

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).

Source	Destination
192.168.1.102	128.119.245.12
Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 151197, Ack: 1, Len: 1460	
Source Port: 1161	
Destination Port: 80	

The client IP address is 192.168.1.102, 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?

Destination
128.119.245.12
Transmission Control Protocol, Src Port: 80, Dst Port: 1161, Seq: 0, Ack: 1, Len: 0
Source Port: 80
Destination Port: 1161

Gaia's IP address is 128.119.245.12, TCP port number is 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?

Source	Destination	Protocol
192.168.0.42	128.119.245.12	TCP
Transmission Control Protocol, Src Port: 56225, Dst Port: 80, Seq: 0, Len: 0		
Source Port: 56225		
Destination Port: 80		

My IP address is 192.168.0.42, TCP port number is 56225

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?

Info

1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1

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)

The sequence number of the TCP SYN segment is 0 because it's used to imitate the TCP connection.

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?

Source	Destination	Protocol	Length	Info
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

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)

Sequence Number (raw): 883061785

[Next Sequence Number: 1 (relative sequence number)]

Acknowledgment Number: 1 (relative ack number)

Acknowledgment number (raw): 232129013

0111 = Header Length: 28 bytes (7)

> Flags: 0x012 (SYN, ACK)

The sequence number of the SYN_ACK segment sent by gaia.cs.umass.edu to the client in reply to the SYN is 0.

The acknowledgement field in the SYN_ACK segment is made by the server at gaia.cs.umass.edu.

The server adds 1 to the sequence number of the SYN segment from the client.

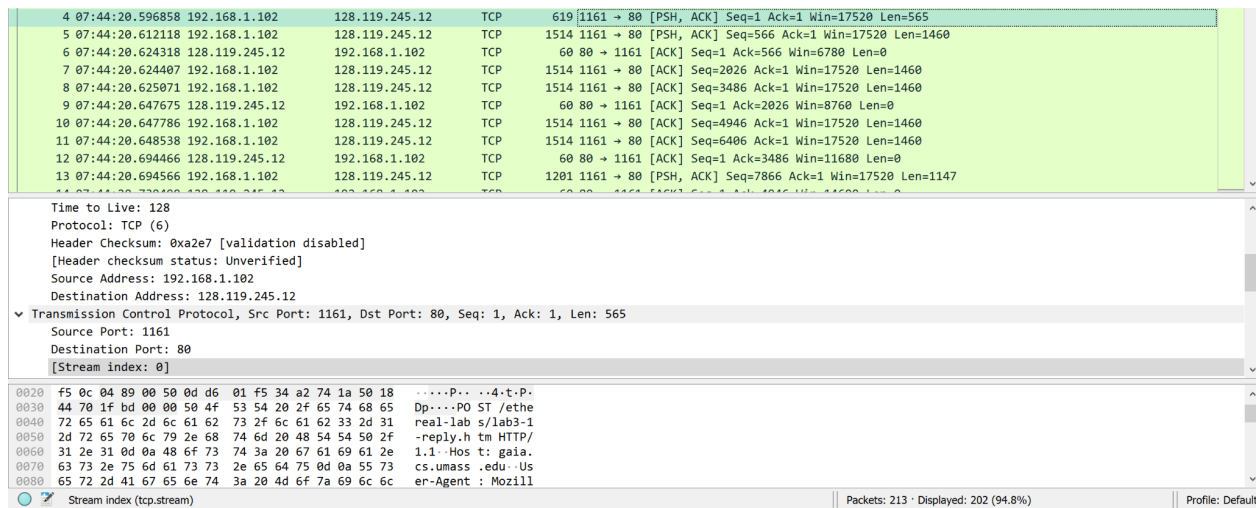
In our example, the sequence number of the SYN segment from the client is 0

So the value of the acknowledgement field in the SYN_ACK segment is 1.

A segment will be identified as a SYN_ACK segment if both the SYN flag and the ACK flag in the segment are 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 “POST” within its DATA field.



```

.....P...4.t.P.
Dp....PO ST /ethe
real-lab s/lab3-1
-reply.h tm HTTP/
1.1..Hos t: gaia.
cs.umass .edu..Us
er-Agent : Mozill

```

The sequence number of the TCP segment containing the Post 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)?

No.	Time	Source	Destination	Protocol	Length	Info
1	07:44:20.570381	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	07:44:20.593553	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	07:44:20.593646	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	07:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565
5	07:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460
6	07:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	07:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460
8	07:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460
9	07:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	07:44:20.647786	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460
11	07:44:20.648538	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460
12	07:44:20.694466	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
13	07:44:20.694566	192.168.1.102	128.119.245.12	TCP	1201	1161 → 80 [PSH, ACK] Seq=7866 Ack=1 Win=17520 Len=1147

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)

Sequence Number (raw): 232129012

[Next Sequence Number: 1 (relative sequence number)]

Acknowledgment Number: 0

Acknowledgment number (raw): 0

```

0000 00 06 25 da af 73 00 20 e0 8a 70 1a 00 00 45 00  ..%.s. .p...E
0010 00 30 1e 1d 40 00 80 06 a5 18 c0 a8 01 66 80 77  0: @... ..f.w
0020 f5 0c 04 89 00 50 0d d6 01 f4 00 00 00 00 70 02  ....P... ..p.
0030 40 00 f6 e9 00 00 02 04 05 b4 01 01 04 02      @.....

```

Stream index (tcp.stream) | Packets: 213 · Displayed: 202 (94.8%) | Profile: Default

No.	Time	Source	Destination	Protocol	Length	Info
1	07:44:20.570381	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	07:44:20.593553	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	07:44:20.593646	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	07:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565
5	07:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460
6	07:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	07:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460
8	07:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460
9	07:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	07:44:20.647786	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460
11	07:44:20.648538	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460
12	07:44:20.694466	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
13	07:44:20.694566	192.168.1.102	128.119.245.12	TCP	1201	1161 → 80 [PSH, ACK] Seq=7866 Ack=1 Win=17520 Len=1147

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)

Sequence Number (raw): 232129578

[Next Sequence Number: 2026 (relative sequence number)]

Acknowledgment Number: 1 (relative ack number)

Acknowledgment number (raw): 883061786

```

0020 f5 0c 04 89 00 50 0d d6 04 2a 34 a2 74 1a 50 18  ....P.. .*4.t.P.
0030 44 70 3b e5 00 00 43 6f 6e 74 65 6e 74 2d 54 79  Dp;...Content-Type
0040 70 65 3a 20 6d 75 6c 74 69 70 61 72 74 2f 66 6f  pe: multipart/form
0050 72 6d 2d 64 61 74 61 3b 20 62 6f 75 6e 64 61 72  rm-data; boundary
0060 79 3d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d  y=-----
0070 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 32 36 35  -----265
0080 30 30 31 39 31 36 39 31 35 37 32 34 0d 0a 43 6f  00191691 5724..Co

```

Sequence number for segment 1 is 1, sequence number for segment 2 is 566.

At what time was each segment sent?

No.	Time	Source	Destination	Protocol	Length
1	07:44:20.570381	192.168.1.102	128.119.245.12	TCP	62
5	07:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514

7:44:20.570381 for segment 1 and 7:44:20.612118 for segment 2.

When was the ACK for each segment received?

2	07:44:20.593553	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
6	07:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0

ACK for segment 1 was received at 7:44:20.593553 and ACK for segment 2 was received at 7:44:20.624318.

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?

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

> [Timestamps]

TCP payload (565 bytes)

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

TCP segment data (565 bytes)

20	f5 0c 04 89 00 50 0d d6	01 f5 34 a2 74 1a 50 18P.. ..4.t.P.
30	44 70 1f bd 00 00 50 4f	53 54 20 2f 65 74 68 65	Dp....PO ST /ethe
40	72 65 61 6c 2d 6c 61 62	73 2f 6c 61 62 33 2d 31	real-lab s/lab3-1
50	2d 72 65 70 6c 79 2e 68	74 6d 20 48 54 54 50 2f	-reply.h tm HTTP/
60	31 2e 31 0d 0a 48 6f 73	74 3a 20 67 61 69 61 2e	1.1..Hos t: gaia.
70	63 73 2e 75 6d 61 73 73	2e 65 64 75 0d 0a 55 73	cs.umass .edu..Us
80	65 72 2d 41 67 65 6e 74	3a 20 4d 6f 7a 69 6c 6c	er-Agent : Mozill

1st segment is 565 bytes

[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)

2nd segment is 1460 bytes

```

[Calculated window size: 17520]
[Window size scaling factor: -2 (no window scaling used)]
Checksum: 0xb98e [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)

```

3rd is 1460 bytes...

Each segment after this is of the same size,
So segments 4-6 are 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?

[Calculated window size: 17520]

```

619 1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=
1514 1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 L
    60 80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
1514 1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1
1514 1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1
    60 80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
1514 1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1
1514 1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1

```

The minimum amount of available buffer space advertised at the received is 17520 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 aren't any retransmitted segments in the trace file. I checked for this by looking for packets with the same sequence number found at different times.

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).

```
Seq=1 Ack=10473
Seq=1 Ack=11933
Seq=1 Ack=13393
Seq=1 Ack=14853
Seq=1 Ack=16313
Seq=1 Ack=17205
```

According to the screenshot, we can see that the ACK numbers increase in the sequence of 10473, 11933, 13393....

The ACK number increases by 1400 each time, which shows that the receiver is acknowledging 1400 bytes.

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

Throughput = Size of Data / Time

Size of Data = 150,965 bytes

Time = 26.031556 - 20.596858 = 5.434698sec

Throughput = 150,965 / 5.434698

=27777 bytes/sec

```
26.031556
```

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

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