Computer Network Study Lab 5

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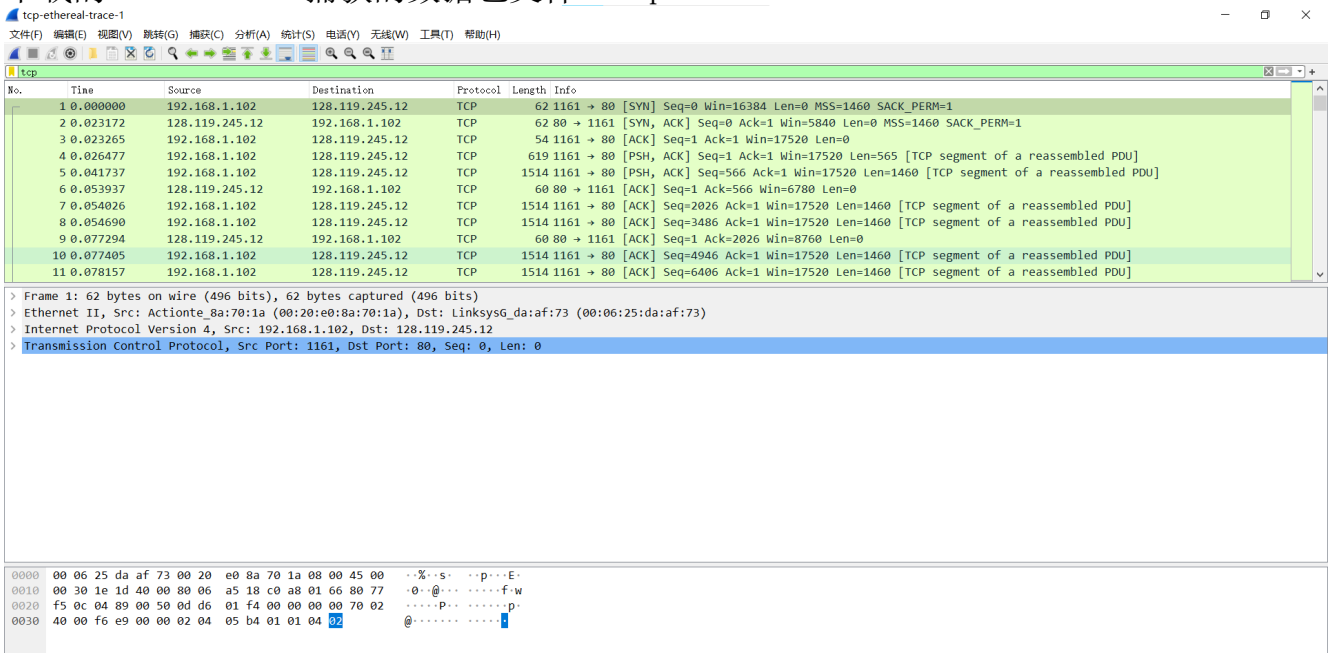
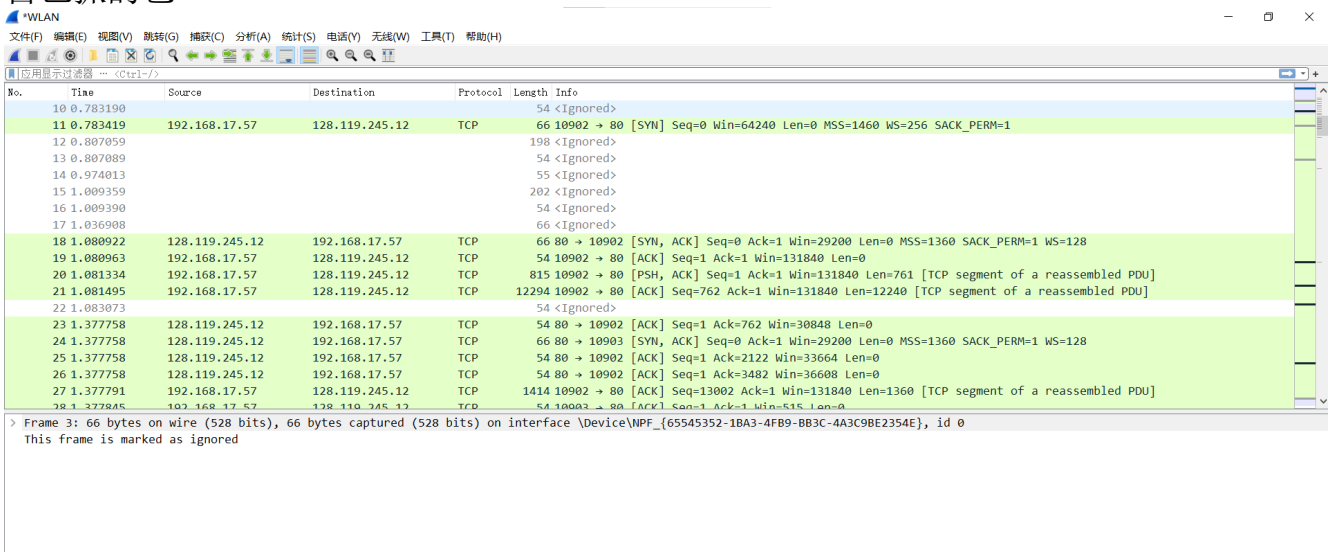
- Time:2021.10.29

1. Capturing a bulk TCP transfer from your computer to a remote server

- 下载的 Wireshark 捕获的数据包文件 Stcp-ethereal-trace-1



- 自己抓的包



2. A first look at the captured trace

Q1.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.

```
> Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
> Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 0, Len: 0
```

- Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
- Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 0, Len: 0

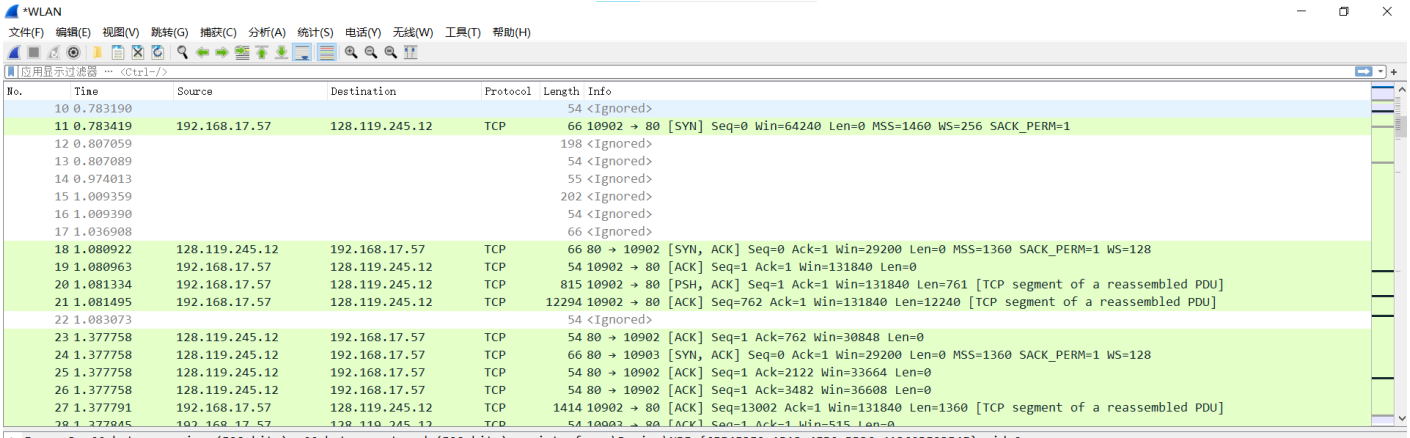
Q2.What is the IP address of gaia.cs.umass.edu? On what port number is it sending and receiving TCP segments for this connection?

```
> Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
> Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 0, Len: 0
```

- ip address of gaia.cs.umass.edu is 128.119.245.12
- On port number 80

Q3. What is the IP address and TCP port number used by your client computer (source) to transfer the file to gaia.cs.umass.edu?

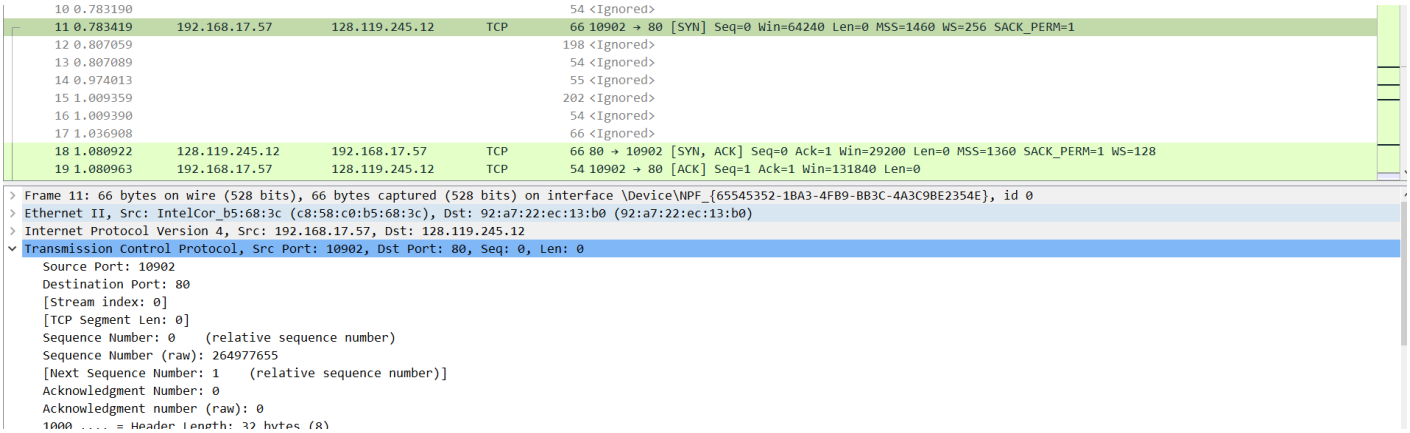
by my client computer



- IP address is 192.168.17.57
- port number is 10902

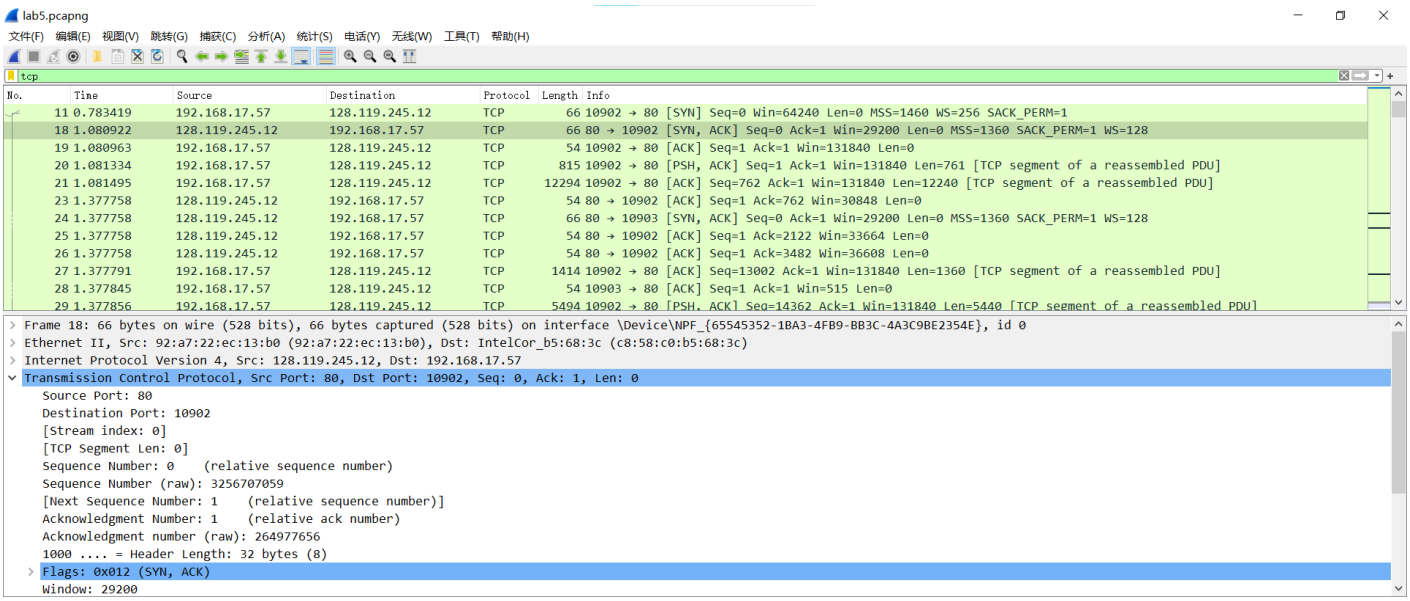
3.TCP Basics

Q4. 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?



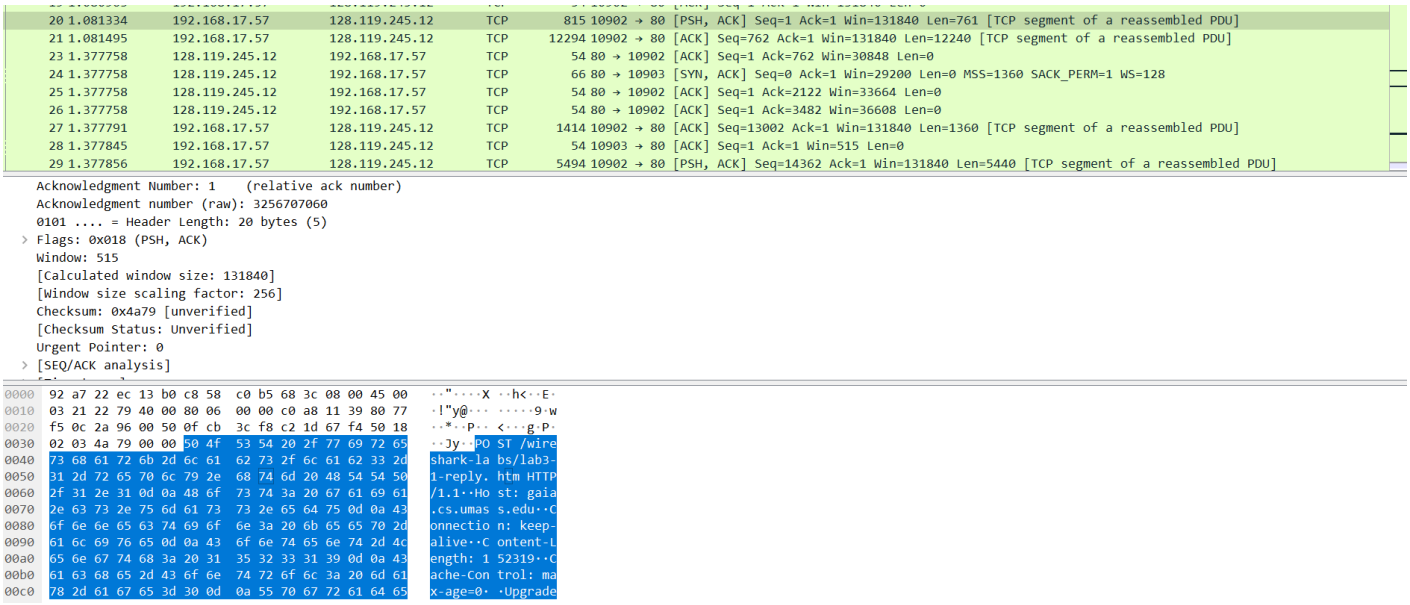
- Sequence Number: 0 (relative sequence number)
- Sequence Number (raw): 264977655
- 第一次握手
- 建立连接

Q5. 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?



- Sequence Number: 0 (relative sequence number)
- Sequence Number (raw): 3256707059
- Acknowledgment Number: 1 (relative ack number)
- Acknowledgment number (raw): 264977656
- ACK=SYN 中的 Seq 值加 1
- 第 2 次握手
- 确认客户端的连接，选择服务器端初始的序列号

Q6. 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.



- Sequence Number: 1 (relative sequence number)
- Sequence Number (raw): 264977656

Q7. 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 EstimatedRTT 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.

- 因为自己抓下来的包有一点问题

- 此题按照下下来的数据包文件 Stcp-ethereal-trace-1 作答

```
Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 1, Ack: 1, Len: 565
    Source Port: 1161
    Destination Port: 80
    [Stream index: 0]
    [TCP Segment Len: 565]
    Sequence Number: 1    (relative sequence number)
    Sequence Number (raw): 232129013
    [Next Sequence Number: 566    (relative sequence number)]
    Acknowledgment Number: 1    (relative ack number)
    Acknowledgment number (raw): 883061786
    0101 .... = Header Length: 20 bytes (5)
  > Flags: 0x018 (PSH, ACK)
    Window: 17520
    [Calculated window size: 17520]
    [Window size scaling factor: -2 (no window scaling used)]
    Checksum: 0x1fbd [unverified]
    [Checksum Status: Unverified]
    Urgent Pointer: 0
  > [SEQ/ACK analysis]
  v [Timestamps]
      [Time since first frame in this TCP stream: 0.026477000 seconds]
      [Time since previous frame in this TCP stream: 0.003212000 seconds]
```

-

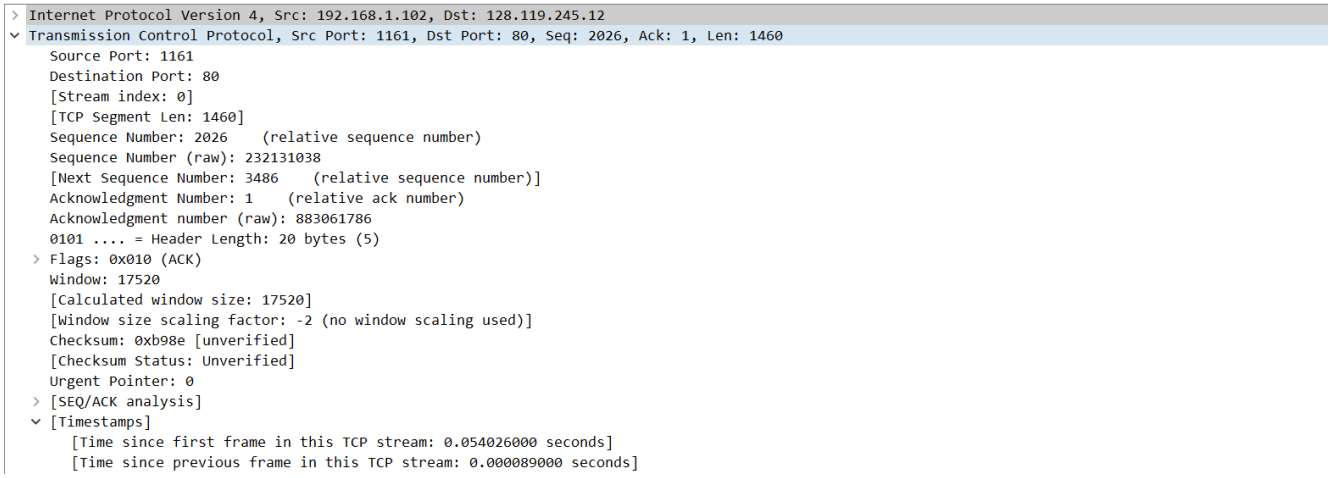
```
> Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102
v Transmission Control Protocol, Src Port: 80, Dst Port: 1161, Seq: 1, Ack: 566, Len: 0
    Source Port: 80
    Destination Port: 1161
    [Stream index: 0]
    [TCP Segment Len: 0]
    Sequence Number: 1    (relative sequence number)
    Sequence Number (raw): 883061786
    [Next Sequence Number: 1    (relative sequence number)]
    Acknowledgment Number: 566    (relative ack number)
    Acknowledgment number (raw): 232129578
    0101 .... = Header Length: 20 bytes (5)
  > Flags: 0x010 (ACK)
    Window: 6780
    [Calculated window size: 6780]
    [Window size scaling factor: -2 (no window scaling used)]
    Checksum: 0x9e30 [unverified]
    [Checksum Status: Unverified]
    Urgent Pointer: 0
  > [SEQ/ACK analysis]
  v [Timestamps]
      [Time since first frame in this TCP stream: 0.053937000 seconds]
      [Time since previous frame in this TCP stream: 0.012200000 seconds]
```

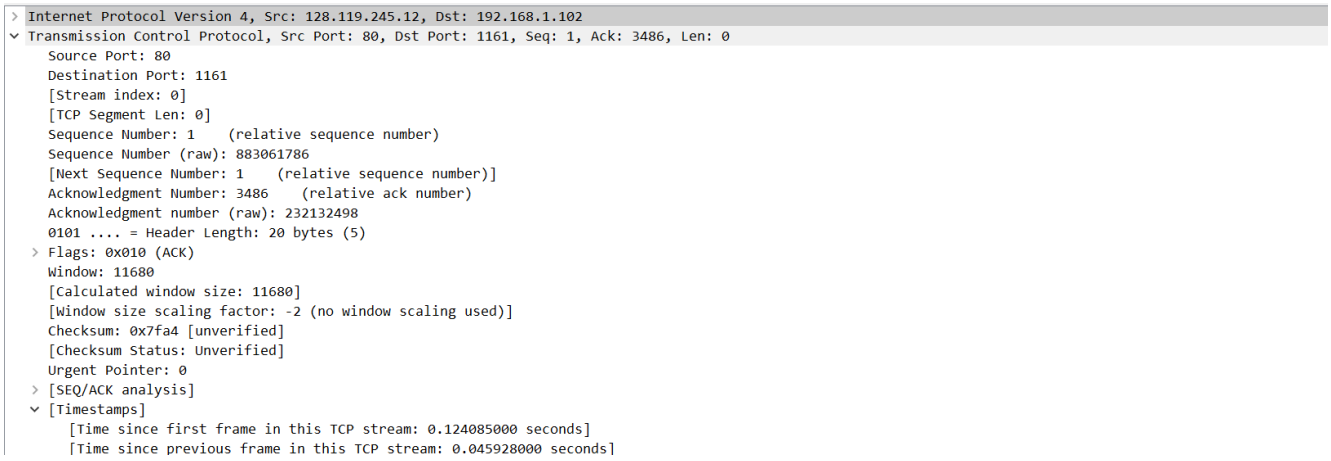
1. Sequence Number: 1 (relative sequence number)
2. 发送时间[Time since first frame in this TCP stream: 0.026477 seconds]
3. Acknowledgment Number: 566 (relative ack number)
4. ACK 时间[Time since first frame in this TCP stream: 0.053937 seconds]
5. RTT:0.02746s
6. EstimatedRTT:0.02746s

```
> Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
v Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 566, Ack: 1, Len: 1460
    Source Port: 1161
    Destination Port: 80
    [Stream index: 0]
    [TCP Segment Len: 1460]
    Sequence Number: 566    (relative sequence number)
    Sequence Number (raw): 232129578
    [Next Sequence Number: 2026    (relative sequence number)]
    Acknowledgment Number: 1    (relative ack number)
    Acknowledgment number (raw): 883061786
    0101 .... = Header Length: 20 bytes (5)
  > Flags: 0x018 (PSH, ACK)
    Window: 17520
    [Calculated window size: 17520]
    [Window size scaling factor: -2 (no window scaling used)]
    Checksum: 0x3be5 [unverified]
    [Checksum Status: Unverified]
    Urgent Pointer: 0
  > [SEQ/ACK analysis]
  v [Timestamps]
      [Time since first frame in this TCP stream: 0.041737000 seconds]
      [Time since previous frame in this TCP stream: 0.015260000 seconds]
```

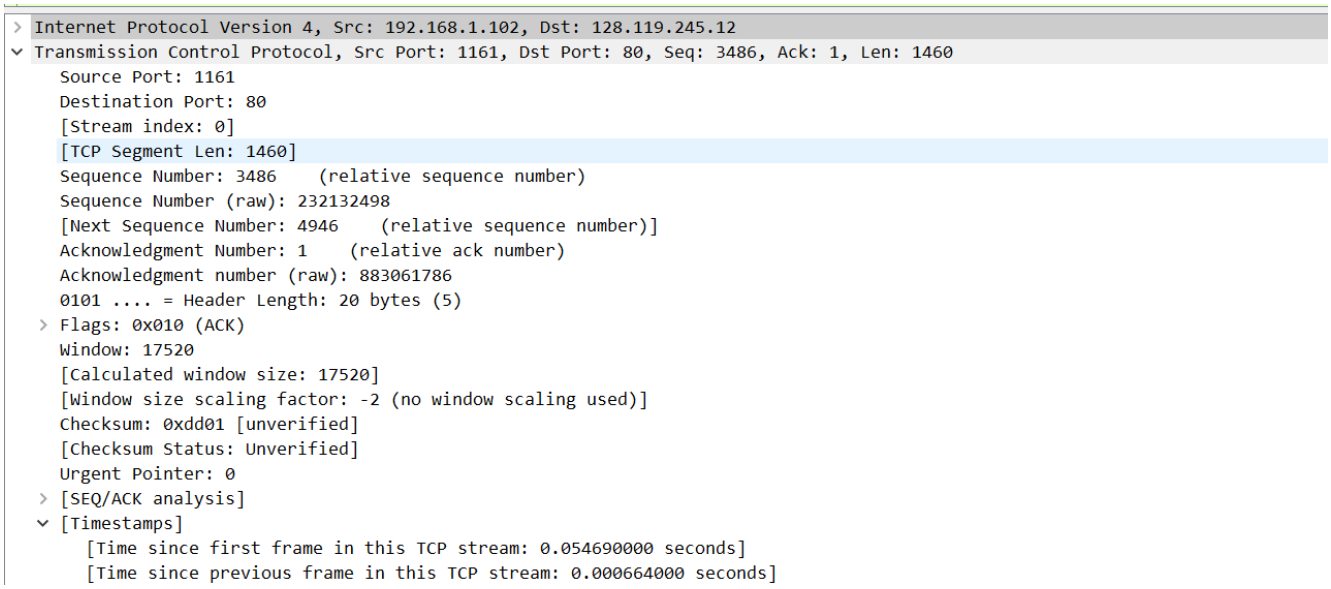
```
> Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102
v Transmission Control Protocol, Src Port: 80, Dst Port: 1161, Seq: 1, Ack: 2026, Len: 0
    Source Port: 80
    Destination Port: 1161
    [Stream index: 0]
    [TCP Segment Len: 0]
    Sequence Number: 1    (relative sequence number)
    Sequence Number (raw): 883061786
    [Next Sequence Number: 1    (relative sequence number)]
    Acknowledgment Number: 2026    (relative ack number)
    Acknowledgment number (raw): 232131038
    0101 .... = Header Length: 20 bytes (5)
  > Flags: 0x010 (ACK)
    Window: 8760
    [Calculated window size: 8760]
    [Window size scaling factor: -2 (no window scaling used)]
    Checksum: 0x90c0 [unverified]
    [Checksum Status: Unverified]
    Urgent Pointer: 0
  > [SEQ/ACK analysis]
  v [Timestamps]
      [Time since first frame in this TCP stream: 0.077294000 seconds]
      [Time since previous frame in this TCP stream: 0.022604000 seconds]
```

1. Sequence Number: 566 (relative sequence number)
2. 发送时间[Time since first frame in this TCP stream: 0.041737 seconds]
3. Acknowledgment Number: 2026 (relative ack number)
4. ACK 时间[Time since first frame in this TCP stream: 0.077294 seconds]
5. RTT:0.035557s
6. EstimatedRTT:0.028472s





1. Sequence Number: 2026 (relative sequence number)
2. 发送时间[Time since first frame in this TCP stream: 0.054026 seconds]
3. Acknowledgment Number: 3486 (relative ack number)
4. ACK 时间[Time since first frame in this TCP stream: 0.124085 seconds]
5. RTT:0.070059 s
6. EstimatedRTT:0.033670s



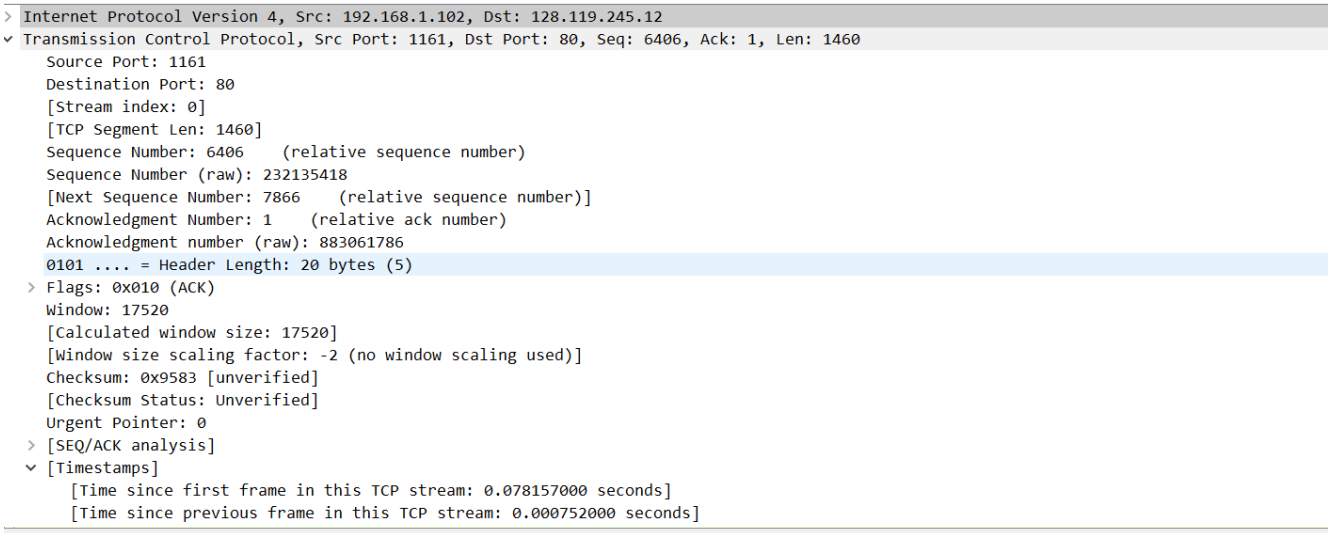
1. Sequence Number: 3486 (relative sequence number)
2. 发送时间[Time since first frame in this TCP stream:0.054690 seconds]
3. Acknowledgment Number: 4946 (relative ack number)
4. ACK 时间[Time since first frame in this TCP stream: 0.169118 seconds]
5. RTT:0.114428 s

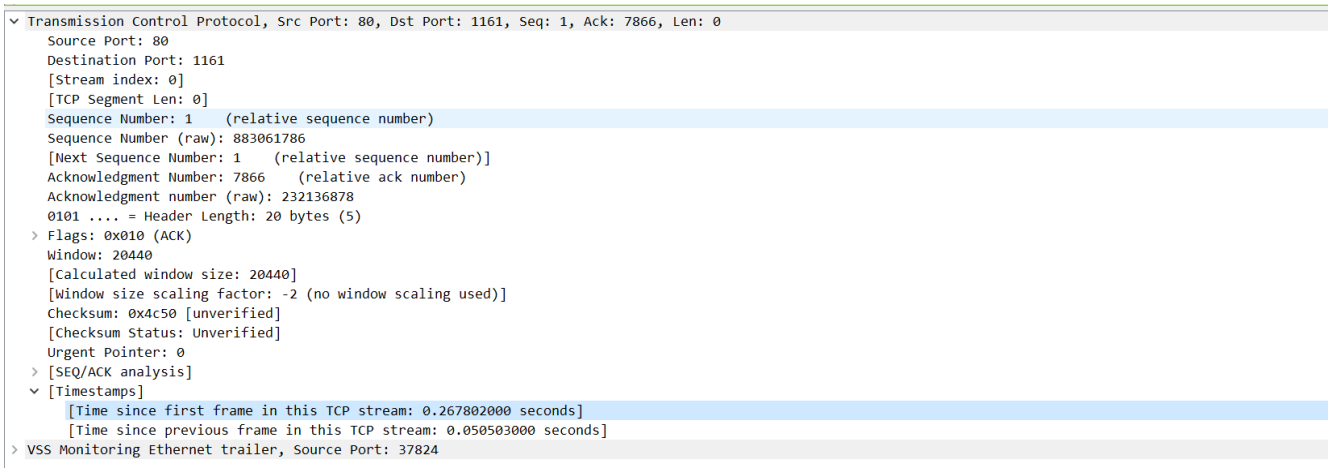
6. EstimatedRTT:0.043765s

```
> Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
v Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 4946, Ack: 1, Len: 1460
    Source Port: 1161
    Destination Port: 80
    [Stream index: 0]
    [TCP Segment Len: 1460]
    Sequence Number: 4946    (relative sequence number)
    Sequence Number (raw): 232133958
    [Next Sequence Number: 6406    (relative sequence number)]
    Acknowledgment Number: 1    (relative ack number)
    Acknowledgment number (raw): 883061786
    0101 .... = Header Length: 20 bytes (5)
  > Flags: 0x010 (ACK)
    Window: 17520
    [Calculated window size: 17520]
    [Window size scaling factor: -2 (no window scaling used)]
    Checksum: 0x908e [unverified]
    [Checksum Status: Unverified]
    Urgent Pointer: 0
  > [SEQ/ACK analysis]
  v [Timestamps]
      [Time since first frame in this TCP stream: 0.077405000 seconds]
      [Time since previous frame in this TCP stream: 0.000111000 seconds]
```

```
> Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102
v Transmission Control Protocol, Src Port: 80, Dst Port: 1161, Seq: 1, Ack: 4946, Len: 0
    Source Port: 80
    Destination Port: 1161
    [Stream index: 0]
    [TCP Segment Len: 0]
    Sequence Number: 1    (relative sequence number)
    Sequence Number (raw): 883061786
    [Next Sequence Number: 1    (relative sequence number)]
    Acknowledgment Number: 4946    (relative ack number)
    Acknowledgment number (raw): 232133958
    0101 .... = Header Length: 20 bytes (5)
  > Flags: 0x010 (ACK)
    Window: 14600
    [Calculated window size: 14600]
    [Window size scaling factor: -2 (no window scaling used)]
    Checksum: 0x6e88 [unverified]
    [Checksum Status: Unverified]
    Urgent Pointer: 0
  > [SEQ/ACK analysis]
  v [Timestamps]
      [Time since first frame in this TCP stream: 0.169118000 seconds]
      [Time since previous frame in this TCP stream: 0.044933000 seconds]
```

1. Sequence Number: 4946 (relative sequence number)
2. 发送时间[Time since first frame in this TCP stream:0.077405 seconds]
3. Acknowledgment Number: 6406 (relative ack number)
4. ACK 时间[Time since first frame in this TCP stream:0.217299 seconds]
5. RTT: 0.139894 s
6. EstimatedRTT:0.055781S



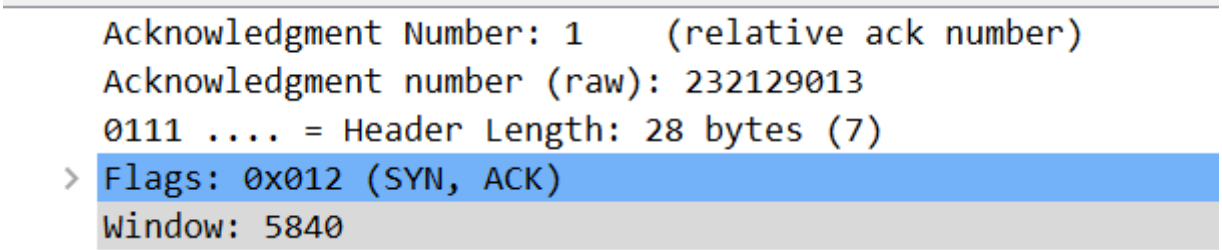
- 

1. Sequence Number: 6406 (relative sequence number)
2. 发送时间[Time since first frame in this TCP stream:0.078157 seconds]
3. Acknowledgment Number: 7866 (relative ack number)
4. ACK 时间[Time since first frame in this TCP stream:0.2678029 seconds]
5. RTT: 0.189645 s
6. EstimatedRTT:0.072514S

Q8.What is the length of each of the first six TCP segments?

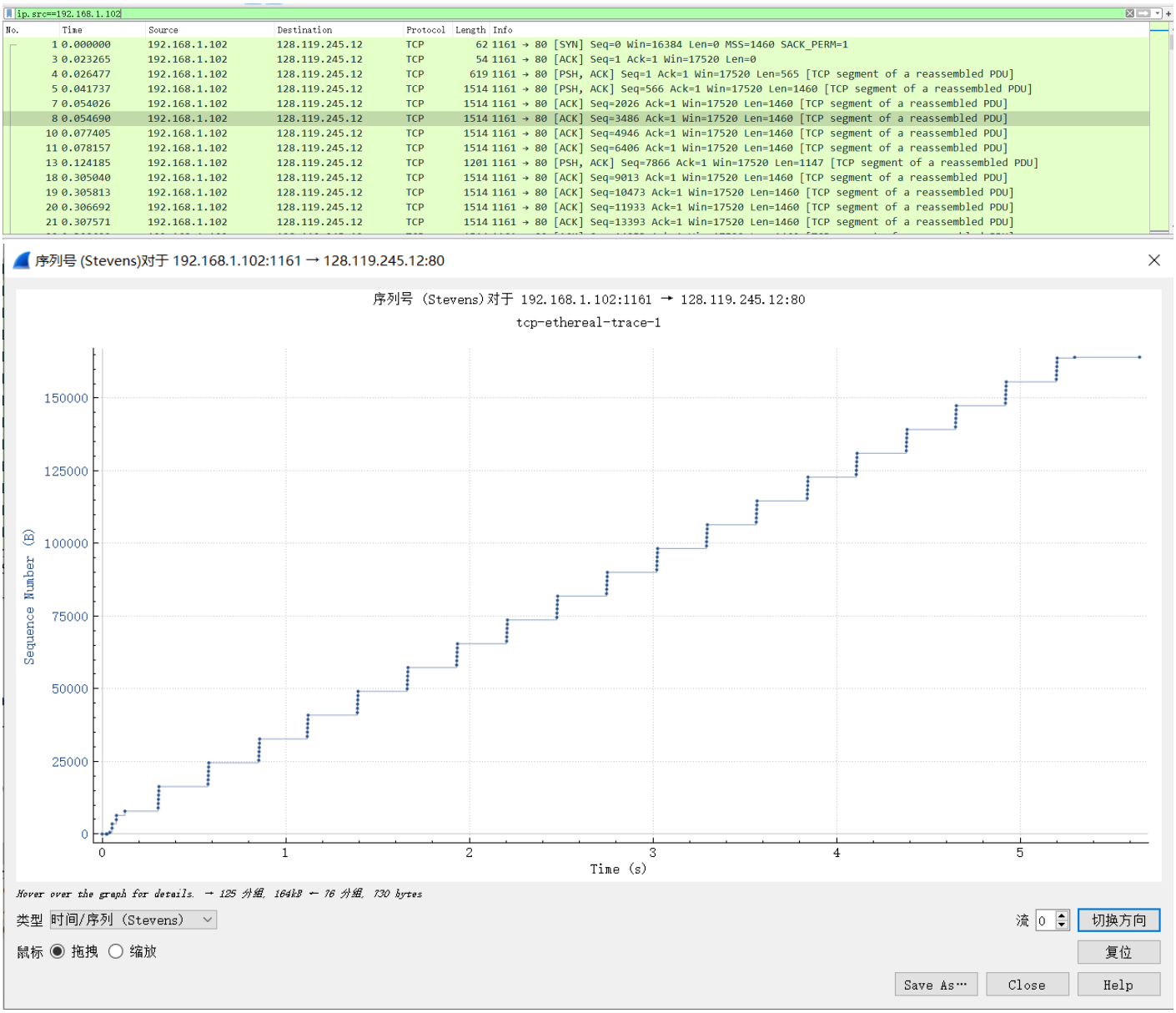
- lenth:565，1460，1460，1460，1460，1460

Q9. 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?



- 接收窗口最小为 5840。缺少接收窗口会限制发送方发送 TCP 报文
- 包中接收窗口大于发送的报文数量，因此不会限制

Q10. Are there any retransmitted segments in the trace file? What did you check for (in the trace) in order to answer this question?



ip.src==192.168.1.102

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.1.102	128.119.245.12	TCP	62	1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1
3	0.023265	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	0.026477	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565 [TCP segment of a reassembled PDU]
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
7	0.054026	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
8	0.054690	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
10	0.077405	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
11	0.078157	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
13	0.124185	192.168.1.102	128.119.245.12	TCP	1201	1161 → 80 [PSH, ACK] Seq=7866 Ack=1 Win=17520 Len=1147 [TCP segment of a reassembled PDU]
18	0.305040	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=9013 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
19	0.305813	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=10473 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
20	0.306692	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=11933 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
21	0.307571	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=13393 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]

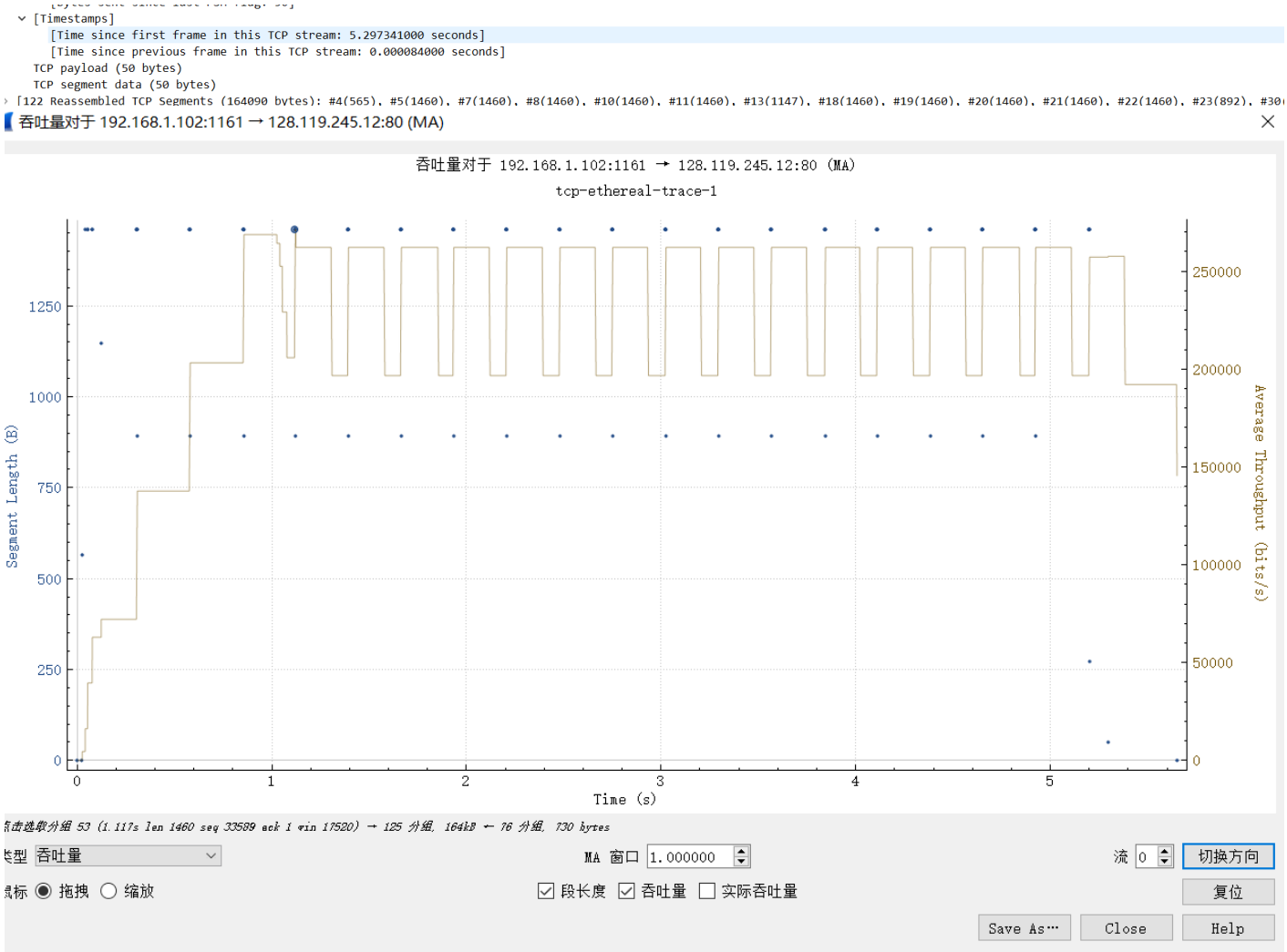
- ip.src==192.168.1.102
- 没有重传，seq 一直在增加

Q11. How much data does the receiver typically acknowledge in an ACK? Can you identify cases where the receiver is ACKing every other received segment (see Table 3.2 on page 250 in the text).

6	0.053937	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
9	0.077294	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
12	0.124085	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
14	0.169118	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=4946 Win=14600 Len=0
15	0.217299	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=6406 Win=17520 Len=0
16	0.267802	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=7866 Win=20440 Len=0
17	0.304807	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=9013 Win=23360 Len=0
24	0.356437	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=10473 Win=26280 Len=0
25	0.400164	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=11933 Win=29200 Len=0
26	0.448613	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=13393 Win=32120 Len=0
27	0.500029	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=14853 Win=35040 Len=0
28	0.545052	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=16313 Win=37960 Len=0
29	0.576417	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=17205 Win=37960 Len=0
36	0.626496	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=18665 Win=40880 Len=0
37	0.672796	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=20125 Win=43800 Len=0
38	0.730684	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=21585 Win=46720 Len=0
39	0.772990	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=23045 Win=49640 Len=0
40	0.820622	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=24505 Win=52560 Len=0
41	0.853186	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=25397 Win=52560 Len=0
48	0.899423	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=26857 Win=55480 Len=0
49	0.949545	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=28317 Win=58400 Len=0

- 1460 bytes
- 可以 比较 2 个连续的 ACK 的差值，就是接受的数据

Q12. What is the throughput (bytes transferred per unit time) for the TCP connection? Explain how you calculated this value.

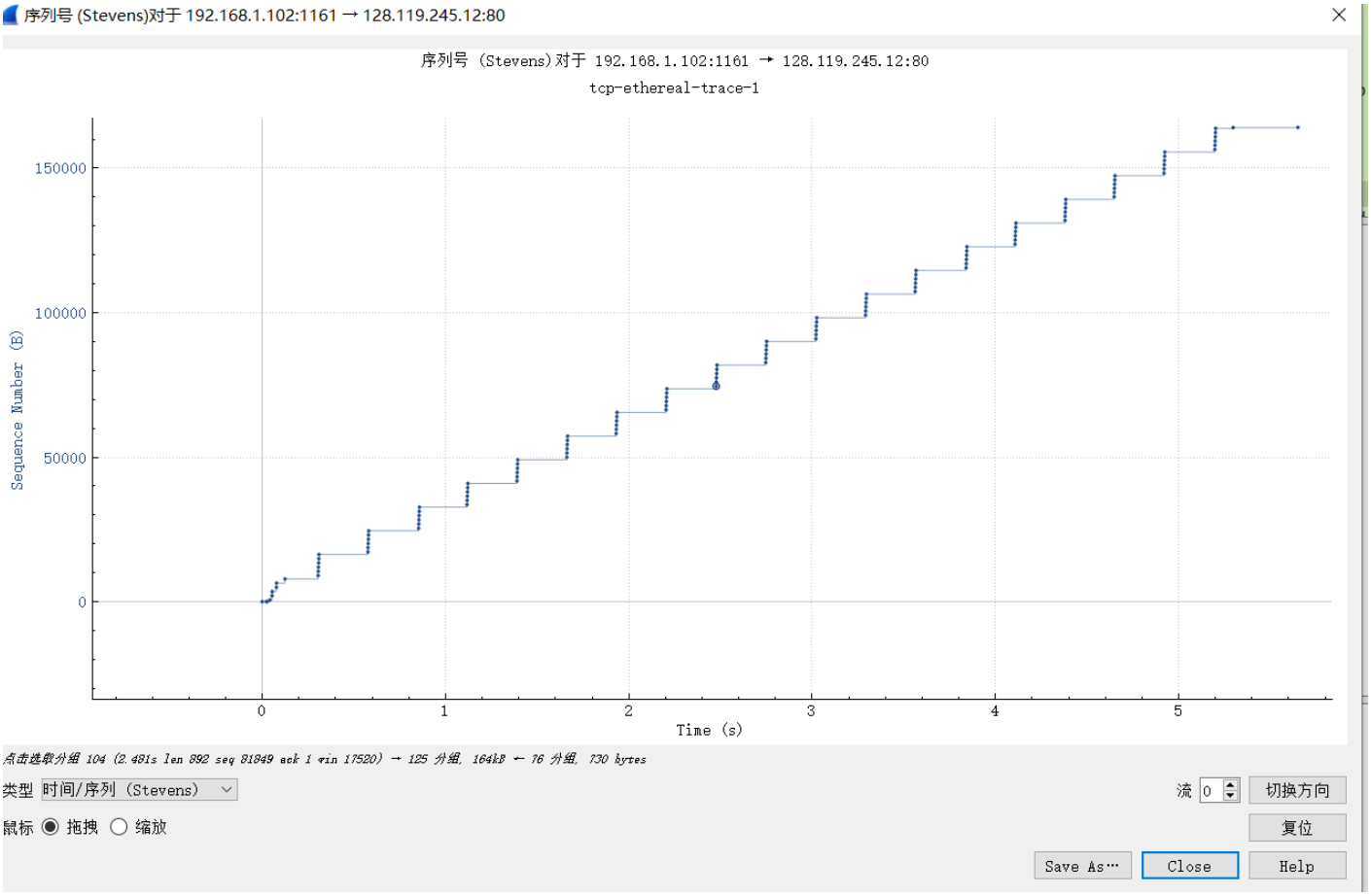


[Time since first frame in this TCP stream: 5.297341000 seconds] [122 Reassembled TCP Segments (164090 bytes): #4(565), #5(1460), #7(1460), #8(1460), #10(1460), #11(1460), #13(1147), #18(1460), #19(1460), #20(1460), #21(1460), #22(1460), #23(892), #30(1460), #31(1460), #32(1460), #33(1460), #34(1460), #3]

- 吞吐量为 Reassembled TCP Segments/Time since first frame in this TCP stream
- 代入 164090bytes/5.2973seconds=30976.1bytes/seconds

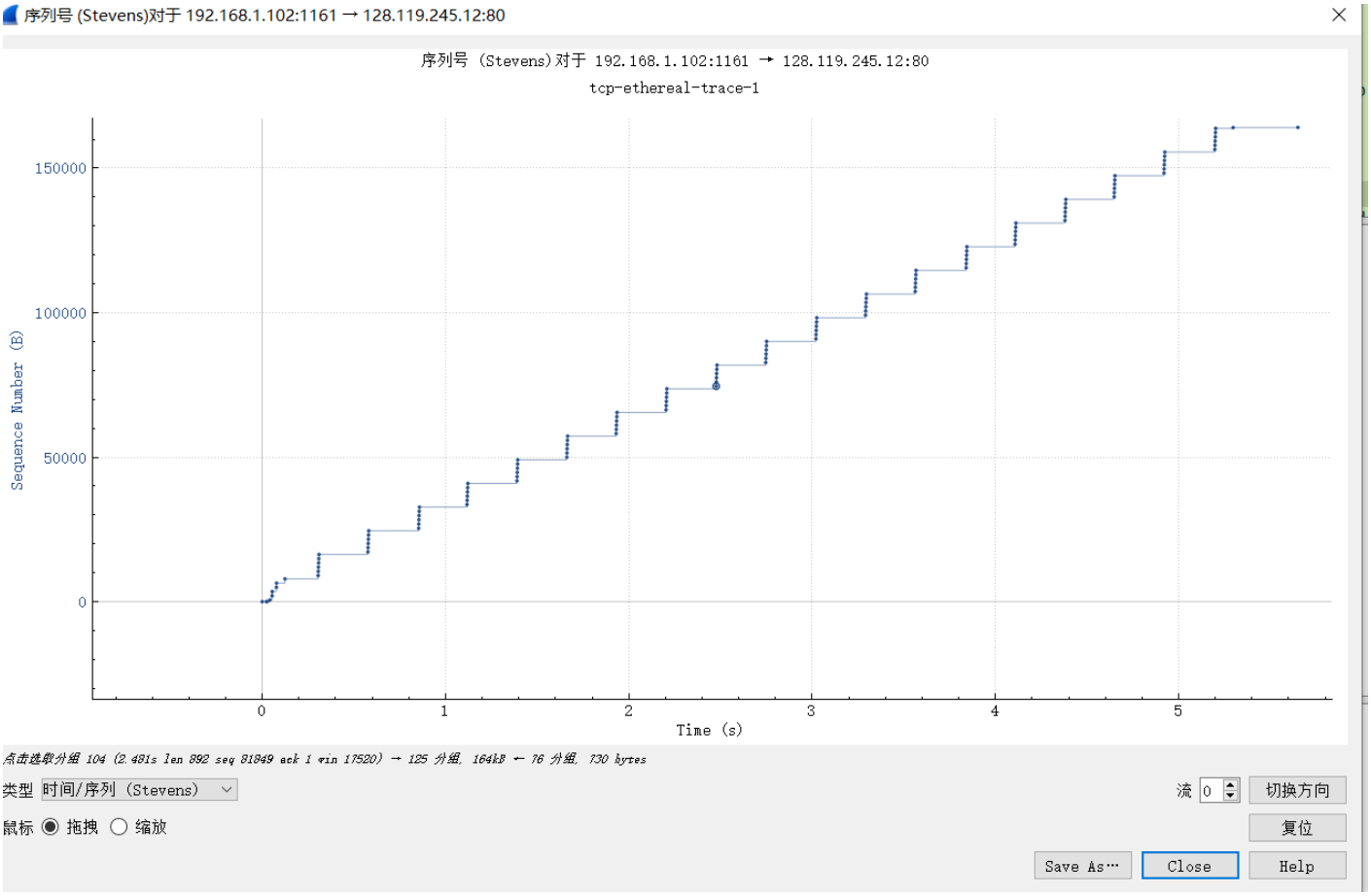
4. TCP congestion control in action

Q13. 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.



- 0-0.124s 为慢启动阶段
- 后面拥塞避免阶段
- 实际的图不是书上严格意义上指数和线性的关系，有波动

Q14. 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



- 看不太出来慢启动阶段 感觉大概 1.08s?