

Gökhan Özeloğlu - 21627557

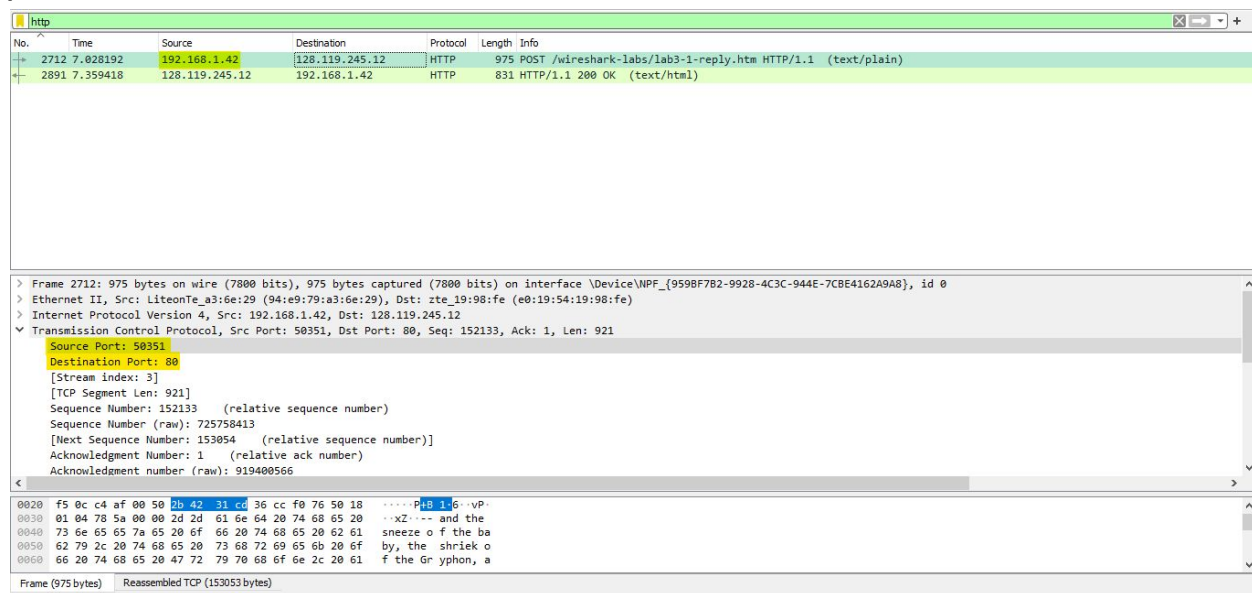
Burak Yılmaz - 21627868

BBM 453 Computer Networks Lab - TCP Lab Assignment

Group ID: 1

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

ANS: My computer(Source) is at 192.168.1.42 (IP address). The source port is 50355



No.	Time	Source	Destination	Protocol	Length	Info
2205	6.270237	192.168.1.42	128.119.245.12	TCP	66	50355 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2209	6.294116	192.168.1.42	128.119.245.12	TCP	786	50351 → 80 [PSH, ACK] Seq=1 Ack=1 Win=260 Len=732 [TCP segment of a reassembled PDU]
2210	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=733 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2211	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=2185 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2212	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=3637 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2213	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=5089 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2214	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=6541 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2215	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=7993 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2216	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=9445 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2217	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=10897 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2218	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=12349 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2260	6.387657	128.119.245.12	192.168.1.42	TCP	66	80 → 50351 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1452 SACK_PERM=1 WS=128
2261	6.387699	192.168.1.42	128.119.245.12	TCP	66	[TCP Dup ACK 2209#1] 50351 → 80 [ACK] Seq=13801 Ack=1 Win=260 Len=0 SLE=0 SRE=1
2285	6.444458	128.119.245.12	192.168.1.42	TCP	66	80 → 50355 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1452 SACK_PERM=1 WS=128

> Frame 2205: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface \Device\NPF_{959BF7B2-9928-4C3C-944E-7CBE4162A9A8}, id 0

> Ethernet II, Src: LiteonTe_a3:6e:29 (94:e9:79:a3:6e:29), Dst: zte_19:98:fe (e0:19:54:19:98:fe)

> Internet Protocol Version 4, Src: 192.168.1.42, Dst: 128.119.245.12

✓ Transmission Control Protocol, Src Port: 50355, Dst Port: 80, Seq: 0, Len: 0

Source Port: 50355

Destination Port: 80

[Stream index: 2]

[TCP Segment Len: 0]

Sequence Number: 0 (relative sequence number)

Sequence Number (raw): 1977609153

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

Acknowledgment Number: 0

Acknowledgment number (raw): 0

1000 = Header Length: 32 bytes (8)

```

0000 e0 19 54 19 98 fe 94 e9 79 a3 6e 29 00 00 45 00  ..T....y.n)E.
0010 00 34 3e 2b 40 00 80 06 85 42 c0 a8 01 2a 80 77  4>+@...B...*w
0020 f5 0c 14 b3 00 50 75 df eb c1 00 00 00 00 00 02  ..P.....
0030 fa f0 16 24 00 00 02 04 05 b4 01 03 03 08 01 01  ..$......
0040 04 02

```

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?

ANS: gaia.cs.umass.edu(destination) is at 128.119.245.12 (IP address)
 TCP port number: 80

No.	Time	Source	Destination	Protocol	Length	Info
2205	6.270237	192.168.1.42	128.119.245.12	TCP	66	50355 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2209	6.294116	192.168.1.42	128.119.245.12	TCP	786	50351 → 80 [PSH, ACK] Seq=1 Ack=1 Win=260 Len=732 [TCP segment of a reassembled PDU]
2210	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=733 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2211	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=2185 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2212	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=3637 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2213	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=5089 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2214	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=6541 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2215	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=7993 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2216	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=9445 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2217	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=10897 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2218	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=12349 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2260	6.387657	128.119.245.12	192.168.1.42	TCP	66	80 → 50351 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1452 SACK_PERM=1 WS=128
2261	6.387699	192.168.1.42	128.119.245.12	TCP	66	[TCP Dup ACK 2209#1] 50351 → 80 [ACK] Seq=13801 Ack=1 Win=260 Len=0 SLE=0 SRE=1
2285	6.444458	128.119.245.12	192.168.1.42	TCP	66	80 → 50355 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1452 SACK_PERM=1 WS=128

> Frame 2205: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface \Device\NPF_{959BF7B2-9928-4C3C-944E-7CBE4162A9A8}, id 0

> Ethernet II, Src: LiteonTe_a3:6e:29 (94:e9:79:a3:6e:29), Dst: zte_19:98:fe (e0:19:54:19:98:fe)

> Internet Protocol Version 4, Src: 192.168.1.42, Dst: 128.119.245.12

✓ Transmission Control Protocol, Src Port: 50355, Dst Port: 80, Seq: 0, Len: 0

Source Port: 50355

Destination Port: 80

[Stream index: 2]

[TCP Segment Len: 0]

Sequence Number: 0 (relative sequence number)

Sequence Number (raw): 1977609153

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

Acknowledgment Number: 0

Acknowledgment number (raw): 0

1000 = Header Length: 32 bytes (8)

```

0000 e0 19 54 19 98 fe 94 e9 79 a3 6e 29 00 00 45 00  ..T....y.n)E.
0010 00 34 3e 2b 40 00 80 06 85 42 c0 a8 01 2a 80 77  4>+@...B...*w
0020 f5 0c 14 b3 00 50 75 df eb c1 00 00 00 00 00 02  ..P.....
0030 fa f0 16 24 00 00 02 04 05 b4 01 03 03 08 01 01  ..$......
0040 04 02

```

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?

ANS: My computer(Source) is at 192.168.1.42 (IP address). The source port is 50355

No.	Time	Source	Destination	Protocol	Length	Info
2285	6.278237	192.168.1.42	128.119.245.12	TCP	66	50355 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2289	6.294116	192.168.1.42	128.119.245.12	TCP	786	50351 → 80 [PSH, ACK] Seq=1 Ack=1 Win=260 Len=732 [TCP segment of a reassembled PDU]
2210	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=733 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2211	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=2185 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2212	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=3637 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2213	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=5089 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2214	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=6541 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2215	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=7993 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2216	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=9445 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2217	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=10897 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2218	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=12349 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2260	6.387657	128.119.245.12	192.168.1.42	TCP	66	80 → 50351 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1452 SACK_PERM=1 WS=128
2261	6.387699	192.168.1.42	128.119.245.12	TCP	66	[TCP Dup ACK 2209#1] 50351 → 80 [ACK] Seq=13801 Ack=1 Win=260 Len=0 SLE=0 SRE=1
2285	6.444458	128.119.245.12	192.168.1.42	TCP	66	80 → 50355 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1452 SACK_PERM=1 WS=128

> Frame 2205: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface \Device\NPF{959BF7B2-9928-4C3C-944E-7CBE4162A9A8}, id 0

> Ethernet II, Src: LiteonTe a3:6e:29 (94:e0:29:a3:6e:29), Dst: zte 19:98:fe (e0:19:54:19:98:fe)

> Internet Protocol Version 4, Src: 192.168.1.42, Dst: 128.119.245.12

> Transmission Control Protocol, Src Port: 50355, Dst Port: 80, Seq: 0, Len: 0

Source Port: 50355

Destination Port: 80

[Stream index: 2]

[TCP Segment Len: 0]

Sequence Number: 0 (relative sequence number)

Sequence Number (raw): 1977609153

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

Acknowledgment Number: 0

Acknowledgment number (raw): 0

1000 = Header Length: 32 bytes (8)

0000 e0 19 54 19 98 fe 94 e9 79 a3 6e 29 08 00 45 00 ..T....y.n)...E-

0010 00 34 3e 2b 40 00 00 06 85 42 c0 a8 01 2a 80 77 .4>+@...B...*w

0020 f5 0c 54 b3 00 50 75 df eb c1 00 00 00 00 00 02 ...Pu.....

0030 f8 fe 16 24 00 00 02 04 05 b4 01 03 03 08 01 01 ...j.....

0040 04 92

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? (Hint: Look at Flags)

ANS: Sequence number of the TCP/SYN segment is used to initiate the TCP connection between the client computer and gaia.cs.umass.edu is equal to 0 in this trace. SYN flag is set to 1 and it indicates that segment is a SYN segment.

No.	Time	Source	Destination	Protocol	Length	Info
2205	6.270237	192.168.1.42	128.119.245.12	TCP	66	50355 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2209	6.294116	192.168.1.42	128.119.245.12	TCP	786	50351 → 80 [PSH, ACK] Seq=1 Ack=1 Win=260 Len=732 [TCP segment of a reassembled PDU]
2210	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=733 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2211	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=2185 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2212	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=3637 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2213	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=5089 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2214	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=6541 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2215	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=7993 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2216	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=9445 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2217	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=10897 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2218	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=12349 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2260	6.387657	128.119.245.12	192.168.1.42	TCP	66	80 → 50351 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1452 SACK_PERM=1 WS=128
2261	6.387699	192.168.1.42	128.119.245.12	TCP	66	[TCP Dup ACK 2209#1] 50351 → 80 [ACK] Seq=13801 Ack=1 Win=260 Len=0 SLE=0 SRE=1
2285	6.444458	128.119.245.12	192.168.1.42	TCP	66	80 → 50355 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1452 SACK_PERM=1 WS=128

1000 = Header Length: 32 bytes (8)	
▼ 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
....0...	Fin: Not set
[TCP Flags: .....S.]	
Window: 64240	

0000	e0 19 54 19 98 fe 94 e9 79 a3 6e 29 08 00 45 00	..T....y.n)..E..
0010	00 34 3e 2b 40 00 00 06 85 42 c0 a8 01 2a 80 77	.4>+@...B...w
0020	f5 0c c4 b3 00 50 75 df eb c1 00 00 00 00 00 02	....Pu.....
0030	fa f0 16 24 00 00 02 04 05 b4 01 03 03 08 01 01	..\$......
0040	04 02	..

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?

ANS: Sequence number of the SYNACK segment from gaia.cs.umass.edu to the client computer in reply to the SYN has equal to 0 in this trace. The value of the Acknowledgement field in the SYNACK segment is 1. The value of the Acknowledgement field in the SYNACK segment is determined by gaia.cs.umass.edu by adding “1” to the initial sequence number of SYN segment from the client computer (because the sequence number of the SYN segment initiated by the client computer is 0). The SYN flag and Acknowledgement flag in the segment are set to 1 and they refer that this segment is a SYNACK segment.

No.	Time	Source	Destination	Protocol	Length	Info
2260	6.387657	128.119.245.12	192.168.1.42	TCP	66	80 → 50351 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1452 SACK_PERM=1 WS=128
2261	6.387699	192.168.1.42	128.119.245.12	TCP	66	[TCP Dup ACK 2209#1] 50351 → 80 [ACK] Seq=13801 Ack=1 Win=260 Len=0 SRE=1
2285	6.444458	128.119.245.12	192.168.1.42	TCP	66	80 → 50355 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1452 SACK_PERM=1 WS=128
2287	6.444574	192.168.1.42	128.119.245.12	TCP	54	50355 → 80 [ACK] Seq=1 Ack=1 Win=66560 Len=0
2292	6.458128	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=733 Win=30720 Len=0
2293	6.458128	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=2185 Win=33664 Len=0
2294	6.458208	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=13801 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2295	6.458208	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=13801 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]

Destination Port: 50351
[Stream index: 3]
[TCP Segment Len: 0]
Sequence Number: 0 (relative sequence number)
Sequence Number (raw): 919400565
[Next Sequence Number: 1 (relative sequence number)]
Acknowledgment Number: 1 (relative ack number)
Acknowledgment number (raw): 725606281
1000 = Header Length: 32 bytes (8)
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

0000 94 e9 79 a3 6e 29 08 19 54 19 98 fe 08 00 45 00 ...n...T...E...
0010 00 34 00 00 40 00 29 06 1a 6e 80 77 f5 0c c0 a8 4...@...n...w...
0020 01 2a 00 50 c4 af 36 cc f0 75 2b 3f df 89 08 12 *P...6...u?...
0030 72 10 ce 97 00 00 02 04 05 ac 01 01 04 02 01 03 p...:.....
0040 03 07 ..

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.

ANS: Sequence number of this segment is 1.

No.	Time	Source	Destination	Protocol	Length	Info
2185	6.234037	192.168.1.42	162.159.128.235	TLSv1.2	140	Application Data
2204	6.265188	162.159.128.235	192.168.1.42	TCP	54	443 → 49947 [ACK] Seq=1 Ack=259 Win=60 Len=0
2205	6.270237	192.168.1.42	128.119.245.12	TCP	66	50355 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2209	6.294116	192.168.1.42	128.119.245.12	TCP	786	50351 → 80 [PSH, ACK] Seq=1 Ack=1 Win=260 Len=732 [TCP segment of a reassembled PDU]
2210	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=733 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2211	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=2185 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2212	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=3637 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2213	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=5089 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2214	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=6541 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2215	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=7993 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2216	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=9445 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2217	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=10897 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2218	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=12349 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2260	6.387657	128.119.245.12	192.168.1.42	TCP	66	80 → 50351 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1452 SACK_PERM=1 WS=128

Transmission Control Protocol, Src Port: 50351, Dst Port: 80, Seq: 1, Ack: 1, Len: 732
Source Port: 50351
Destination Port: 80
[Stream index: 3]
[TCP Segment Len: 732]
Sequence Number: 1 (relative sequence number)
Sequence Number (raw): 725606281
[Next Sequence Number: 733 (relative sequence number)]
Acknowledgment Number: 1 (relative ack number)
Acknowledgment number (raw): 919400566
0101 = Header Length: 20 bytes (5)
0000 f5 0c c4 af 00 50 2b 3f df 89 36 cc f0 76 50 18P...G...vP...
0010 01 04 67 6c 00 00 50 4f 53 54 20 2f 77 69 72 65 ...gl..PO ST//wire...
0020 73 68 61 72 50 2d 6c 61 62 73 2f 6c 61 62 33 2d shark-lab3/lab3...
0030 31 2d 72 65 70 6c 79 2e 68 74 6d 20 48 54 54 50 1-reply.htm HTTP...
0040 2f 31 2e 31 0d 0a 48 6f 73 74 3a 20 67 61 69 61 /1.1: Host: gaia...
0050 2e 63 73 2e 75 6d 61 73 73 2e 65 64 75 0d 0a 43 .cs.umas.s.edu: C...
0060 6f 6e 6e 65 63 74 69 6f 6e 6e 3a 20 6b 65 65 70 2d connectio n: keep-...
0070 61 6c 69 76 65 0d 0a 43 6f 6e 74 65 6e 74 2d 4c alive: Content-L...
0080 65 6e 67 74 68 3a 20 31 35 32 33 32 31 0d 0a 43 length: 1 52321: C...
0090 61 63 68 65 2d 43 6f 6e 74 72 6f 6c 3a 20 6d 61 ache-Con trol: ma...

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 239 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 239 (or described below) for all subsequent segments

ANS: Sequence number of this segment is 1.

No.	Time	Source	Destination	Protocol	Length	Info
2185	6.234037	192.168.1.42	162.159.128.235	TLSv1.2	140	Application Data
2204	6.265188	162.159.128.235	192.168.1.42	TCP	54	443 → 49947 [ACK] Seq=1 Ack=259 Win=69 Len=0
2205	6.270237	192.168.1.42	128.119.245.12	TCP	66	50355 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2209	6.294116	192.168.1.42	128.119.245.12	TCP	786	50351 → 80 [PSH, ACK] Seq=1 Ack=1 Win=260 Len=732 [TCP segment of a reassembled PDU]
2210	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=733 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2211	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=2185 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2212	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=3637 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2213	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=5089 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2214	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=6541 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2215	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=7993 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2216	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=9445 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2217	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=10897 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2218	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=12349 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2269	6.287667	128.119.245.12	192.168.1.42	TCP	66	80 → 50351 [ACK] Seq=0 Ack=1 Win=30300 Len=0 MSS=1460 SACK_PERM=1 WS=256

Transmission Control Protocol, Src Port: 50351, Dst Port: 80, Seq: 1, Ack: 1, Len: 732	
Source Port: 50351	
Destination Port: 80	
[Stream index: 3]	
[TCP Segment Len: 732]	
Sequence Number: 1 (relative sequence number)	
Sequence Number (raw): 725606281	
[Next Sequence Number: 733 (relative sequence number)]	
Acknowledgment Number: 1 (relative ack number)	
Acknowledgment number (raw): 919400566	
0101 = Header Length: 20 bytes (5)	

0020	f5 0c c4 af 00 50 1b 3f df 39 36 cc f0 76 50 18	.....P12.06 vP-
0030	01 04 67 6c 00 00 50 4f 53 54 20 2f 77 69 72 65	..gl.P0.S1/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
00a0	65 6e 67 74 68 3a 20 31 35 32 33 32 31 0d 0a 43	ength: 1 52321..C
00b0	61 63 68 65 2d 43 6f 6e 74 72 6f 6c 3a 20 6d 61	ache-Con trol: ma

Sequence number for segment 2 is 733

No.	Time	Source	Destination	Protocol	Length	Info
2185	6.234037	192.168.1.42	162.159.128.235	TLSv1.2	140	Application Data
2204	6.265188	162.159.128.235	192.168.1.42	TCP	54	443 → 49947 [ACK] Seq=1 Ack=259 Win=69 Len=0
2205	6.270237	192.168.1.42	128.119.245.12	TCP	66	50355 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2209	6.294116	192.168.1.42	128.119.245.12	TCP	786	50351 → 80 [PSH, ACK] Seq=1 Ack=1 Win=260 Len=732 [TCP segment of a reassembled PDU]
2210	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=733 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2211	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=2185 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2212	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=3637 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2213	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=5089 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2214	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=6541 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2215	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=7993 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2216	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=9445 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2217	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=10897 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2218	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=12349 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
Transmission Control Protocol, Src Port: 50351, Dst Port: 80, Seq: 733, Ack: 1, Len: 1452						
Source Port: 50351						
Destination Port: 80						
[Stream index: 3]						
[TCP Segment Len: 1452]						
Sequence Number: 733 (relative sequence number)						
Sequence Number (raw): 725607013						
[Next Sequence Number: 2185 (relative sequence number)]						
Acknowledgment Number: 1 (relative ack number)						
Acknowledgment number (raw): 919400566						
0101 = Header Length: 20 bytes (5)						
0020	f5 0c c4 af 00 50 2b 3f e2 65 36 cc f0 76 50 10	.....P?..e6..vP..				
0030	01 04 35 24 00 00 2d 2d 2d 2d 2d 57 65 62 4b	...55....---WebK				
0040	69 74 46 6f 72 6d 42 6f 75 6e 64 61 72 79 47 34	itformBo undaryG4				
0050	34 58 53 42 51 63 4f 67 73 69 4a 47 33 68 0d 0a	4XSBQcQg si0G3h				
0060	43 6f 6e 74 65 6e 74 2d 44 69 73 70 6f 73 69 74	Content- Disposit				
0070	69 6f 6e 3a 20 66 6f 72 6d 2d 64 61 74 61 3b 20	ion: for m-data;				
0080	6e 61 6d 65 3d 22 66 69 6c 65 22 3b 20 66 69 6c	name="fi le"; fil				
0090	65 6e 61 6d 65 3d 22 61 6c 69 63 65 2e 74 70 74	enname="a lice.txt				
00a0	22 0d 0a 43 6f 6e 74 65 6e 74 2d 54 79 70 65 3a	"...Conte nt-Type:				
00b0	20 74 65 78 74 2f 70 6c 61 69 6e 0d 0a 0d 0a 20	text/pl ain....				

Sequence number for segment 3 is 2185

No.	Time	Source	Destination	Protocol	Length	Info
2185	6.234037	192.168.1.42	162.159.128.235	TLSv1.2	140	Application Data
2204	6.265188	162.159.128.235	192.168.1.42	TCP	54	443 → 49947 [ACK] Seq=1 Ack=259 Win=69 Len=0
2205	6.270237	192.168.1.42	128.119.245.12	TCP	66	50355 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2209	6.294116	192.168.1.42	128.119.245.12	TCP	786	50351 → 80 [PSH, ACK] Seq=1 Ack=1 Win=260 Len=732 [TCP segment of a reassembled PDU]
2210	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=733 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2211	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=2185 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2212	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=3637 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2213	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=5089 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2214	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=6541 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2215	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=7993 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2216	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=9445 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2217	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=10897 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2218	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=12349 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
Transmission Control Protocol, Src Port: 50351, Dst Port: 80, Seq: 2185, Ack: 1, Len: 1452						
Source Port: 50351						
Destination Port: 80						
[Stream index: 3]						
[TCP Segment Len: 1452]						
Sequence Number: 2185 (relative sequence number)						
Sequence Number (raw): 725608465						
[Next Sequence Number: 3637 (relative sequence number)]						
Acknowledgment Number: 1 (relative ack number)						
Acknowledgment number (raw): 919400566						
0101 = Header Length: 20 bytes (5)						
0020	f5 0c c4 af 00 50 2b 3f e8 11 36 cc f0 76 50 10	.....P?..e8..vP..				
0030	01 04 88 e1 00 00 20 66 6f 72 20 69 74 20 66 6c	.....f or it fl				
0040	61 73 68 65 64 20 61 63 72 6f 73 73 20 68 65 72	ashed ac ross her				
0050	20 6d 69 6e 64 20 74 68 61 74 20 73 68 65 20 68	mind th at she h				
0060	61 64 20 6e 65 76 65 72 0d 0a 62 65 66 6f 72 65	ad never ..before				
0070	20 73 65 65 6e 20 61 20 72 61 62 62 69 74 20 77	seen a rabbit w				
0080	69 74 68 20 65 69 74 68 65 72 20 61 20 77 61 69	ith eith er a wai				
0090	73 74 63 6f 61 74 2d 70 6f 63 6b 65 74 2c 20 6f	stcoat-p ocket, o				
00a0	72 20 61 20 77 61 74 63 68 20 74 6f 0d 0a 74 61	r a watc h to :ta				
00b0	6b 65 20 6f 75 74 20 6f 66 20 69 74 2c 20 61 6e	ke out o f it, an				

Sequence number for segment 4 is 3637

No.	Time	Source	Destination	Protocol	Length	Info
2185	6.234037	192.168.1.42	162.159.128.235	TLSv1.2	140	Application Data
2204	6.265188	162.159.128.235	192.168.1.42	TCP	54	443 → 49947 [ACK] Seq=1 Ack=259 Win=69 Len=0
2205	6.270237	192.168.1.42	128.119.245.12	TCP	66	50355 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2209	6.294116	192.168.1.42	128.119.245.12	TCP	786	50351 → 80 [PSH, ACK] Seq=1 Ack=1 Win=260 Len=732 [TCP segment of a reassembled PDU]
2210	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=733 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2211	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=2185 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2212	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=3637 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2213	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=5089 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2214	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=6541 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2215	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=7993 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2216	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=9445 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2217	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=10897 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2218	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=12349 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
Transmission Control Protocol, Src Port: 50351, Dst Port: 80, Seq: 3637, Ack: 1, Len: 1452						
Source Port: 50351						
Destination Port: 80						
[Stream index: 3]						
[TCP Segment Len: 1452]						
Sequence Number: 3637 (relative sequence number)						
Sequence Number (raw): 725609917						
[Next Sequence Number: 5089 (relative sequence number)]						
Acknowledgment Number: 1 (relative ack number)						
Acknowledgment number (raw): 919400566						
0101 = Header Length: 20 bytes (5)						
0020	f5 0c c4 af 00 50 2b 3f ed bd 36 cc f0 76 50 10	.....P+? ..6..vP..				
0030	01 04 30 9d 00 00 f5 6d 62 66 69 6e 67 20 6a 6f	..9...lm bling de				
0040	77 66 20 73 74 61 69 72 73 21 20 20 48 6f 77 20	..m stair si' How				
0050	62 72 61 76 65 20 74 68 65 79 27 6c 6c 0d 0a 61	..brave they'll..a				
0060	6c 6c 20 74 68 69 6e 6b 20 6d 65 20 61 74 20 68	..ll think me at h				
0070	6f 6d 65 21 20 20 57 68 79 2c 20 49 20 77 6f 75	..ome! Wh y, I wou				
0080	6c 64 6e 27 74 20 73 61 79 20 61 6e 79 74 68 69	..ldn't sa y anythi				
0090	6e 67 20 61 62 6f 75 74 20 69 74 2c 0d 0a 65 76	..ng about it, rev				
00a0	65 6e 20 69 66 20 49 20 66 65 6c 6c 20 6f 66 66	..m if I fell off				
00b0	20 74 68 65 20 74 6f 70 20 6f 66 20 74 68 65 20	..the top of the				

Sequence number for segment 5 is 5089

No.	Time	Source	Destination	Protocol	Length	Info
2185	6.234037	192.168.1.42	162.159.128.235	TLSv1.2	140	Application Data
2204	6.265188	162.159.128.235	192.168.1.42	TCP	54	443 → 49947 [ACK] Seq=1 Ack=259 Win=69 Len=0
2205	6.270237	192.168.1.42	128.119.245.12	TCP	66	50355 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2209	6.294116	192.168.1.42	128.119.245.12	TCP	786	50351 → 80 [PSH, ACK] Seq=1 Ack=1 Win=260 Len=732 [TCP segment of a reassembled PDU]
2210	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=733 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2211	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=2185 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2212	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=3637 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2213	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=5089 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2214	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=6541 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2215	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=7993 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2216	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=9445 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2217	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=10897 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2218	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=12349 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
Transmission Control Protocol, Src Port: 50351, Dst Port: 80, Seq: 5089, Ack: 1, Len: 1452						
Source Port: 50351						
Destination Port: 80						
[Stream index: 3]						
[TCP Segment Len: 1452]						
Sequence Number: 5089 (relative sequence number)						
Sequence Number (raw): 725611369						
[Next Sequence Number: 6541 (relative sequence number)]						
Acknowledgment Number: 1 (relative ack number)						
Acknowledgment number (raw): 919400566						
0101 = Header Length: 20 bytes (5)						
0020	f5 0c c4 af 00 50 2b 3f f3 69 36 cc f0 76 50 10	.....P+? ..6..vP..				
0030	01 04 01 1d 00 00 75 6c 64 20 6d 61 6e 61 67 65	.....ul d manage				
0040	20 69 74 3f 29 20 20 60 41 6e 64 20 77 68 61 74	..it?) And what				
0050	0d 0a 61 6e 20 69 67 6e 6f 72 61 6e 74 20 6c 69	..an ign orant li				
0060	74 74 6c 65 20 67 69 72 6c 20 73 68 65 27 6c 6c	..ttle gir l she'll				
0070	20 74 68 69 6e 6b 20 6d 65 20 66 6f 72 20 61 73	..think m e for as				
0080	6b 69 6e 67 21 20 20 4e 6f 2c 20 69 74 27 6c 6c	..king! N o, it'll				
0090	0d 0a 6e 65 76 65 72 20 64 6f 20 74 6f 20 61 73	..never do to as				
00a0	6b 3a 20 20 70 65 72 68 61 70 73 20 49 20 73 68	..k: perh aps I sh				
00b0	61 6c 6c 20 73 65 65 20 69 74 20 77 62 69 74 74	..all see it writt				

Sequence number for segment 6 is 6541

No.	Time	Source	Destination	Protocol	Length	Info
2185	6.234037	192.168.1.42	162.159.128.235	TLSv1.2	140	Application Data
2204	6.265188	162.159.128.235	192.168.1.42	TCP	54	443 → 49947 [ACK] Seq=1 Ack=259 Win=69 Len=0
2205	6.270237	192.168.1.42	128.119.245.12	TCP	66	50355 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2209	6.294116	192.168.1.42	128.119.245.12	TCP	786	50351 → 80 [PSH, ACK] Seq=1 Ack=1 Win=260 Len=732 [TCP segment of a reassembled PDU]
2210	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=733 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2211	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=2185 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2212	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=3637 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2213	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=5089 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2214	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=6541 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2215	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=7993 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2216	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=9445 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2217	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=10897 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2218	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=12349 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]

Transmission Control Protocol, Src Port: 50351, Dst Port: 80, Seq: 6541, Ack: 1, Len: 1452	
Source Port:	50351
Destination Port:	80
[Stream index:]	3
[TCP Segment Len:]	1452
Sequence Number:	6541 (relative sequence number)
Sequence Number (raw):	725612821
[Next Sequence Number:]	7993 (relative sequence number)]
Acknowledgment Number:	1 (relative ack number)
Acknowledgment number (raw):	919400566
0101 = Header Length: 20 bytes (5)	

Offset	Hex	ASCII
0020	f5 0c c4 af 00 50 2b 3f f9 15 36 cc f0 76 50 10	.....P?..G..vP.
0030	01 04 0b 55 00 00 77 69 6e 64 2c 20 61 6e 64 20	...U..wi nd, and
0040	77 61 73 20 6a 75 73 74 20 69 6e 20 74 69 6d 65	was just in time
0050	20 74 6f 20 68 65 61 72 20 69 74 0d 0a 73 61 79	to hear it say
0060	2c 20 61 73 20 69 74 20 74 75 72 6e 65 64 20 61	, as it turned a
0070	20 63 6f 72 6e 65 72 2c 20 60 4f 68 20 6d 79 20	corner, 'Oh my
0080	65 61 72 73 20 61 6e 64 20 77 68 69 73 6b 65 72	ears and whisker
0090	73 2c 20 68 6f 77 20 6c 61 74 65 0d 0a 69 74 27	s, how l ate..it'
00a0	73 20 67 65 74 74 69 6e 67 21 27 20 20 53 68 65	s gettin gl' She
00b0	20 77 61 73 20 63 6c 6f 73 65 20 62 65 68 69 6e	was clo se behin

Segment 1 is sent at 6.294116 s,
Segment 2 is sent at 6.294335 s,
Segment 3 is sent at 6.294335 s,
Segment 4 is sent at 6.294335 s,
Segment 5 is sent at 6.294335 s,
Segment 6 is sent at 6.294335 s.

No.	Time	Source	Destination	Protocol	Length	Info
2185	6.234037	192.168.1.42	162.159.128.235	TLSv1.2	140	Application Data
2204	6.265188	162.159.128.235	192.168.1.42	TCP	54	443 → 49947 [ACK] Seq=1 Ack=259 Win=69 Len=0
2205	6.270237	192.168.1.42	128.119.245.12	TCP	66	50355 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2209	6.294116	192.168.1.42	128.119.245.12	TCP	786	50351 → 80 [PSH, ACK] Seq=1 Ack=1 Win=260 Len=732 [TCP segment of a reassembled PDU]
2210	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=733 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2211	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=2185 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2212	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=3637 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2213	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=5089 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2214	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=6541 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2215	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=7993 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2216	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=9445 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2217	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=10897 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2218	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=12349 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]

Transmission Control Protocol, Src Port: 50351, Dst Port: 80, Seq: 6541, Ack: 1, Len: 1452	
Source Port:	50351
Destination Port:	80
[Stream index:]	3
[TCP Segment Len:]	1452
Sequence Number:	6541 (relative sequence number)
Sequence Number (raw):	725612821
[Next Sequence Number:]	7993 (relative sequence number)]
Acknowledgment Number:	1 (relative ack number)
Acknowledgment number (raw):	919400566
0101 = Header Length: 20 bytes (5)	

Offset	Hex	ASCII
0020	f5 0c c4 af 00 50 2b 3f f9 15 36 cc f0 76 50 10	.....P?..G..vP.
0030	01 04 0b 55 00 00 77 69 6e 64 2c 20 61 6e 64 20	...U..wi nd, and
0040	77 61 73 20 6a 75 73 74 20 69 6e 20 74 69 6d 65	was just in time
0050	20 74 6f 20 68 65 61 72 20 69 74 0d 0a 73 61 79	to hear it say
0060	2c 20 61 73 20 69 74 20 74 75 72 6e 65 64 20 61	, as it turned a
0070	20 63 6f 72 6e 65 72 2c 20 60 4f 68 20 6d 79 20	corner, 'Oh my
0080	65 61 72 73 20 61 6e 64 20 77 68 69 73 6b 65 72	ears and whisker
0090	73 2c 20 68 6f 77 20 6c 61 74 65 0d 0a 69 74 27	s, how l ate..it'
00a0	73 20 67 65 74 74 69 6e 67 21 27 20 20 53 68 65	s gettin gl' She
00b0	20 77 61 73 20 63 6c 6f 73 65 20 62 65 68 69 6e	was clo se behin

ACK for segment 1 is received 6.458128,
 segment 2 is received 6.458128,
 segment 3 is received 6.458306,
 segment 4 is received 6.458306,
 segment 5 is received 6.464761,
 segment 6 is received 6.464761

No.	Time	Source	Destination	Protocol	Length	Info
2285	6.444458	128.119.245.12	192.168.1.42	TCP	66	80 → 50355 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1452 SACK_PERM=1 WS=128
2287	6.444574	192.168.1.42	128.119.245.12	TCP	54	50355 → 80 [ACK] Seq=1 Ack=1 Win=66560 Len=0
2292	6.458128	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=733 Win=30720 Len=0
2293	6.458128	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=2185 Win=33664 Len=0
2294	6.458208	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=13801 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2295	6.458208	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=15253 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2296	6.458208	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [PSH, ACK] Seq=16705 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2298	6.458306	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=3637 Win=36608 Len=0
2299	6.458306	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=5089 Win=39424 Len=0
2300	6.458373	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=18157 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2301	6.458373	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=19609 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2302	6.458373	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=21061 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2303	6.458373	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=22513 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2307	6.464761	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=6541 Win=42368 Len=0
2308	6.464761	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=7993 Win=45312 Len=0
2309	6.464827	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=23965 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2310	6.464827	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=25417 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2311	6.464827	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=26869 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2312	6.464827	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=28321 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2313	6.464953	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=9445 Win=48256 Len=0

... ..0 = Fin: Not set
 [TCP Flags:A....]
 Window: 240
 [Calculated window size: 30720]

```

0000  94 e9 79 a3 6e 29 e0 19 54 19 98 fe 08 00 45 00  .y n)  T....E
0010  00 28 06 97 40 00 29 06 13 e3 80 77 f5 0c c0 a8  .(.@).  ...w...
0020  01 2a 00 50 c4 af 36 cc f0 76 2b 3f e2 65 50 10  .*.P..6.  .v+?.eP.
0030  00 f0 7d a6 00 00  .)...
  
```

RTT for segment 1 is 0.164012 sec,
 RTT for segment 2 is 0.163793 sec,
 RTT for segment 3 is 0.163971 sec,
 RTT for segment 4 is 0.163971 sec,
 RTT for segment 5 is 0.170426 sec,
 RTT for segment 6 is 0.170426 sec.

EstimatedRTT = 0.875 * EstimatedRTT + 0.125 * SampleRTT

EstimatedRTT for ACK of segment 1 = 0.164012 sec

EstimatedRTT for ACK of segment 2 = 0.163984 sec

EstimatedRTT for ACK of segment 3 = 0.163982 sec

EstimatedRTT for ACK of segment 4 = 0.163980 sec

EstimatedRTT for ACK of segment 5 = 0.164785 sec

EstimatedRTT for ACK of segment 6 = 0.165449 sec

	Sequence Number	Sent Time	ACK received time	RTT(seconds)
Segment1	1	6.294116	6.458128	0.164012
Segment2	733	6.294335	6.458128	0.163793
Segment3	2185	6.294335	6.458306	0.163971
Segment4	3637	6.294335	6.458306	0.163971
Segment5	5089	6.294335	6.464761	0.170426
Segment6	6541	6.294335	6.464761	0.170426

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

ANS: Length of the segment 1 is **732 bytes**. The following segments are **1452 bytes**.

No.	Time	Source	Destination	Protocol	Length	Info
2185	6.234037	192.168.1.42	162.159.128.235	TLSv1.2	140	Application Data
2204	6.265188	162.159.128.235	192.168.1.42	TCP	54	443 → 49947 [ACK] Seq=1 Ack=259 Win=69 Len=0
2205	6.270237	192.168.1.42	128.119.245.12	TCP	66	50355 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2209	6.294116	192.168.1.42	128.119.245.12	TCP	786	50351 → 80 [PSH, ACK] Seq=1 Ack=1 Win=260 Len=732 [TCP segment of a reassembled PDU]
2210	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=733 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2211	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=2185 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2212	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=3637 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2213	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=5089 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2214	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=6541 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2215	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=7993 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2216	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=9445 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2217	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=10897 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2218	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=12349 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]

Transmission Control Protocol, Src Port: 50351, Dst Port: 80, Seq: 1, Ack: 1, Len: 732	
Source Port:	50351
Destination Port:	80
[Stream index:	3]
[TCP Segment Len:	732]
Sequence Number:	1 (relative sequence number)
Sequence Number (raw):	725606281
[Next Sequence Number:	733 (relative sequence number)]
Acknowledgment Number:	1 (relative ack number)
Acknowledgment number (raw):	919400566
0101 = Header Length: 20 bytes (5)	

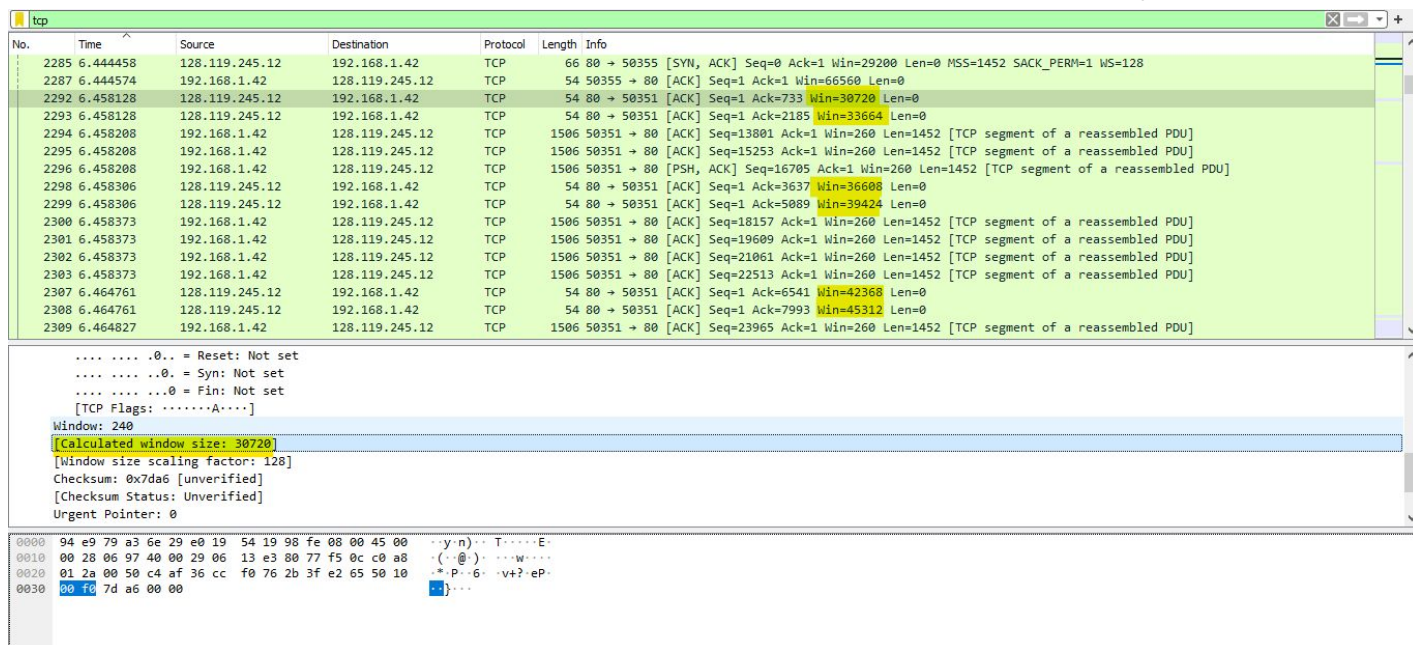

```

0020 f5 0c c4 af 00 50 2b 3f df 89 36 cc f0 76 50 18  ....P+?..6...vP+
0030 01 04 67 6c 00 00 50 4f 53 54 20 2f 77 69 72 65  ..g1..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 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
00a0 65 6e 67 74 68 3a 20 31 35 32 33 32 31 0d 0a 43  engh: 1 52321 C
00b0 61 63 68 65 2d 43 6f 6e 74 72 6f 6c 3a 20 6d 61  ache-Con trol: ma

```

9. What is the minimum amount of available buffer space (receiver window) advertised at the received for the entire trace? Does the lack of receiver buffer space ever throttle the sender? If any, justify your reason.

ANS: The minimum amount of available buffer space has 30720 bytes. It does not throttle the sender because in each tcp segment we can see the window size increased. If there is a throttle we should have seen that window size has to be shrunk in the trace. However it increased every time.



The image shows a Wireshark packet capture of a TCP connection. The top pane displays a list of packets, and the bottom pane shows the details of a selected packet (No. 2292).

No.	Time	Source	Destination	Protocol	Length	Info
2285	6.444458	128.119.245.12	192.168.1.42	TCP	66	80 → 50355 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1452 SACK_PERM=1 WS=128
2287	6.444574	192.168.1.42	128.119.245.12	TCP	54	50355 → 80 [ACK] Seq=1 Ack=1 Win=66560 Len=0
2292	6.458128	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=733 Win=30720 Len=0
2293	6.458128	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=2185 Win=33664 Len=0
2294	6.458208	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=13801 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2295	6.458208	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=15253 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2296	6.458208	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [PSH, ACK] Seq=16705 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2298	6.458306	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=3637 Win=36608 Len=0
2299	6.458306	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=5089 Win=39424 Len=0
2300	6.458373	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=18157 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2301	6.458373	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=19609 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2302	6.458373	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=21061 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2303	6.458373	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=22513 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2307	6.464761	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=6541 Win=42368 Len=0
2308	6.464761	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=7993 Win=45312 Len=0
2309	6.464827	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=23965 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]

Details of packet 2292:

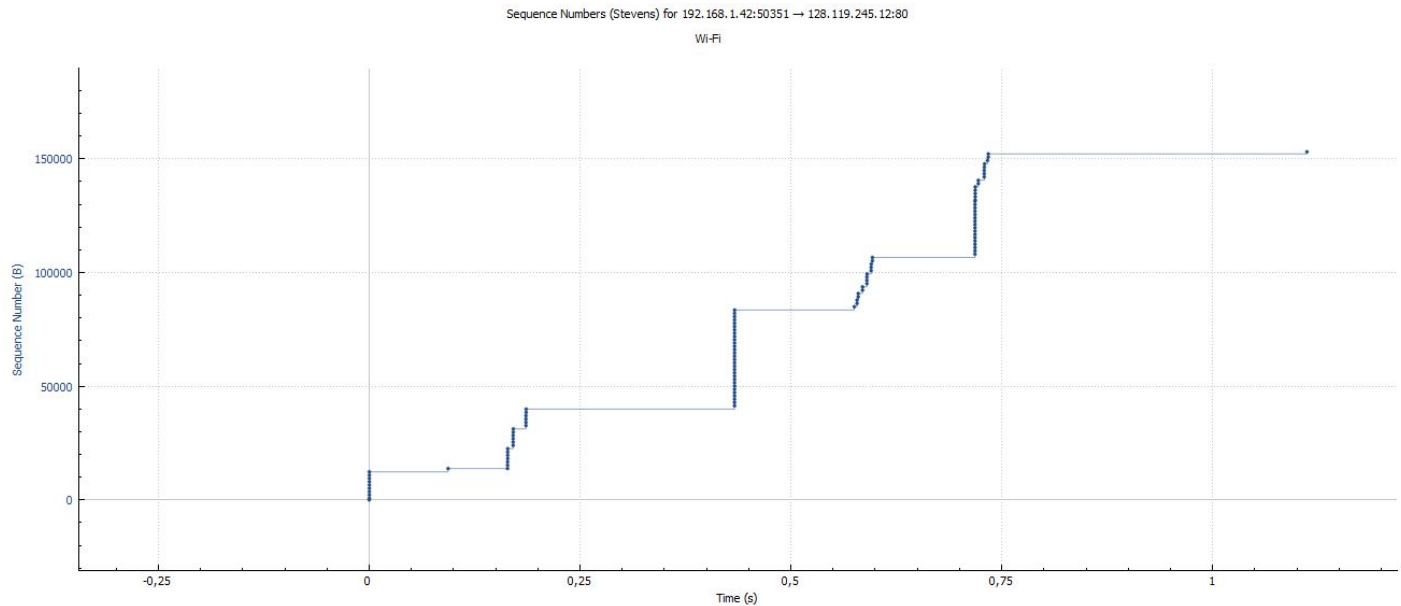
```
.... ..0.. = Reset: Not set
.... ..0.. = Syn: Not set
.... ..0.. = Fin: Not set
[TCP Flags: .....A....]
Window: 240
[Calculated window size: 30720]
[Window size scaling factor: 128]
Checksum: 0x7da6 [unverified]
[Checksum Status: Unverified]
Urgent Pointer: 0
```

Hex dump:

```
0000 94 e9 79 a3 6e 29 e0 19 54 19 98 fe 08 00 45 00  ..y.n)..T....E-
0010 00 28 06 97 40 00 29 06 13 e3 80 77 f5 0c c0 a8  ..(.@)..w....
0020 01 2a 00 50 c4 af 36 cc f0 76 2b 3f e2 65 50 10  *.P..6..v+?eP-
0030 00 7c 7d a6 00 00  }...
```

10. Are there any retransmitted segments in the trace file? What did you check for (in the trace) in order to answer this question? (You can use Statistics->TCP Stream Graph-> Time-Sequence-Graph(Stevens) of this trace from your source:client to destination:server, and look for sequence numbers are increasing monotonically with respect to time)

ANS: No there are no retransmitted segments in the trace file. This can be explained by packets with the same sequence number at different time is not found.



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 247 in the text)?

ANS: When we examine the results, ACK values increase by 1452(ex: 3637-2185 = 1452) bytes in general for each response from the server.

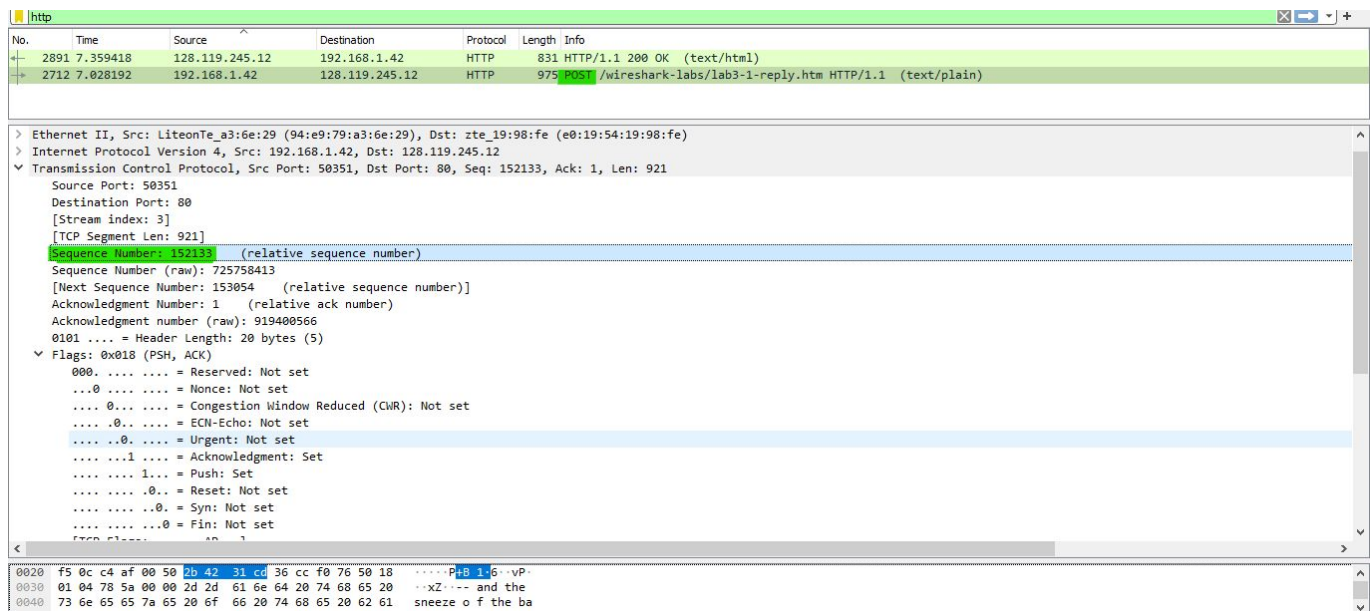
No.	Time	Source	Destination	Protocol	Length	Info
2280	6.387657	128.119.245.12	192.168.1.42	TCP	66	80 → 50351 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1452 SACK_PERM=1 WS=128
2285	6.444458	128.119.245.12	192.168.1.42	TCP	66	80 → 50355 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1452 SACK_PERM=1 WS=128
2292	6.458128	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=733 Win=30720 Len=0
2293	6.458128	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=2185 Win=33664 Len=0
2298	6.458306	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=3637 Win=36608 Len=0
2299	6.458306	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=5089 Win=39424 Len=0
2307	6.464761	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=6541 Win=42368 Len=0
2308	6.464761	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=7993 Win=45312 Len=0
2313	6.464953	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=9445 Win=48256 Len=0
2321	6.479883	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=10897 Win=51200 Len=0
2322	6.479883	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=12349 Win=54144 Len=0
2327	6.480178	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=13801 Win=56960 Len=0
2434	6.727198	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=15253 Win=59904 Len=0
2435	6.727198	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=16705 Win=62848 Len=0
2436	6.727198	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=18157 Win=65792 Len=0
2437	6.727198	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=19609 Win=68736 Len=0
2438	6.727198	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=21061 Win=71552 Len=0
2439	6.727198	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=22513 Win=74496 Len=0
2440	6.727198	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=23965 Win=77440 Len=0
2441	6.727198	128.119.245.12	192.168.1.42	TCP	54	80 → 50351 [ACK] Seq=1 Ack=25417 Win=80384 Len=0

.....0.. = Reset: Not set
>1.. = Syn: Set
.....0 = Fin: Not set
[TCP Flags: .....A..S.]
Window: 29200
[Calculated window size: 29200]
Checksum: 0xc97 [unverified]
[Checksum Status: Unverified]
Urgent Pointer: 0
Options: (12 bytes) Maximum segment size NoOperation (NOP) NoOperation (NOP) SACK permitted NoOperation (NOP) Window scale

0000	94 e9 79 a3 6e 29 e0 19 54 19 98 fe 08 00 45 00	..y.n...T....E..
0010	00 34 00 00 40 00 29 06 1a 6e 80 77 f5 0c c0 a8	..4..@...n.nw....
0020	01 2a 00 50 c4 af 36 cc f0 75 2b 3f df 89 80 12	..*..P..6...u+?....
0030	72 10 ce 97 00 00 02 04 05 ac 01 01 04 02 01 03	..P.....

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

ANS: If we look at our http/post request we can see total data is $152133 - 1 = 152132$ bytes (Sequence number - ACK number)



No.	Time	Source	Destination	Protocol	Length	Info
2891	7.359418	128.119.245.12	192.168.1.42	HTTP	831	HTTP/1.1 200 OK (text/html)
2712	7.028192	192.168.1.42	128.119.245.12	HTTP	975	POST /wireshark-labs/lab3-1-reply.htm HTTP/1.1 (text/plain)

Ethernet II, Src: LiteonTe_a3:6e:29 (94:e9:79:a3:6e:29), Dst: zte_19:98:fe (e0:19:54:19:98:fe)

Internet Protocol Version 4, Src: 192.168.1.42, Dst: 128.119.245.12

Transmission Control Protocol, Src Port: 50351, Dst Port: 80, Seq: 152133, Ack: 1, Len: 921

Source Port: 50351

Destination Port: 80

[Stream index: 3]

[TCP Segment Len: 921]

Sequence Number: 152133 (relative sequence number)

Sequence Number (raw): 725758413

[Next Sequence Number: 153054 (relative sequence number)]

Acknowledgment Number: 1 (relative ack number)

Acknowledgment number (raw): 919400566

0101 = Header Length: 20 bytes (5)

Flags: 0x018 (PSH, ACK)

0000 = 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

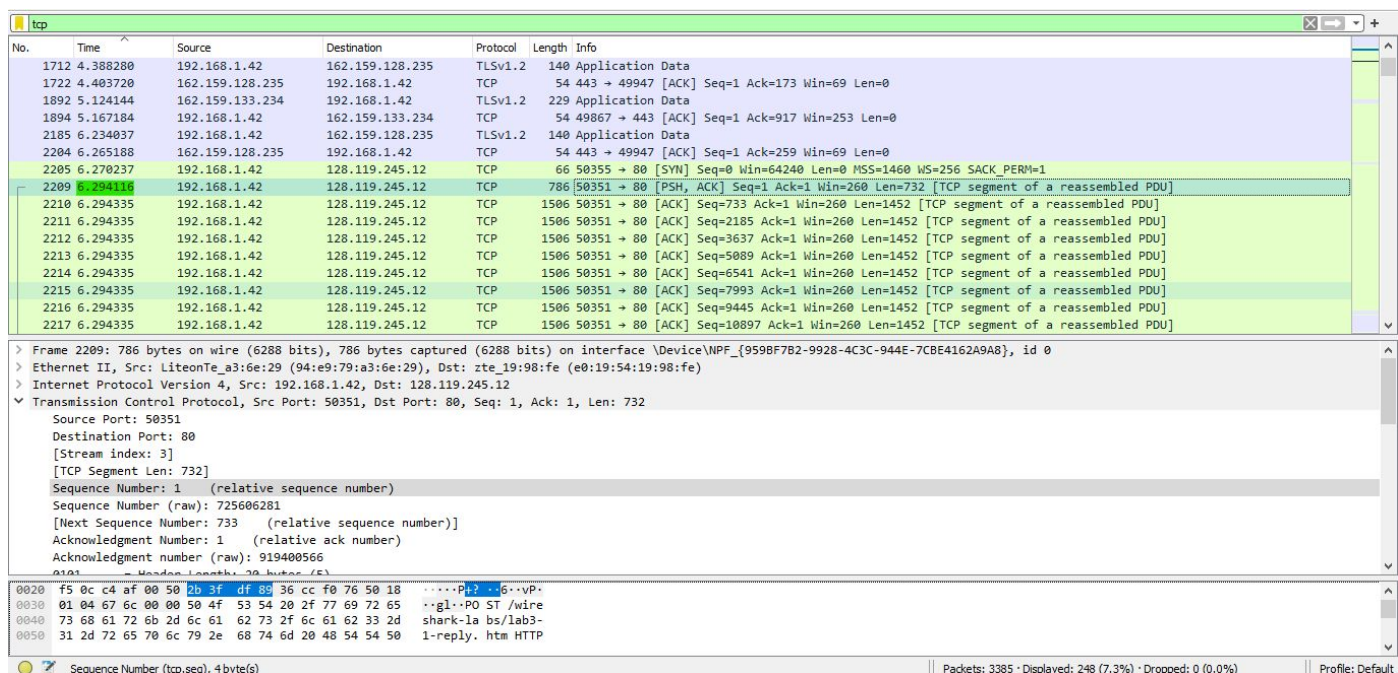
...0 = Fin: Not set

0020 f5 0c c4 af 00 50 2b 42 31 c0 36 cc f0 76 50 18P+16-vP

0030 01 04 78 5a 00 00 2d 2d 61 6e 64 20 74 68 65 20 ...xZ... and the

0040 73 6e 65 65 7a 65 20 6f 66 20 74 68 65 20 62 61 ...sneeze o f the ba

The total transmission time is 7.028192 (Post request time) - 6.294116 (first sending segment time) = 0.734076 seconds.



No.	Time	Source	Destination	Protocol	Length	Info
1712	4.388280	192.168.1.42	162.159.128.235	TLSv1.2	140	Application Data
1722	4.403720	162.159.128.235	192.168.1.42	TCP	54	443 → 49947 [ACK] Seq=1 Ack=173 Win=69 Len=0
1892	5.124144	162.159.133.234	192.168.1.42	TLSv1.2	229	Application Data
1894	5.167184	192.168.1.42	162.159.133.234	TCP	54	49867 → 443 [ACK] Seq=1 Ack=917 Win=253 Len=0
2185	6.234037	192.168.1.42	162.159.128.235	TLSv1.2	140	Application Data
2204	6.265188	162.159.128.235	192.168.1.42	TCP	54	443 → 49947 [ACK] Seq=1 Ack=259 Win=69 Len=0
2205	6.270237	192.168.1.42	128.119.245.12	TCP	66	50355 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
2209	6.294116	192.168.1.42	128.119.245.12	TCP	786	50351 → 80 [PSH, ACK] Seq=1 Ack=1 Win=260 Len=732 [TCP segment of a reassembled PDU]
2210	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=733 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2211	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=2185 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2212	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=3637 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2213	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=5089 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2214	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=6541 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2215	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=7993 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2216	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=9445 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]
2217	6.294335	192.168.1.42	128.119.245.12	TCP	1506	50351 → 80 [ACK] Seq=10897 Ack=1 Win=260 Len=1452 [TCP segment of a reassembled PDU]

Ethernet II, Src: LiteonTe_a3:6e:29 (94:e9:79:a3:6e:29), Dst: zte_19:98:fe (e0:19:54:19:98:fe)

Internet Protocol Version 4, Src: 192.168.1.42, Dst: 128.119.245.12

Transmission Control Protocol, Src Port: 50351, Dst Port: 80, Seq: 1, Ack: 1, Len: 732

Source Port: 50351

Destination Port: 80

[Stream index: 3]

[TCP Segment Len: 732]

Sequence Number: 1 (relative sequence number)

Sequence Number (raw): 725606281

[Next Sequence Number: 733 (relative sequence number)]

Acknowledgment Number: 1 (relative ack number)

Acknowledgment number (raw): 919400566

0101 = Header Length: 20 bytes (5)

0020 f5 0c c4 af 00 50 2b 3f df 89 36 cc f0 76 50 18P+?..6..vP

0030 01 04 67 6c 00 00 50 4f 53 54 20 2f 77 69 72 65 ...gl..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 54 50 ...1-reply. htm HTTP

Sequence Number (tcp.seq), 4 byte(s)

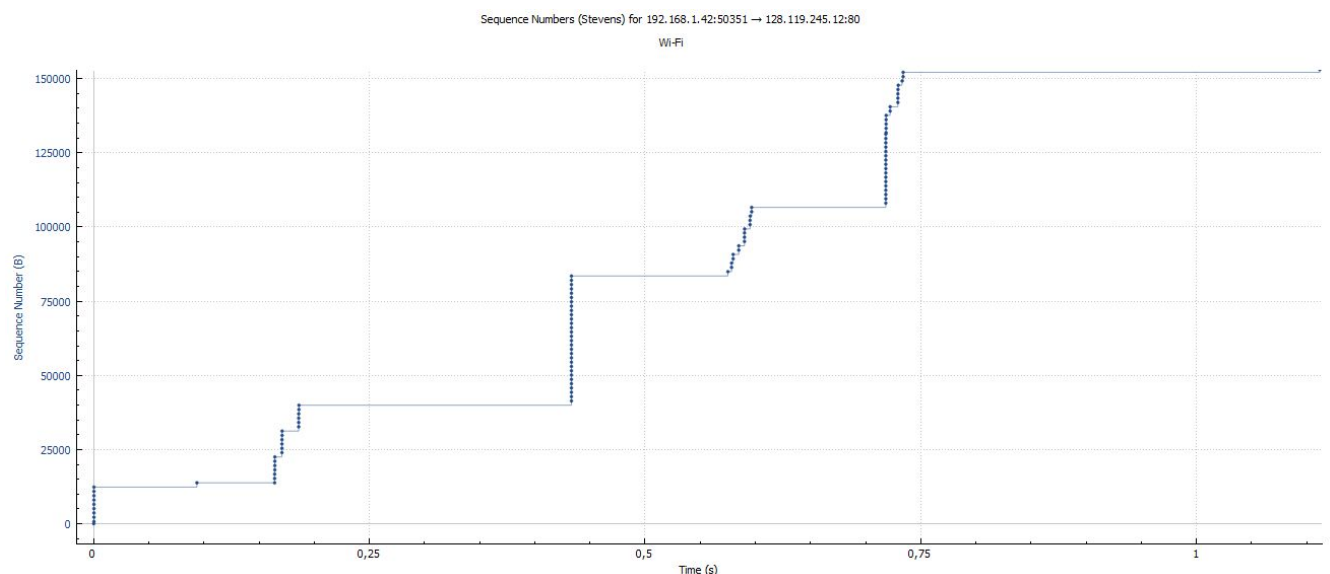
Packets: 3385 · Displayed: 248 (7.3%) · Dropped: 0 (0.0%)

Profile: Default

The throughput for the TCP connection is computed as:
 $152132 \text{ bytes} / 0.734076 \text{ sec.} = 207242.847 \text{ bytes/sec.}$

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 slow start 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.

ANS: The slow start phase begins around zero and ends around 0.1 second. After that congestion avoidance takes over the control.



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?

ANS: The questions had been answered above .