.078157 = **0.18964**

After receipt of ACK 1

EstimatedRTT₁ = **0.02746**

After receipt of ACK 2

$$\text{EstimatedRTT}_2 = 0.875 * 0.02746 + 0.125 * 0.035557 = \mathbf{0.028472125}$$

After receipt of ACK 3

$$\text{EstimatedRTT}_3 = 0.875 * 0.028472125 + 0.125 * 0.070059 = \mathbf{0.033760484}$$

After receipt of ACK 4

$$\text{EstimatedRTT}_4 = 0.875 * 0.033760484 + 0.125 * 0.11443 = \mathbf{0.043765424}$$

After receipt of ACK 5

$$\text{EstimatedRTT}_5 = 0.875 * 0.043765424 + 0.125 * 0.13989 = \mathbf{0.055780996}$$

After receipt of ACK 6

$$\text{EstimatedRTT}_6 = 0.875 * 0.055780996 + 0.125 * 0.18964 = \mathbf{0.072513371}$$

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

Note that I restarted the capture for this question.

87	5.421705	192.168.0.14	128.119.245.12	TCP	54	50845	→ 80	[ACK]	Seq=1 Ack=1 Win=131
88	5.429594	192.168.0.14	128.119.245.12	TCP	1514	50845	→ 80	[ACK]	Seq=1 Ack=1 Win=131
89	5.429598	192.168.0.14	128.119.245.12	TCP	1514	50845	→ 80	[ACK]	Seq=1461 Ack=1 Win=
90	5.429601	192.168.0.14	128.119.245.12	TCP	1514	50845	→ 80	[ACK]	Seq=2921 Ack=1 Win=
91	5.429612	192.168.0.14	128.119.245.12	TCP	1514	50845	→ 80	[ACK]	Seq=4381 Ack=1 Win=
92	5.429614	192.168.0.14	128.119.245.12	TCP	1514	50845	→ 80	[ACK]	Seq=5841 Ack=1 Win=
93	5.429616	192.168.0.14	128.119.245.12	TCP	1514	50845	→ 80	[ACK]	Seq=7301 Ack=1 Win=
94	5.429618	192.168.0.14	128.119.245.12	TCP	1514	50845	→ 80	[ACK]	Seq=8761 Ack=1 Win=
95	5.429620	192.168.0.14	128.119.245.12	TCP	1514	50845	→ 80	[ACK]	Seq=10221 Ack=1 Win=
96	5.429622	192.168.0.14	128.119.245.12	TCP	1514	50845	→ 80	[ACK]	Seq=11681 Ack=1 Win=
97	5.429624	192.168.0.14	128.119.245.12	TCP	1514	50845	→ 80	[ACK]	Seq=13141 Ack=1 Win=

> [Timestamps]	
TCP payload (1460 bytes)	
▼ Data (1460 bytes)	
Data: 504f5354202f77697265736861726b2d6c6162732f6c6162...	
[Length: 1460]	

0010	05 dc a3 bb 40 00 80 06	1b 26 c0 a8 00 0e 80 77	...@...&...w
0020	f5 0c c6 9d 00 50 92 ab	54 dc 23 86 cf f0 50 10	...P...T#...P
0030	02 01 42 c9 00 00 50 4f	53 54 20 2f 77 69 72 65	..B...PO ST /wire
0040	73 68 61 72 6b 2d 6c 61	62 73 2f 6c 61 62 33 2d	shark-labs/lab3-
0050	31 2d 72 65 70 6c 79 2e	68 74 6d 20 48 54 54 50	1-reply. htm HTTP
0060	2f 31 2e 31 0d 0a 48 6f	73 74 3a 20 67 61 69 61	/1.1...Host: gaia
0070	2e 63 73 2e 75 6d 61 73	73 2e 65 64 75 0d 0a 43	.cs.umas s.edu..C

The first segment is 1460 bytes, and so were the rest. So, all of the first six TCP segments were 1460 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?

No.	Time	Source	Destination	Protocol	Length	Info
4	3.379471	40.122.162.208	192.168.0.14	TCP	56	443 → 50838 [RST, ACK] Seq=1 Ack=1 Win=0
5	3.499937	192.168.0.14	192.168.0.23	TCP	171	50700 → 8009 [PSH, ACK] Seq=1 Ack=1 Win=0
6	3.506919	192.168.0.23	192.168.0.14	TCP	171	8009 → 50700 [PSH, ACK] Seq=1 Ack=11 Win=0
7	3.560698	192.168.0.14	192.168.0.23	TCP	54	50700 → 8009 [ACK] Seq=118 Ack=118 Win=0
85	5.329861	192.168.0.14	128.119.245.12	TCP	66	50845 → 80 [SYN] Seq=0 Win=64240 Len=0
86	5.421165	128.119.245.12	192.168.0.14	TCP	66	80 → 50845 [SYN, ACK] Seq=0 Ack=1 Win=0
87	5.421705	192.168.0.14	128.119.245.12	TCP	54	50845 → 80 [ACK] Seq=1 Ack=1 Win=131
88	5.429594	192.168.0.14	128.119.245.12	TCP	1514	50845 → 80 [ACK] Seq=1 Ack=1 Win=131
89	5.429598	192.168.0.14	128.119.245.12	TCP	1514	50845 → 80 [ACK] Seq=1461 Ack=1 Win=131
90	5.429601	192.168.0.14	128.119.245.12	TCP	1514	50845 → 80 [ACK] Seq=2921 Ack=1 Win=131
91	5.429612	192.168.0.14	128.119.245.12	TCP	1514	50845 → 80 [ACK] Seq=4381 Ack=1 Win=131

Window size value: 29200
 [Calculated window size: 29200]
 Checksum: 0x24cb [unverified]
 [Checksum Status: Unverified]
 Urgent pointer: 0

The minimum of available buffer space advertised at the received for the entire trace is **29200**.

No, the sender is never throttled.

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

No, there were no retransmitted segments. If there were retransmitted segments, then it would be explicitly stated in the info section with the words "TCP RETRANSMISSION".

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).

No.	Time	Source	Destination	Protocol	Length	Info
105	5.525131	192.168.0.14	128.119.245.12	TCP	1514	50845 → 80 [ACK] Seq=21901 Ack=1 Win=131328 Len=0
106	5.525134	192.168.0.14	128.119.245.12	TCP	1514	50845 → 80 [ACK] Seq=23361 Ack=1 Win=131328 Len=0
107	5.525152	192.168.0.14	128.119.245.12	TCP	1514	50845 → 80 [ACK] Seq=24821 Ack=1 Win=131328 Len=0
108	5.525864	128.119.245.12	192.168.0.14	TCP	56	80 → 50845 [ACK] Seq=1 Ack=10221 Win=49664 Len=0
109	5.525867	128.119.245.12	192.168.0.14	TCP	56	80 → 50845 [ACK] Seq=1 Ack=13141 Win=55552 Len=0
110	5.526331	192.168.0.14	128.119.245.12	TCP	1514	50845 → 80 [ACK] Seq=26281 Ack=1 Win=131328 Len=0
111	5.526335	192.168.0.14	128.119.245.12	TCP	1514	50845 → 80 [ACK] Seq=27741 Ack=1 Win=131328 Len=0
112	5.526337	192.168.0.14	128.119.245.12	TCP	1514	50845 → 80 [ACK] Seq=29201 Ack=1 Win=131328 Len=0
113	5.526340	192.168.0.14	128.119.245.12	TCP	1514	50845 → 80 [ACK] Seq=30661 Ack=1 Win=131328 Len=0
114	5.526343	192.168.0.14	128.119.245.12	TCP	1514	50845 → 80 [ACK] Seq=32121 Ack=1 Win=131328 Len=0
115	5.526346	192.168.0.14	128.119.245.12	TCP	1514	50845 → 80 [ACK] Seq=33581 Ack=1 Win=131328 Len=0

Total Length: 52
 Identification: 0x0000 (0)
 Flags: 0x4000, Don't fragment
 0... .. = Reserved bit: Not set
 1 - Don't fragment: Set

Difference between two consecutive acknowledgements = $13141 - 10221 = 2920$

The receiver typically acknowledges **2920** bytes per ACK.

For all cases, the receiver is ACKing every other received segment.

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

Size: 127 KB (130,500 bytes)

Size on disk: 128 KB (131,072 bytes)

149	1.348741	128.119.245.12	192.168.0.14	TCP	831 80 → 51172 [PSH, ACK] Seq=1 Ack=131447 Win=265
150	1.392368	192.168.0.14	128.119.245.12	TCP	54 51172 → 80 [ACK] Seq=131447 Ack=778 Win=130560
151	1.445833	192.168.0.14	77.234.41.215	TLSv1.2	797 Application Data
152	1.463846	77.234.41.215	192.168.0.14	TLSv1.2	599 Application Data
153	1.505424	192.168.0.14	77.234.41.215	TCP	54 51158 → 443 [ACK] Seq=744 Ack=546 Win=513 Len=
155	6.193341	192.168.0.14	192.168.0.23	TCP	171 50700 → 8009 [PSH, ACK] Seq=118 Ack=118 Win=51
156	6.210345	192.168.0.23	192.168.0.14	TCP	171 8009 → 50700 [PSH, ACK] Seq=118 Ack=235 Win=29
157	6.254181	192.168.0.14	192.168.0.23	TCP	54 50700 → 8009 [ACK] Seq=235 Ack=235 Win=512 Len=
158	6.354220	128.119.245.12	192.168.0.14	TCP	56 80 → 51172 [FIN, ACK] Seq=778 Ack=131447 Win=2
159	6.355108	192.168.0.14	128.119.245.12	TCP	54 51172 → 80 [ACK] Seq=131447 Ack=779 Win=130560
7	0.863766	192.168.0.14	128.119.245.12	TCP	66 51172 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=146
8	0.864000	192.168.0.14	128.119.245.12	TCP	54 51170 → 80 [FIN, ACK] Seq=1 Ack=1 Win=512 Len=
9	0.864037	192.168.0.14	128.119.245.12	TCP	54 51170 → 80 [RST, ACK] Seq=2 Ack=1 Win=0 Len=0
10	0.952463	128.119.245.12	192.168.0.14	TCP	66 80 → 51172 [SYN, ACK] Seq=0 Ack=1 Win=29200 Le
11	0.952900	192.168.0.14	128.119.245.12	TCP	54 51172 → 80 [ACK] Seq=1 Ack=1 Win=131328 Len=0
12	0.957154	128.119.245.12	192.168.0.14	TCP	56 80 → 51170 [ACK] Seq=1 Ack=2 Win=238 Len=0
13	0.958509	192.168.0.14	128.119.245.12	TCP	1514 51172 → 80 [ACK] Seq=1 Ack=1 Win=131328 Len=14
14	0.958512	192.168.0.14	128.119.245.12	TCP	1514 51172 → 80 [ACK] Seq=1461 Ack=1 Win=131328 Len=
15	0.958514	192.168.0.14	128.119.245.12	TCP	1514 51172 → 80 [ACK] Seq=2921 Ack=1 Win=131328 Len=
16	0.958521	192.168.0.14	128.119.245.12	TCP	1514 51172 → 80 [ACK] Seq=4381 Ack=1 Win=131328 Len=
17	0.958523	192.168.0.14	128.119.245.12	TCP	1514 51172 → 80 [ACK] Seq=5841 Ack=1 Win=131328 Len=

[Calculated window size: 131328]				
[Window size scaling factor: 256]				
Checksum: 0x29c1 [unverified]				
[Checksum Status: Unverified]				
Urgent pointer: 0				
[SEQ/ACK analysis]				

0030	02 01 29 c1 00 00 50 4f	53 54 20 2f 77 69 72 65	..)..PO ST /wire
0040	73 68 61 72 6b 2d 6c 61	62 73 2f 6c 61 62 33 2d	shark-la bs/lab3-
0050	31 2d 72 65 70 6c 79 2e	68 74 6d 20 48 54 50	1-reply. htm HTTP
0060	2f 31 2e 31 0d 0a 48 6f	73 74 3a 20 67 61 69 61	/1.1..Ho st: gaia
0070	2e 63 73 2e 75 6d 61 73	73 2e 65 64 75 0d 0a 43	.cs.umas s.edu..C
0080	6f 6e 6e 65 63 74 69 6f	6e 3a 20 6b 65 65 70 2d	onnectio n: keep-
0090	61 6c 69 76 65 0d 0a 43	6f 6e 74 65 6e 74 2d 4c	alive..C ontent-L

Throughput is the “bytes transferred per unit time” as defined the question. As a result, I first took the file size, which on my computer is 130,500 bytes then I calculated the transmission time.

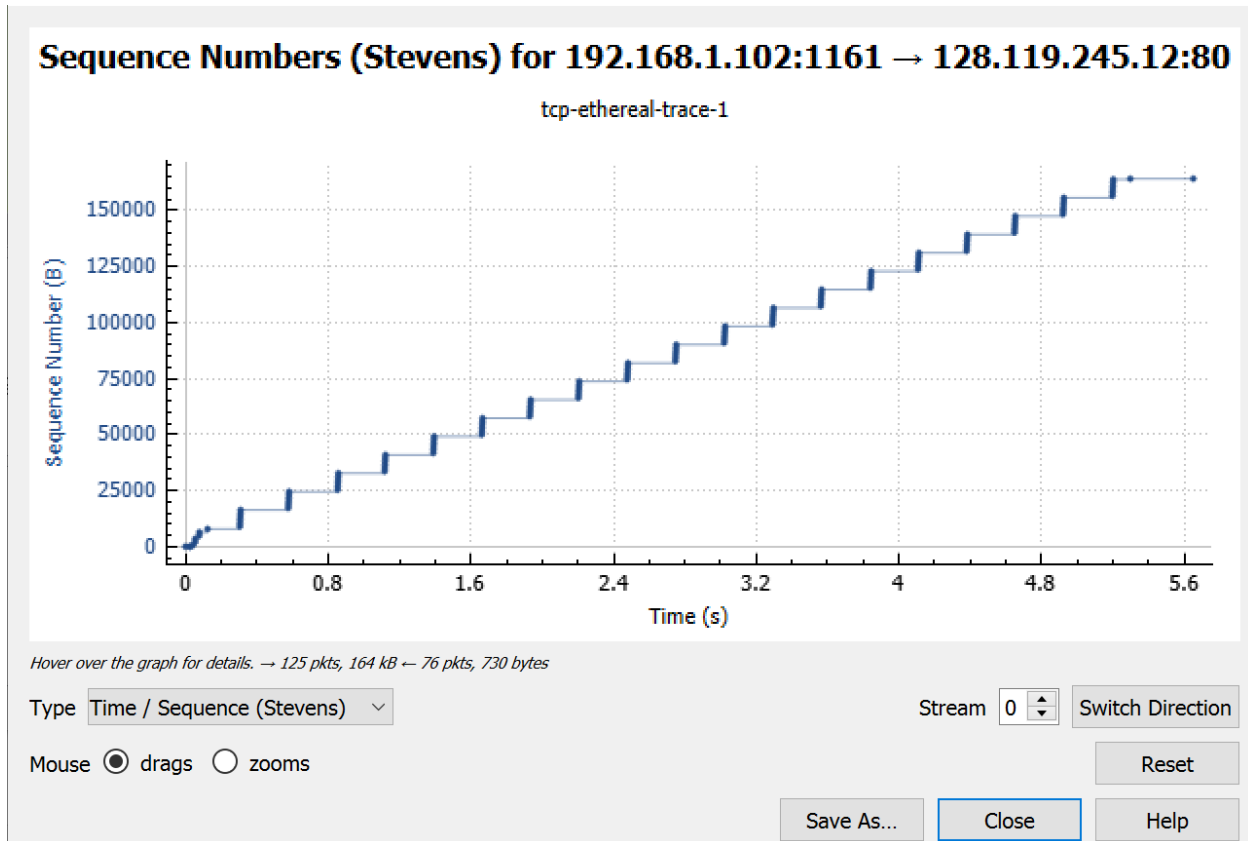
I took the time when the first TCP was sent, and I subtracted it from the Fin ACK.

$$6.354220 - 0.958509 = 5.395711$$

Then I divided the file size by the time.

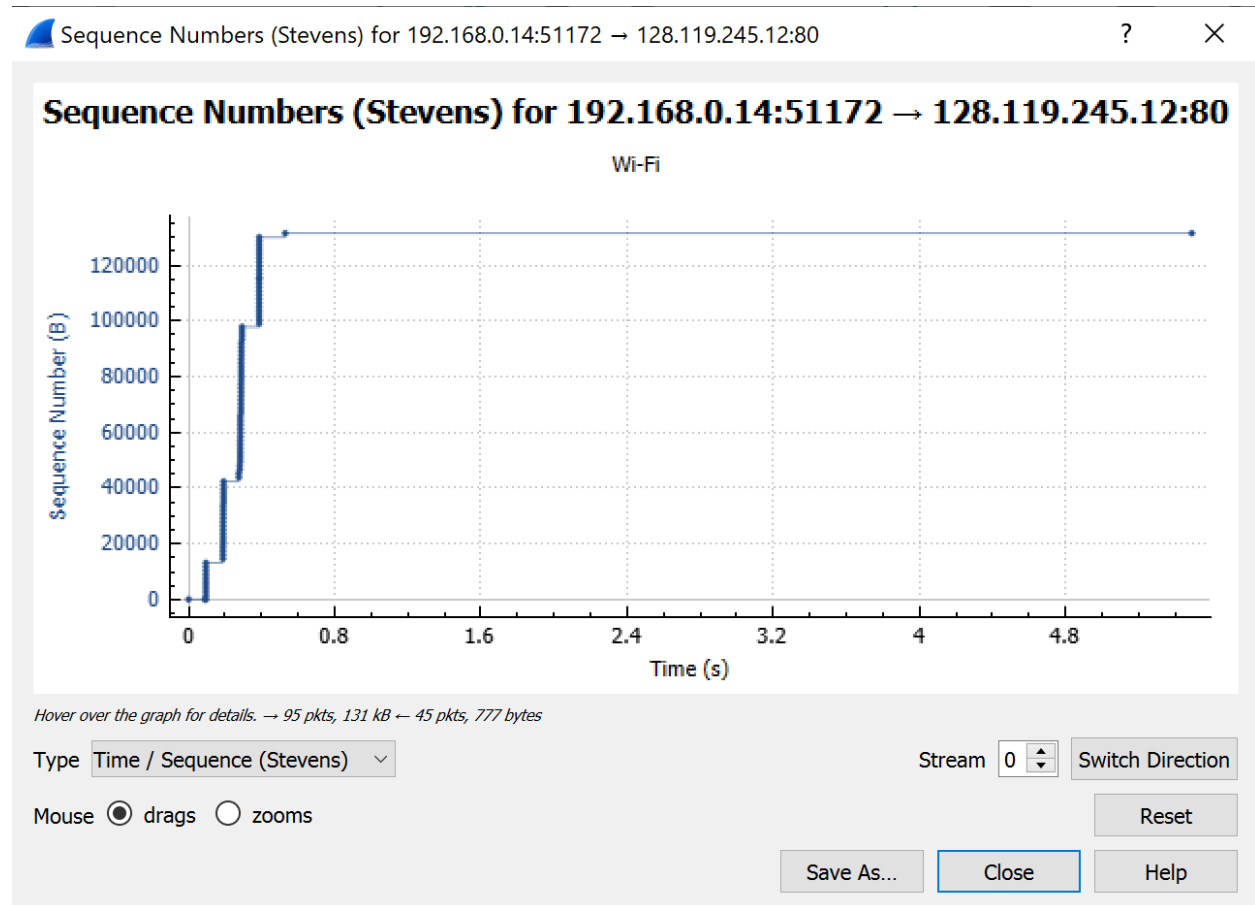
$$130,500 / 5.395711 = \mathbf{24,185.88 \text{ bytes/second}}$$

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.



Slowstart appears to begin at 0.02648 and ends at 0.07741. Congestion avoidance begins at 0.1242.

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



Slowstart appears to begin at 0.1 and ends around 0.6. Congestion avoidance begins at 0.7.