Gabriel Emerson
ELEC 5220 - Lab 4
10/19/21

Questions

Figures 1 and 2 show the set up of the host (in Figure 1) and the client (in Figure 2) servers.

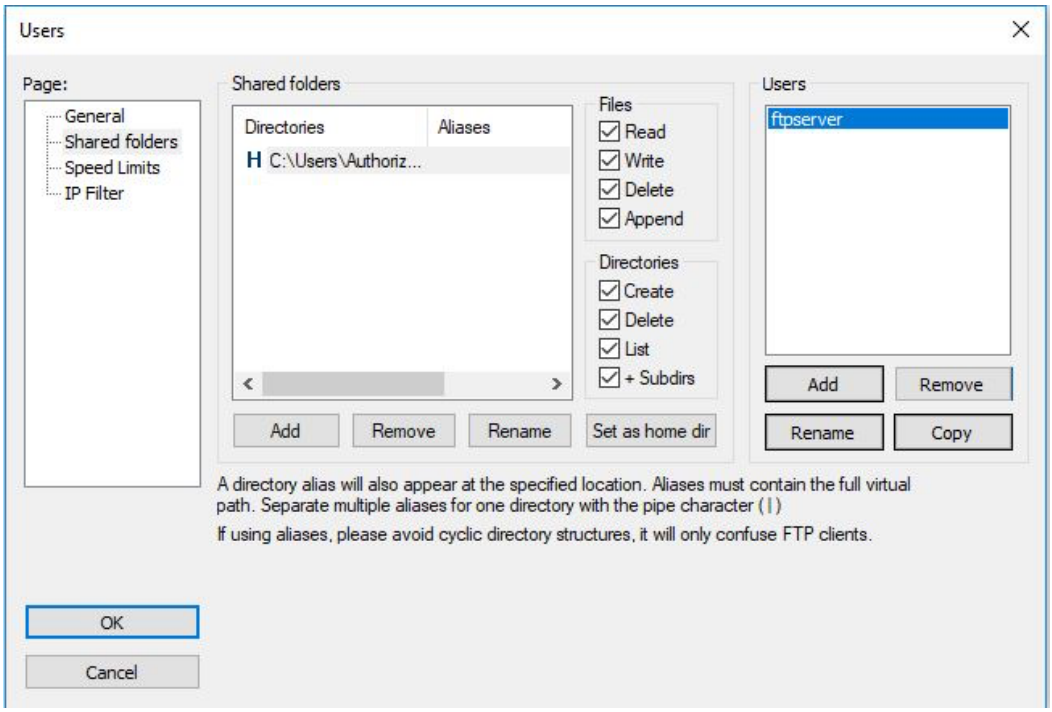


Figure 1

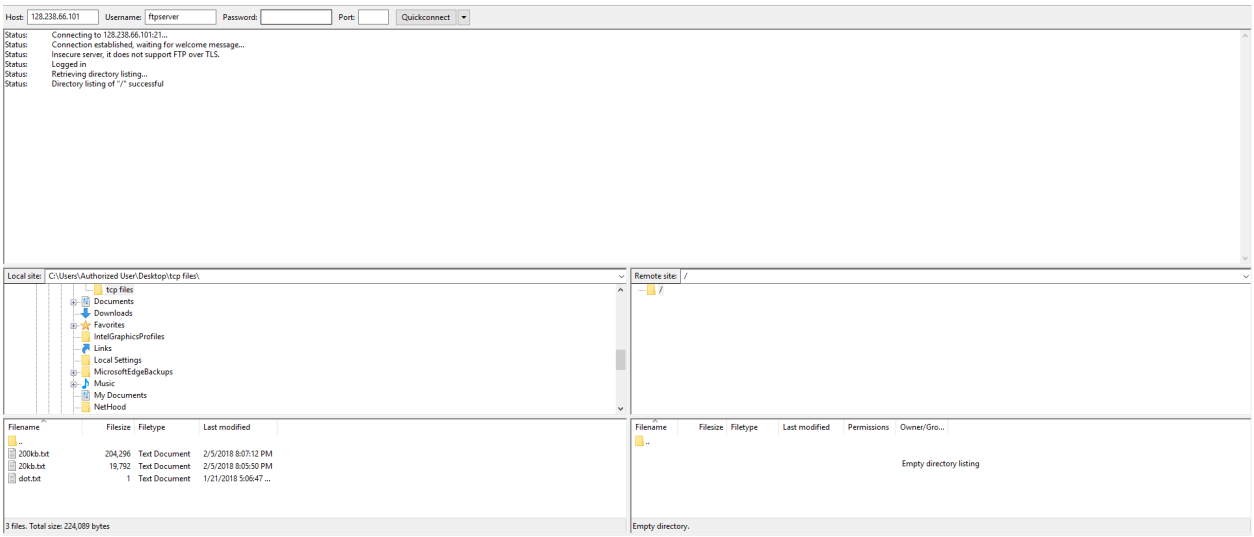
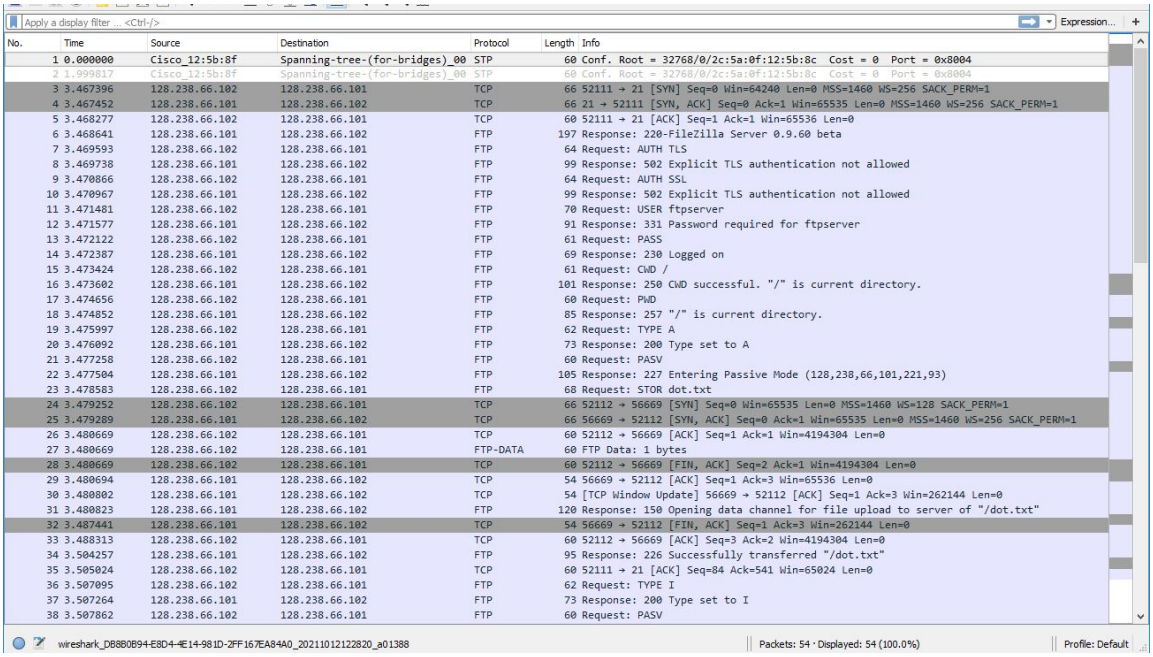


Figure 2

Questions 1 and 2 are shown in Figure 3

1. Show three FTP request commands sent from the client by highlighting them in a screenshot.



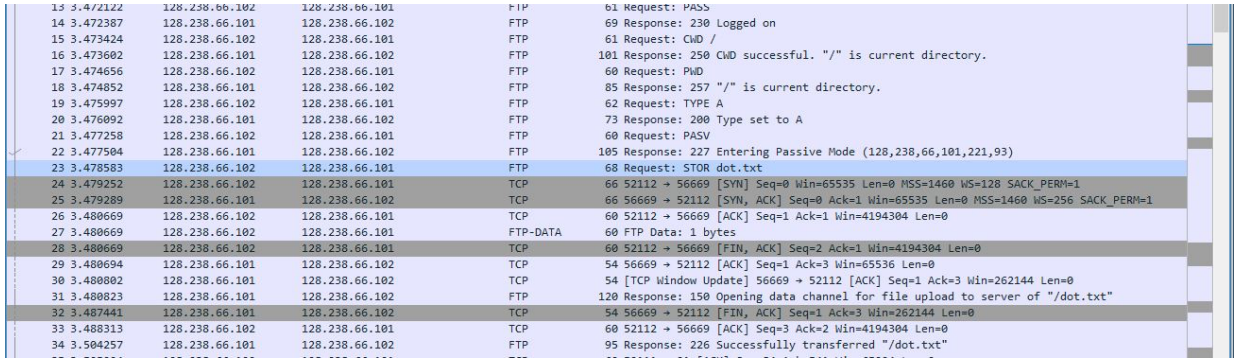
No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	Cisco_12:5b:8f	Spanning-tree-(for-bridges)_00	STP	60	Conf. Root = 32768/0/2c:5a:0f:12:5b:8c Cost = 0 Port = 0x8004
2	1.999817	Cisco_12:5b:8f	Spanning-tree-(for-bridges)_00	STP	60	Conf. Root = 32768/0/2c:5a:0f:12:5b:8c Cost = 0 Port = 0x8004
3	3.467396	128.238.66.102	128.238.66.101	TCP	66	52111 → 21 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
4	3.467452	128.238.66.101	128.238.66.102	TCP	66	21 → 52111 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM=1
5	3.468277	128.238.66.102	128.238.66.101	TCP	60	52111 → 21 [ACK] Seq=1 Ack=1 Win=65536 Len=0
6	3.468641	128.238.66.101	128.238.66.102	FTP	197	Response: 220-FileZilla Server 0.9.60 beta
7	3.469593	128.238.66.102	128.238.66.101	FTP	64	Request: AUTH TLS
8	3.469738	128.238.66.101	128.238.66.102	FTP	99	Response: 502 Explicit TLS authentication not allowed
9	3.470866	128.238.66.102	128.238.66.101	FTP	64	Request: AUTH SSL
10	3.470967	128.238.66.101	128.238.66.102	FTP	99	Response: 502 Explicit TLS authentication not allowed
11	3.471481	128.238.66.102	128.238.66.101	FTP	70	Request: USER ftpserver
12	3.471577	128.238.66.101	128.238.66.102	FTP	91	Response: 331 Password required for ftpserver
13	3.472122	128.238.66.102	128.238.66.101	FTP	61	Request: PASS
14	3.472387	128.238.66.101	128.238.66.102	FTP	69	Response: 230 Logged on
15	3.473424	128.238.66.102	128.238.66.101	FTP	61	Request: CWD /
16	3.473602	128.238.66.101	128.238.66.102	FTP	101	Response: 250 CWD successful. "/" is current directory.
17	3.474656	128.238.66.102	128.238.66.101	FTP	60	Request: PWD
18	3.474852	128.238.66.101	128.238.66.102	FTP	85	Response: 257 "/" is current directory.
19	3.475997	128.238.66.102	128.238.66.101	FTP	62	Request: TYPE A
20	3.476092	128.238.66.101	128.238.66.102	FTP	73	Response: 200 Type set to A
21	3.477258	128.238.66.102	128.238.66.101	FTP	60	Request: PASV
22	3.477504	128.238.66.101	128.238.66.102	FTP	105	Response: 227 Entering Passive Mode (128,238,66,101,221,93)
23	3.478583	128.238.66.102	128.238.66.101	FTP	68	Request: STOR dot.txt
24	3.479252	128.238.66.102	128.238.66.101	TCP	66	52112 → 56669 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=128 SACK_PERM=1
25	3.479289	128.238.66.101	128.238.66.102	TCP	66	56669 → 52112 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM=1
26	3.480669	128.238.66.102	128.238.66.101	TCP	60	52112 → 56669 [ACK] Seq=1 Ack=1 Win=4194304 Len=0
27	3.480669	128.238.66.102	128.238.66.101	FTP-DATA	60	FTP Data: 1 bytes
28	3.480669	128.238.66.102	128.238.66.101	TCP	60	52112 → 56669 [FIN, ACK] Seq=2 Ack=1 Win=4194304 Len=0
29	3.480694	128.238.66.101	128.238.66.102	TCP	54	56669 → 52112 [ACK] Seq=1 Ack=3 Win=65536 Len=0
30	3.480802	128.238.66.101	128.238.66.102	TCP	54	[TCP Window Update] 56669 → 52112 [ACK] Seq=1 Ack=3 Win=262144 Len=0
31	3.480823	128.238.66.101	128.238.66.102	FTP	120	Response: 150 Opening data channel for file upload to server of "/dot.txt"
32	3.487441	128.238.66.101	128.238.66.102	TCP	54	56669 → 52112 [FIN, ACK] Seq=1 Ack=3 Win=262144 Len=0
33	3.488313	128.238.66.102	128.238.66.101	TCP	60	52112 → 56669 [ACK] Seq=3 Ack=2 Win=4194304 Len=0
34	3.504257	128.238.66.101	128.238.66.102	FTP	95	Response: 226 Successfully transferred "/dot.txt"
35	3.505024	128.238.66.102	128.238.66.101	TCP	60	52111 → 21 [ACK] Seq=84 Ack=541 Win=65024 Len=0
36	3.507095	128.238.66.102	128.238.66.101	FTP	62	Request: TYPE I
37	3.507264	128.238.66.101	128.238.66.102	FTP	73	Response: 200 Type set to I
38	3.507862	128.238.66.102	128.238.66.101	FTP	60	Request: PASV

Figure 3

2. In an FTP request from the client, what is the servers port number? What is the clients port number? Please attach a relevant output to support your answer.

Client port number = 52111
Host port number = 21
Check Figure 3 first and second TCP statement

3. Show the data transfer packet for the file “dot” by highlighting it in an output screenshot. What are servers port number and client port number, respectively? Please attach the relevant output to support your answer.



13	3.472122	128.238.66.102	128.238.66.101	FTP	61	Request: PASS
14	3.472387	128.238.66.101	128.238.66.102	FTP	69	Response: 230 Logged on
15	3.473424	128.238.66.102	128.238.66.101	FTP	61	Request: CWD /
16	3.473602	128.238.66.101	128.238.66.102	FTP	101	Response: 250 CWD successful. "/" is current directory.
17	3.474656	128.238.66.102	128.238.66.101	FTP	60	Request: PWD
18	3.474852	128.238.66.101	128.238.66.102	FTP	85	Response: 257 "/" is current directory.
19	3.475997	128.238.66.102	128.238.66.101	FTP	62	Request: TYPE A
20	3.476092	128.238.66.101	128.238.66.102	FTP	73	Response: 200 Type set to A
21	3.477258	128.238.66.102	128.238.66.101	FTP	60	Request: PASV
22	3.477504	128.238.66.101	128.238.66.102	FTP	105	Response: 227 Entering Passive Mode (128,238,66,101,221,93)
23	3.478583	128.238.66.102	128.238.66.101	FTP	68	Request: STOR dot.txt
24	3.479252	128.238.66.102	128.238.66.101	TCP	66	52112 → 56669 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=128 SACK_PERM=1
25	3.479289	128.238.66.101	128.238.66.102	TCP	66	56669 → 52112 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM=1
26	3.480669	128.238.66.102	128.238.66.101	TCP	60	52112 → 56669 [ACK] Seq=1 Ack=1 Win=4194304 Len=0
27	3.480669	128.238.66.102	128.238.66.101	FTP-DATA	60	FTP Data: 1 bytes
28	3.480669	128.238.66.102	128.238.66.101	TCP	60	52112 → 56669 [FIN, ACK] Seq=2 Ack=1 Win=4194304 Len=0
29	3.480694	128.238.66.101	128.238.66.102	TCP	54	56669 → 52112 [ACK] Seq=1 Ack=3 Win=65536 Len=0
30	3.480802	128.238.66.101	128.238.66.102	TCP	54	[TCP Window Update] 56669 → 52112 [ACK] Seq=1 Ack=3 Win=262144 Len=0
31	3.480823	128.238.66.101	128.238.66.102	FTP	120	Response: 150 Opening data channel for file upload to server of "/dot.txt"
32	3.487441	128.238.66.101	128.238.66.102	TCP	54	56669 → 52112 [FIN, ACK] Seq=1 Ack=3 Win=262144 Len=0
33	3.488313	128.238.66.102	128.238.66.101	TCP	60	52112 → 56669 [ACK] Seq=3 Ack=2 Win=4194304 Len=0
34	3.504257	128.238.66.101	128.238.66.102	FTP	95	Response: 226 Successfully transferred "/dot.txt"

Figure 4

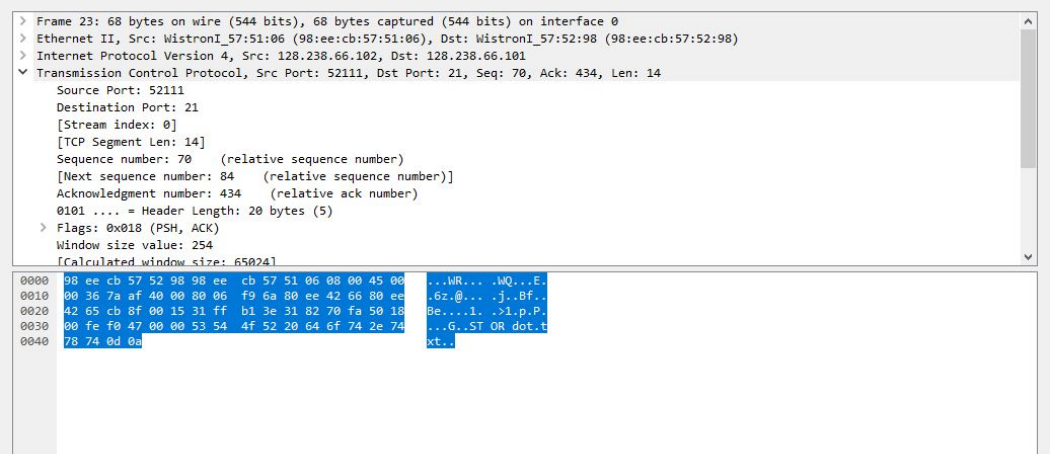


Figure 5

Servers port is 52111 and Client port is 21

4. Show the data transfer packet for the severs directory list updating by highlighting it in an output screenshot. What are servers port number and clients port number, respectively? Please attach relevant output to support your answer.

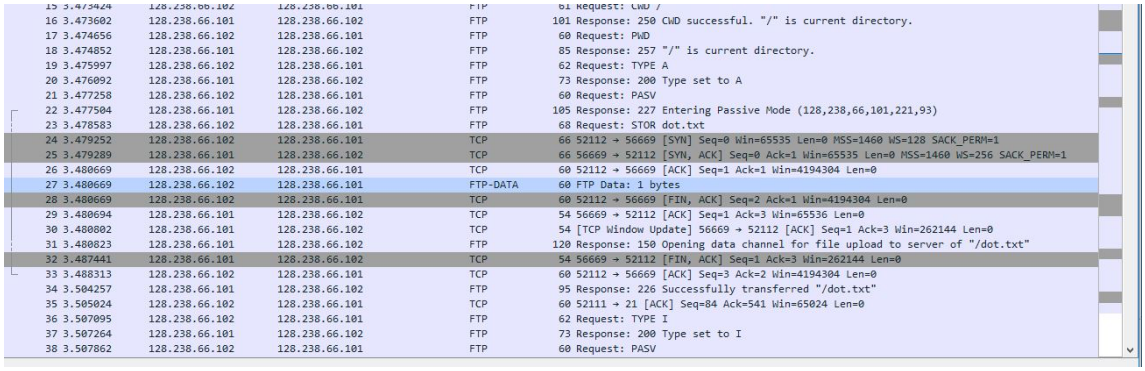


Figure 6

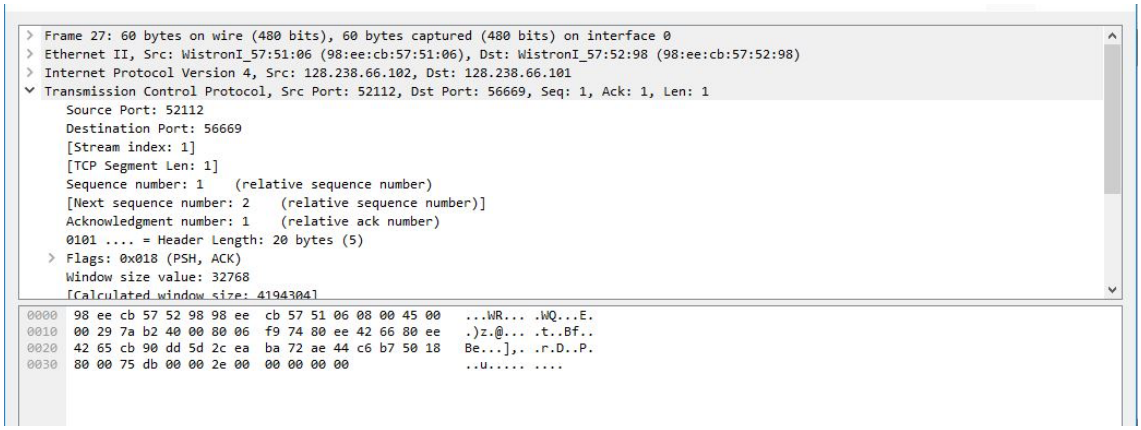


Figure 7

Source port is 52112 and Destination port is 56669

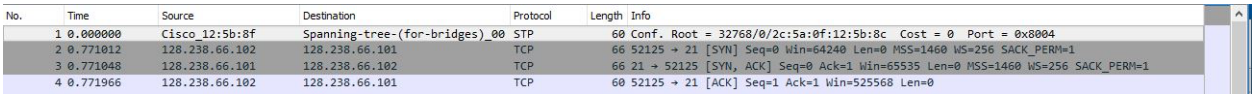
5. TCP uses three-way handshake to set up a connection. How many TCP connections have been established according to your result?

If you include the setup, 2 different data connections, and exit handshakes, there are 4 total connections

6. Answer the following questions.

---

1. Highlight the three-way handshake segments and explain the purpose of each segment. For each segment
    a. Specify the value of the sequence number field
    b. Specify the value of the ACK number field



No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	Cisco_12:5b:8f	Spanning-tree-(for-bridges)_00	STP	60	Conf. Root = 32768/0/2c:5a:0f:12:5b:8c Cost = 0 Port = 0x8004
2	0.771012	128.238.66.102	128.238.66.101	TCP	66	52125 → 21 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
3	0.771048	128.238.66.101	128.238.66.102	TCP	66	21 → 52125 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM=1
4	0.771966	128.238.66.102	128.238.66.101	TCP	60	52125 → 21 [ACK] Seq=1 Ack=1 Win=525568 Len=0

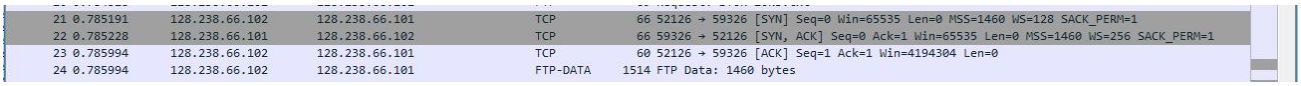
Figure 8

There are three segments in a 3 way handshake. The first segment is the client telling the host it is done sending data and is ready to close. The second segment is the host telling the client that it acknowledges the clients request to close, and also sends its own close message. Then the last segment acknowledges the host telling the client it is ready to close.

a. Sequence number = 1st: 0 2nd: 0 3rd: 1
b. ACK number = 1st: None 2nd: 1 3rd: 1

2. Is it a control connection or a data connection?

The connection shown in Figure 8 is a control connection. The connection shown below in Figure 9 is a control connection. In the 4 connections, the first one is a control, the next two are data, and the last is another control.



21	0.785191	128.238.66.102	128.238.66.101	TCP	66	52126 → 59326 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=128 SACK_PERM=1
22	0.785228	128.238.66.101	128.238.66.102	TCP	66	59326 → 52126 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM=1
23	0.785994	128.238.66.102	128.238.66.101	TCP	60	52126 → 59326 [ACK] Seq=1 Ack=1 Win=4194304 Len=0
24	0.785994	128.238.66.102	128.238.66.101	FTP-DATA	1514	FTP Data: 1460 bytes

Figure 9

3. What are server's port number and client's port number, respectively?

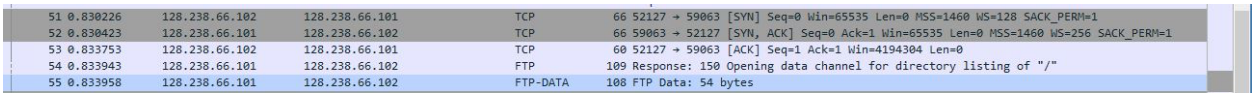


Figure 10

Server port number is 52127 and client port number is 59063

4. After the TCP connection is established, consider the first TCP segment exchanged. What is the value of the sequence number field? What is the value of the ACK field if it is valid?

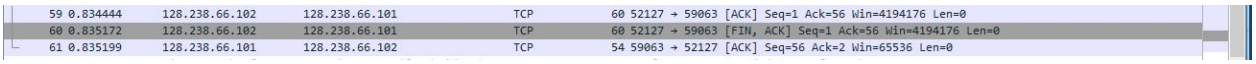


Figure 11

Sequence number = 1
ACK number = 56

5. Which side initiates the TCP connection termination, the server or the client? How many segments are involved? Highlight all involved segments. For each of those segments,

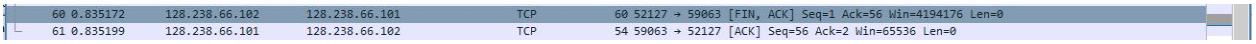


Figure 12

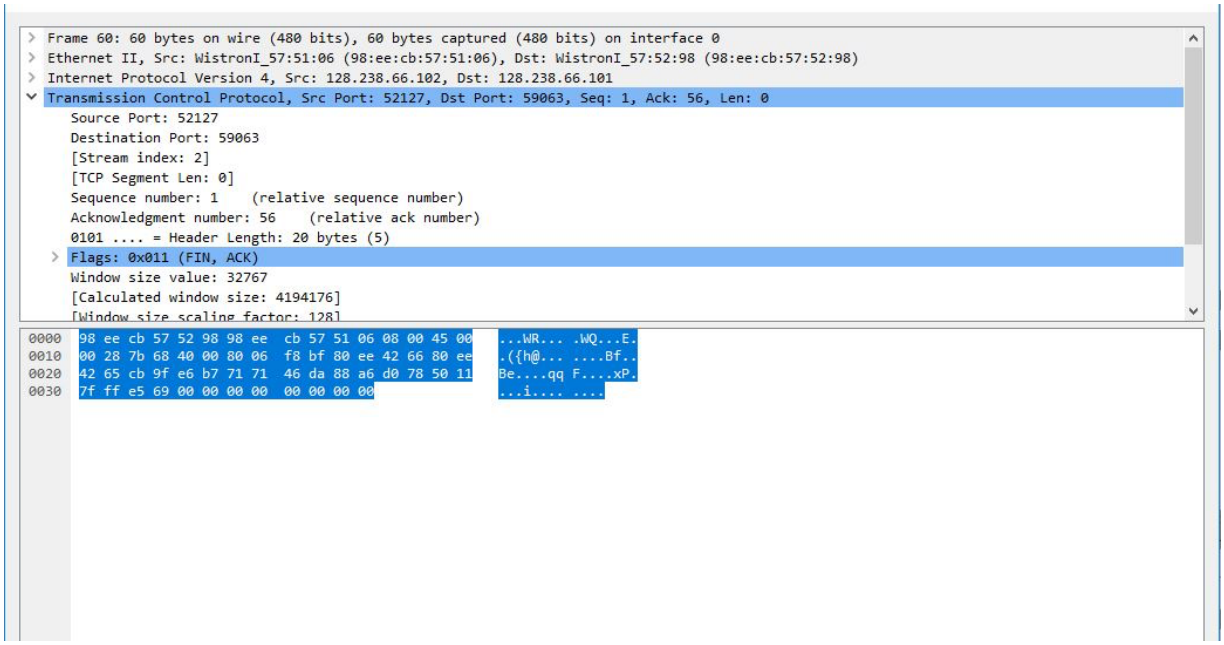


Figure 13

The client initializes the connection termination. There are two involved segments involved, the FIN, Ack segment and the Ack segment.

a. Specify its valid flags,
b. Specify the value of the sequence number field, and
c. Specify the value of the ACK number field if it is valid.

a. 0x011 (FIN, ACK)
b. Sequence number = 1
c. ACK number = 56

Q7: Consider the data connection for the file transmission

1. Does the server send an ACK for every data segment it receives?

No

2. How many bytes are sent in one segment (except the last one)? Why?

1460, because the Maximum Segment Size is equal to 1460. This is calculated by finding that MTU size is 1500 and subtract the 40 bytes for the header file. This gives us 1460.

3. Consider the first ACK by the server for the file data it receives from the client.
    a. What is the value of the sequence number field?
    b. What is the value of the ACK number field?

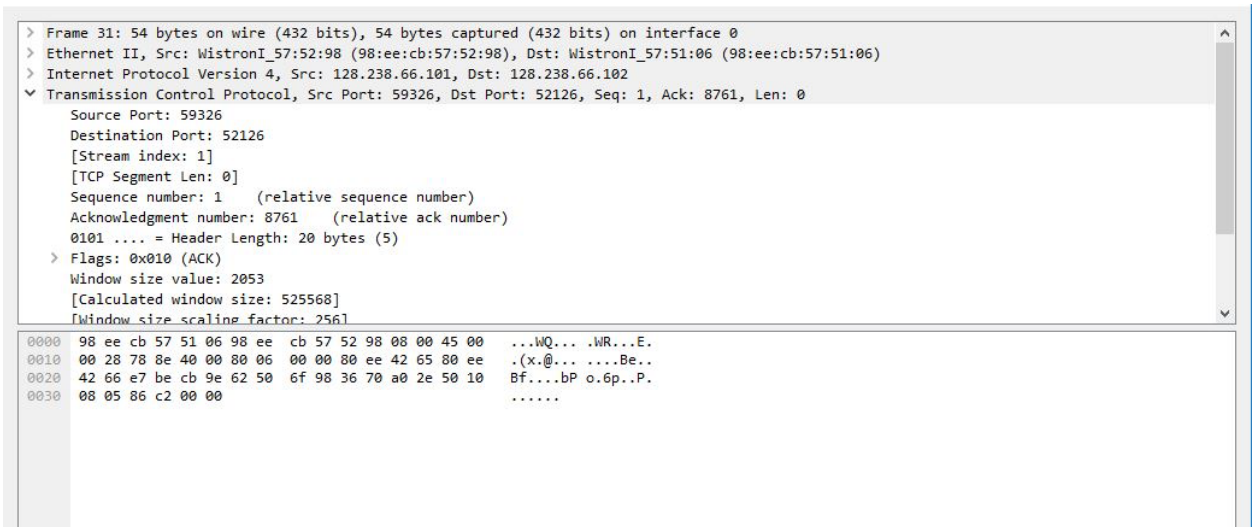


Figure 14

a. **Sequence number = 1**
b. **ACK number = 8761**

4. Consider the last ACK by the server for the file data transmission before the first FIN segment.
    a. What is the value of the sequence number field? Is it the same as the result from question Q7(3a)? Why or why not?
    b. What is the value of the ACK number field?

    a. **1: Yes, because server has not sent anything**
    b. **1**

Q8: Consider the example plot shown in the figure above. How long does it take to transfer all segments? Can you identify where slow start phase begins and ends, and where congestion avoidance takes over?

It takes approximately 5.2 seconds to transfer, and 20 segments. Slow start begins at t = 0, and goes until approximately 0.12 seconds (slow start is the first segment with a slight curve which differs from all the other segments). Congestion avoidance begins immediately after the end of slow start.

Q9: Consider the plot you get from Step 4. How long does it take to transfer all segments? Can you observe TCP's slow start in this plot? Why or why not? Please attach the screen shot of your plot.

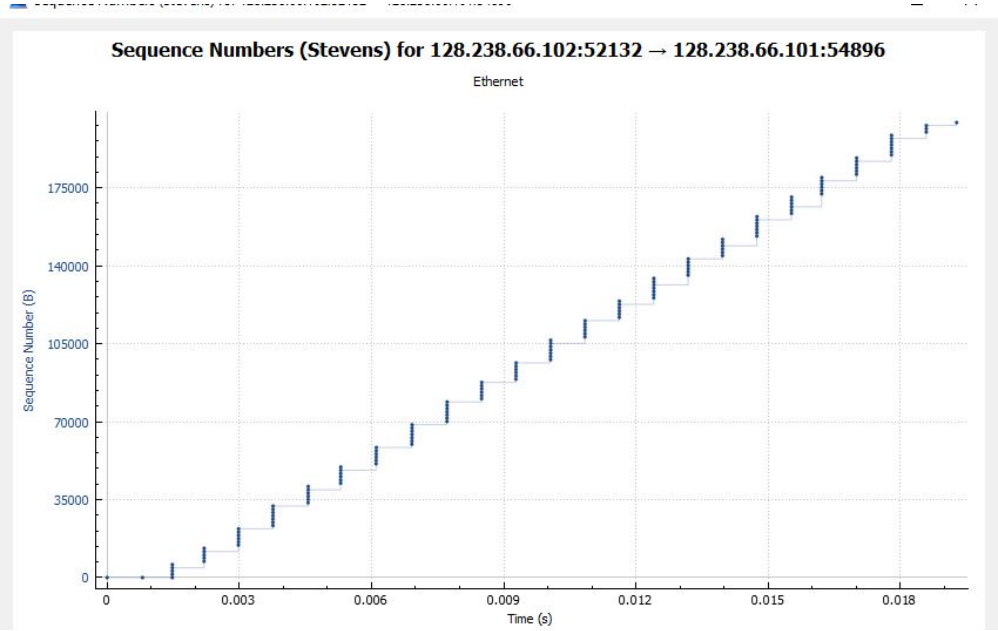


Figure 15

It takes 0.0175 seconds to transfer all segments. You cannot observe the slow start phase because it happens too fast and the data being sent is much smaller in size (which is what leads to the faster graph).