

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

**Client IP/PORT: 192.168.1.102:1161**

5	06:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
6	06:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=1 Ack=566 Win=6780 Len=0
7	06:44:20.624407	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	06:44:20.625071	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	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	06:44:20.647786	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	06:44:20.648538	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[ACK] Seq=6406 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
12	06:44:20.694466	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=1 Ack=3486 Win=11680 Len=0
13	06:44:20.694566	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	06:44:20.739499	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=1 Ack=4946 Win=14600 Len=0
15	06:44:20.787600	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=1 Ack=6406 Win=17520 Len=0
16	06:44:20.838183	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=1 Ack=7866 Win=20440 Len=0

< Frame 5: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface 0  
> Ethernet II, Src: PremaxPe\_8a:20:1a:00:20:00:8a:70:1a, Dst: LinksysG\_d8: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

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?

**Gaia.cs.umass.edu IP/PORT: 128.119.245.12:80**

5	06:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
6	06:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=1 Ack=566 Win=6780 Len=0
7	06:44:20.624407	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	06:44:20.625071	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	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	06:44:20.647786	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	06:44:20.648538	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[ACK] Seq=6406 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
12	06:44:20.694466	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=1 Ack=3486 Win=11680 Len=0
13	06:44:20.694566	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	06:44:20.739499	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=1 Ack=4946 Win=14600 Len=0
15	06:44:20.787600	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=1 Ack=6406 Win=17520 Len=0
16	06:44:20.838183	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=1 Ack=7866 Win=20440 Len=0

< Frame 5: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface 0  
> Ethernet II, Src: PremaxPe\_8a:20:1a:00:20:00:8a:70:1a, Dst: LinksysG\_d8: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

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?

**Client IP/PORT: 10.0.0.170:41077**

58	23:30:43.524390	128.119.245.12	10.0.0.170	TCP	60	80 → 41077	[ACK] Seq=1 Ack=22570 Win=74368 Len=0
59	23:30:43.524484	10.0.0.170	128.119.245.12	TCP	14654	41077 → 80	[PSH, ACK] Seq=44470 Ack=1 Win=65536 Len=14600 [TCP segment of a reassembled PDU]
60	23:30:43.524544	128.119.245.12	10.0.0.170	TCP	60	80 → 41077	[ACK] Seq=1 Ack=26950 Win=83200 Len=0
61	23:30:43.524545	128.119.245.12	10.0.0.170	TCP	60	80 → 41077	[ACK] Seq=1 Ack=28410 Win=86144 Len=0
62	23:30:43.524580	10.0.0.170	128.119.245.12	TCP	11734	41077 → 80	[PSH, ACK] Seq=59070 Ack=1 Win=65536 Len=11680 [TCP segment of a reassembled PDU]
63	23:30:43.525683	128.119.245.12	10.0.0.170	TCP	60	80 → 41077	[ACK] Seq=1 Ack=32790 Win=94848 Len=0
64	23:30:43.525684	128.119.245.12	10.0.0.170	TCP	60	80 → 41077	[ACK] Seq=1 Ack=37170 Win=103552 Len=0
65	23:30:43.525685	128.119.245.12	10.0.0.170	TCP	60	80 → 41077	[ACK] Seq=1 Ack=41550 Win=112384 Len=0
66	23:30:43.525771	10.0.0.170	128.119.245.12	TCP	26334	41077 → 80	[PSH, ACK] Seq=70750 Ack=1 Win=65536 Len=26280 [TCP segment of a reassembled PDU]
67	23:30:43.603099	128.119.245.12	10.0.0.170	TCP	60	80 → 41077	[ACK] Seq=1 Ack=44470 Win=118144 Len=0
68	23:30:43.603230	10.0.0.170	128.119.245.12	TCP	5894	41077 → 80	[PSH, ACK] Seq=97030 Ack=1 Win=65536 Len=5840 [TCP segment of a reassembled PDU]

< Frame 59: 14654 bytes on wire (117232 bits), 14654 bytes captured (117232 bits) on interface 0  
> Ethernet II, Src: AsustekC\_7:65:6e (08:62:66:c7:65:6e), Dst: ArrisGro\_16:67:0b (2c:7e:81:16:67:0b)  
> Internet Protocol Version 4, Src: 10.0.0.170, Dst: 128.119.245.12  
> Transmission Control Protocol, Src Port: 41077, Dst Port: 80, Seq: 44470, Ack: 1, Len: 14600

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?

**The TCP SYN segment has a sequence number of 0 in the trace. The SYN flag is set to 1 which identifies that the segment is a SYN segment.**

1	06:44:20.570381	192.168.1.102	128.119.245.12	TCP	62	1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1
2	06:44:20.593553	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM=1
3	06:44:20.593646	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	06:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565
5	06:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=565 Ack=1 Win=17520 Len=1460
6	06:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	06:44:20.624487	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	06:44:20.647786	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460
11	06:44:20.648538	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460
12	06:44:20.694466	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
13	06:44:20.694566	192.168.1.102	128.119.245.12	TCP	1201	1161 → 80 [PSH, ACK] Seq=7866 Ack=1 Win=17520 Len=1147
14	06:44:20.739499	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=4946 Win=14600 Len=0
15	06:44:20.787680	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=6406 Win=17520 Len=0
16	06:44:20.838183	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=7866 Win=20440 Len=0

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)	
Acknowledgment number: 0	
0111 .... = Header Length: 28 bytes (7)	
Flags: 0x0002 (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: .....A..S.]	

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 sent by gaia.cs.umass.edu is 0. The value of the Acknowledgement field in the SYNACK it is determined by adding 1 to the SYN segment from the client. Therefore the value of the Acknowledgement field in the SYNACK is 1. The segment that identifies the segment as SYN ACK is the SYN and ACK flags are set as 1

1	06:44:20.570381	192.168.1.102	128.119.245.12	TCP	62	1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1
2	06:44:20.593553	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM=1
3	06:44:20.593646	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	06:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565
5	06:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=565 Ack=1 Win=17520 Len=1460
6	06:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	06:44:20.624487	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	06:44:20.647786	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460
11	06:44:20.648538	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460
12	06:44:20.694466	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
13	06:44:20.694566	192.168.1.102	128.119.245.12	TCP	1201	1161 → 80 [PSH, ACK] Seq=7866 Ack=1 Win=17520 Len=1147
14	06:44:20.739499	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=4946 Win=14600 Len=0
15	06:44:20.787680	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=6406 Win=17520 Len=0
16	06:44:20.838183	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=7866 Win=20440 Len=0

[Stream index: 0]	
[TCP Segment Len: 0]	
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	
...1 .... = Acknowledgment: Set	
...0 .... = Push: Not set	
...0 .... = Reset: Not set	
...1 .... = SYN Set	
...0 .... = Fin: Not set	
[TCP Flags: .....A..S.]	

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 4<sup>th</sup> segment which has a sequence number of 1 contains the HTTP POST command.

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1 06:44:20.570381 192.168.1.102 128.119.245.12 TCP 62 1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1
2 06:44:20.593553 128.119.245.12 192.168.1.102 TCP 62 80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM=1
3 06:44:20.593646 192.168.1.102 128.119.245.12 TCP 54 1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4 06:44:20.596858 192.168.1.102 128.119.245.12 TCP 619 1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565
5 06:44:20.612118 192.168.1.102 128.119.245.12 TCP 1514 1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460
6 06:44:20.624318 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7 06:44:20.624407 192.168.1.102 128.119.245.12 TCP 1514 1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460
8 06:44:20.625071 192.168.1.102 128.119.245.12 TCP 1514 1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460
9 06:44:20.647675 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1 Ack=2926 Win=8760 Len=0
10 06:44:20.647786 192.168.1.102 128.119.245.12 TCP 1514 1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460
11 06:44:20.648538 192.168.1.102 128.119.245.12 TCP 1514 1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460
12 06:44:20.694466 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
13 06:44:20.694566 192.168.1.102 128.119.245.12 TCP 1201 1161 → 80 [PSH, ACK] Seq=7886 Ack=1 Win=17520 Len=1147
14 06:44:20.739499 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1 Ack=4946 Win=14600 Len=0
15 06:44:20.787680 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1 Ack=6406 Win=17520 Len=0
16 06:44:20.838183 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1 Ack=7886 Win=20440 Len=0

[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...]

0000 00 06 25 da af 73 00 20 e0 8a 70 1a 08 00 45 00 ..%.s. .P..E.
0018 02 5d 1e 21 40 00 00 06 a2 e7 c9 a8 01 66 80 77 .l.l@... ..f.
0020 f5 0c 04 89 00 50 0d d6 01 f5 34 a2 74 1a 50 18 ....P... ..
0030 44 70 1f bd 00 00 50 4f 53 54 20 2f 65 74 68 65 Dp....PO ST /e/h
0040 72 03 01 0c 20 0c 61 62 73 2f 6c 61 62 35 2d 31 Rell..b s/ldes/
0050 2d 72 65 70 6c 79 2e 68 74 6d 20 48 54 54 50 2f ..reply.h t= HTTP/
0060 31 2e 31 0d 0a 48 6f 73 74 3a 20 67 61 69 61 2e i.l..hos t: gaia
0070 63 73 2e 75 6d 61 73 73 2e 65 64 75 6d 0a 55 72 ck.umass .edu..h

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- 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.

Segment	Seq. #	Send Time	Receive Time	RTT(s)
1	1	0.026477	0.053937	0.02746
2	566	0.041737	0.077294	0.035557
3	2026	0.054026	0.124085	0.070059
4	3486	0.054690	0.169118	0.114428
5	4946	0.077405	0.217299	0.139894
6	6406	0.078157	0.267802	0.189645

Formula = EstimateRTT = 0.875 \* EstimatedRTT + 0.125 \* SampleRTT

Segment	EstimatedRTT
1	<b>0.02746</b>
2	<b>0.02847</b>
3	<b>0.03367</b>
4	<b>0.04376</b>
5	<b>0.05578</b>
6	<b>0.07251</b>

## TCP Connection packet sequence numbers

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
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
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
8	0.054690	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460
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
11	0.078157	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460
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
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
19	0.305813	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=10473 Ack=1 Win=17520 Len=1460
20	0.306692	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=11933 Ack=1 Win=17520 Len=1460
21	0.307571	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=13393 Ack=1 Win=17520 Len=1460
22	0.308699	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=14853 Ack=1 Win=17520 Len=1460
23	0.309553	192.168.1.102	128.119.245.12	TCP	946	1161 → 80 [PSH, ACK] Seq=16313 Ack=1 Win=17520 Len=892
24	0.356437	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=10473 Win=26280 Len=0

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> Frame 11: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)  
> Ethernet II, Src: PremaxPe\_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  
v Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 6406, Ack: 1, Len: 1460  
Source Port: 1161  
Destination Port: 80  
[Stream index: 0]  
[TCP Segment Len: 1460]  
Sequence number: 6406 (relative sequence number)  
[Next sequence number: 7866 (relative sequence number)]  
Acknowledgment number: 1 (relative ack number)

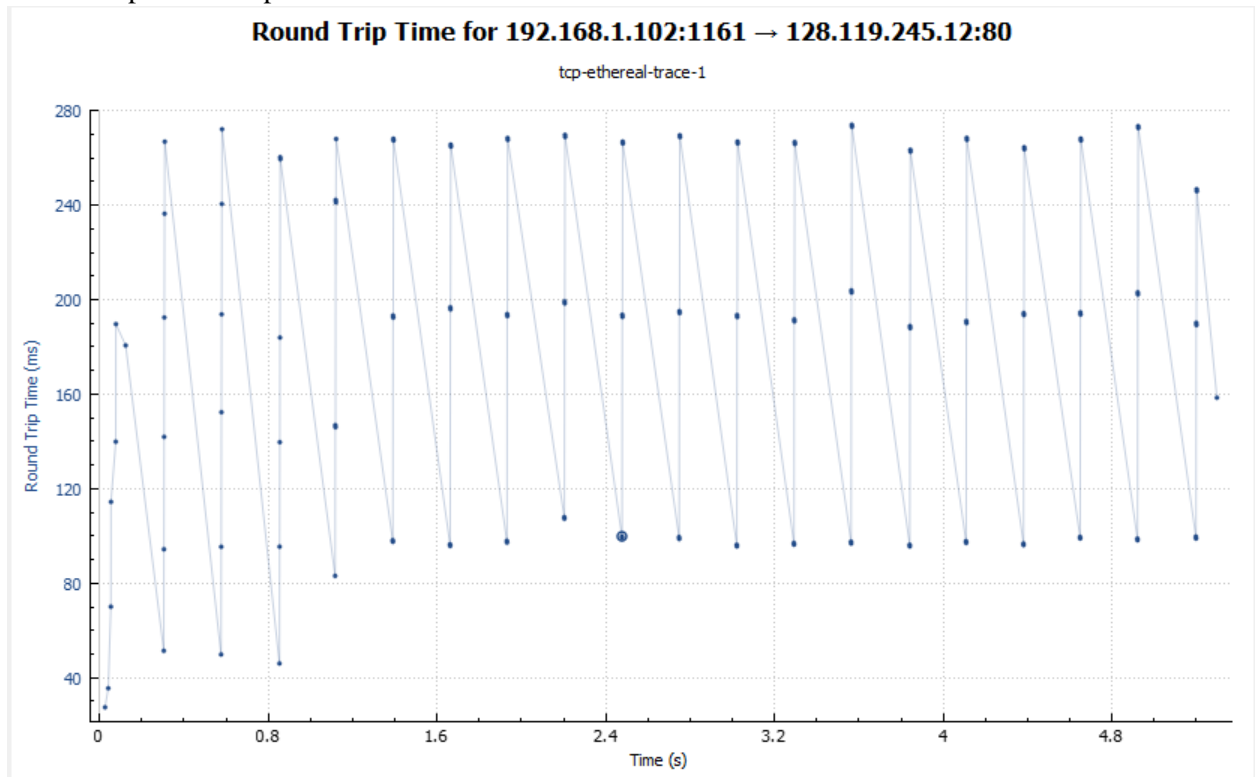
## 6 ACK Sequences

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
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
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
8	0.054690	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460
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
11	0.078157	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460
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
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
19	0.305813	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=10473 Ack=1 Win=17520 Len=1460
20	0.306692	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=11933 Ack=1 Win=17520 Len=1460
21	0.307571	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=13393 Ack=1 Win=17520 Len=1460
22	0.308699	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=14853 Ack=1 Win=17520 Len=1460
23	0.309553	192.168.1.102	128.119.245.12	TCP	946	1161 → 80 [PSH, ACK] Seq=16313 Ack=1 Win=17520 Len=892
24	0.356437	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=10473 Win=26280 Len=0

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> Frame 16: 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: PremaxPe\_8a:70:1a (00:20:e0:8a:70:1a)  
> Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102  
v Transmission Control Protocol, Src Port: 80, Dst Port: 1161, Seq: 1, Ack: 7866, Len: 0  
Source Port: 80  
Destination Port: 1161  
[Stream index: 0]  
[TCP Segment Len: 0]  
Sequence number: 1 (relative sequence number)  
Acknowledgment number: 7866 (relative ack number)  
0101 .... = Header Length: 20 bytes (5)

Round Trip Time Graph



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

**The length of the first segment is 565 bytes.**


4	06:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	1161 → 80	[PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565
5	06:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460
6	06:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=1 Ack=566 Win=6780 Len=0
7	06:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[ACK] Seq=2026 Ack=1 Win=17520 Len=1460
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[ACK] Seq=3486 Ack=1 Win=17520 Len=1460
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	06:44:20.647786	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[ACK] Seq=4946 Ack=1 Win=17520 Len=1460
11	06:44:20.648538	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[ACK] Seq=6406 Ack=1 Win=17520 Len=1460
12	06:44:20.694466	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=1 Ack=3486 Win=11680 Len=0
13	06:44:20.694566	192.168.1.102	128.119.245.12	TCP	1201	1161 → 80	[PSH, ACK] Seq=7866 Ack=1 Win=17520 Len=1147
14	06:44:20.739499	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=1 Ack=4946 Win=14600 Len=0
15	06:44:20.787680	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=1 Ack=6406 Win=17520 Len=0
16	06:44:20.838183	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=1 Ack=7866 Win=20440 Len=0
17	06:44:20.875188	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=1 Ack=9013 Win=23360 Len=0
18	06:44:20.875421	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[ACK] Seq=9013 Ack=1 Win=17520 Len=1460

< Frame 4: 619 bytes on wire (4952 bits), 619 bytes captured (4952 bits)  
> Ethernet II, Src: PremaxPe\_Ba: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)

**The length of the other 5 segments is 1460 bytes.**

5	06:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460
6	06:44:20.624318	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	06:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	06:44:20.647786	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460
11	06:44:20.648538	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=6486 Ack=1 Win=17520 Len=1460
12	06:44:20.694465	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
13	06:44:20.694566	192.168.1.102	128.119.245.12	TCP	1201 1161 → 80 [PSH, ACK] Seq=7866 Ack=1 Win=17520 Len=1147
14	06:44:20.739499	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=4946 Win=14600 Len=0
15	06:44:20.787680	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=6406 Win=17520 Len=0
16	06:44:20.838183	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=7866 Win=20440 Len=0
17	06:44:20.875188	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=9013 Win=23360 Len=0
18	06:44:20.875421	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=9013 Ack=1 Win=17520 Len=1460

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
> Frame 11: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)  
> Ethernet II, Src: PremaxPe\_Ba: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: 6406, Ack: 1, Len: 1460  
Source Port: 1161  
Destination Port: 80  
[Stream index: 0]  
[TCP Segment Len: 1460]   
Sequence number: 6406 (relative sequence number)

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?

**The minimum amount of buffer space is 5840 bytes which can be seen in the initial ACK from the server. Based off the trace the sender is never throttled due to lacking receiver buffer space.**

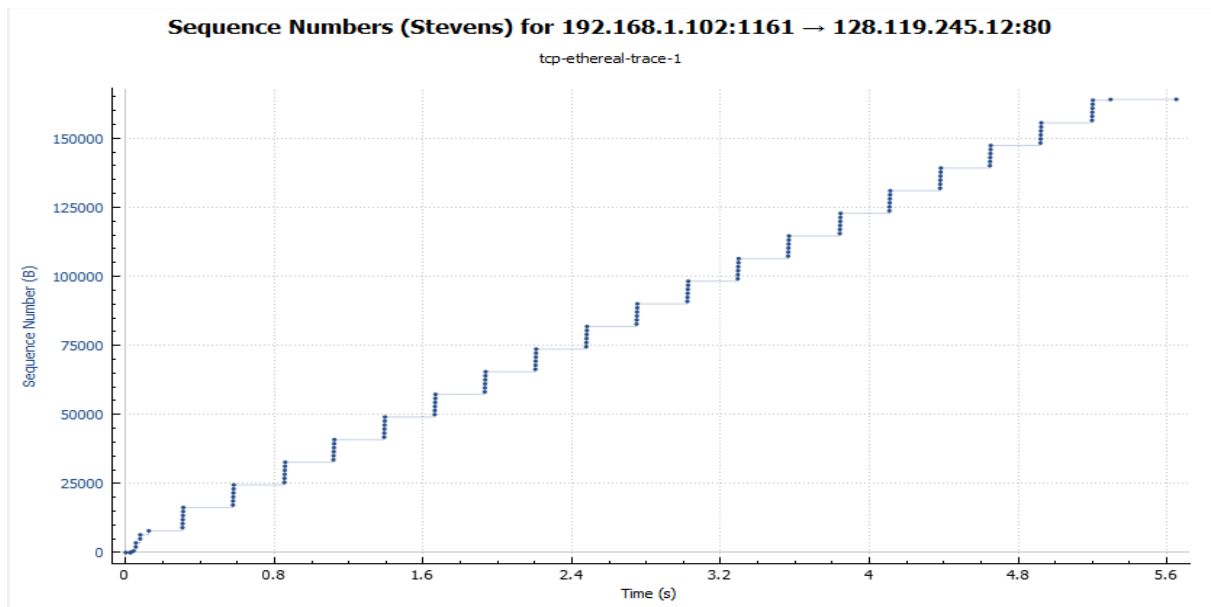
1	06:44:20.570381	192.168.1.102	128.119.245.12	TCP	62 1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1
2	06:44:20.593553	128.119.245.12	192.168.1.102	TCP	62 80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM=1
3	06:44:20.593646	192.168.1.102	128.119.245.12	TCP	54 1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	06:44:20.596858	192.168.1.102	128.119.245.12	TCP	619 1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565
5	06:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460
6	06:44:20.624318	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	06:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	06:44:20.647786	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460
11	06:44:20.648538	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=6486 Ack=1 Win=17520 Len=1460
12	06:44:20.694466	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
13	06:44:20.694566	192.168.1.102	128.119.245.12	TCP	1201 1161 → 80 [PSH, ACK] Seq=7866 Ack=1 Win=17520 Len=1147
14	06:44:20.739499	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=4946 Win=14600 Len=0
15	06:44:20.787680	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=6406 Win=17520 Len=0
16	06:44:20.838183	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=7866 Win=20440 Len=0

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> Ethernet II, Src: LinksysG\_da:af:73 (00:06:25:da:af:73), Dst: PremaxPe\_Ba: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)  
Acknowledgment number: 1 (relative ack number)  
0111... = Header Length: 28 bytes (7)  
✖ Flags: 0x012 (SYN, ACK)  
Window size value: 5840   
[Calculated window size: 5840]

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 are not any retransmitted segments in the trace file, shown by the time-sequence-graph. If there was a retransmitted segment the retransmitted segment would be smaller than the segments around it.**



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 difference between ACK s is the amount of data received by each ACK.**

	ACK Seq. #	ACK Data Size
1	566	566
2	2026	1460
3	3486	1460
4	4946	1460
5	6406	1460
6	7866	1460
7	9013	1460
8	10473	1460
9	11933	1460
10	13393	1460



1	06:44:20.570381	192.168.1.102	128.119.245.12	TCP	62	1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1
2	06:44:20.593553	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM=1
3	06:44:20.593646	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	06:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565
5	06:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460
6	06:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	06:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	06:44:20.647786	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460
11	06:44:20.648538	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460
12	06:44:20.694466	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
13	06:44:20.694566	192.168.1.102	128.119.245.12	TCP	1201	1161 → 80 [PSH, ACK] Seq=7866 Ack=1 Win=17520 Len=1147
14	06:44:20.739499	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=4946 Win=14600 Len=0
15	06:44:20.787680	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=6406 Win=17520 Len=0
16	06:44:20.838183	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=7866 Win=20440 Len=0
17	06:44:20.875188	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=9013 Win=23360 Len=0
18	06:44:20.875421	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=9013 Ack=1 Win=17520 Len=1460
19	06:44:20.876194	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=10473 Ack=1 Win=17520 Len=1460
20	06:44:20.877073	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=11933 Ack=1 Win=17520 Len=1460
21	06:44:20.877952	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=13393 Ack=1 Win=17520 Len=1460
22	06:44:20.879980	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=14853 Ack=1 Win=17520 Len=1460
23	06:44:20.879934	192.168.1.102	128.119.245.12	TCP	946	1161 → 80 [PSH, ACK] Seq=16313 Ack=1 Win=17520 Len=892
24	06:44:20.926818	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=10473 Win=26280 Len=0
25	06:44:20.970545	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=11933 Win=29280 Len=0

> Frame 4: 619 bytes on wire (4952 bits), 619 bytes captured (4952 bits)  
> Ethernet II, Src: PrenaxPe\_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)

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

Explain how you calculated this value.

**You can calculate the throughput by the dividing the total number of bytes transmitted by the total time it takes to transmit.**

Total Transmitted: Sequence - 1 = 164091-1 = 164090 bytes

Total Time: Last ACK - first ACK = 5.45583-0.026477 = 5.4294s

Throughput = Total Transmitted/Total Time = 164090 / 5.4294 = **30222.49 bytes/sec**

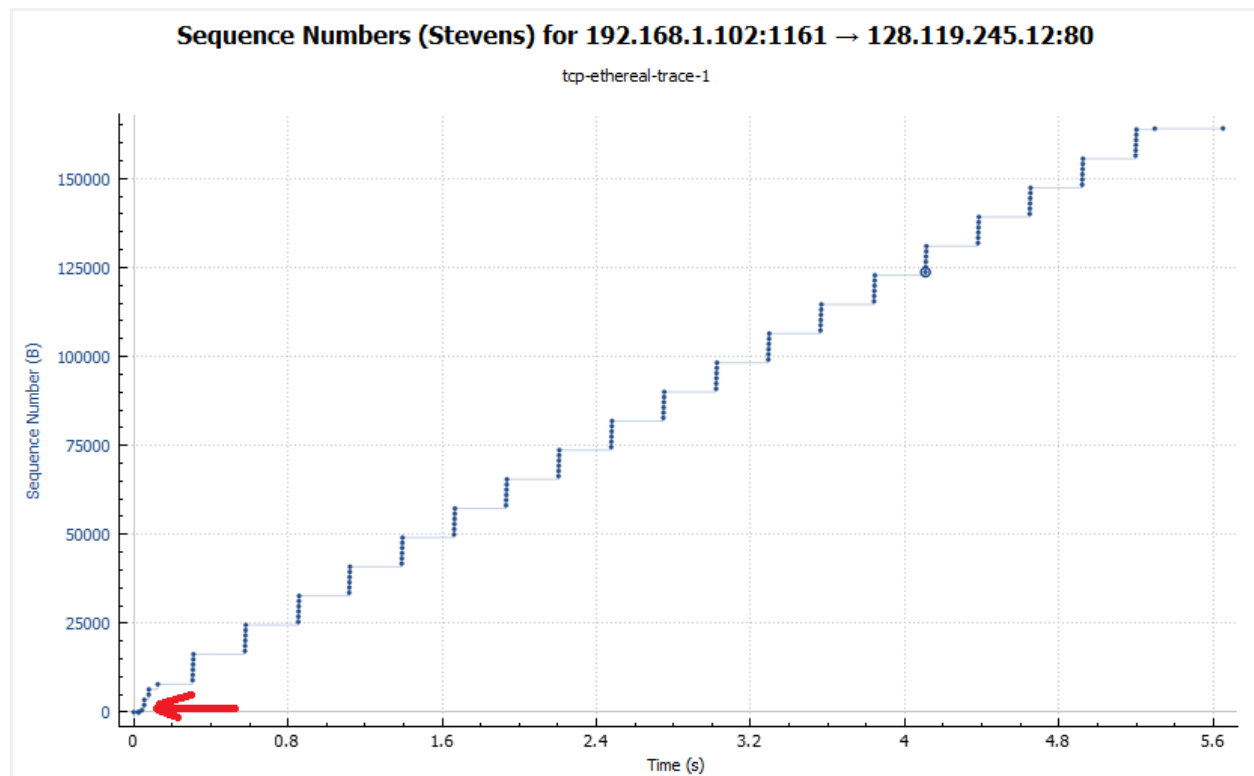
No.	Time	Source	Destination	Protocol	Length	Info
191	5.197286	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=156469 Win=62780 Len=0
192	5.197508	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=156469 Ack=1 Win=17520 Len=1460
193	5.198388	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=157929 Ack=1 Win=17520 Len=1460
194	5.199275	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=159389 Ack=1 Win=17520 Len=1460
195	5.200252	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=160849 Ack=1 Win=17520 Len=1460
196	5.201150	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=162309 Ack=1 Win=17520 Len=1460
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
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	TCP	104	1161 → 80 [PSH, ACK] Seq=164041 Ack=1 Win=17520 Len=50
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	TCP	784	80 → 1161 [PSH, ACK] Seq=1 Ack=164091 Win=62780 Len=730
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	6.181044	192.168.1.100	192.168.1.1	SSDP	174	M-SEARCH * HTTP/1.1
208	6.182069	192.168.1.100	192.168.1.1	SSDP	175	M-SEARCH * HTTP/1.1
209	6.600152	192.168.1.100	192.168.1.1	SSDP	174	M-SEARCH * HTTP/1.1
210	6.601063	192.168.1.100	192.168.1.1	SSDP	175	M-SEARCH * HTTP/1.1
211	7.182852	192.168.1.100	192.168.1.1	SSDP	174	M-SEARCH * HTTP/1.1
212	7.183780	192.168.1.100	192.168.1.1	SSDP	175	M-SEARCH * HTTP/1.1
213	7.595557	192.168.1.102	199.2.53.206	TCP	62	1162 → 631 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1

> Frame 206: 54 bytes on wire (432 bits), 54 bytes captured (432 bits)  
Encapsulation type: Ethernet (1)  
Arrival Time: Aug 21, 2004 06:44:26.221522000 Pacific Daylight Time  
[Time shift for this packet: 0.000000000 seconds]  
Epoch Time: 1093895866.221522000 seconds  
[Time delta from previous captured frame: 0.052059000 seconds]  
[Time delta from previous displayed frame: 0.052059000 seconds]  
[Time since reference or first frame: 5.651141000 seconds]



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.

**The slow start phase lasts for about 0.1 seconds and then the TCP window does not grow. This is shown by the number of packets transmitted after the rate limiting where 6 packets is being sent during each TCP transmit window. This might mean that the data is being limited either by the sender or the server. This differs from the text, which assumes that the TCP senders aggressively send data which may cause network congestion.**



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 is working through the entire TCP session since the window size is continuously increasing during the transfer. Since the transmission window size does not decrease, it does not appear to have congestion control affecting the transfer throughout the transfer. Therefore the behavior is closer to the idealized behavior from the text, since there is no congestion control.**

