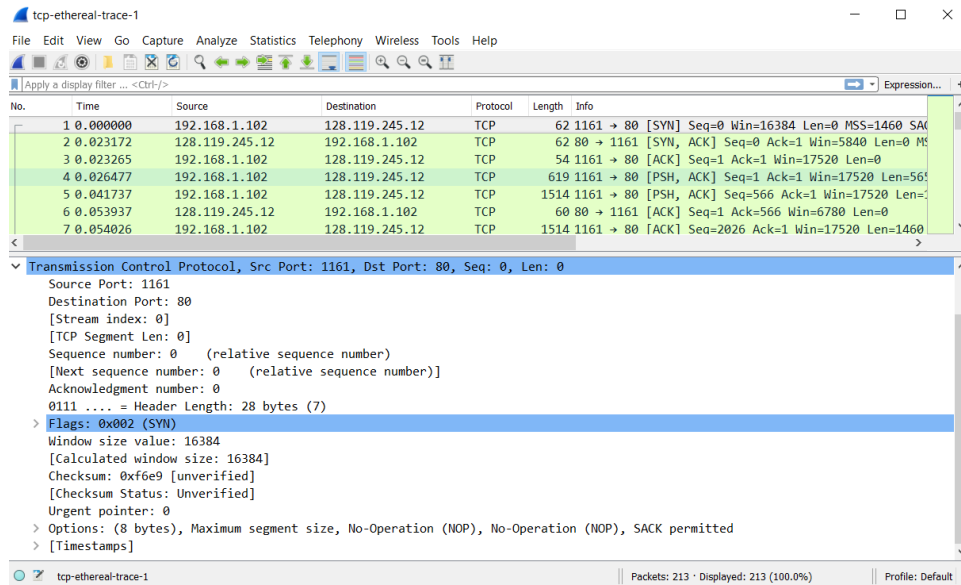
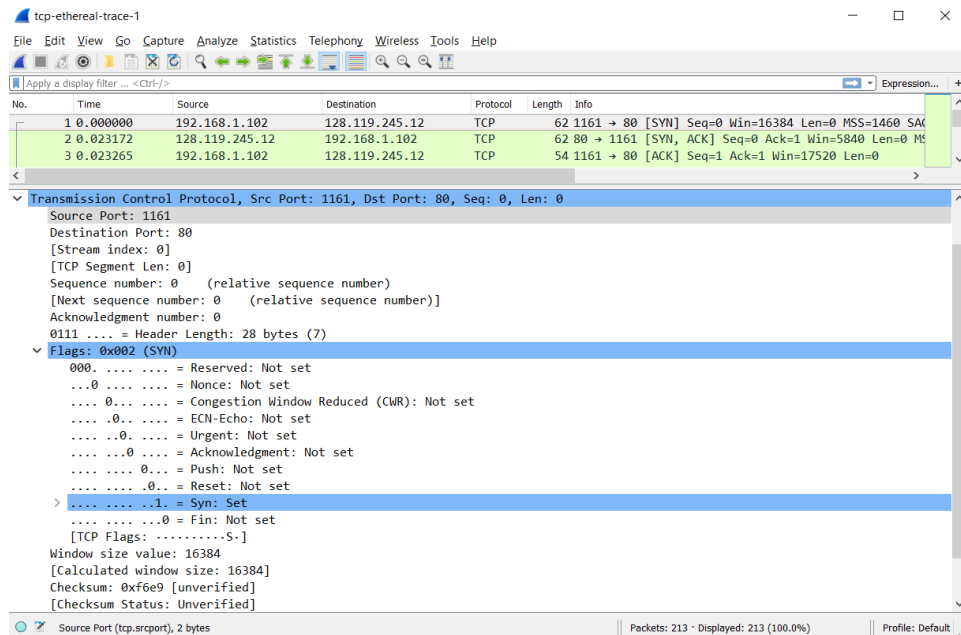


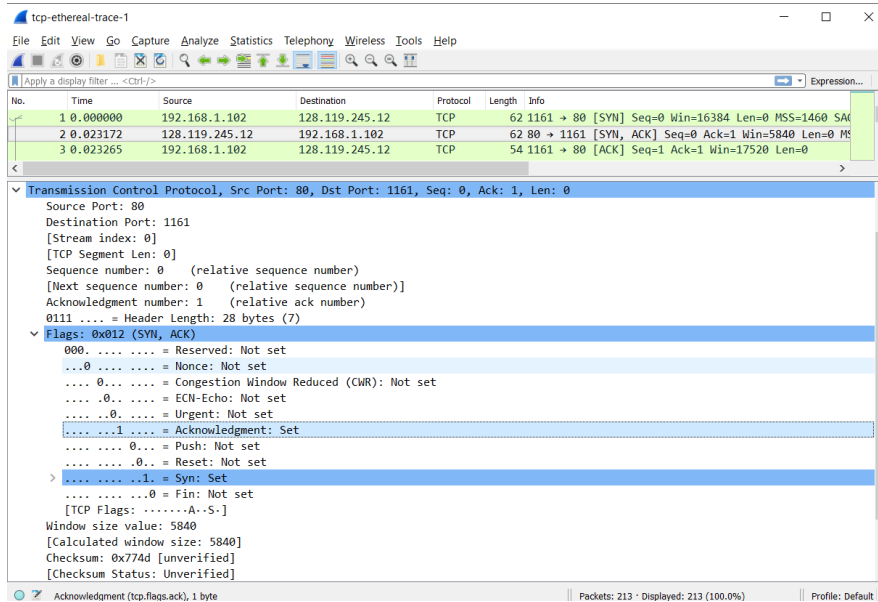
PART 1



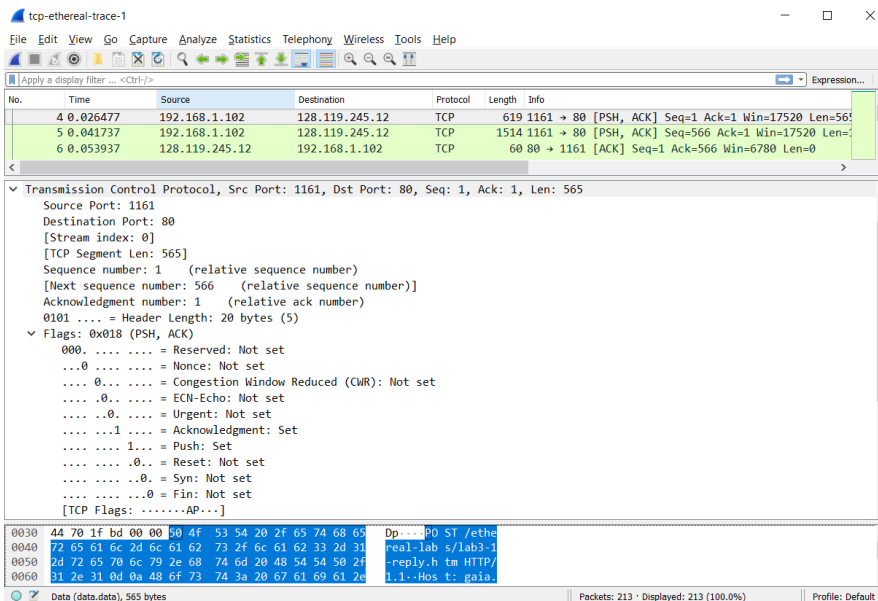
1. IP Address: 192.168.1.102 TCP Port Number: 1161
2. IP Address: 128.119.245.12 TCP Port Number: 80
3. Was unable to create my own trace with "Alice in Wonderland" file.



4. The TCP SYN sequence number is 0. The SYN flag indicates that this is a SYN segment (SYN: Set).



5. The SYNACK sequence number is 0. The Acknowledgment field has a value of 1, which is determined by adding 1 to the sequence number of the SYN segment from the client ($0+1=1$). The SYN flag and the Acknowledgment flag indicate that this is a SYNACK segment (SYN: Set & Acknowledgment: Set).



6. The HTTP POST TCP segment has the sequence number 1.

No.	Time	Source	Destination	Protocol	Length	Info
4	0.026477	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=566
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=...
6	0.053937	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	0.054026	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460
8	0.054690	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460
9	0.077294	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	0.077405	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460
11	0.078157	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460
12	0.124085	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
13	0.124185	192.168.1.102	128.119.245.12	TCP	1201	1161 → 80 [PSH, ACK] Seq=7866 Ack=1 Win=17520 Len=...
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

Frame 4: 619 bytes on wire (4952 bits), 619 bytes captured (4952 bits)
 Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: Linksys6_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: 1161, Dst Port: 80, Seq: 1, Ack: 1, Len: 565
 Data (565 bytes)

0030 44 70 1f bd 00 00 50 4f 53 54 20 2f 65 74 68 65 Dp... 80 ST /ethe
 0040 72 65 61 6c 2d 6c 61 62 73 2f 6c 61 62 33 2d 31 real-lab s/lab3-1

Data (data.data), 565 bytes Packets: 213 · Displayed: 213 (100.0%) Profile: Default

7.

Segment #	Trace #	ACK #	Sequence #	Sent Time	ACK Received Time	RTT (seconds)	Estimated RTT
1	4	6	1	0.026477	0.053937	0.02746	0.02746
2	5	9	566	0.041737	0.077294	0.035557	0.0285
3	7	12	2026	0.054026	0.124085	0.070059	0.0337
4	8	14	2486	0.054690	0.169118	0.11443	0.0438
5	10	15	4946	0.077405	0.217299	0.13989	0.0558
6	11	16	6406	0.078157	0.267802	0.18964	0.0725

Estimated RTT Calculations

Formula: $\text{EstimatedRTT} = 0.875 * \text{EstimatedRTT} + 0.125 * \text{SampleRTT}$

After ACK of Segment 1:

$\text{EstimatedRTT} = \text{RTT for Segment 1} = 0.02746$

After ACK of Segment 2:

$\text{EstimatedRTT} = 0.875 * 0.02746 + 0.125 * 0.035557 = 0.0240475 + 0.0044446 = 0.0285$

After ACK of Segment 3:

$\text{EstimatedRTT} = 0.875 * 0.0285 + 0.125 * 0.070059 = 0.0249375 + 0.0087573 = 0.0337$

After ACK of Segment 4:

$\text{EstimatedRTT} = 0.875 * 0.0337 + 0.125 * 0.11443 = 0.0294875 + 0.0143037 = 0.0438$

After ACK of Segment 5:

$\text{EstimatedRTT} = 0.875 * 0.0438 + 0.125 * 0.13989 = 0.038325 + 0.0174862 = 0.0558$

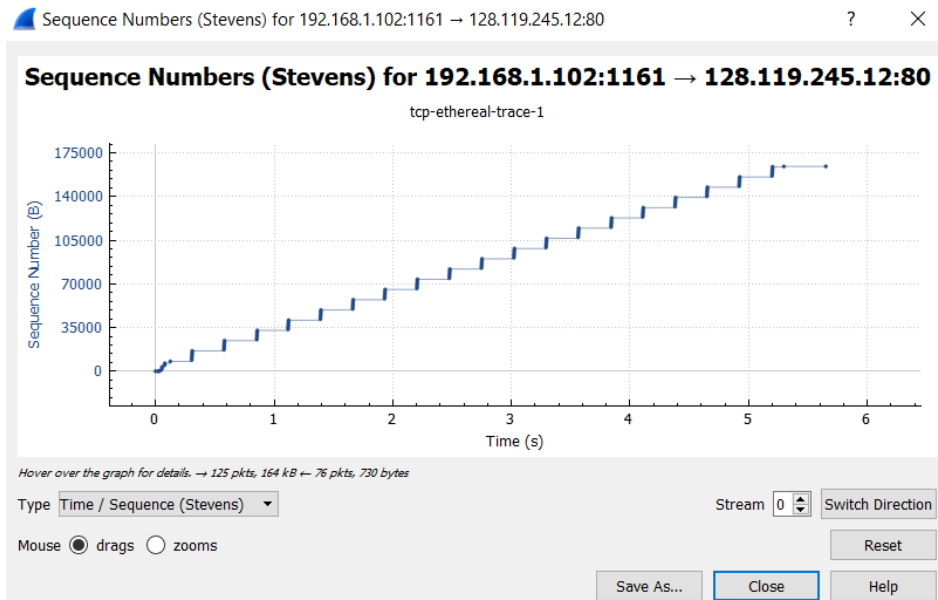
After ACK of Segment 6:

$\text{EstimatedRTT} = 0.875 * 0.0558 + 0.125 * 0.18964 = 0.048825 + 0.023705 = 0.0725$

8. The Length of the first TCP segment is 565 bytes and the Lengths of the remaining 5 TCP segments are 1460 bytes.

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
2	0.023172	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=
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
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
6	0.053937	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	0.054026	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460
8	0.054690	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460
9	0.077294	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	0.077405	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460
11	0.078157	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460
12	0.124085	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
13	0.124185	192.168.1.102	128.119.245.12	TCP	1201	1161 → 80 [PSH, ACK] Seq=7866 Ack=1 Win=17520 Len=11680

9. The minimum amount of available buffer space advertised at the received for the entire trace is 5840 bytes (Win=5840). The receiver window increases up to a maximum of 62780 (Win=62780). The lack of buffer space never throttles the sender in this trace.



10. There are no retransmitted segments in the trace file. I checked to see that the sequence numbers followed a positive trend, never decreasing, which would indicate a repeated segment.

tcp-ethereal-trace-1

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter ... <Ctrl-F> Expression...

No.	Time	Source	Destination	Protocol	Length	Info
79	1.860063	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=55813 Win=62780 Len=0
80	1.930880	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=58165 Win=62780 Len=0
81	1.931099	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=58165 Ack=1 Win=17520 Len=1460
82	1.931879	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=59625 Ack=1 Win=17520 Len=1460
83	1.932757	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=61085 Ack=1 Win=17520 Len=1460
84	1.933636	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=62545 Ack=1 Win=17520 Len=1460
85	1.934770	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=64005 Ack=1 Win=17520 Len=1460
86	1.935586	192.168.1.102	128.119.245.12	TCP	946	1161 → 80 [PSH, ACK] Seq=65465 Ack=1 Win=17520 Len=892
87	2.029069	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=61085 Win=62780 Len=0
88	2.126682	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=64005 Win=62780 Len=0
89	2.203195	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=66357 Win=62780 Len=0
90	2.203411	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=66357 Ack=1 Win=17520 Len=1460

> Frame 167: 946 bytes on wire (7568 bits), 946 bytes captured (7568 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: 1161, Dst Port: 80, Seq: 139193, Ack: 1, Len: 892
 > Data (892 bytes)

Data (data.data), 892 bytes Packets: 213 · Displayed: 213 (100.0%) Profile: Default

11. The typical amount of data received by acknowledging in an ACK seems to be 1460. One case where the receiver is ACKing every other segment is seen in packets numbered 87 and 88, where the ACK increase is 2920, which is 1460×2 .

The top screenshot shows a list of TCP packets. The selected packet (No. 4) is expanded, showing the following details:

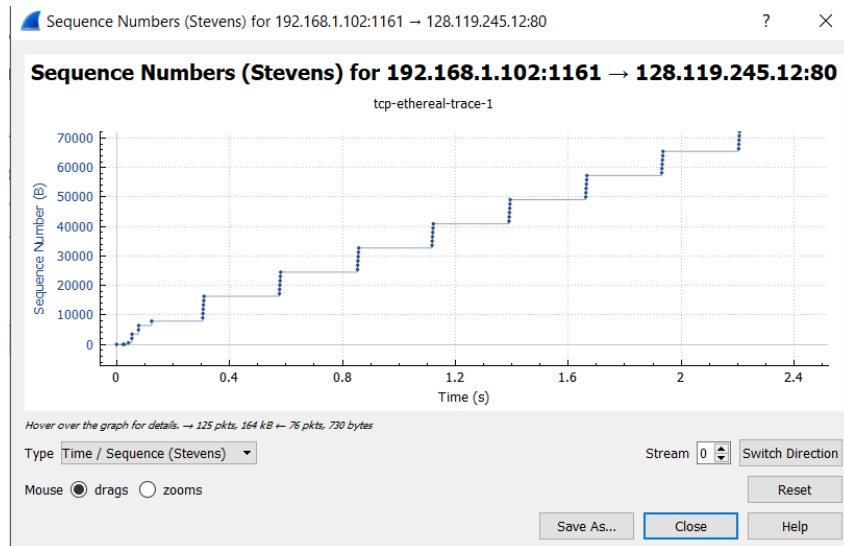
- Frame 4: 619 bytes on wire (4952 bits), 619 bytes captured (4952 bits)
- Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af:73)
- Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
- Transmission Control Protocol, Src Port: 1161, Dst Port: 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)
 - [Next sequence number: 566 (relative sequence number)]
 - Acknowledgment number: 1 (relative ack number)
 - 0101 = Header Length: 20 bytes (5)

The bottom screenshot shows a later packet (No. 206) selected. The details pane shows:

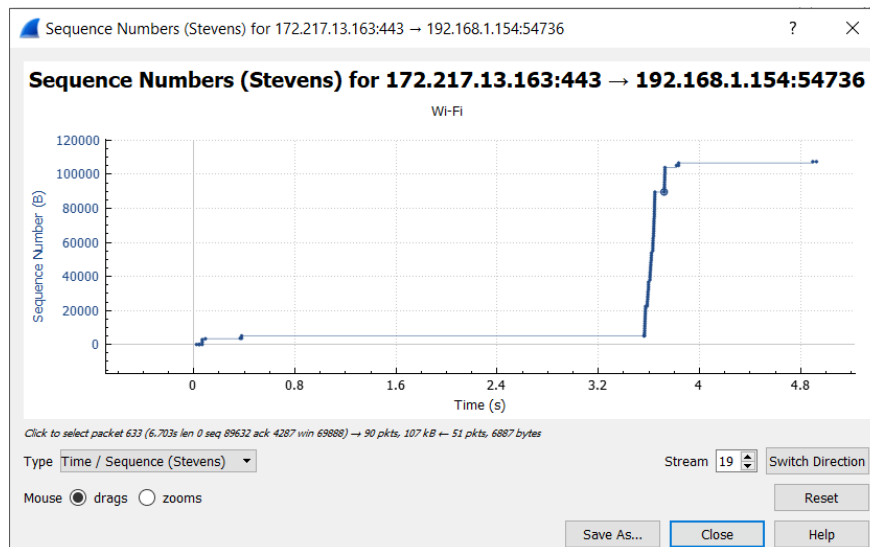
- Frame 206: 54 bytes on wire (432 bits), 54 bytes captured (432 bits)
- Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af:73)
- Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
- Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 164091, Ack: 731, Len: 0
 - Source Port: 1161
 - Destination Port: 80
 - [Stream index: 0]
 - [TCP Segment Len: 0]
 - Sequence number: 164091 (relative sequence number)
 - [Next sequence number: 164091 (relative sequence number)]
 - Acknowledgment number: 731 (relative ack number)
 - 0101 = Header Length: 20 bytes (5)

12. Throughput

$$\begin{aligned}
 &= (\text{Amount of Data Transmitted}) / (\text{Time Incurred}) \\
 &= ((\text{End Sequence \#}) - 1) / ((\text{End Time}) - (\text{Beginning Time})) \\
 &= (164091 - 1) / (5.651141 - 0.026477) \\
 &= 164090 / 5.624664 \\
 &= 29173 \text{ B/s} \\
 &= 29.173 \text{ KB/s}
 \end{aligned}$$



13. It seems that the slow start phase begins at 0 seconds and goes until about 0.15 seconds, after which the TCP session seems to go into a congestion avoidance state. The increase in Sequence Number is not linear, but rather a jagged, where the packets are sent in groups of 6. In the textbook, the graphs for TCP seem to be linear and gradual rather than jagged with quick inclines.



14. The slow start phase begins at 0 seconds and ends at about 0.4 seconds, after which congestion avoidance takes over.