

Class: CS-372
Term: Fall 2017
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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`?

Answer:

IP address: 192.168.1.102

Port number: 1161

See screenshot below.

| No. | Time | Source | Destination | Protocol | Length | Info |
|-----|-----------------|----------------|----------------|----------|--------|------------------------------------|
| 1 | 06:44:20.570381 | 192.168.1.102 | 128.119.245.12 | TCP | 62 | 1161 → 80 [SYN] Seq: 1 |
| 2 | 06:44:20.593553 | 128.119.245.12 | 192.168.1.102 | TCP | 62 | 80 → 1161 [SYN, ACK] Seq: 2 → 1162 |
| 3 | 06:44:20.593646 | 192.168.1.102 | 128.119.245.12 | TCP | 54 | 1161 → 80 [ACK] Seq: 1162 → 1163 |

- 2) What is the IP address of `gaia.cs.umass.edu`? On what port number is it sending and receiving TCP segment for this connection?

Answer:

IP address: 128.119.245.12

Port number: 80

See screenshot below.

| No. | Time | Source | Destination | Protocol | Length | Info |
|-----|-----------------|----------------|----------------|----------|--------|---------------------------------------|
| 1 | 06:44:20.570381 | 192.168.1.102 | 128.119.245.12 | TCP | 62 | 1161 → 80 [SYN] Seq: 1 |
| 2 | 06:44:20.593553 | 128.119.245.12 | 192.168.1.102 | TCP | 62 | 80 → 1161 [SYN, ACK] Seq: 2 → 1162 |
| 3 | 06:44:20.593646 | 192.168.1.102 | 128.119.245.12 | TCP | 54 | 1161 → 80 [ACK] Seq: 1162 → 1163 |
| 4 | 06:44:20.596858 | 192.168.1.102 | 128.119.245.12 | TCP | 619 | 1161 → 80 [PSH, ACK] Seq: 1163 → 1782 |
| 5 | 06:44:20.612118 | 192.168.1.102 | 128.119.245.12 | TCP | 1514 | 1161 → 80 [PSH, ACK] Seq: 1783 → 3307 |
| 6 | 06:44:20.624318 | 128.119.245.12 | 192.168.1.102 | TCP | 60 | 80 → 1161 [ACK] Seq: 3308 → 3309 |

- 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?

Answer:

IP address: 192.168.1.7

Port number: 61493

See screenshot below.

| No. | Time | Source | Destination | Protocol | Length | Info |
|-----|-----------------|----------------|----------------|----------|--------|--------------------|
| 55 | 11:55:43.211977 | 192.168.1.7 | 128.119.245.12 | TCP | 78 | 61493 → 80 [SYN] S |
| 56 | 11:55:43.305098 | 128.119.245.12 | 192.168.1.7 | TCP | 74 | 80 → 61493 [SYN, A |
| 57 | 11:55:43.305166 | 192.168.1.7 | 128.119.245.12 | TCP | 66 | 61493 → 80 [ACK] S |

- 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?

Answer:

Sequence number of the TCP SYN segment: 0 (relative sequence number)

Identifier: The Syn flag is set.

See screenshot below.

| No. | Time | Source | Destination | Protocol | Length | Info |
|-----|-----------------|-------------|----------------|----------|--------|--------------------|
| 55 | 11:55:43.211977 | 192.168.1.7 | 128.119.245.12 | TCP | 78 | 61493 → 80 [SYN] S |

▶ Frame 55: 78 bytes on wire (624 bits), 78 bytes captured (624 bits) on interface 0
 ▶ Ethernet II, Src: Apple_38:94:d0 (f4:0f:24:38:94:d0), Dst: Netgear_23:3e:0e (c4:04:15:23:3e:
 ▶ Internet Protocol Version 4, Src: 192.168.1.7, Dst: 128.119.245.12
 ▶ Transmission Control Protocol, Src Port: 61493, Dst Port: 80, Seq: 0, Len: 0

Source Port: 61493
 Destination Port: 80
 [Stream index: 4]
 [TCP Segment Len: 0]
 Sequence number: 0 (relative sequence number)
 Acknowledgment number: 0
 1011 = Header Length: 44 bytes (11)
 ▶ 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

- 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 the value? What is it in the segment that identifies the segment as a SYNACK segment.

Answer:

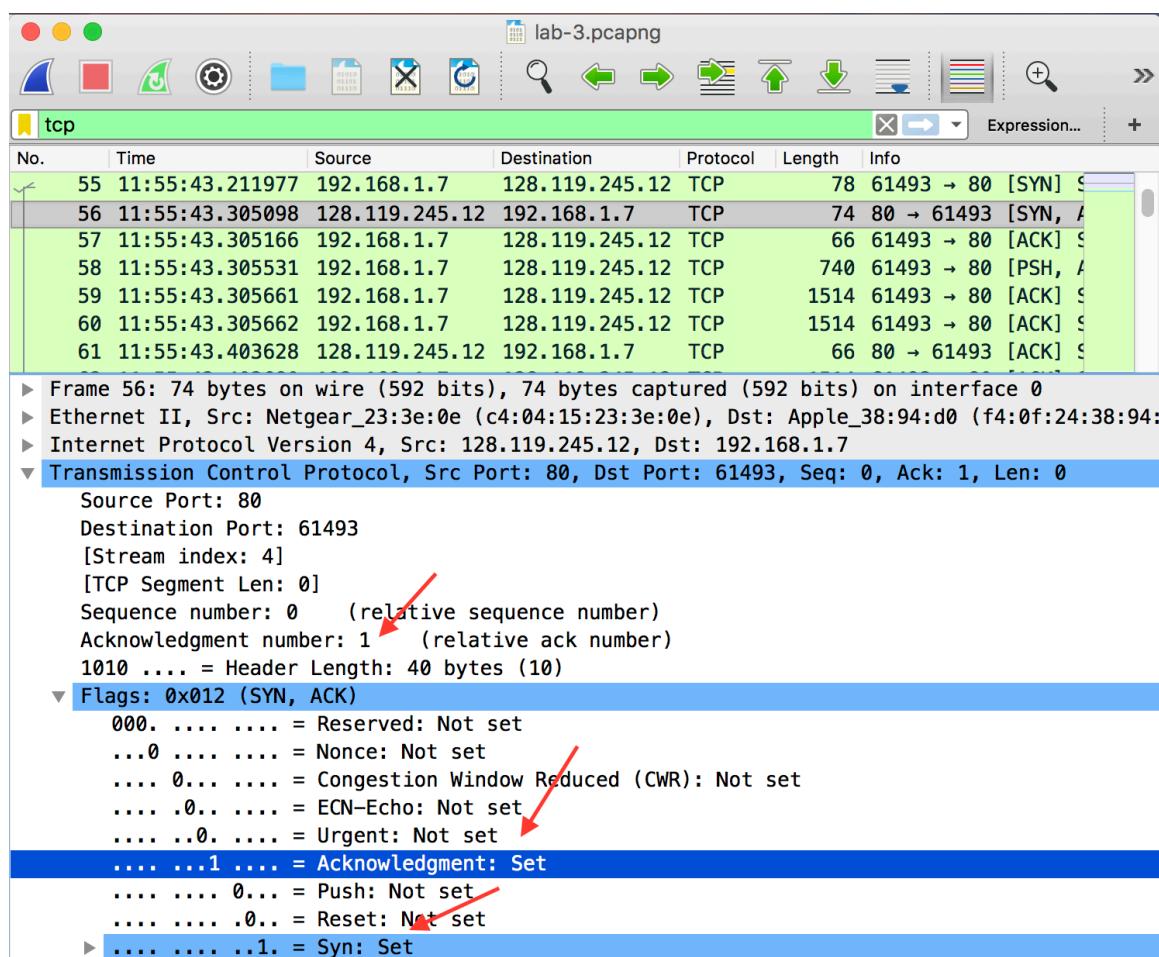
Sequence number of the SYNACK segment: 0

Acknowledgement value in SYNACK segment: 1

How: gaia.cs.umass.edu determined the value by adding 1 to the initial sequence value.

Identifier: The Acknowledgment and Syn flags are set.

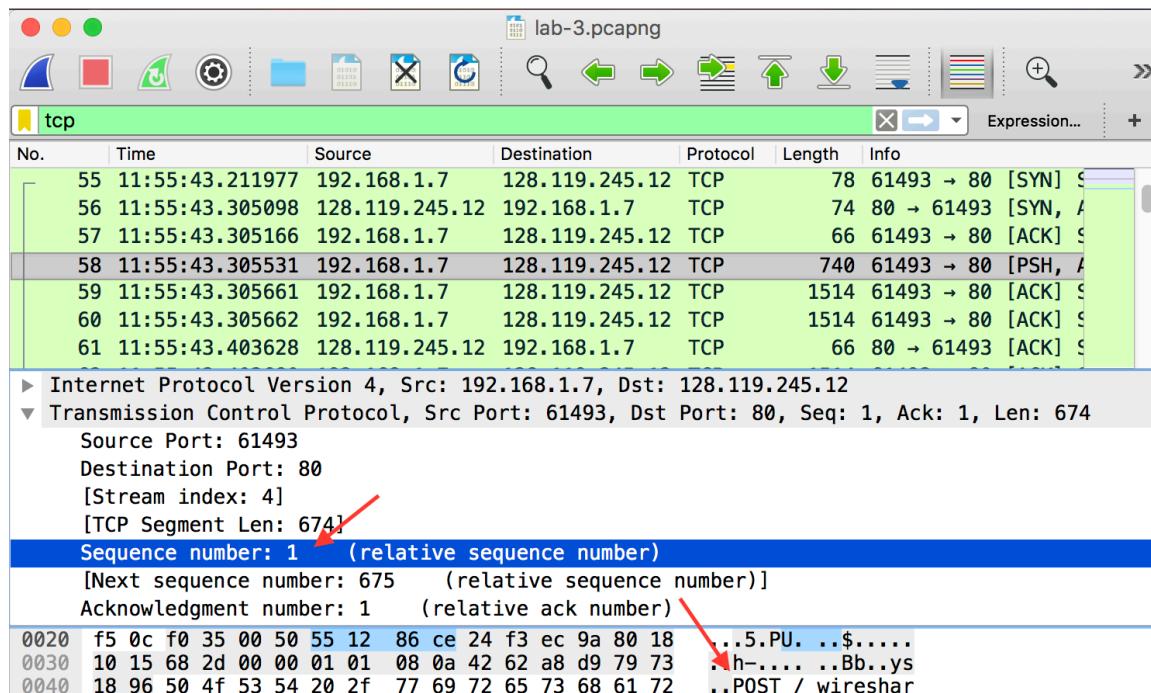
See the screenshot below.



- 6) What is the sequence number of the TCP segment containing the HTTP POST command?

Answer:

Sequence number: 1
See screenshot below.



- 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 Estimated RTT 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.

Answer:

Segment numbers 1-6 are the following: 58,59,60,62,65,66 in the screenshot below.
Acknowledgement segment numbers 1-6 are the following: 61,63,64,69,70,71 in the screenshot below.

Segment number 1

No. 58

Sequence number: 1

Time sent: 11:55:43.305531

No. 61

Time received: 11:55:43.403628

RTT: 0.098097 seconds
EstimatedRTT = 0.098097 seconds

Segment number 2

No. 59
Sequence number: 675
Time sent: 11:55:43.305661
No. 63
Time received: 11:55:43.404498
RTT: 0.098837 seconds
EstimatedRTT = 0.875*EstimatedRTT + 0.125*SampleRTT
EstimatedRTT = 0.875* 0.098097 + 0.125* 0.098837
EstimatedRTT = 0.098189 seconds

Segment number 3

No. 60
Sequence number: 2123
Time sent: 11:55:43.305662
No. 64
Time received: 11:55:43.404501
RTT: 0.098839 seconds
EstimatedRTT = 0.875*EstimatedRTT + 0.125*SampleRTT
EstimatedRTT = 0.875* 0.098189 + 0.125* 0.098839
EstimatedRTT = 0.09827 seconds

Segment number 4

No. 62
Sequence number: 3571
Time sent: 11:55:43.403680
No. 69
Time received: 11:55:43.511239
RTT: 0.107559 seconds
EstimatedRTT = 0.875*EstimatedRTT + 0.125*SampleRTT
EstimatedRTT = 0.875* 0.09827 + 0.125* 0.107559
EstimatedRTT = 0.09943 seconds

Segment number 5

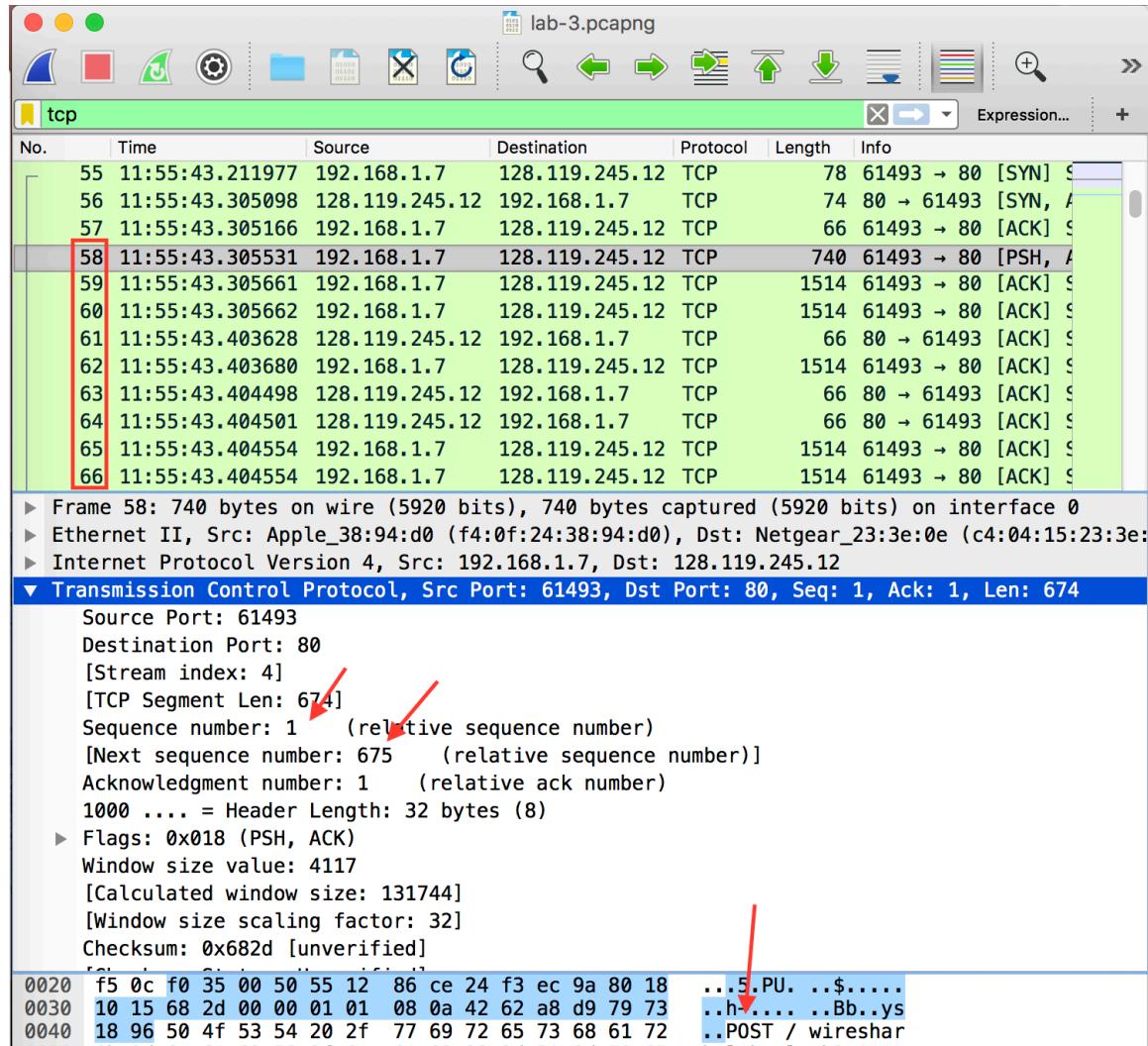
No. 65
Sequence number: 5019
Time sent: 11:55:43.404554
No. 70
Time received: 11:55:43:511243
RTT: 0.106689 seconds
EstimatedRTT = 0.875*EstimatedRTT + 0.125*SampleRTT
EstimatedRTT = 0.875* 0.09943 + 0.125* 0.106689
EstimatedRTT = 0.100337 seconds

Segment number 6

No. 66
Sequence number: 6467
Time sent: 11:55:43.404554
No. 71
Time received: 11:55:43:511244

RTT: 0.10669 seconds
 EstimatedRTT = 0.875*EstimatedRTT + 0.125*SampleRTT
 EstimatedRTT = 0.875* 0.100337 + 0.125* 0.10669
 EstimatedRTT = 0.10113 seconds

See screenshots below.



Screenshot of Wireshark showing a sequence of TCP segments. The first six segments (Frame 61 to Frame 66) are highlighted with a red box. A red arrow points from the question text to the sequence number field of the first segment's details pane.

| No. | Time | Source | Destination | Protocol | Length | Info |
|-----|-----------------|----------------|----------------|----------|--------|------------------|
| 61 | 11:55:43.403628 | 128.119.245.12 | 192.168.1.7 | TCP | 66 | 80 → 61493 [ACK] |
| 62 | 11:55:43.403680 | 192.168.1.7 | 128.119.245.12 | TCP | 1514 | 61493 → 80 [ACK] |
| 63 | 11:55:43.404498 | 128.119.245.12 | 192.168.1.7 | TCP | 66 | 80 → 61493 [ACK] |
| 64 | 11:55:43.404501 | 128.119.245.12 | 192.168.1.7 | TCP | 66 | 80 → 61493 [ACK] |
| 65 | 11:55:43.404554 | 192.168.1.7 | 128.119.245.12 | TCP | 1514 | 61493 → 80 [ACK] |
| 66 | 11:55:43.404554 | 192.168.1.7 | 128.119.245.12 | TCP | 1514 | 61493 → 80 [ACK] |
| 67 | 11:55:43.404554 | 192.168.1.7 | 128.119.245.12 | TCP | 1514 | 61493 → 80 [ACK] |
| 68 | 11:55:43.404555 | 192.168.1.7 | 128.119.245.12 | TCP | 1514 | 61493 → 80 [ACK] |
| 69 | 11:55:43.511239 | 128.119.245.12 | 192.168.1.7 | TCP | 66 | 80 → 61493 [ACK] |
| 70 | 11:55:43.511243 | 128.119.245.12 | 192.168.1.7 | TCP | 66 | 80 → 61493 [ACK] |
| 71 | 11:55:43.511244 | 128.119.245.12 | 192.168.1.7 | TCP | 66 | 80 → 61493 [ACK] |
| 72 | 11:55:43.511245 | 128.119.245.12 | 192.168.1.7 | TCP | 66 | 80 → 61493 [ACK] |
| 73 | 11:55:43.511285 | 128.119.245.12 | 192.168.1.7 | TCP | 66 | 80 → 61493 [ACK] |
| 74 | 11:55:43.511348 | 192.168.1.7 | 128.119.245.12 | TCP | 1514 | 61493 → 80 [ACK] |
| 75 | 11:55:43.511349 | 192.168.1.7 | 128.119.245.12 | TCP | 1514 | 61493 → 80 [ACK] |
| 76 | 11:55:43.511349 | 192.168.1.7 | 128.119.245.12 | TCP | 1514 | 61493 → 80 [ACK] |
| 77 | 11:55:43.511350 | 192.168.1.7 | 128.119.245.12 | TCP | 1514 | 61493 → 80 [ACK] |
| 78 | 11:55:43.511432 | 192.168.1.7 | 128.119.245.12 | TCP | 1514 | 61493 → 80 [ACK] |

Frame details for the first segment:

- Frame 61: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface 0
- Ethernet II, Src: Netgear_23:3e:0e (c4:04:15:23:3e:0e), Dst: Apple_38:94:d0 (f4:0f:24:38:94:d0)
- Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.7
- Transmission Control Protocol, Src Port: 80, Dst Port: 61493, Seq: 1, Ack: 675, Len: 0

Protocol details for the first segment:

- Source Port: 80
- Destination Port: 61493
- [Stream index: 4]
- [TCP Segment Len: 0]
- Sequence number: 1 (relative sequence number)
- Acknowledgment number: 675 (relative ack number)

8) What is the length of each of the six TCP segments?

Answer:

See screenshots below.

Segment number 1

674 bytes

Screenshot of Wireshark showing a sequence of TCP segments. The first segment (Frame 58) is highlighted with a red box. A red arrow points from the question text to the length field of the first segment's details pane.

| No. | Time | Source | Destination | Protocol | Length | Info |
|-----|-----------------|----------------|----------------|----------|--------|-----------------------|
| 58 | 11:55:43.305531 | 192.168.1.7 | 128.119.245.12 | TCP | 740 | 61493 → 80 [PSH, ACK] |
| 59 | 11:55:43.305661 | 192.168.1.7 | 128.119.245.12 | TCP | 1514 | 61493 → 80 [ACK] |
| 60 | 11:55:43.305662 | 192.168.1.7 | 128.119.245.12 | TCP | 1514 | 61493 → 80 [ACK] |
| 61 | 11:55:43.403628 | 128.119.245.12 | 192.168.1.7 | TCP | 66 | 80 → 61493 [ACK] |

Frame details for the first segment:

- Frame 58: 740 bytes on wire (5920 bits), 740 bytes captured (5920 bits) on interface 0
- Ethernet II, Src: Apple_38:94:d0 (f4:0f:24:38:94:d0), Dst: Netgear_23:3e:0e (c4:04:15:23:3e:0e)
- Internet Protocol Version 4, Src: 192.168.1.7, Dst: 128.119.245.12
- Transmission Control Protocol, Src Port: 61493, Dst Port: 80, Seq: 1, Ack: 1, Len: 674

Segment number 2

1448 bytes

The screenshot shows a Wireshark interface with the following details:

- Panels:** Top bar with file, edit, search, and zoom controls; bottom bar with expression and plus sign.
- Toolbar:** Standard Wireshark icons for file operations, selection, and analysis.
- Packet List:** Shows 61 total frames, with frames 58, 59, 60, and 61 highlighted in green. Frame 58 is selected.
- Details:** Shows the structure of frame 58, which is a TCP segment from port 61493 to port 80. It includes fields like Source IP (192.168.1.7), Destination IP (128.119.245.12), Protocol (TCP), Length (740), and Info (PSH, ACK).
- Bytes:** Shows the raw hex and ASCII representation of the selected frame's payload.
- Status Bar:** Shows the frame number (58), bytes (1514), and time (11:55:43.305531).
- Bottom Panel:** Shows expanded details for the selected frame, including:
 - Frame 59: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface 0
 - Ethernet II, Src: Apple_38:94:d0 (f4:0f:24:38:94:d0), Dst: Netgear_23:3e:0e (c4:04:15:23:3e:0)
 - Internet Protocol Version 4, Src: 192.168.1.7, Dst: 128.119.245.12
 - Transmission Control Protocol, Src Port: 61493, Dst Port: 80, Seq: 675, Ack: 1, Len: 1448A red arrow points to the last item in this list.

Segment number 3

1448 bytes

The Wireshark interface displays a list of network frames. The first few frames are highlighted in green, indicating they are selected. The columns shown are No., Time, Source, Destination, Protocol, Length, and Info. The Info column shows details like port numbers and ACK/SYN flags. Below the list, the packet details pane shows the structure of frame 60, which is an ACK from port 80 to port 61493.

| No. | Time | Source | Destination | Protocol | Length | Info |
|-----|-----------------|----------------|----------------|----------|--------|--------------------|
| 59 | 11:55:43.305661 | 192.168.1.7 | 128.119.245.12 | TCP | 1514 | 61493 → 80 [ACK] S |
| 60 | 11:55:43.305662 | 192.168.1.7 | 128.119.245.12 | TCP | 1514 | 61493 → 80 [ACK] S |
| 61 | 11:55:43.403628 | 128.119.245.12 | 192.168.1.7 | TCP | 66 | 80 → 61493 [ACK] S |
| 62 | 11:55:43.403629 | 192.168.1.7 | 128.119.245.12 | TCP | 1514 | 61493 → 80 [ACK] S |

► Frame 60: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface 0
► Ethernet II, Src: Apple_38:94:d0 (f4:0f:24:38:94:d0), Dst: Netgear_23:3e:0e (c4:04:15:23:3e:
► Internet Protocol Version 4, Src: 192.168.1.7, Dst: 128.119.245.12
▼ Transmission Control Protocol, Src Port: 61493, Dst Port: 80, Seq: 2123, Ack: 1, Len: 1448

Segment number 4

1448 bytes

The Wireshark interface displays a list of captured network frames. The first three frames are highlighted in green, indicating they are part of a single TCP session. Frame 62 is the second frame in this session, showing a TCP segment from port 192.168.1.7 to port 80, with a length of 1514 bytes. The packet details pane shows the raw hex and ASCII data, and the bytes pane shows the raw binary data. The bottom status bar indicates the frame number and byte count.

| No. | Time | Source | Destination | Protocol | Length | Info |
|-----|-----------------|----------------|----------------|----------|--------|--------------------|
| 61 | 11:55:43.403628 | 128.119.245.12 | 192.168.1.7 | TCP | 66 | 80 → 61493 [ACK] S |
| 62 | 11:55:43.403680 | 192.168.1.7 | 128.119.245.12 | TCP | 1514 | 61493 → 80 [ACK] S |
| 63 | 11:55:43.404498 | 128.119.245.12 | 192.168.1.7 | TCP | 66 | 80 → 61493 [ACK] S |
| 64 | 11:55:43.404501 | 128.119.245.12 | 192.168.1.7 | TCP | 66 | 80 → 61493 [ACK] S |

Frame 62: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface 0
Ethernet II, Src: Apple_38:94:d0 (f4:0f:24:38:94:d0), Dst: Netgear_23:3e:0e (c4:04:15:23:3e:
Internet Protocol Version 4, Src: 192.168.1.7, Dst: 128.119.245.12
Transmission Control Protocol, Src Port: 61493, Dst Port: 80, Seq: 3571, Ack: 1, Len: 1448

Segment number 5

1448 bytes

Segment number 6

1448 bytes

The Wireshark interface displays a list of network captures. The packet list shows several TCP segments, primarily ACKs, being exchanged between two hosts. The details and bytes panes below the list pane show the structure of these segments.

| No. | Time | Source | Destination | Protocol | Length | Info |
|-----|-----------------|-------------|----------------|----------|--------|--------------------|
| 65 | 11:55:43.404554 | 192.168.1.7 | 128.119.245.12 | TCP | 1514 | 61493 → 80 [ACK] S |
| 66 | 11:55:43.404554 | 192.168.1.7 | 128.119.245.12 | TCP | 1514 | 61493 → 80 [ACK] S |
| 67 | 11:55:43.404554 | 192.168.1.7 | 128.119.245.12 | TCP | 1514 | 61493 → 80 [ACK] S |
| 68 | 11:55:43.404555 | 192.168.1.7 | 128.119.245.12 | TCP | 1514 | 61493 → 80 [ACK] S |

Frame 66: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface 0
Ethernet II, Src: Apple_38:94:d0 (f4:0f:24:38:94:d0), Dst: Netgear_23:3e:0e (c4:04:35:23:3e:0e)
Internet Protocol Version 4, Src: 192.168.1.7, Dst: 128.119.245.12

Transmission Control Protocol, Src Port: 61493, Dst Port: 80, Seq: 6467, Ack: 1, Len: 1448

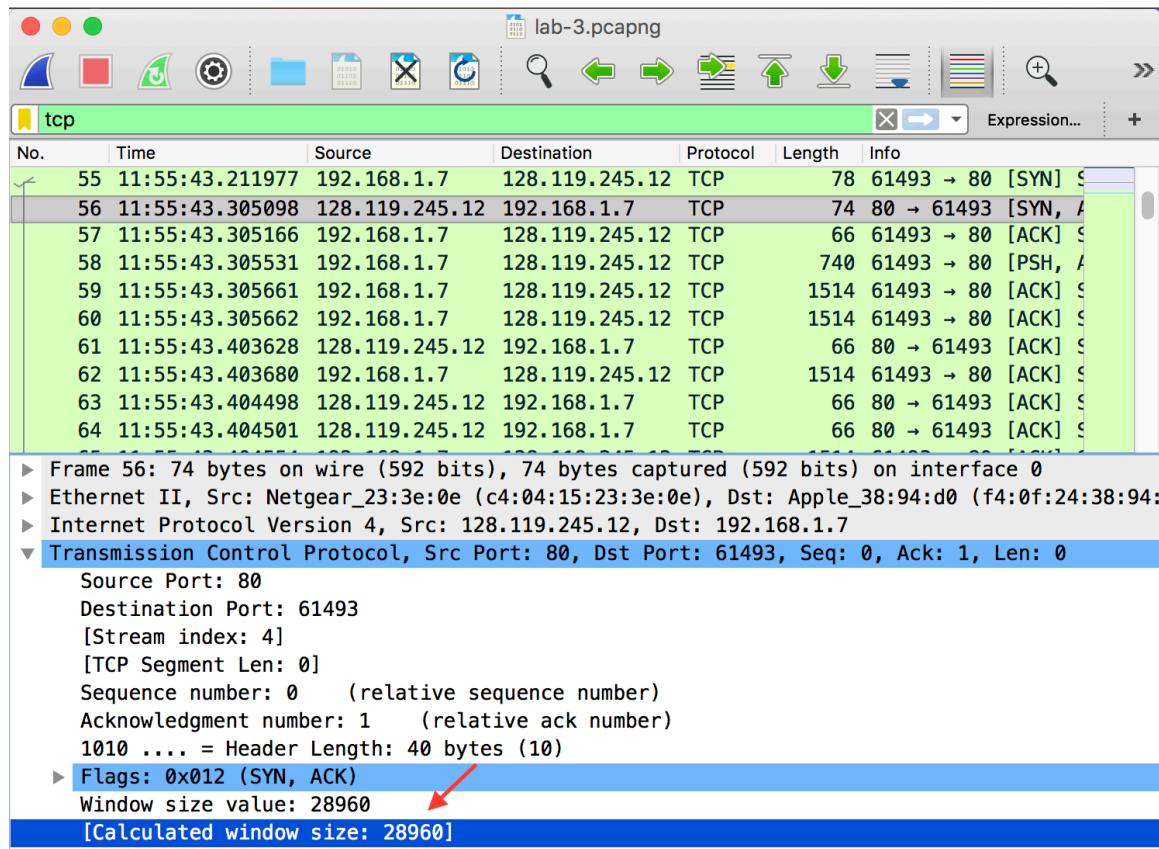
- 9) What is the minimum amount of available buffer space advertised at the received for the entire trace? Does the lack of receiver buffer space ever throttle the sender?

Answer:

28960 bytes

This lack of receiver buffer space does not throttle the sender.

See screenshots below.

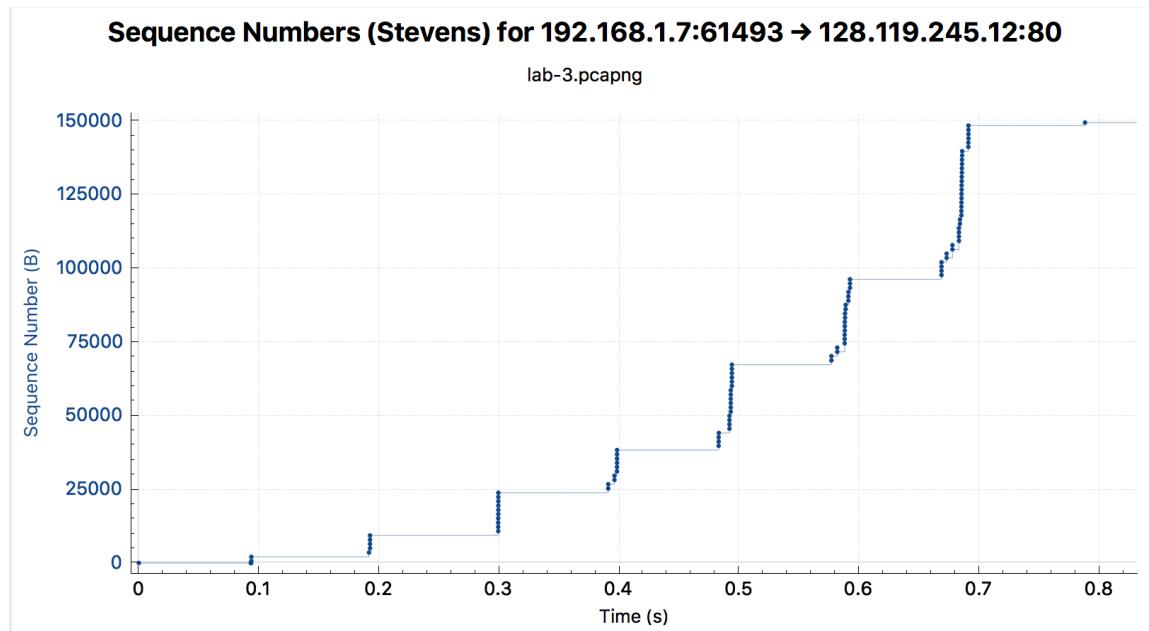


10) Are there any retransmitted segments in the trace file? What did you check for (in the trace) in order to answer this question?

Answer:

No. This was determined because the sequence numbers of the TCP segments in the trace file increase. I checked the Time-Sequence-Graph (Stevens) in order to answer this question.

See screenshot below.



11) How much data does the receiver typically acknowledge in a ACK? Can you identify cases where the receiver is ACKing every other received segment (see Table 3.2 on page 250 in the text).

Answer:

For the first segment, the receiver acknowledged 674 bytes. For the rest, the receiver acknowledged 1448 bytes. After analyzing ACK numbers, they increased by 1448 bytes each time. From that, I would say that there were no cases where the receiver ACKed every other received segment.

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

Explain how you calculated this value.

Answer:

The throughput can be calculated by taking the total amount of data that was transmitted and dividing it by the total connection time. Our time started at the segment that contained the HTTP POST (11:55:43.305531). Our time stopped when the last ACK comes back (11:55:43.999582). The total amount of data transmitted is the sequence number of the last ACK(149397 bytes). Putting it altogether, the total connection time => .694 seconds. Therefore, the throughput for the TCP connection is (149397 -1 bytes) / (.694 seconds) = 0.215 MBytes/sec.

See screenshot below.

| No. | Time | Source | Destination | Protocol | Length | Info |
|-----|-----------------|----------------|----------------|----------|--------|---------------------|
| 55 | 11:55:43.211977 | 192.168.1.7 | 128.119.245.12 | TCP | 78 | 61493 → 80 [SYN] S |
| 56 | 11:55:43.305098 | 128.119.245.12 | 192.168.1.7 | TCP | 74 | 80 → 61493 [SYN, A] |
| 57 | 11:55:43.305166 | 192.168.1.7 | 128.119.245.12 | TCP | 66 | 61493 → 80 [ACK] S |
| 58 | 11:55:43.305531 | 192.168.1.7 | 128.119.245.12 | TCP | 740 | 61493 → 80 [PSH, A] |

| No. | Time | Source | Destination | Protocol | Length | Info |
|-----|-----------------|----------------|----------------|----------|--------|---------------------|
| 239 | 11:55:43.994761 | 128.119.245.12 | 192.168.1.7 | TCP | 66 | 80 → 61493 [ACK] S |
| 240 | 11:55:43.994767 | 128.119.245.12 | 192.168.1.7 | TCP | 66 | 80 → 61493 [ACK] S |
| 241 | 11:55:43.995759 | 128.119.245.12 | 192.168.1.7 | TCP | 66 | 80 → 61493 [ACK] S |
| 242 | 11:55:43.998428 | 128.119.245.12 | 192.168.1.7 | TCP | 66 | 80 → 61493 [ACK] S |
| 243 | 11:55:43.999577 | 128.119.245.12 | 192.168.1.7 | TCP | 66 | 80 → 61493 [ACK] S |
| 244 | 11:55:43.999582 | 128.119.245.12 | 192.168.1.7 | TCP | 66 | 80 → 61493 [ACK] S |
| 245 | 11:55:44.000099 | 128.119.245.12 | 192.168.1.7 | HTTP | 843 | HTTP/1.1 200 OK (|
| 246 | 11:55:44.000196 | 192.168.1.7 | 128.119.245.12 | TCP | 66 | 61493 → 80 [ACK] S |
| 249 | 11:55:49.127124 | 128.119.245.12 | 192.168.1.7 | TCP | 66 | 80 → 61493 [FIN, A] |
| 250 | 11:55:49.127320 | 192.168.1.7 | 128.119.245.12 | TCP | 66 | 61493 → 80 [ACK] S |

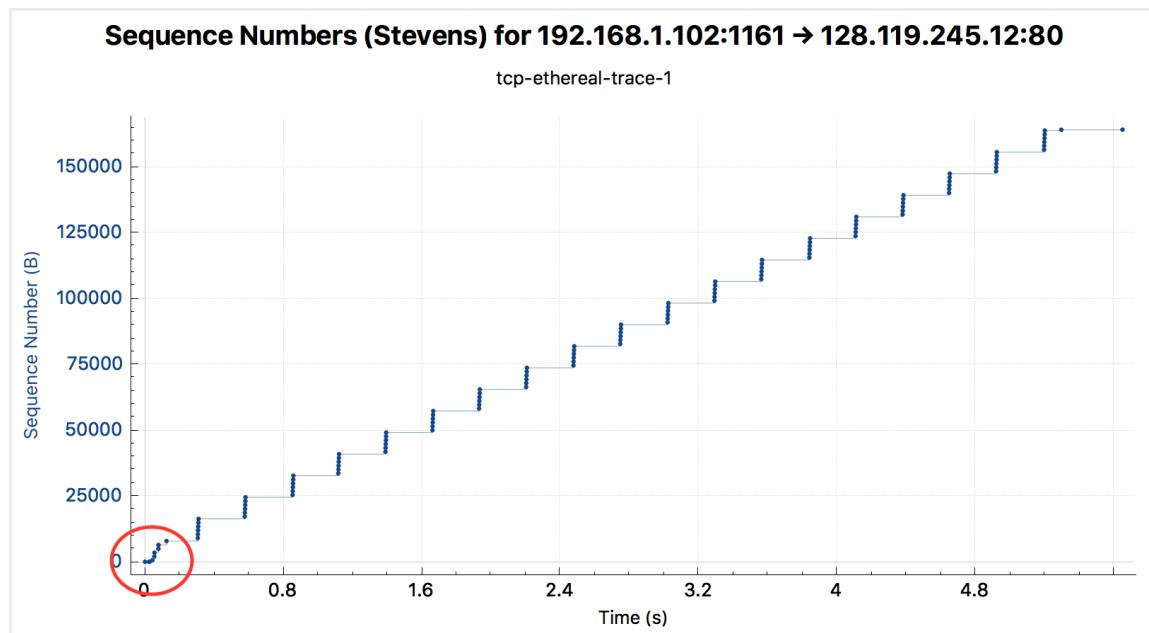

```
▶ Frame 244: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface 0
▶ Ethernet II, Src: Netgear_23:3e:0e (c4:04:15:23:3e:0e), Dst: Apple_38:94:d0 (f4:0f:24:38:94:)
▶ Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.7
▶ Transmission Control Protocol, Src Port: 80, Dst Port: 61493, Seq: 1, Ack: 149397, Len: 0
```

- 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.

Answer:

The slowstart happens in the beginning and is circled in the screenshot below. Also, the congestion avoidance takes over in the circled portion of the graph. This congestion control sets the limit of TCP segments that can be sent.

See screenshot below.



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

Answer:

The slow start on my trace appears to be half the graph. The number of TCP segments that are being sent grows. As discussed previously, there was no congestion avoidance that took place because the window was large enough. I imagine if the file was larger that there would be some congestion avoidance that would come into play.

See screenshot below.

