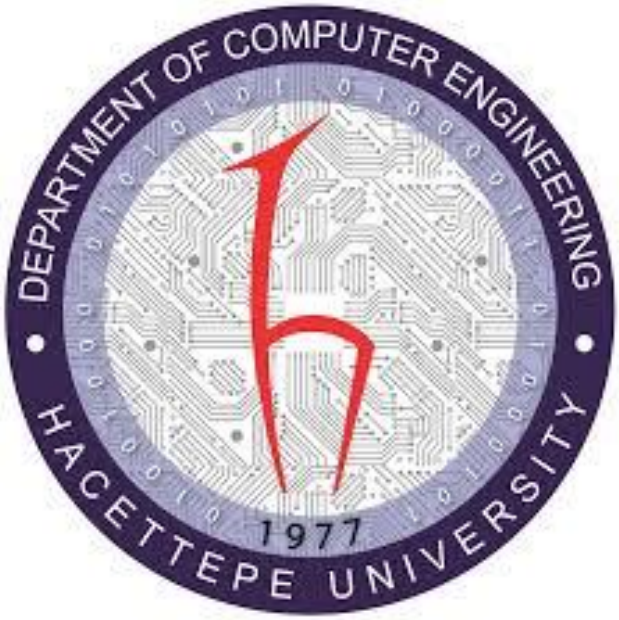
# HACETTEPE UNIVERSITY

# COMPUTER ENGINEERING DEPARTMENT

# COMPUTER NETWORKS LABORATORY




## EXPERIMENT 5

## TCP

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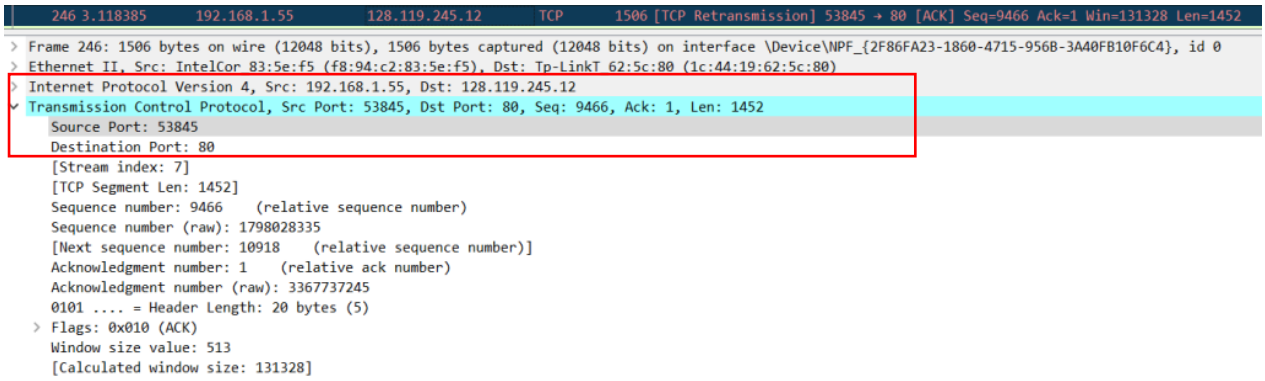
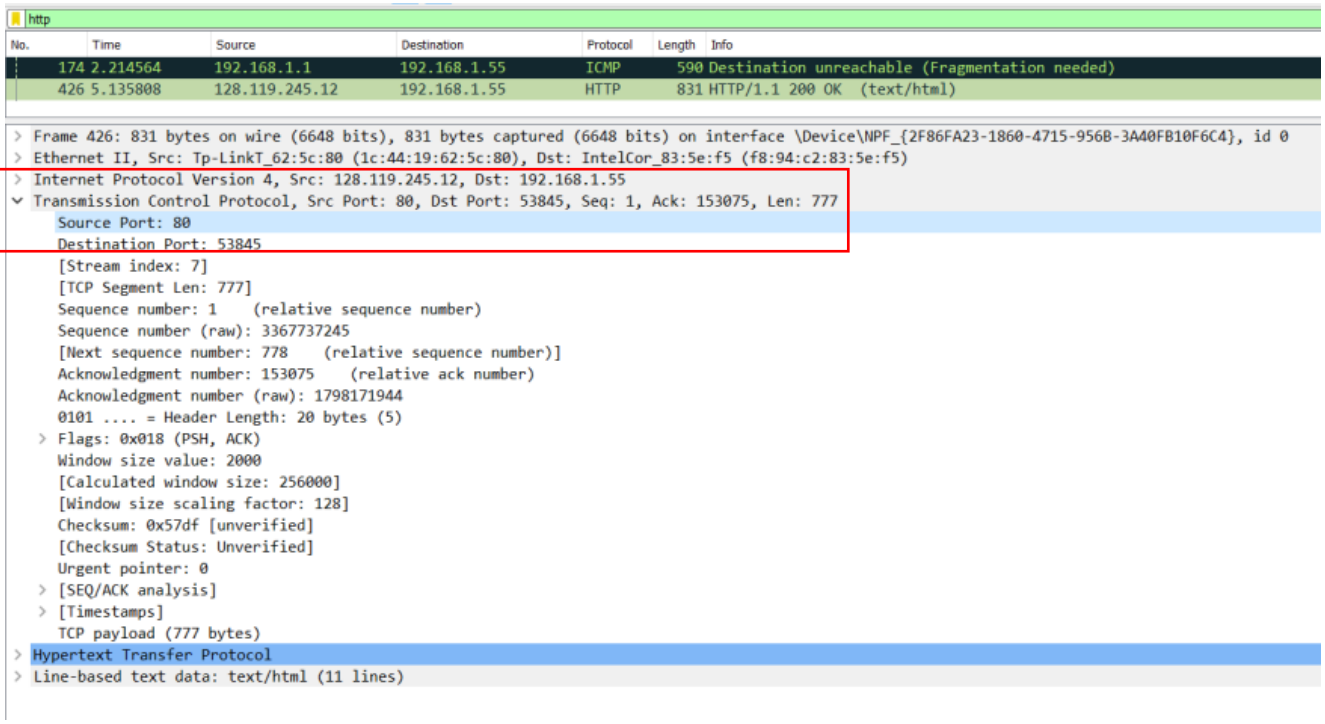
**GROUP NUMBER : 12**

IP address of our computer: 192.168.1.55

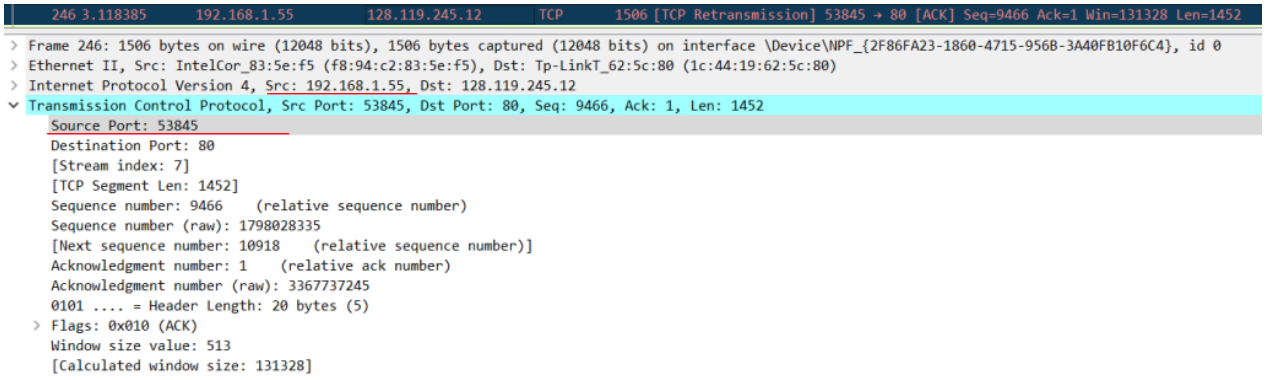
1. IP address of our source computer is 192.168.1.55 and TCP source port number is 53845



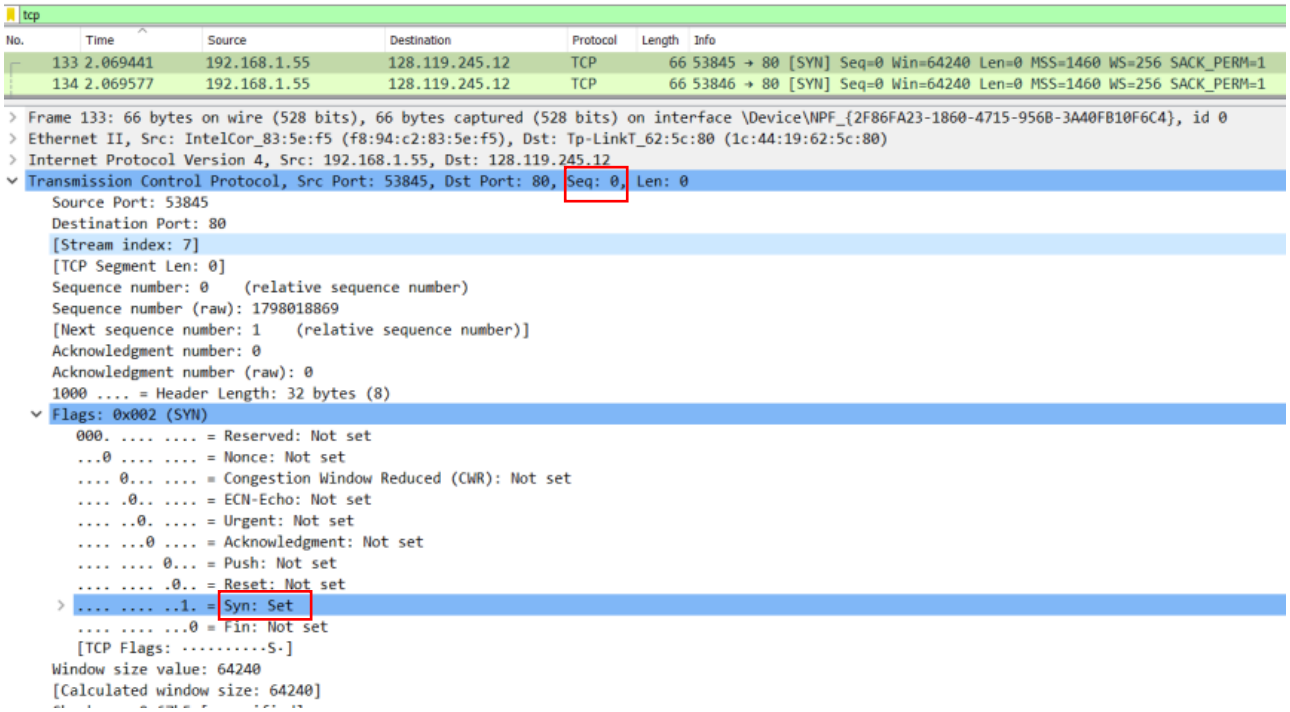

2. IP address of gaia.cs.umass.edu is 128.119.245.12 and port number is 80 which is source port.



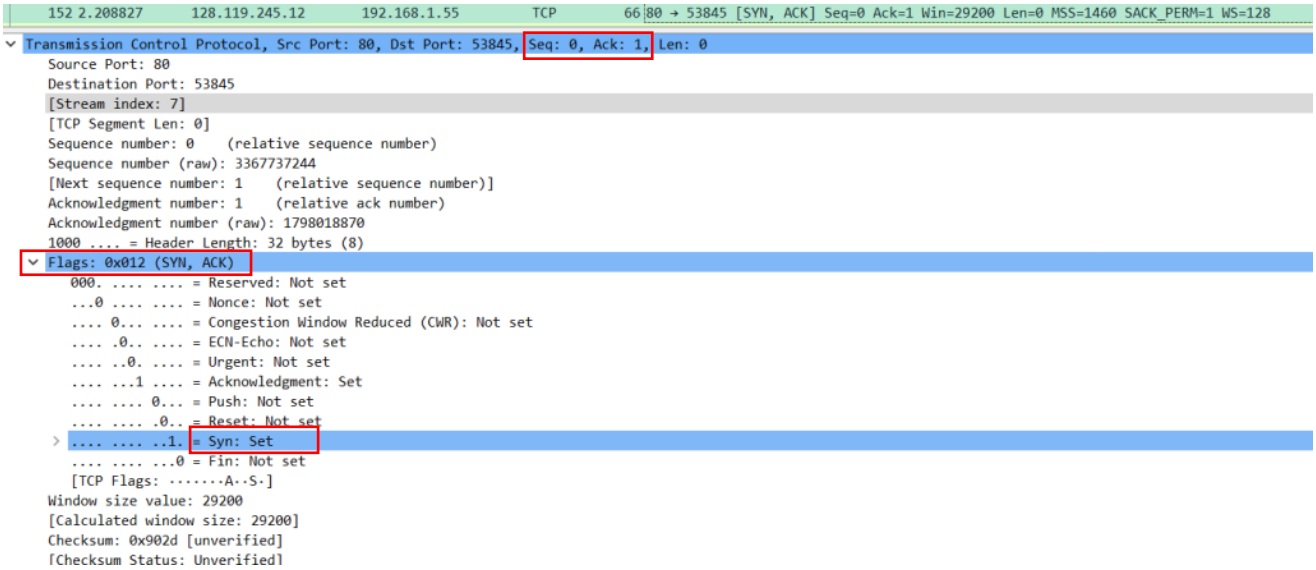

3. TCP port is 53845 and IP address is 192.168.1.55



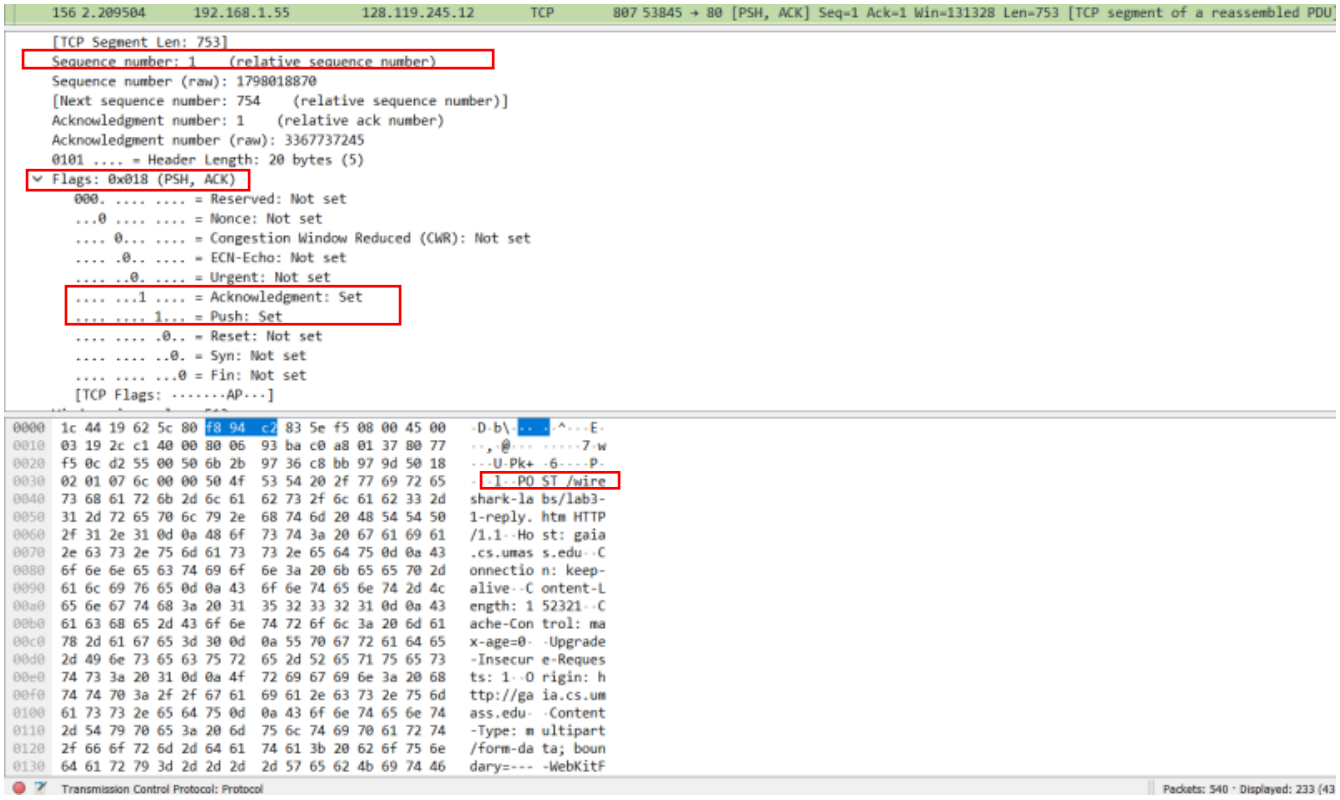
4. The sequence number of TCP SYN segment is 0. It is used to initiate the TCP connection between our client computer and gaia.cs.umass.edu.



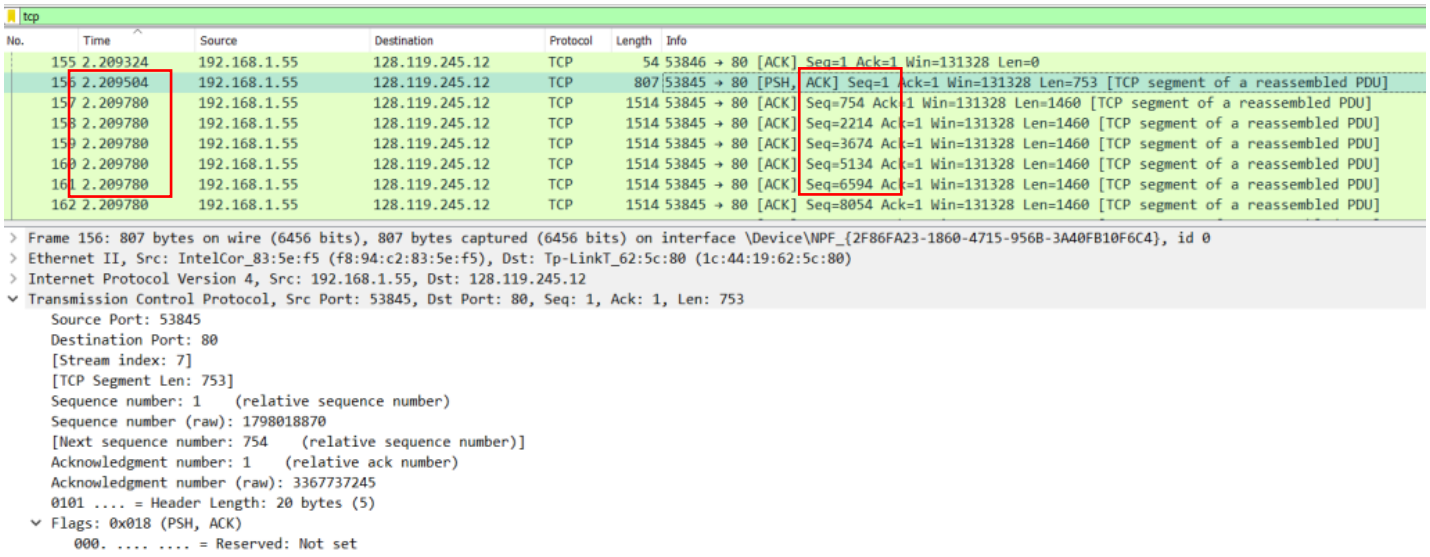

5. The sequence number of SYN_ACK segment sent by gaia.cs.umass.edu website to our client computer in reply to SYN is 0. Server adds 1 to initial sequence number of SYN segment from the client computer. Because of that, our initial sequence number is 0 thus, SYN_ACK segment is 1. SYN and Acknowledgment flag indicates that this segment is a SYN_ACK segment if they both set to 1.



6. Sequence number of TCP segment that contains HTTP POST is 1. It is in 6th segment.




7. Sequence numbers of first 6 segment are: 1, 754, 2214, 3674, 5134, 6594




| Sequence number | Sent time | ACK received time | RTT (seconds) |
|---|---|---|---|
| 1 | 2.209504 | 2.212378 | 0.002874 |
| 754 | 2.209780 | 2.215534 | 0.005754 |
| 2214 | 2.209780 | 2.348727 | 0.138947 |
| 3674 | 2.209780 | 2.838023 | 0,628243 |
| 5134 | 2.209780 | 3.117821 | 0,908041 |
| 6594 | 2.209780 | 3.118279 | 0,908499 |

By using the formula: EstimatedRTT = 0.875 * EstimatedRTT + 0.125 * SampleRTT

(RTT for segment 1 is found by: 2. 212378 – 2. 209504 = 0.002874)

<u>EstimatedRTT after the receipt of the ACK of segment 1:</u>

EstimatedRTT = RTT for Segment 1 = 0.002874 second

<u>EstimatedRTT after the receipt of the ACK of segment 2:</u>

EstimatedRTT = 0.875 * 0.002874 + 0.125 * 0.005754 = 0,003234

<u>EstimatedRTT after the receipt of the ACK of segment 3:</u>

EstimatedRTT = 0.875 * 0,003234 + 0.125 * 0.138947 = 0,020198125

<u>EstimatedRTT after the receipt of the ACK of segment 4:</u>

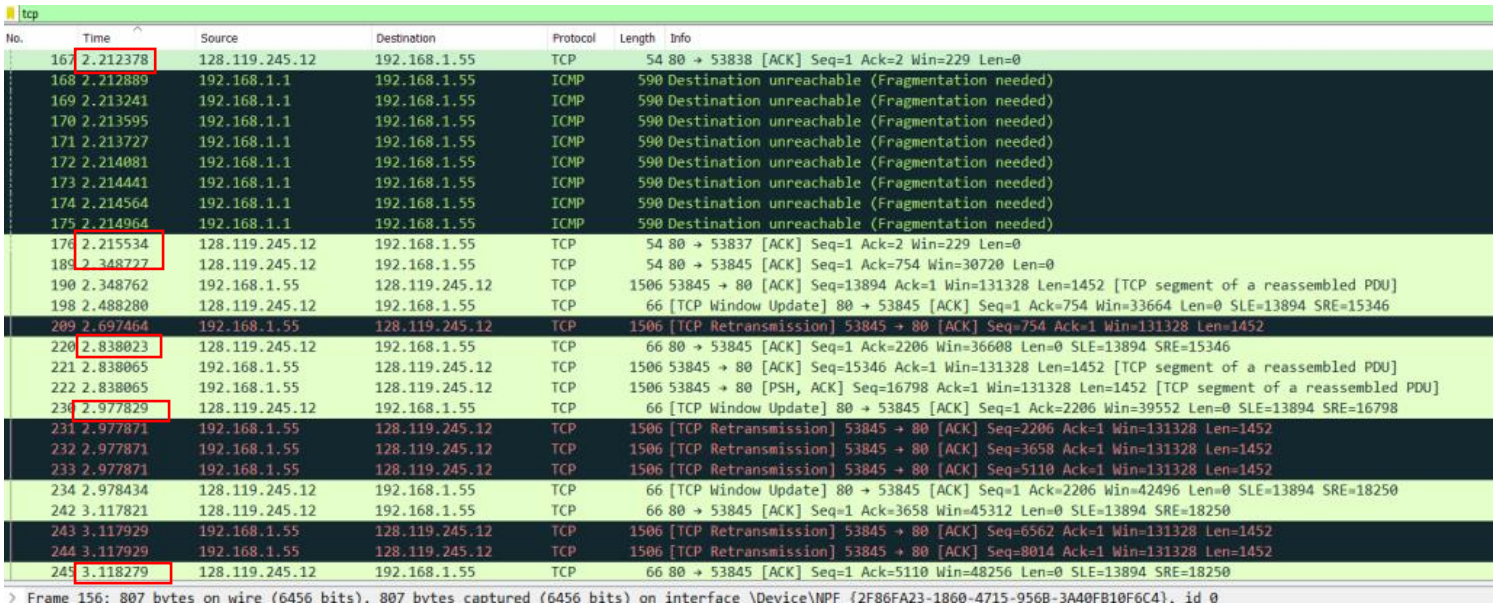
EstimatedRTT = 0.875 * 0,020198125 + 0.125 * 0.628243 = 0.09620373437

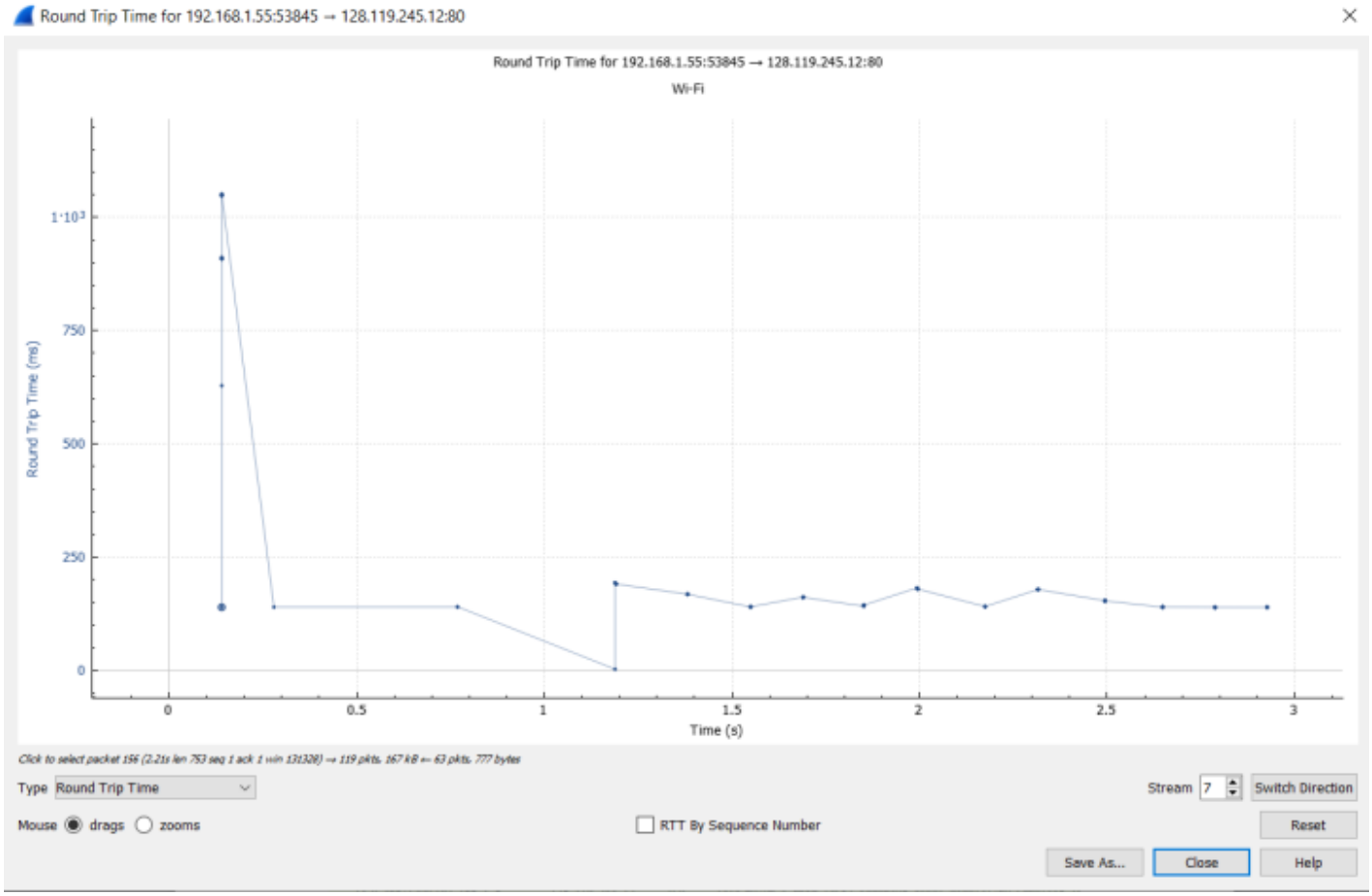
<u>EstimatedRTT after the receipt of the ACK of segment 5:</u>

EstimatedRTT = 0.875 * 0.09620373437 + 0.125 * 0.908041 = 0.19768339257

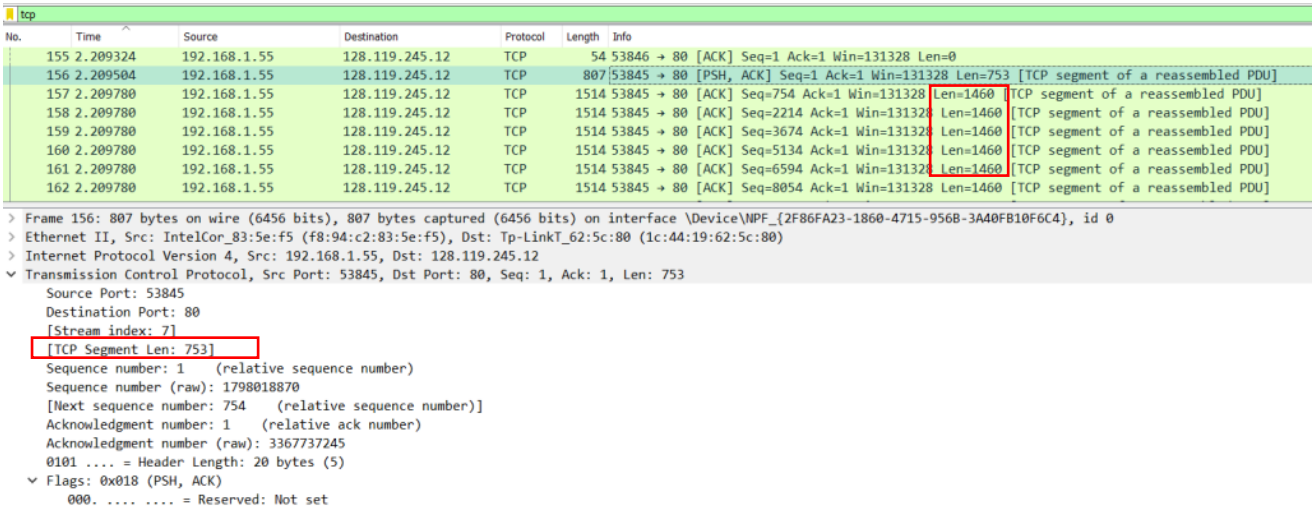
<u>EstimatedRTT after the receipt of the ACK of segment 6:</u>

EstimatedRTT = 0.875 * 0.19768339257 + 0.125 * 0,908499 = 0.28653534349 second



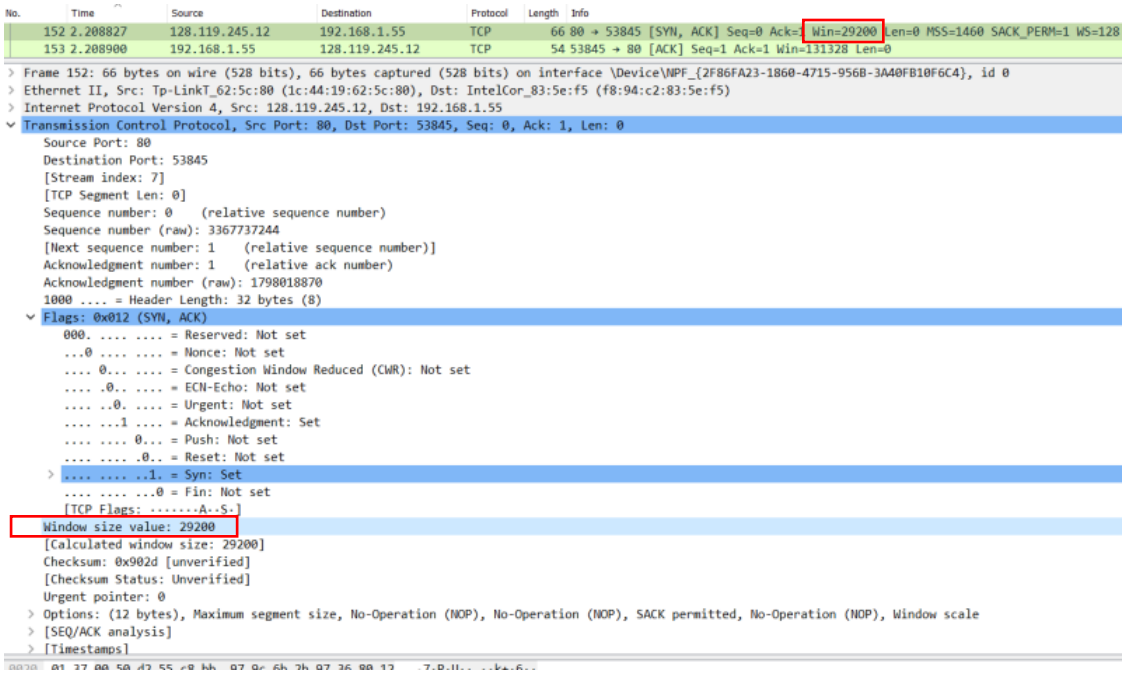



8. The length of first TCP segment is 753 bytes and other five segments' length is 1460 bytes.

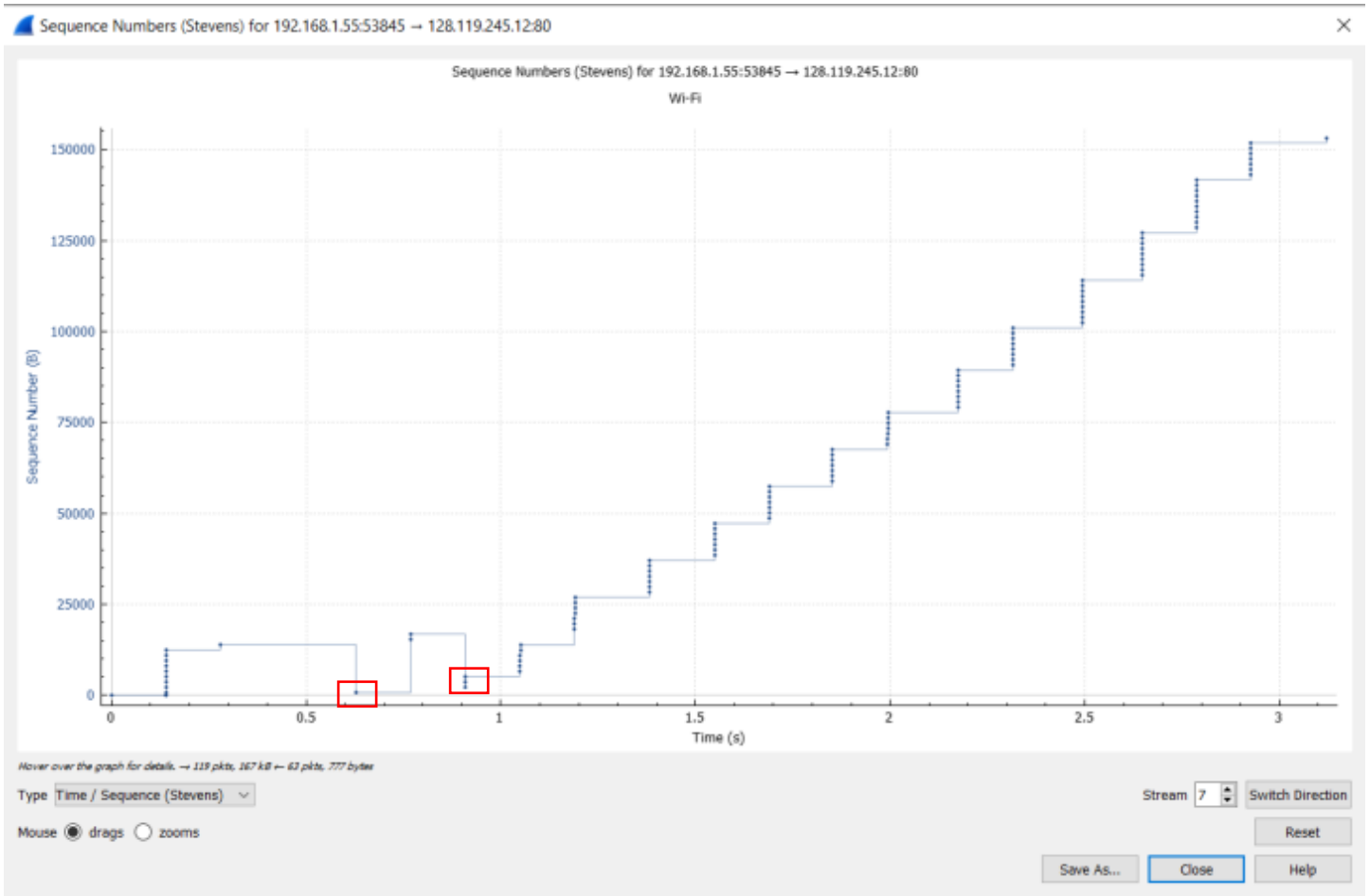


```
tcp
No.  Time      Source          Destination     Protocol  Length  Info
 155 2.209324  192.168.1.55    128.119.245.12  TCP         54    53846 → 80 [ACK] Seq=1 Ack=1 Win=131328 Len=0
 156 2.209504  192.168.1.55    128.119.245.12  TCP        807    53845 → 80 [PSH, ACK] Seq=1 Ack=1 Win=131328 Len=753 [TCP segment of a reassembled PDU]
 157 2.209780  192.168.1.55    128.119.245.12  TCP       1514    53845 → 80 [ACK] Seq=754 Ack=1 Win=131328 Len=1460 [TCP segment of a reassembled PDU]
 158 2.209780  192.168.1.55    128.119.245.12  TCP       1514    53845 → 80 [ACK] Seq=2214 Ack=1 Win=131328 Len=1460 [TCP segment of a reassembled PDU]
 159 2.209780  192.168.1.55    128.119.245.12  TCP       1514    53845 → 80 [ACK] Seq=3674 Ack=1 Win=131328 Len=1460 [TCP segment of a reassembled PDU]
 160 2.209780  192.168.1.55    128.119.245.12  TCP       1514    53845 → 80 [ACK] Seq=5134 Ack=1 Win=131328 Len=1460 [TCP segment of a reassembled PDU]
 161 2.209780  192.168.1.55    128.119.245.12  TCP       1514    53845 → 80 [ACK] Seq=6594 Ack=1 Win=131328 Len=1460 [TCP segment of a reassembled PDU]
 162 2.209780  192.168.1.55    128.119.245.12  TCP       1514    53845 → 80 [ACK] Seq=8054 Ack=1 Win=131328 Len=1460 [TCP segment of a reassembled PDU]

> Frame 156: 807 bytes on wire (6456 bits), 807 bytes captured (6456 bits) on interface \Device\NPF_{2F86FA23-1860-4715-956B-3A40FB10F6C4}, id 0
> Ethernet II, Src: IntelCor_83:5e:f5 (f8:94:c2:83:5e:f5), Dst: Tp-LinkT_62:5c:80 (1c:44:19:62:5c:80)
> Internet Protocol Version 4, Src: 192.168.1.55, Dst: 128.119.245.12
v Transmission Control Protocol, Src Port: 53845, Dst Port: 80, Seq: 1, Ack: 1, Len: 753
    Source Port: 53845
    Destination Port: 80
    [Stream index: 7]
    [TCP Segment Len: 753]
    Sequence number: 1    (relative sequence number)
    Sequence number (raw): 1798018870
    [Next sequence number: 754    (relative sequence number)]
    Acknowledgment number: 1    (relative ack number)
    Acknowledgment number (raw): 3367737245
    0101 .... = Header Length: 20 bytes (5)
  v Flags: 0x018 (PSH, ACK)
      000. .... .... = Reserved: Not set
```

9. The minimum amount of available buffer space (receiver window) advertised at the received for the entire trace is 29200 bytes. It is found by looking at the first acknowledgement from the server.

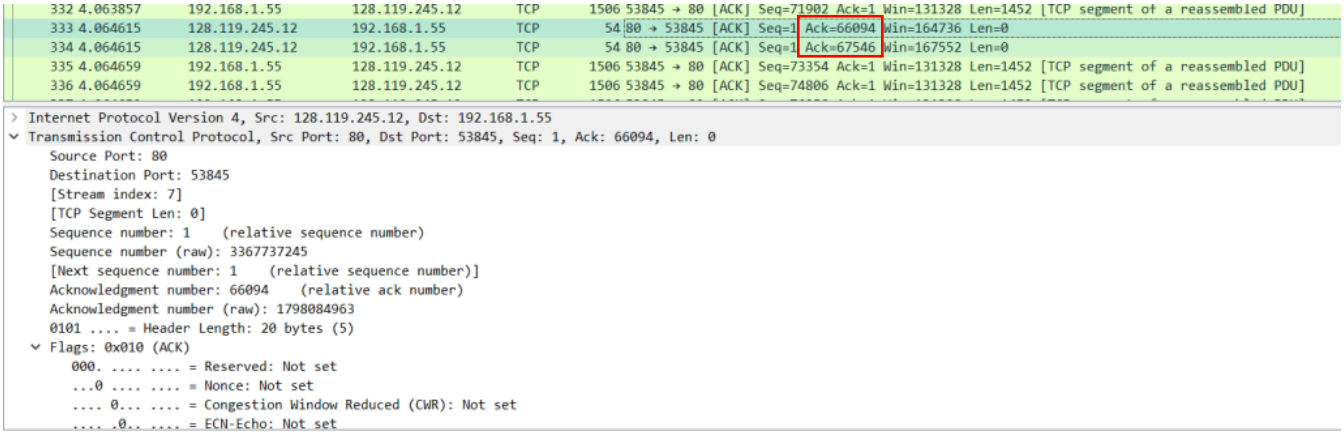



10. There are 4 retransmitted segments in the trace file. We found this by looking at Stevens table.

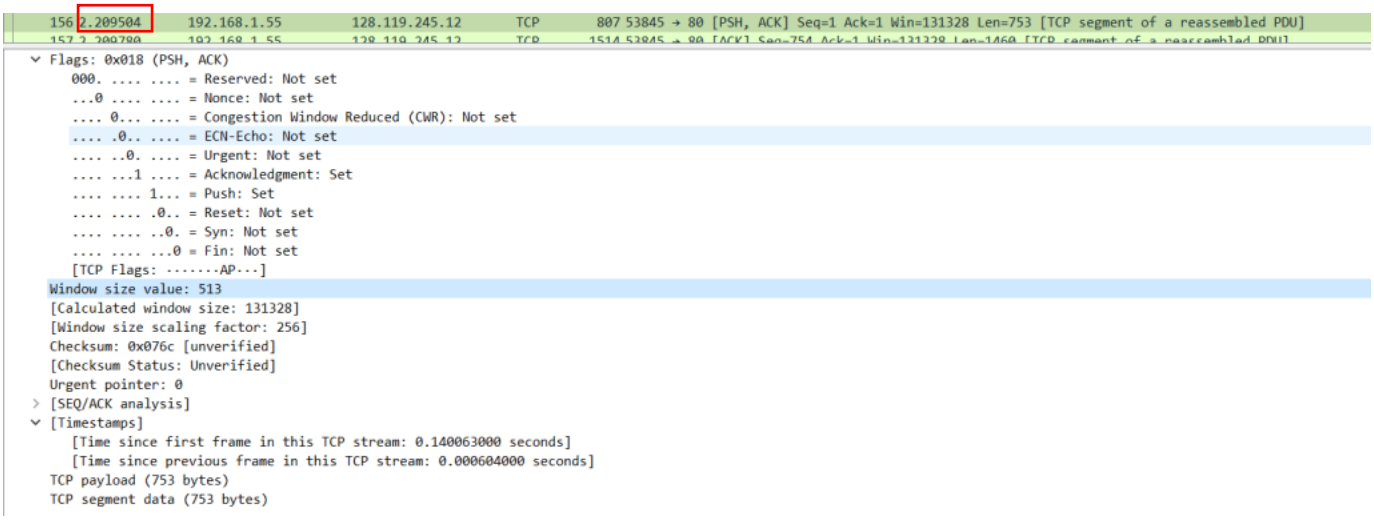


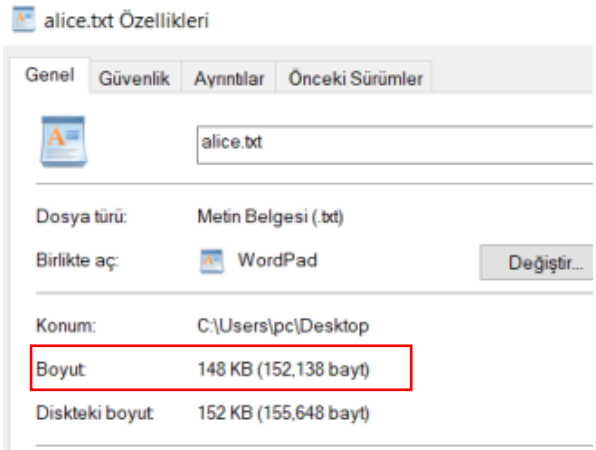
Except these ones, sequence numbers are increasing monotonically with respect to time.

11. The difference between two consecutive ACK is (67546 – 66094 =) 1452 as we can see in the screenshot below. That specifies the data received by server between these two ACKs.




12. Time for first TCP segment: 2.209504




Size of alice.txt: 152138 bytes

Time for last ACK: 5.135453

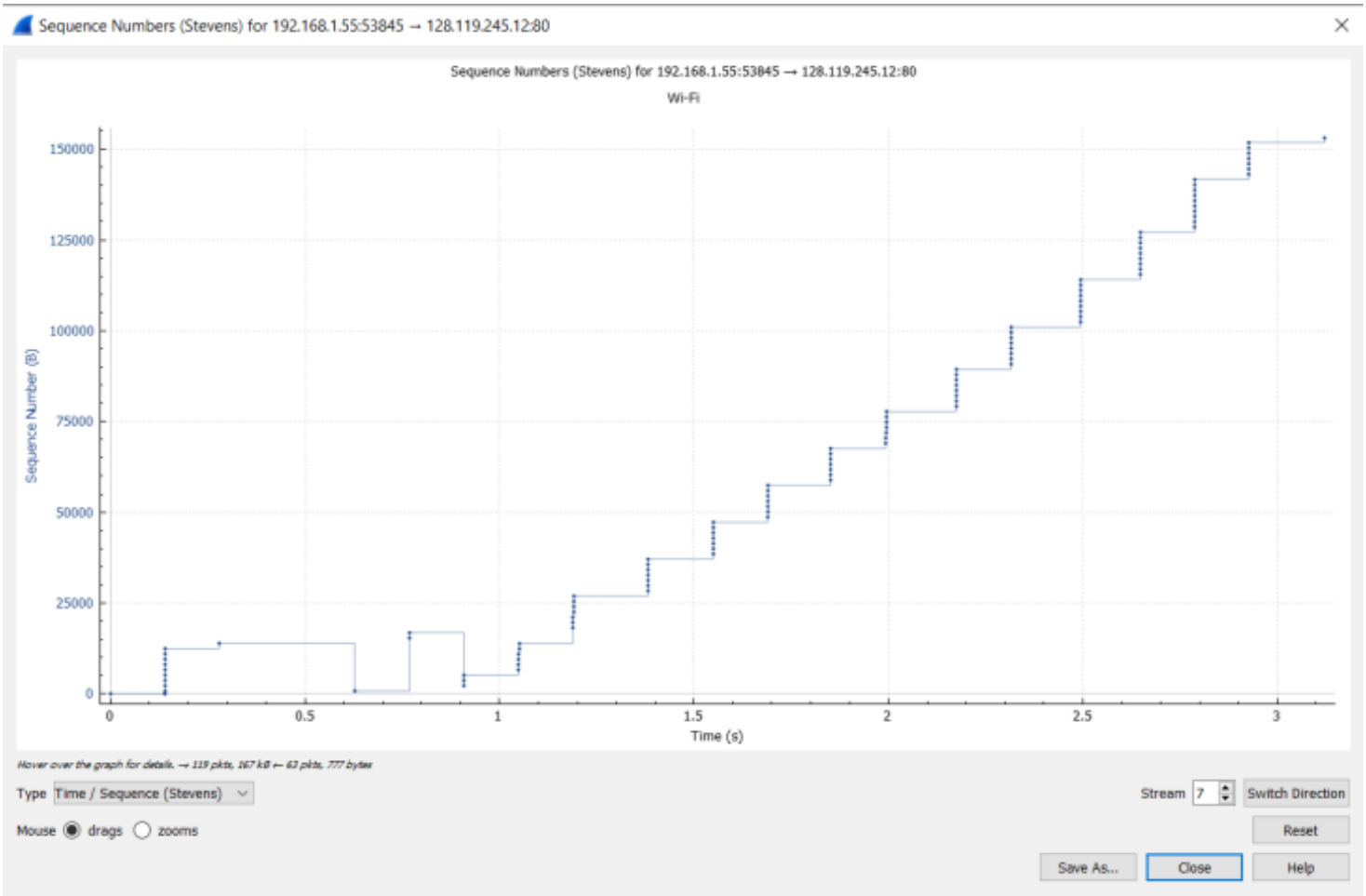
```
425 5.135453    128.119.245.12    192.168.1.55    TCP     54 80 → 53845 [ACK] Seq=1 Ack=153075 Win=256000 Len=0
426 5.135808    128.119.245.12    192.168.1.55    HTTP    831 HTTP/1.1 200 OK  (text/html)

    Acknowledgment number: 153075    (relative ack number)
    Acknowledgment number (raw): 1798171944
    0101 .... = Header Length: 20 bytes (5)
  ▾ Flags: 0x010 (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
      .... .... ..0. = Syn: Not set
      .... .... ...0 = Fin: Not set
      [TCP Flags: ·····A····]
    Window size value: 2000
    [Calculated window size: 256000]
    [Window size scaling factor: 128]
    Checksum: 0xe54b [unverified]
    [Checksum Status: Unverified]
    Urgent pointer: 0
  ▸ [SEQ/ACK analysis]
  ▾ [Timestamps]
      [Time since first frame in this TCP stream: 3.066012000 seconds]
      [Time since previous frame in this TCP stream: 0.000119000 seconds]
```

*According to formula*:

time incurred: 5.135453 - 2.209504 = 2.925949

Throughput for TCP connection: file size / time incurred = 152138 / 2.925949

= 51996.1216002 bytes/sec = 51.996 kB/sec



13. If we look at the Stevens table above, slowstart phase of TCP begins at nearly 0.15 and ends at about 0.30. Congestion avoidance takes over at about 0.15. Afterward there are a couple resent transmissions but after this the amount of data transmitted gets consistent after around 1.08 because the amount of data sent gets lesser.

14. We already answered 😊