Rusu Wu
11694764
Assignment4
CPTs455

1. IP address : 192.168.1.102
   TCP port number: 1161

```
No.     Time           Source                Destination           Protocol Length Info
      5 0.041737       192.168.1.102         128.119.245.12        TCP      1514   health-polling(1161) → http(80) [PSH, ACK] Seq=566 Ack=1
Win=17520 Len=1460 [TCP segment of a reassembled PDU]
Frame 5: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)
Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af:73)
Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
Transmission Control Protocol, Src Port: health-polling (1161), Dst Port: http (80), Seq: 566, Ack: 1, Len: 1460
    Source Port: health-polling (1161)
    Destination Port: http (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]
    [Timestamps]
    TCP payload (1460 bytes)
    [Reassembled PDU in frame: 199]
    TCP segment data (1460 bytes)
```

2. IP address of gaia.cs.umass.edu：128.119.245.12
   TCP port number：80

```
No.     Time           Source                Destination           Protocol Length Info
      5 0.041737       192.168.1.102         128.119.245.12        TCP      1514   health-polling(1161) → http(80) [PSH, ACK] Seq=566 Ack=1
Win=17520 Len=1460 [TCP segment of a reassembled PDU]
Frame 5: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)
Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af:73)
Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
Transmission Control Protocol, Src Port: health-polling (1161), Dst Port: http (80), Seq: 566, Ack: 1, Len: 1460
    Source Port: health-polling (1161)
    Destination Port: http (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]
    [Timestamps]
    TCP payload (1460 bytes)
    [Reassembled PDU in frame: 199]
    TCP segment data (1460 bytes)
```

3. IP address my source：20.190.151.9
   TCP port number：443

```
No.     Time           Source                Destination           Protocol Length Info
      1 0.000000       20.190.151.9          192.168.88.222        TCP      1454   https(443) → 63033 [ACK] Seq=1 Ack=1 Win=2047 Len=1400
[TCP segment of a reassembled PDU]
Frame 1: 1454 bytes on wire (11632 bits), 1454 bytes captured (11632 bits) on interface \Device\NPF_{98A1DF7F-1159-4B54-9341-3CFCE2DEA3FD},
id 0
Ethernet II, Src: Routerbo_68:59:a3 (c4:ad:34:68:59:a3), Dst: BizlinkT_48:70:7e (0c:37:96:48:70:7e)
Internet Protocol Version 4, Src: 20.190.151.9, Dst: 192.168.88.222
Transmission Control Protocol, Src Port: https (443), Dst Port: 63033 (63033), Seq: 1, Ack: 1, Len: 1400
    Source Port: https (443)
    Destination Port: 63033 (63033)
    [Stream index: 0]
    [TCP Segment Len: 1400]
    Sequence Number: 1    (relative sequence number)
    Sequence Number (raw): 4145787667
    [Next Sequence Number: 1401    (relative sequence number)]
    Acknowledgment Number: 1    (relative ack number)
    Acknowledgment number (raw): 663682865
    0101 .... = Header Length: 20 bytes (5)
    Flags: 0x010 (ACK)
    Window: 2047
    [Calculated window size: 2047]
    [Window size scaling factor: -1 (unknown)]
    Checksum: 0x0bca [unverified]
    [Checksum Status: Unverified]
    Urgent Pointer: 0
    [SEQ/ACK analysis]
    [Timestamps]
    TCP payload (1400 bytes)
    [Reassembled PDU in frame: 8]
    TCP segment data (1400 bytes)
```

4. The initial sequence number of the TCP SYN segment: 0

The is a flat in the packet header that identifies it is a SYN segment.(SYN row is 1)

```
No.     Time           Source                Destination           Protocol Length Info
      1 0.000000       192.168.1.102         128.119.245.12        TCP      62     health-polling(1161) → http(80) [SYN] Seq=0 Win=16384
Len=0 MSS=1460 SACK_PERM=1
Frame 1: 62 bytes on wire (496 bits), 62 bytes captured (496 bits)
Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af:73)
Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
Transmission Control Protocol, Src Port: health-polling (1161), Dst Port: http (80), Seq: 0, Len: 0
    Source Port: health-polling (1161)
    Destination Port: http (80)
    [Stream index: 0]
    [TCP Segment Len: 0]
    Sequence Number: 0    (relative sequence number)
    Sequence Number (raw): 232129012
    [Next Sequence Number: 1    (relative sequence number)]
    Acknowledgment Number: 0
    Acknowledgment number (raw): 0
    0111 .... = Header Length: 28 bytes (7)
    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: 16384
    [Calculated window size: 16384]
    Checksum: 0xf6e9 [unverified]
    [Checksum Status: Unverified]
    Urgent Pointer: 0
    Options: (8 bytes), Maximum segment size, No-Operation (NOP), No-Operation (NOP), SACK permitted
    [Timestamps]
```

5.

The sequence number of the SYNACK segment : 0

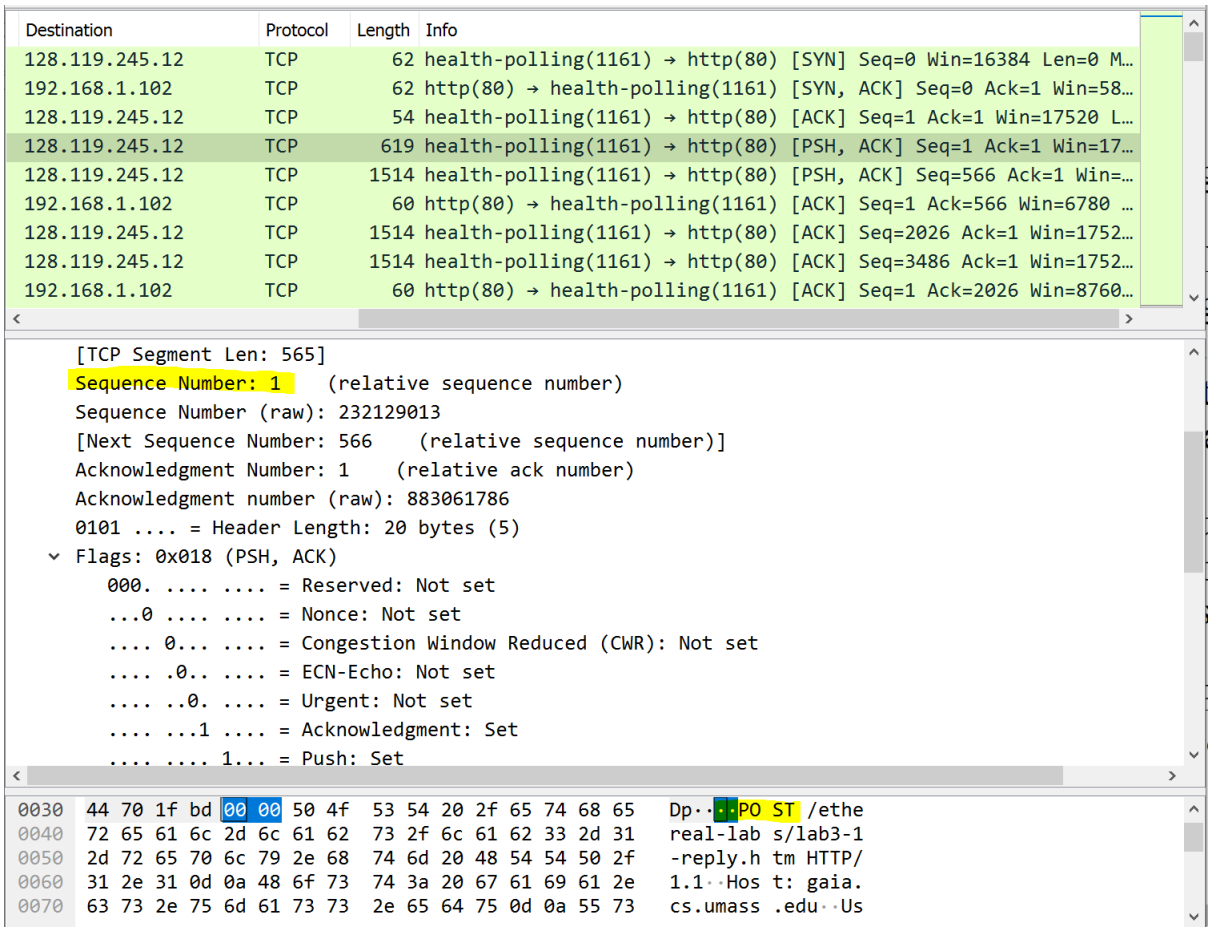
The value of the Acknowledgement field in the SYNACK segment : 1

The server, which is gaia.cs.umass.edu, adds 1 to the initial sequence number of the previous SYN message as the value of the Acknowledgement field in the SYNACK segment.

According to the flag head, the row of Acknowledgement and SYN are both 1, which identifies it is an SYNACK segment.

```
No.     Time           Source                Destination           Protocol Length Info
     2 0.023172       128.119.245.12        192.168.1.102         TCP      62     http(80) → health-polling(1161) [SYN, ACK] Seq=0 Ack=1
Win=5840 Len=0 MSS=1460 SACK_PERM=1
Frame 2: 62 bytes on wire (496 bits), 62 bytes captured (496 bits)
Ethernet II, Src: LinksysG_da:af:73 (00:06:25:da:af:73), Dst: Actionte_8a:70:1a (00:20:e0:8a:70:1a)
Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102
Transmission Control Protocol, Src Port: http (80), Dst Port: health-polling (1161), Seq: 0, Ack: 1, Len: 0
    Source Port: http (80)
    Destination Port: health-polling (1161)
    [Stream index: 0]
    [TCP Segment Len: 0]
    Sequence Number: 0    (relative sequence number)
    Sequence Number (raw): 883061785
    [Next Sequence Number: 1    (relative sequence number)]
    Acknowledgment Number: 1    (relative ack number)
    Acknowledgment number (raw): 232129013
    0111 .... = Header Length: 28 bytes (7)
    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
        [TCP Flags: ·····A··S·]
    Window: 5840
    [Calculated window size: 5840]
    Checksum: 0x774d [unverified]
    [Checksum Status: Unverified]
    Urgent Pointer: 0
    Options: (8 bytes), Maximum segment size, No-Operation (NOP), No-Operation (NOP), SACK permitted
    [SEQ/ACK analysis]
    [Timestamps]
```

6. The sequence number of the TCP segment containing the HTTP POST command: 1

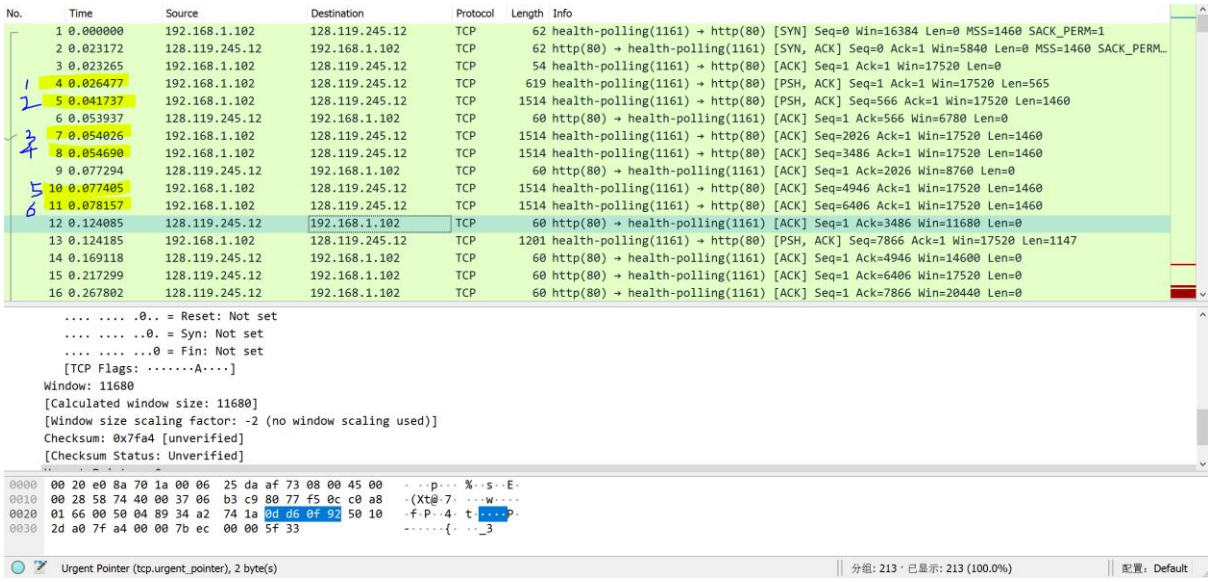


Destination	Protocol	Length	Info
128.119.245.12	TCP	62	health-polling(1161) → http(80) [SYN] Seq=0 Win=16384 Len=0 M…
192.168.1.102	TCP	62	http(80) → health-polling(1161) [SYN, ACK] Seq=0 Ack=1 Win=58…
128.119.245.12	TCP	54	health-polling(1161) → http(80) [ACK] Seq=1 Ack=1 Win=17520 L…
128.119.245.12	TCP	619	health-polling(1161) → http(80) [PSH, ACK] Seq=1 Ack=1 Win=17…
128.119.245.12	TCP	1514	health-polling(1161) → http(80) [PSH, ACK] Seq=566 Ack=1 Win=…
192.168.1.102	TCP	60	http(80) → health-polling(1161) [ACK] Seq=1 Ack=566 Win=6780 …
128.119.245.12	TCP	1514	health-polling(1161) → http(80) [ACK] Seq=2026 Ack=1 Win=1752…
128.119.245.12	TCP	1514	health-polling(1161) → http(80) [ACK] Seq=3486 Ack=1 Win=1752…
192.168.1.102	TCP	60	http(80) → health-polling(1161) [ACK] Seq=1 Ack=2026 Win=8760…

```
    [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)
      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
      .... .... 1... = Push: Set
```

```
0030  44 70 1f bd 00 00 50 4f  53 54 20 2f 65 74 68 65   Dp····PO ST /ethe
0040  72 65 61 6c 2d 6c 61 62  73 2f 6c 61 62 33 2d 31   real-lab s/lab3-1
0050  2d 72 65 70 6c 79 2e 68  74 6d 20 48 54 54 50 2f   -reply.h tm HTTP/
0060  31 2e 31 0d 0a 48 6f 73  74 3a 20 67 61 69 61 2e   1.1··Hos t: gaia.
0070  63 73 2e 75 6d 61 73 73  2e 65 64 75 0d 0a 55 73   cs.umass .edu··Us
```

7.



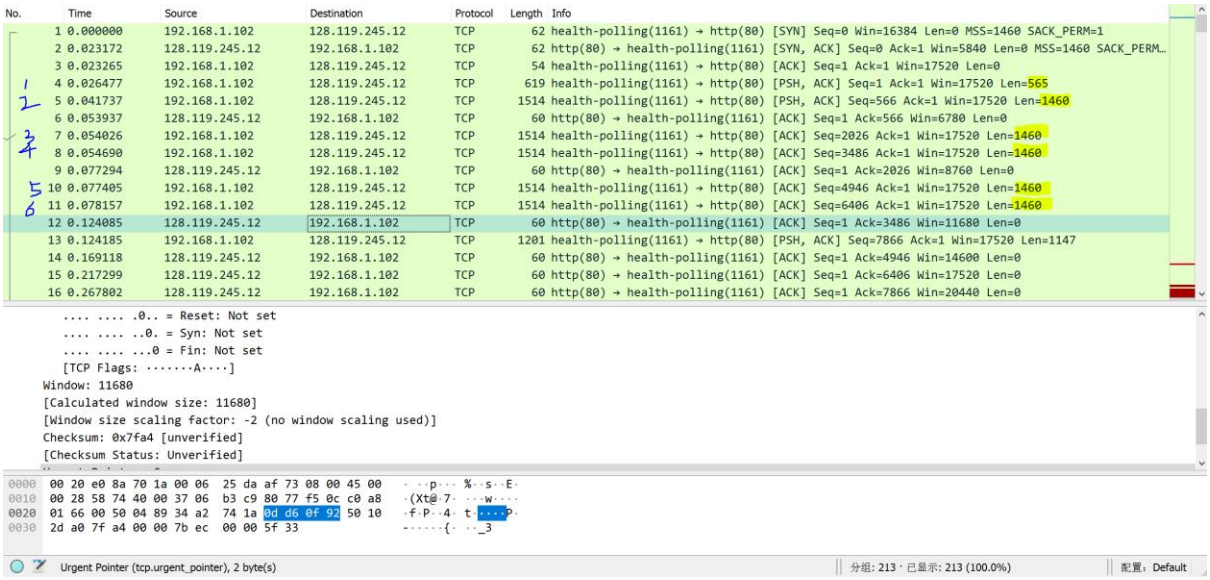
The of the first six segments:

	sequence numbers	Sending time	Receiving time	RTT
segment 1:	1	0.026477	0.053937	0.02746
segment 2:	566	0.041737	0.077294	0.035557
segment 3:	2026	0.054026	0.124085	0.070059
segment 4:	3846	0.054690	0.169118	0.114428
segment 5:	4946	0.077405	0.217299	0.139894
segment 6:	6406	0.078157	0.267802	0.189645

EstimatedRTT = 0.875 * EstimatedRTT + 0.125 * SampleRTT

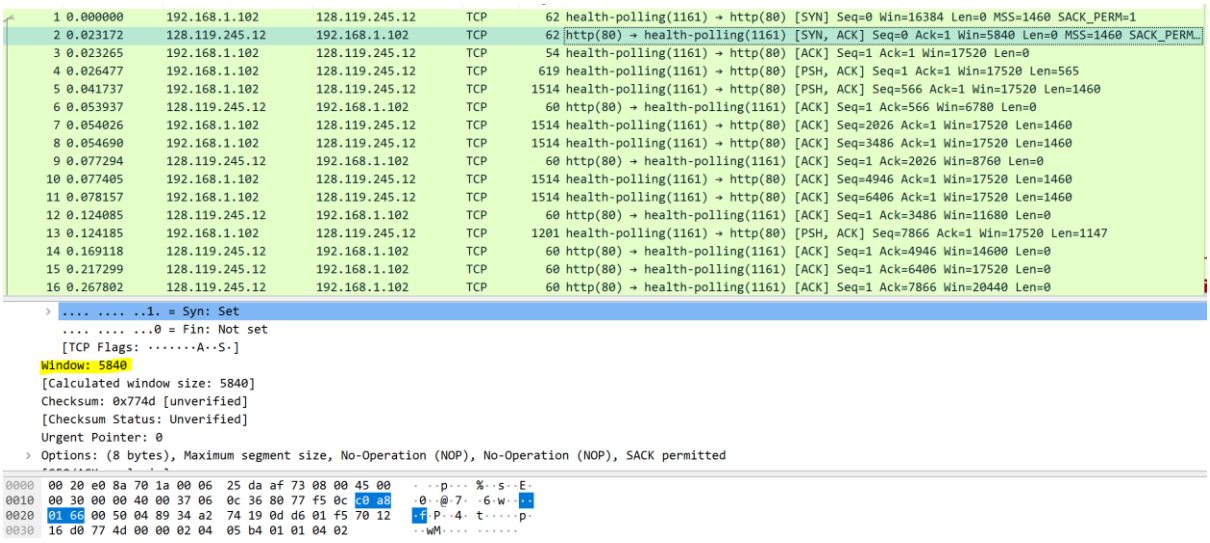
EstimatedRTT for Segment 1 = RTT for Segment 1 = 0.02746 s
EstimatedRTT for Segment 2 =0.875 * EstimatedRTT for Segment 1+ 0.125 * SampleRTT=0.0285
EstimatedRTT for Segment 3 =0.875 * EstimatedRTT for Segment 2+ 0.125 * SampleRTT=0.0337
EstimatedRTT for Segment 4 =0.875 * EstimatedRTT for Segment 3+ 0.125 * SampleRTT=0.0438
EstimatedRTT for Segment 5 =0.875 * EstimatedRTT for Segment 4+ 0.125 * SampleRTT=0.0558
EstimatedRTT for Segment 6 =0.875 * EstimatedRTT for Segment 5+ 0.125 * SampleRTT=0.0725

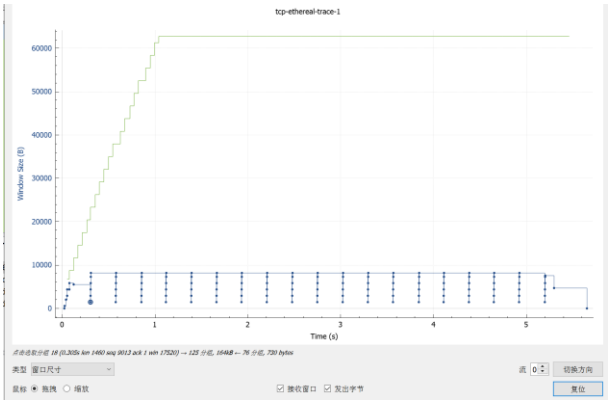
8.



	Length
segment 1:	565
segment 2:	1460
segment 3:	1460
segment 4:	1460
segment 5:	1460
segment 6:	1460

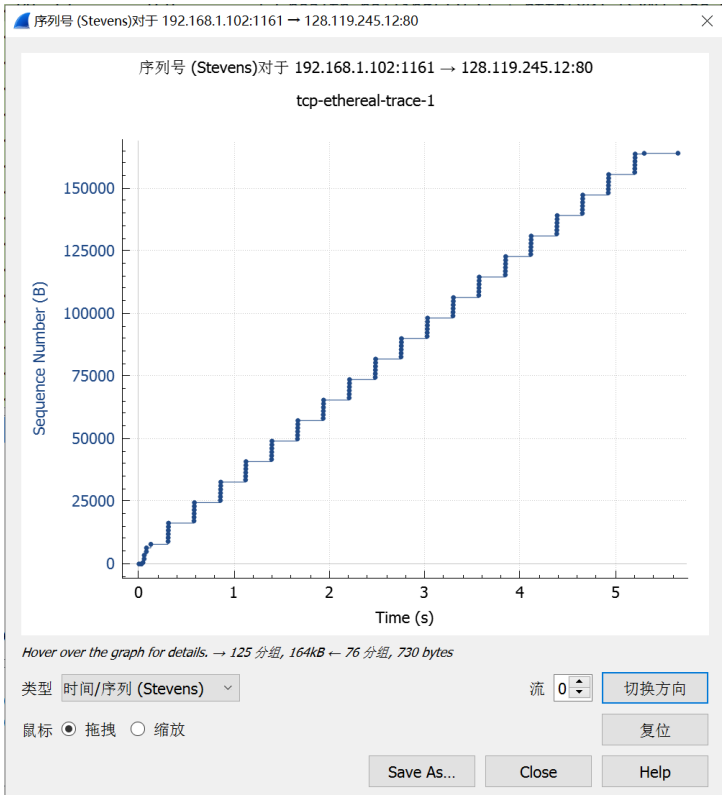
9.





The minimum amount of available buffer space advertised at the received for the entire trace is 5840 byte.
The maximum receiver buffer size: 62780 bytes
In the case, the lack of receiver buffer space never throttle the sender.

10. There is no retransmitted segments in the trace file because the Stevens TCP Stream Graph increases in order.



11. We could get the data that acknowledged by the receiver from two in order ACK messages. The number between two ACK number is the number of bytes that are acknowledged.
Take the following ACK messages as example. The acknowledged date is 1460. (4946-3486)

12	0.124085	128.119.245.12	192.168.1.102	TCP	60 http(80) → health-polling(1161) [ACK] Seq=1 Ack=3486 Win=11680 Len=0
13	0.124185	192.168.1.102	128.119.245.12	TCP	1201 health-polling(1161) → http(80) [PSH, ACK] Seq=7866 Ack=1 Win=17520 Len=1147
14	0.169118	128.119.245.12	192.168.1.102	TCP	60 http(80) → health-polling(1161) [ACK] Seq=1 Ack=4946 Win=14600 Len=0

12.

alice.txt: 152,138 bytes

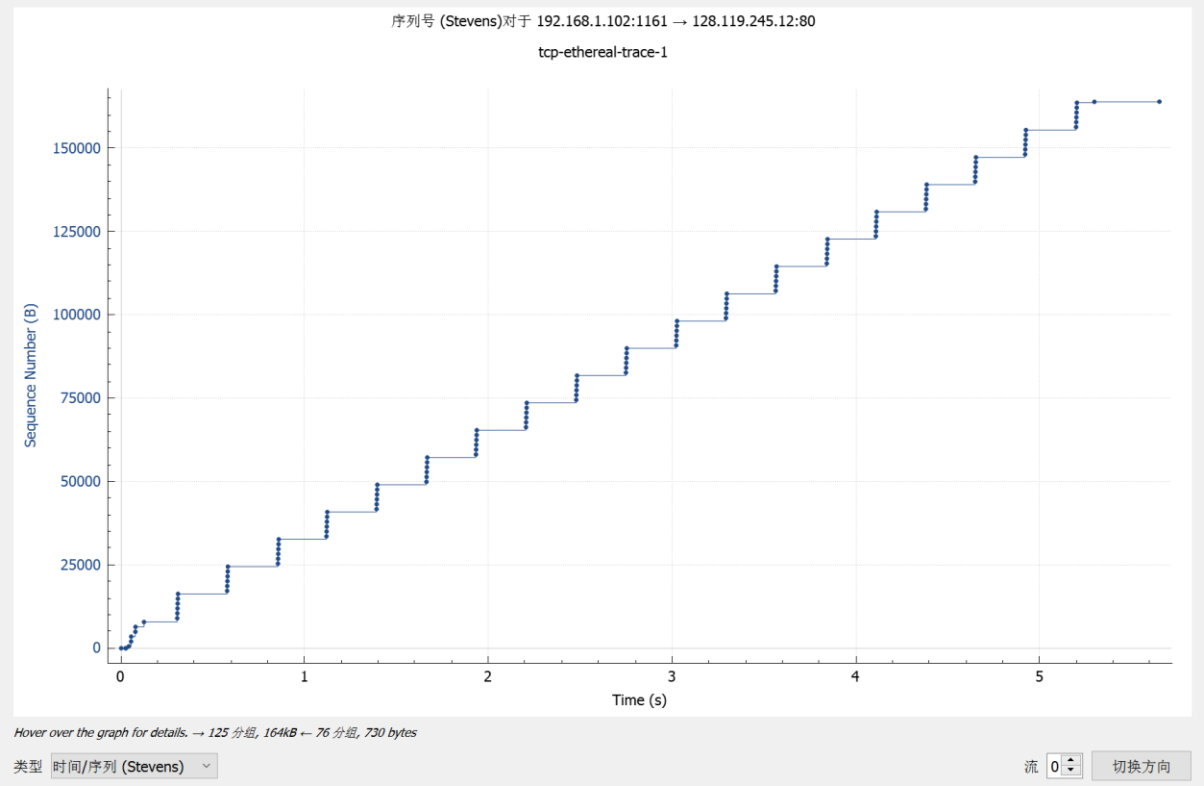
Time that transfers the txt: Last ACK Time - First Segment Sending Time = 5.461157s -0.026477= 5.43468s

Throughput=152,138 bytes/5.43468s=27,993.9205 bytes/s

1	0.000000	192.168.1.102	128.119.245.12	TCP	62 health-polling(1161) → http(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 health-polling(1161) → http(80) [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	0.026477	192.168.1.102	128.119.245.12	TCP	619 health-polling(1161) → http(80) [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514 health-polling(1161) → http(80) [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460
7	0.054026	192.168.1.102	128.119.245.12	TCP	1514 health-polling(1161) → http(80) [ACK] Seq=2026 Ack=1 Win=17520 Len=1460

202	5.455830	128.119.245.12	192.168.1.102	TCP	60 http(80) → health-polling(1161) [ACK] Seq=1 Ack=164091 Win=62780 Len=0
203	5.461175	128.119.245.12	192.168.1.102	TCP	784 http(80) → health-polling(1161) [PSH, ACK] Seq=1 Ack=164091 Win=62780 Len=730
213	7.595557	192.168.1.102	199.2.53.206	TCP	62 health-trap(1162) → ipp(631) [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1

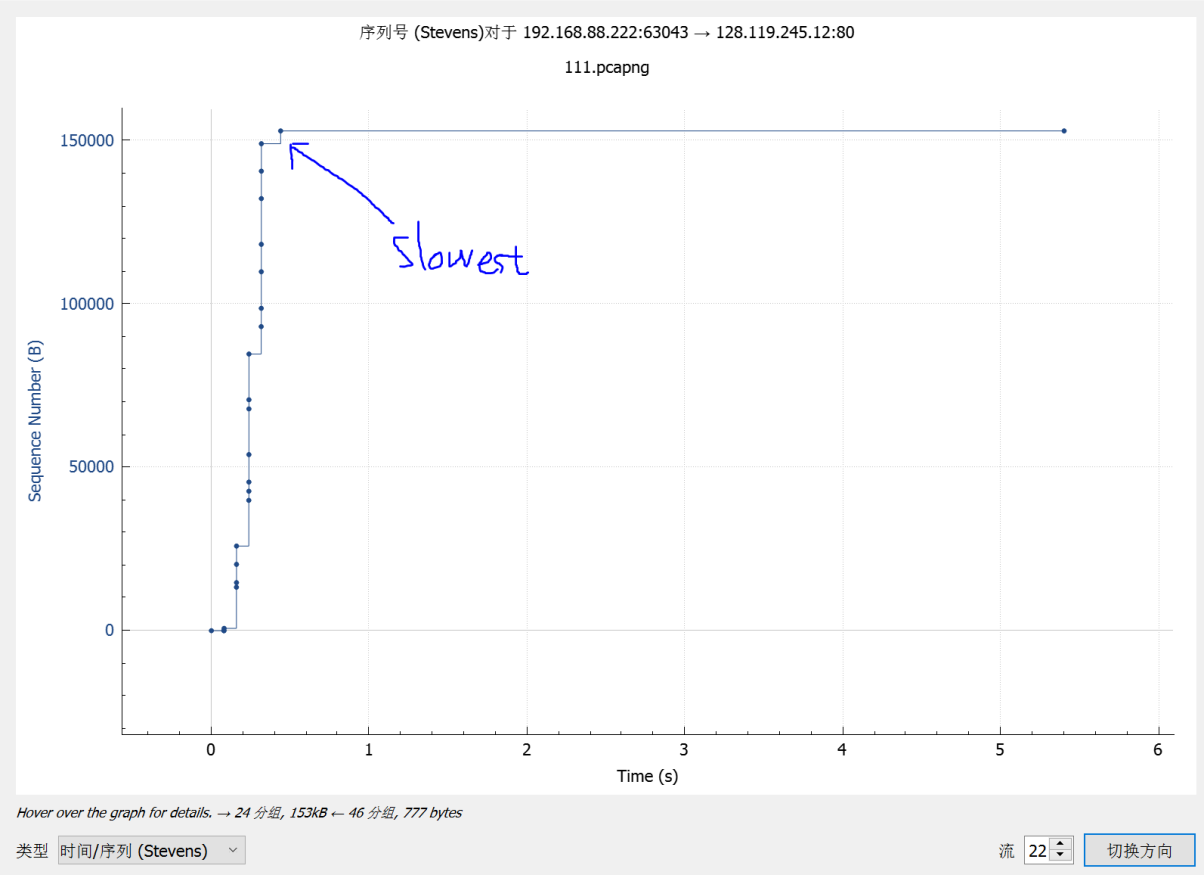
13.



Most of the phases experience almost the same begins and end time. It seems the phase from 0.3s-0.6 is the slowest.

No congestion avoidance takes over in the case.

14. Time-Sequence-Graph(Stevens) of my trace is shown below.



TCP's slowstart phase begins at 1.4s and ends at 1.5s

No congestion avoidance takes over in the case.