Computer Networks CSE 5344 Project 2

Transmission Control Protocol Analysis using Wireshark

Name: Sushmitha Nagarajan

Student ID: 1001556348

Objective:

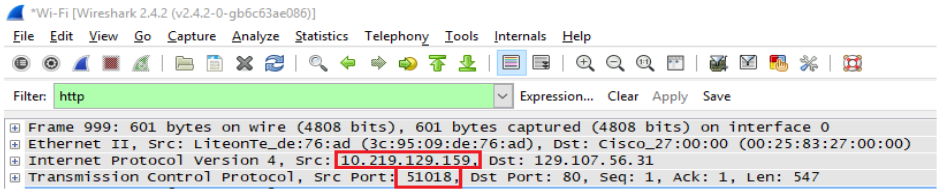
Problem Set 1:

1. What is the IP address and TCP port number used by your client computer (source) to browse the page uta.edu? Use the 'GET' message to answer the following questions.

Ans:

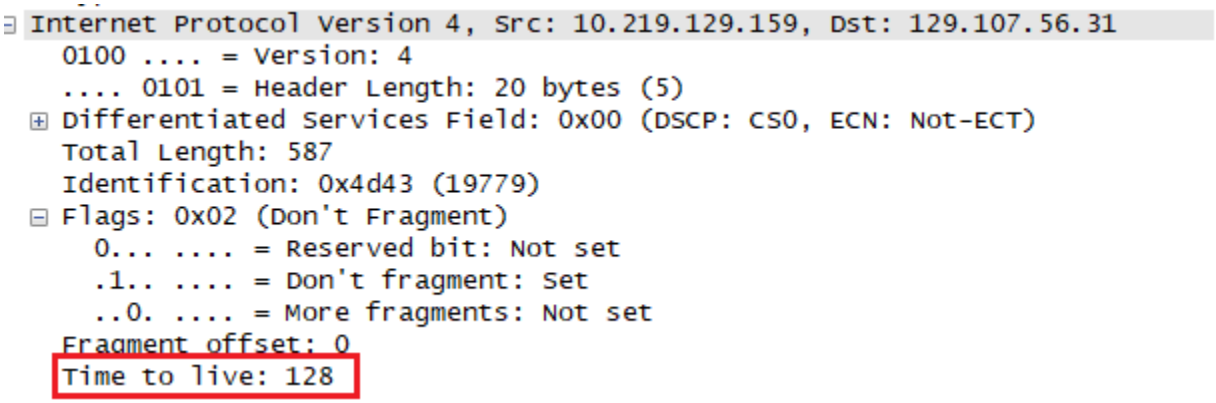
IP address used by the client: 10.219.129.159

TCP Port number used by the client: 51018



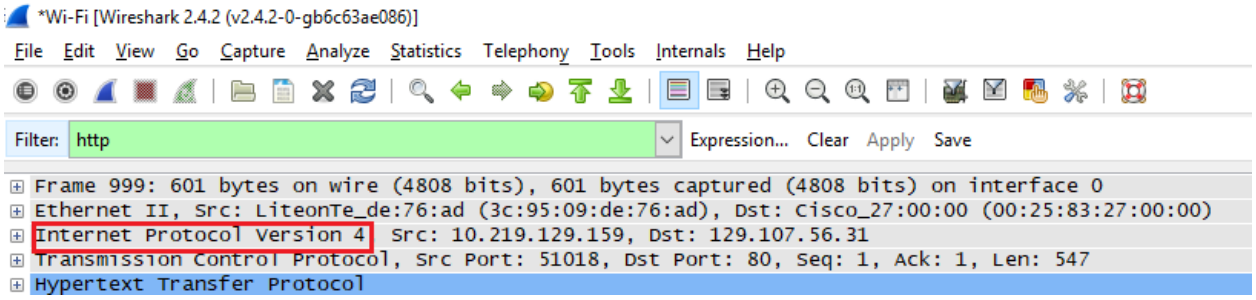
2. What is the TTL value that is used in this communication?

Ans. TTL: 128 secs



3. Did you use IPV4 or IPV6 for communication?

Ans. The client uses IPV4 for communication.

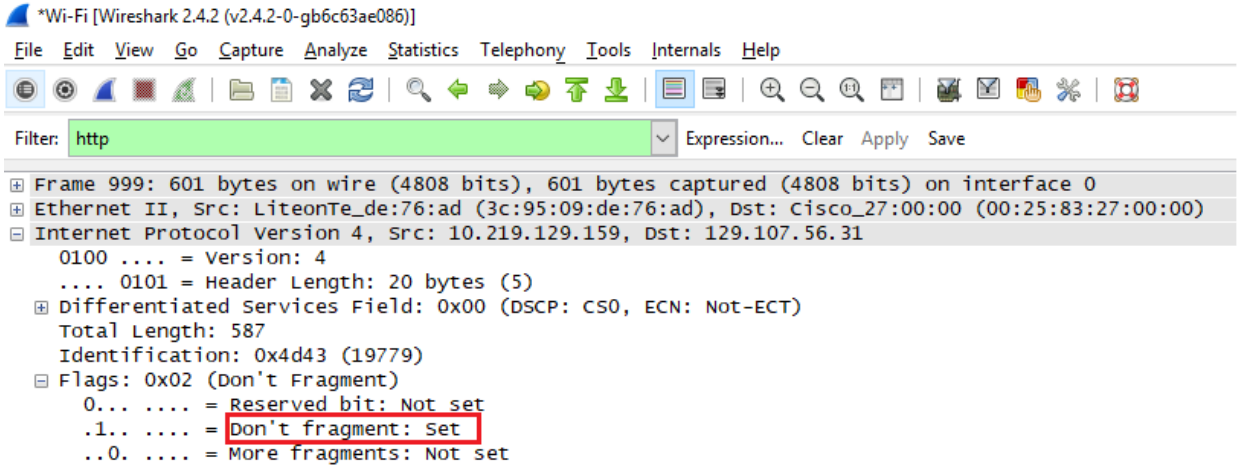


4 Do your optional field has some information or not?

Ans: The optional field is not available in HTTP segment.

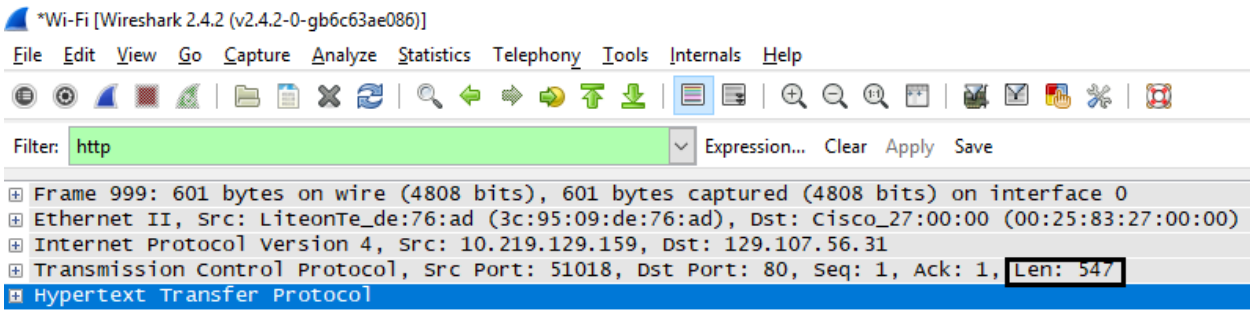
5. Is the Packet Fragmented

Ans. Packet is not fragmented as the 'Don't Fragment' packet is Set.



6. What is the TCP segment length?

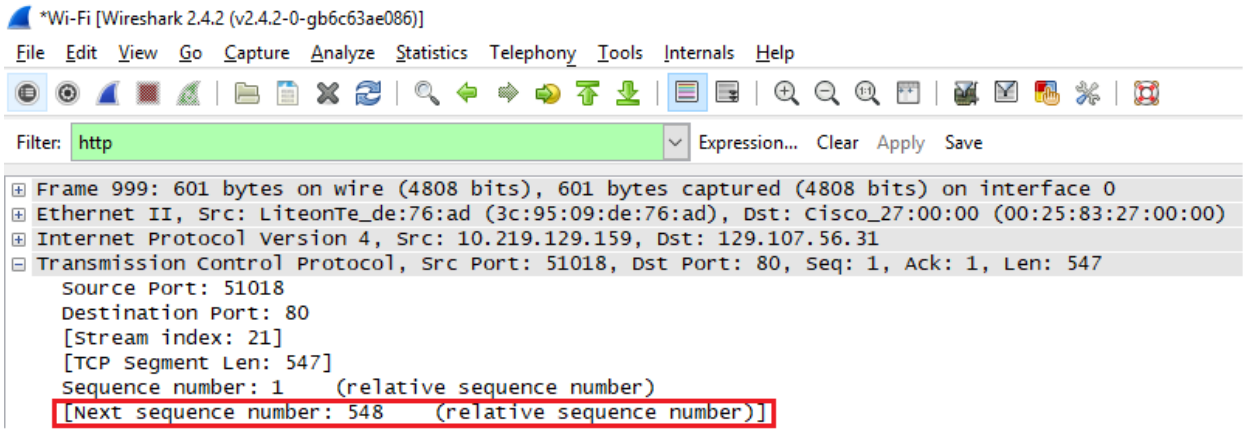
Ans. The length of the TCP segment is 547 bytes.



7. What is the Sequence Number of TCP segment (you can use the relative sequence number)?

Ans. Sequence Number of TCP segment: 1

Next sequence number: 548

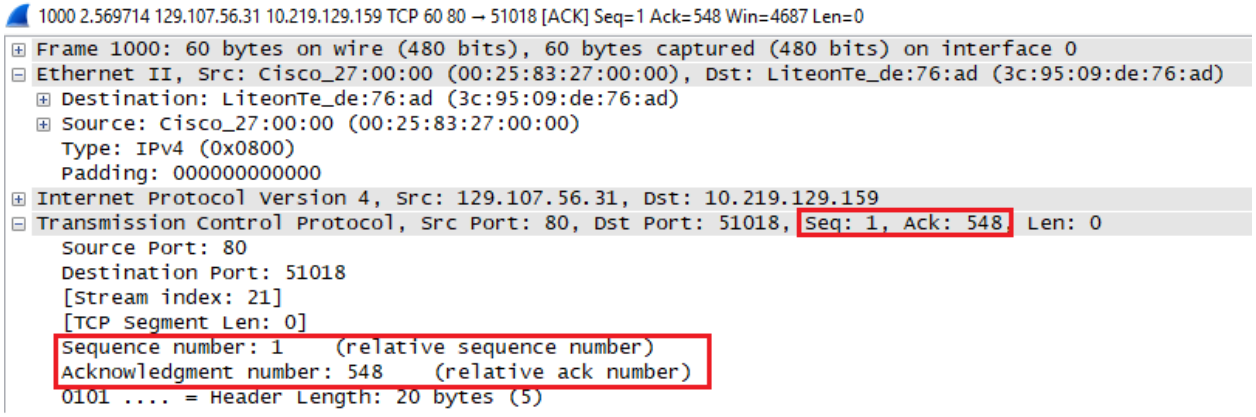


8. Calculate the acknowledgement number based on the two questions above. Verify your solution with the Wireshark values.

Ans. From the previous question, we can derive that: Initial Sequence number = 1, ACK = 1,

Acknowledgment number = (ACK number of HTTP segment + TCP Segment length) = 1+547= 548.

So, ACK number should be equal to Next Sequence number i.e. 548.

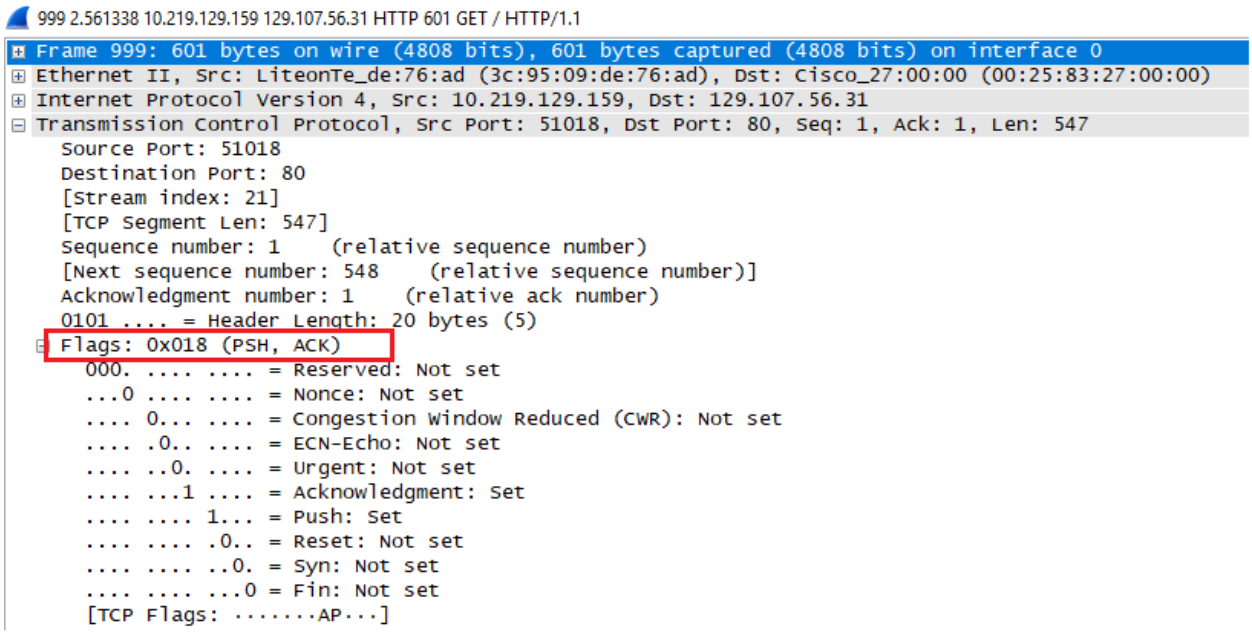


9. What are the fields in the TCP Flags? No need to give any values but give the field names given in Wireshark

Ans. TCP Flags are: PSH and ACK bit are set

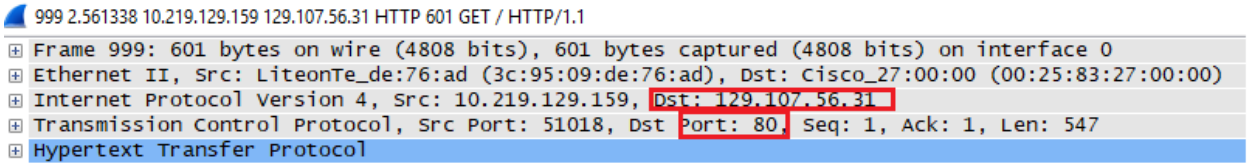
- Reserved

- Nonce
- Congestion Window Reduced
- ECN- Echo
- Urgent
- Acknowledgment
- Push
- Reset
- Syn
- Fin



10. What is the IP address of uta.edu? On what port number is it sending and receiving TCP segments for this connection?

Ans. IP address of uta.edu: 129.107.56.31, Port number used by uta.edu to send TCP segments: 80

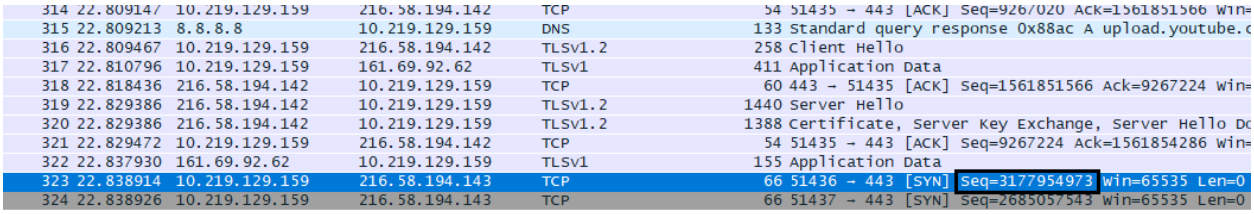


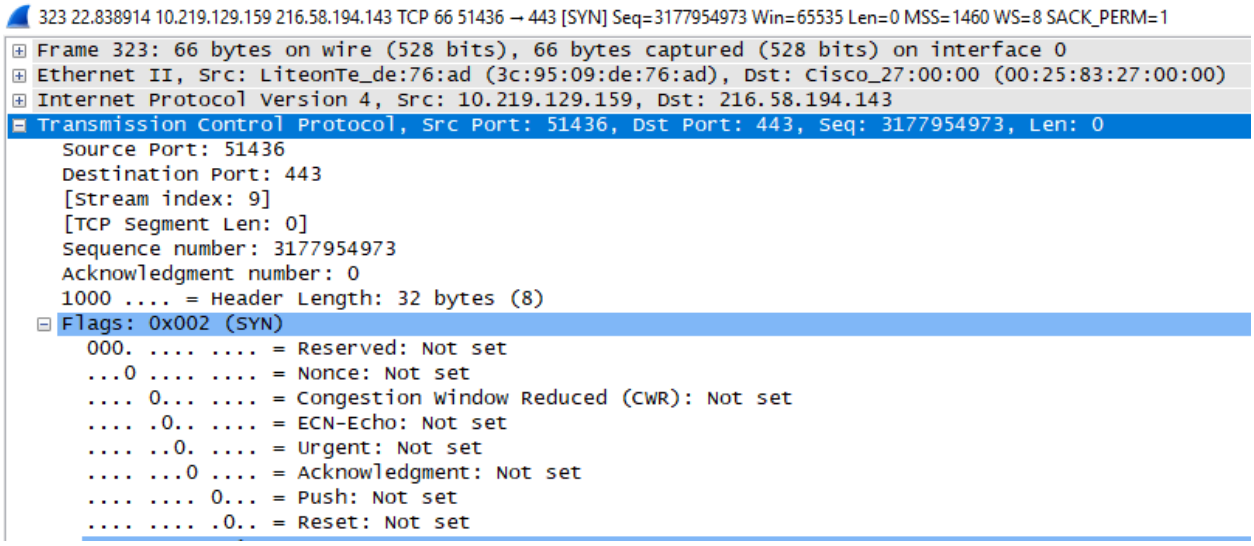
Section 2: Analyzing the Connection Parameters in TCP

Problem Set 2

1. What is the sequence number (absolute) of the TCP SYN segment that is used to initiate the TCP connection between the client computer and youtube.com?

Ans. The absolute sequence number of the of the TCP SYN segment is **3177954973**.

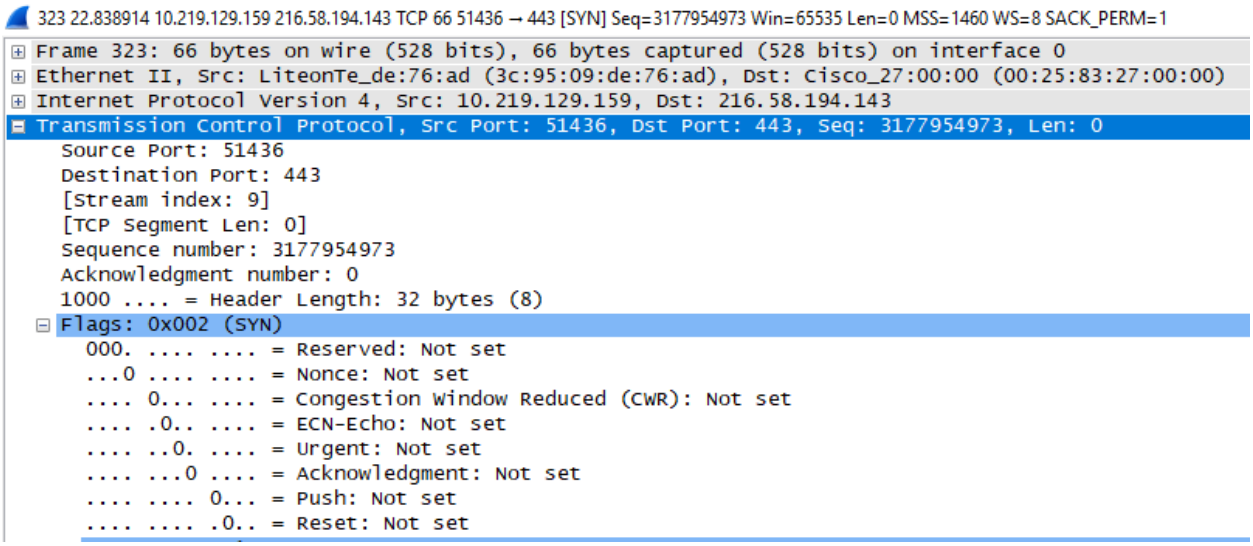




2. What is it in the segment that identifies the segment as a SYN segment?

Ans. Flag in the TCP protocol depicts that it is a SYN bit.

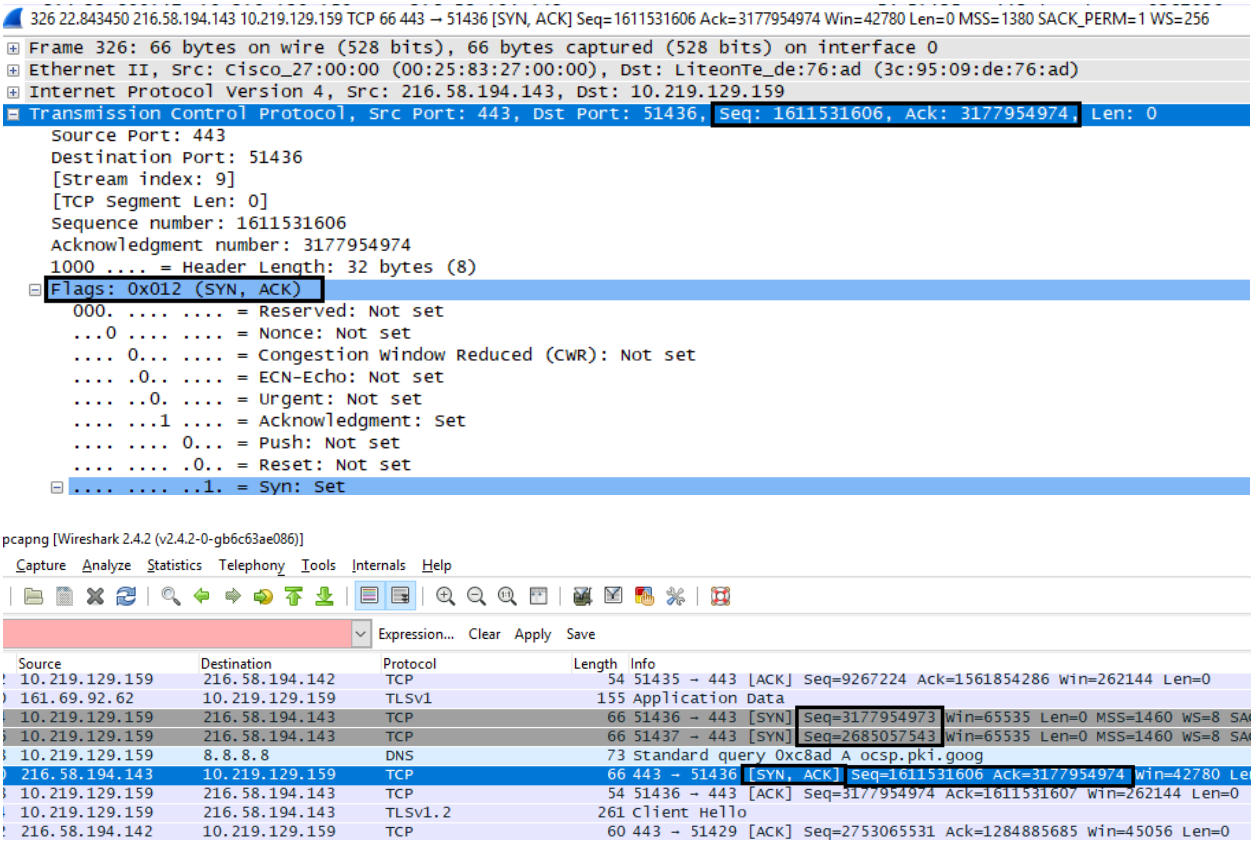
Flags – 0x002 (SYN)



3. What is the sequence number of the SYNACK segment sent by youtube.com to the client computer in reply to the SYN? What is the value of the Acknowledgement field in the SYNACK segment?

Ans. **Sequence number** of the SYNACK segment sent by youtube.com to the client computer - 1611531606

Acknowledgement number in the SYNACK segment – 3177954974

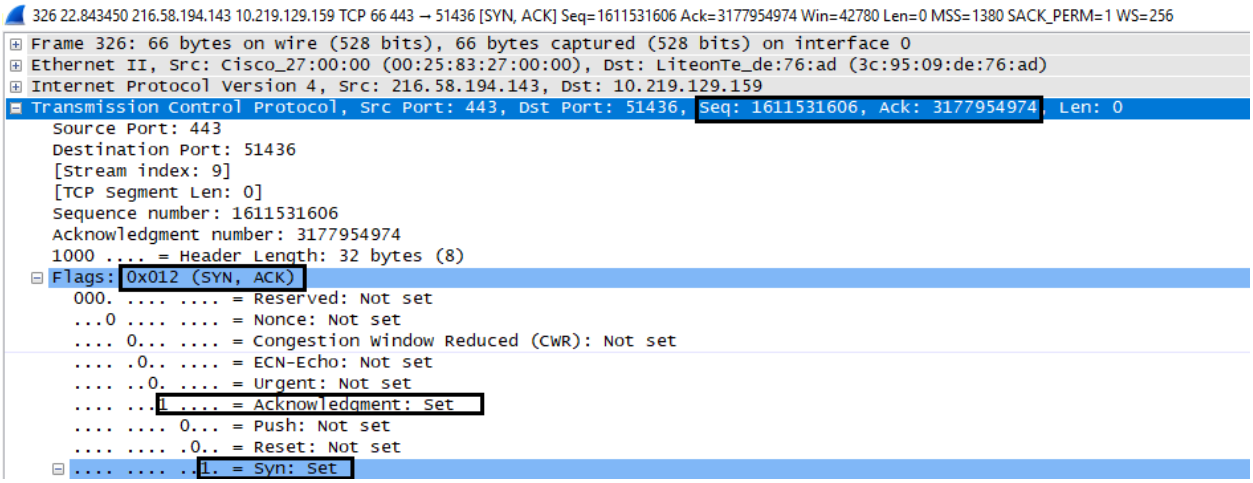


4. How did youtube.com determine that value? What is it in the segment that identifies the segment as a SYNACK segment?

Ans. Youtube.com determines the value using Flag bit.

The segment that identifies SYNACK segment in the Flag bit.

Flag – 0x012 (SYN,ACK)

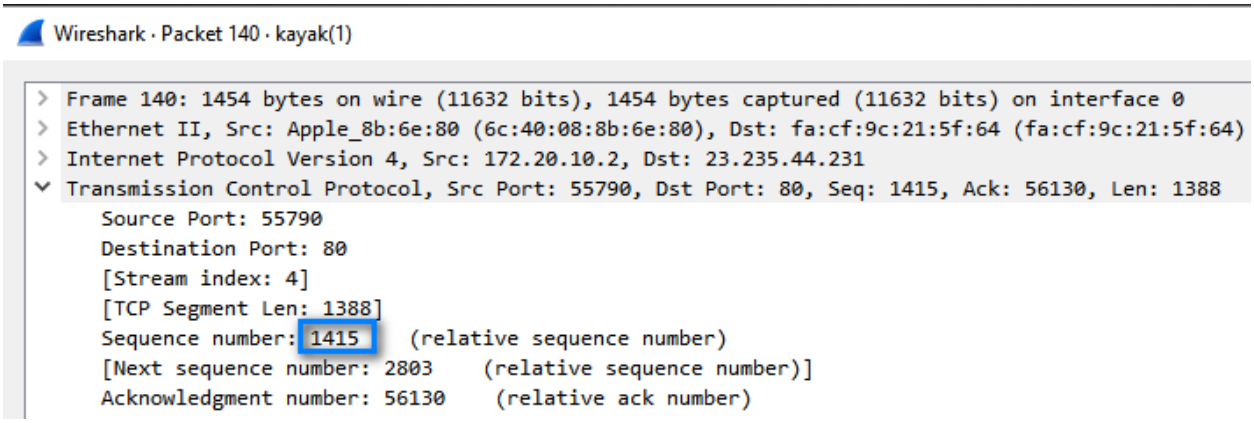


Section 3: Analysis of the trace provided

Problem Set 3:

1. What is the sequence number of the TCP segment containing the first HTTP POST command?

Ans. Relative Sequence number for the TCP segment containing the first HTTP POST command is **1415**.



```
0000  fa cf 9c 21 5f 64 6c 40  08 8b 6e 80 08 00 45 00   ...!_dl@ ..n...E.
0010  05 a0 d5 66 40 00 40 06  65 09 ac 14 0a 02 17 eb   ...f@.@. e.......
0020  2c e7 d9 ee 00 50 12 fc  0d cf 3f 57 a5 79 80 10   ,....P.. ..?W.y..
0030  10 00 36 9a 00 00 01 01  08 0a 06 4f 76 33 03 0d   ..6..... ...Ov3..
0040  d1 4e 50 4f 53 54 20 2f  76 73 2f 70 61 67 65 2f   .NPOST / vs/page/
0050  68 6f 74 65 6c 2f 72 65  73 75 6c 74 73 20 48 54   hotel/re sults HT
0060  54 50 2f 31 2e 31 0d 0a  48 6f 73 74 3a 20 77 77   TP/1.1.. Host: ww
0070  77 2e 6b 61 79 61 6b 2e  63 6f 6d 0d 0a 41 63 63   w.kayak. com..Acc
0080  65 70 74 3a 20 2a 2f 2a  0d 0a 58 2d 52 65 71 75   ept: */* ..X-Requ
0090  65 73 74 65 64 2d 57 69  74 68 3a 20 58 4d 4c 48   ested-Wi th: XMLH
00a0  74 74 70 52 65 71 75 65  73 74 0d 0a 41 63 63 65   ttpReque st..Acce
00b0  70 74 2d 4c 61 6e 67 75  61 67 65 3a 20 65 6e 2d   pt-Langu age: en-
00c0  75 73 0d 0a 41 63 63 65  70 74 2d 45 6e 63 6f 64   us..Acce pt-Encod
00d0  69 6e 67 3a 20 67 7a 69  70 2c 20 64 65 66 6c 61   ing: gzi p, defla
00e0  74 65 0d 0a 43 6f 6e 74  65 6e 74 2d 54 79 70 65   te..Cont ent-Type
00f0  3a 20 61 70 70 6c 69 63  61 74 69 6f 6e 2f 78 2d   : applic ation/x-
0100  77 77 77 2d 66 6f 72 6d  2d 75 72 6c 65 6e 63 6f   www-form -urlenco
0110  64 65 64 3b 20 63 68 61  72 73 65 74 3d 55 54 46   ded; cha rset=UTF
```

2. Consider the TCP segment containing the HTTP POST as the first segment in the TCP connection.

i) What are the sequence numbers of the first four segments in the TCP connection (including the segment containing the HTTP POST)?

Ans. TCP segment having HTTP POST: (140)

TCP Segment 1: (140)

Sequence number: 1415 (Relative), Next Sequence number: (Relative)

TCP Segment 2: (141)

Sequence number: 2803 (Relative), Next Sequence number: (Relative)

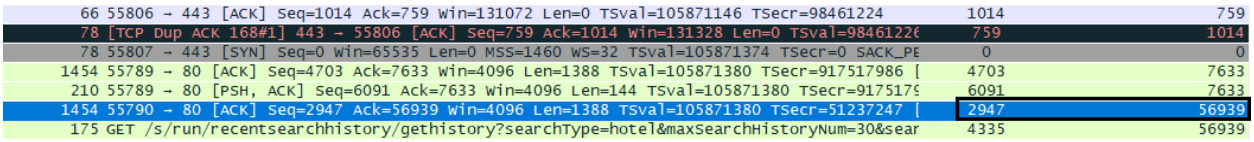
TCP Segment 3: (142)

Sequence number: 2938 (Relative), Next Sequence number: (Relative)

TCP Segment 4: (174)

Sequence number: 2947 (Relative), Next Sequence number: (Relative)

Length	Info	Sequence Number	Acknowledgement Number
66	80 → 55789 [ACK] Seq=5152 Ack=2946 Win=85 Len=0 TSval=917517929 TSecr=105870856	5152	2946
66	80 → 55789 [ACK] Seq=5152 Ack=3138 Win=90 Len=0 TSval=917517929 TSecr=105870856	5152	3138
74	443 → 55806 [SYN, ACK] Seq=0 Ack=1 Win=8192 Len=0 MSS=1400 WS=256 SACK_PERM=1 TSval=98	0	1
66	55806 → 443 [ACK] Seq=1 Ack=1 Win=131840 Len=0 TSval=105870899 TSecr=98461199	1	1
1454	55790 → 80 [ACK] Seq=1415 Ack=56130 Win=4096 Len=1388 TSval=105870899 TSecr=51237198 [	1415	56130
201	55790 → 80 [PSH, ACK] Seq=2803 Ack=56130 Win=4096 Len=135 TSval=105870899 TSecr=512371	2803	56130
75	POST /vs/page/hotel/results HTTP/1.1 (application/x-www-form-urlencoded)	2938	56130
583	Client Hello	1	1
66	80 → 55790 [ACK] Seq=56130 Ack=2803 Win=72 Len=0 TSval=51237230 TSecr=105870899	56130	2803



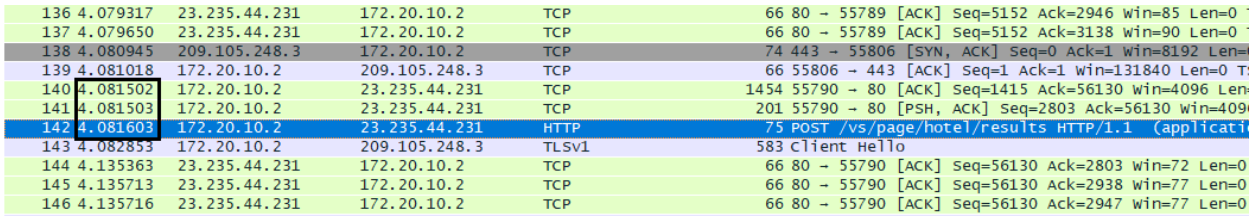
ii) At what time was each segment sent?

Ans. Time for each segment is as follows:

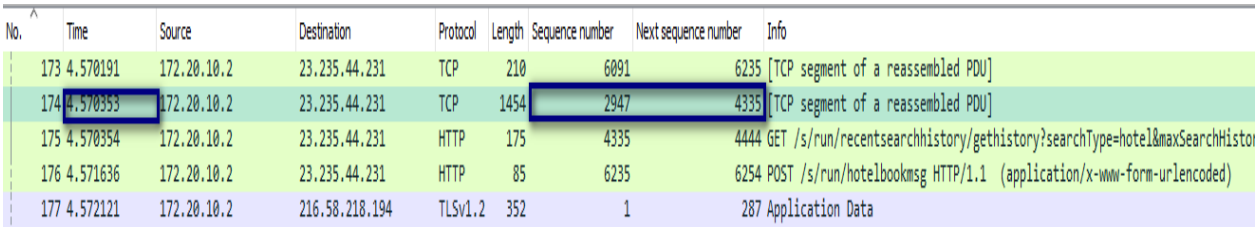
TCP segment having HTTP POST: 4.081502 secs

TCP Segment 1: 4.081503 secs

TCP Segment 2: 4.081603 secs



TCP Segment 3: 4.570353 secs

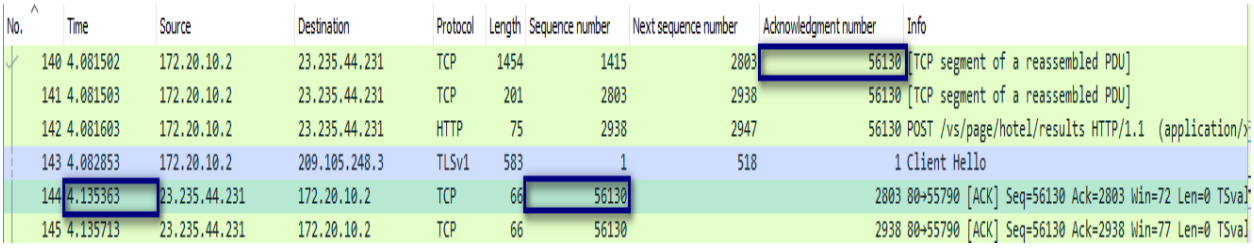


iii) When was the ACK for each segment received?

Ans.

TCP containing HTTP Post (140): Sequence number: 1415, ACK: 56130

ACK for HTTP (144): Sequence number: 56130 ACK: 2803, Time: 4.135363 secs



TCP Segment 1 (141): Sequence number: 2803, ACK: 56130

ACK for TCP Segment 1(145): Sequence number: 56130, ACK: 2938, Time: 4.135713 secs

We have considered this packet as the next sequence number of the ACK packet is equal to sequence number of the next TCP segment.

No.	Time	Source	Destination	Protocol	Length	Sequence number	Next sequence number	Acknowledgment number	Info
140	4.081502	172.20.10.2	23.235.44.231	TCP	1454	1415	2803	56130	[TCP segment of a reassembled PDU]
141	4.081503	172.20.10.2	23.235.44.231	TCP	201	2803	2938	56130	[TCP segment of a reassembled PDU]
142	4.081603	172.20.10.2	23.235.44.231	HTTP	75	2938	2947	56130	POST /vs/page/hotel/results HTTP/1.1 (application/x
143	4.082853	172.20.10.2	209.105.248.3	TLSv1	583	1	518	1	Client Hello
144	4.135363	23.235.44.231	172.20.10.2	TCP	66	56130		2803	80→55790 [ACK] Seq=56130 Ack=2803 Win=72 Len=0 TSval
145	4.135713	23.235.44.231	172.20.10.2	TCP	66	56130		2938	80→55790 [ACK] Seq=56130 Ack=2938 Win=77 Len=0 TSval
146	4.135716	23.235.44.231	172.20.10.2	TCP	66	56130		2947	80→55790 [ACK] Seq=56130 Ack=2947 Win=77 Len=0 TSval

TCP Segment 2 (142): Sequence number: 2938, ACK: 56130

ACK for TCP Segment 2 (146): Sequence number: 56130, ACK: 2947, Time: 4.135716 Secs

No.	Time	Source	Destination	Protocol	Length	Sequence number	Next sequence number	Acknowledgment number	Info
140	4.081502	172.20.10.2	23.235.44.231	TCP	1454	1415	2803	56130	[TCP segment of a reassembled PDU]
141	4.081503	172.20.10.2	23.235.44.231	TCP	201	2803	2938	56130	[TCP segment of a reassembled PDU]
142	4.081603	172.20.10.2	23.235.44.231	HTTP	75	2938	2947	56130	POST /vs/page/hotel/results HTTP/1.1 (application/x
143	4.082853	172.20.10.2	209.105.248.3	TLSv1	583	1	518	1	Client Hello
144	4.135363	23.235.44.231	172.20.10.2	TCP	66	56130		2803	80→55790 [ACK] Seq=56130 Ack=2803 Win=72 Len=0 TSval
145	4.135713	23.235.44.231	172.20.10.2	TCP	66	56130		2938	80→55790 [ACK] Seq=56130 Ack=2938 Win=77 Len=0 TSval
146	4.135716	23.235.44.231	172.20.10.2	TCP	66	56130		2947	80→55790 [ACK] Seq=56130 Ack=2947 Win=77 Len=0 TSval
147	4.136062	209.105.248.3	172.20.10.2	TLSv1	211	1	146	518	Server Hello, Change Cipher Spec, Encrypted Handshak

TCP Segment 3 (174): Sequence number: 4335, ACK: 56939

ACK for TCP Segment 3: Sequence number: 56939, ACK: 4335, Time: 4.646868 Secs

No.	Time	Source	Destination	Protocol	Length	Sequence number	Next sequence number	Acknowledgment number	Info
173	4.570191	172.20.10.2	23.235.44.231	TCP	210	6091	6235	7633	[TCP segment of a reassembled PDU]
174	4.570353	172.20.10.2	23.235.44.231	TCP	1454	2947	4335	56939	[TCP segment of a reassembled PDU]
175	4.570354	172.20.10.2	23.235.44.231	HTTP	175	4335	4444	56939	GET /s/run/recentsearchhistory/gethistory?searchType
176	4.571636	172.20.10.2	23.235.44.231	HTTP	85	6235	6254	7633	POST /s/run/hotelbookmsg HTTP/1.1 (application/x-ww
177	4.572121	172.20.10.2	216.58.218.194	TLSv1.2	352	1	287	1	Application Data
178	4.575141	172.20.10.2	172.20.10.1	DNS	74				Standard query 0xceb2 A www.google.com
179	4.640828	173.194.115.60	172.20.10.2	TCP	74	0		1	443→55807 [SYN, ACK] Seq=0 Ack=1 Win=42540 Len=0 MSS
180	4.640909	172.20.10.2	173.194.115.60	TCP	66	1		1	55807→443 [ACK] Seq=1 Ack=1 Win=131840 Len=0 TSval=1
181	4.641019	172.20.10.1	172.20.10.2	DNS	154				Standard query response 0xceb2 A www.google.com A 17
182	4.643313	172.20.10.2	173.194.115.51	TCP	78	0		0	55808→80 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=32
183	4.643917	172.20.10.2	173.194.115.60	TLSv1.2	300	1	235	1	Client Hello
184	4.646397	23.235.44.231	172.20.10.2	TCP	66	7633		6091	80→55789 [ACK] Seq=7633 Ack=6091 Win=106 Len=0 TSval
185	4.646590	23.235.44.231	172.20.10.2	TCP	66	7633		6235	80→55789 [ACK] Seq=7633 Ack=6235 Win=112 Len=0 TSval
186	4.646868	23.235.44.231	172.20.10.2	TCP	66	56939		4335	80→55790 [ACK] Seq=56939 Ack=4335 Win=82 Len=0 TSval
187	4.649228	216.58.218.194	172.20.10.2	TCP	66	1		287	443→55496 [ACK] Seq=1 Ack=287 Win=455 Len=0 TSval=24

iv) Given the difference between when each TCP segment was sent, and when its acknowledgement was received,

Ans.

Segment	Time (secs)	Time (ACK received) (secs)	Difference (Time(ACK)- Time) (secs)
TCP Segment with HTTP post	4.081502	4.135363	0.053861
TCP Segment 1	4.081503	4.135713	0.05421
TCP Segment 2	4.081603	4.135716	0.054113
TCP Segment 3	4.570353	4.646868	0.076518

v) what is the RTT value for each of the four segments?

Ans.

Segment	Time (secs)	Time (ACK received) (secs)	Sample RTT (Time(ACK)- Time) (secs)
TCP Segment with HTTP post	4.081502	4.135716	0.053861
TCP Segment 1	4.081503	4.135713	0.05421
TCP Segment 2	4.081603	4.135716	0.054113
TCP Segment 3	4.570373	4.646868	0.076518

vi) What is the EstimatedRTT value (see Section 3.5.3, page 239 in text) after the receipt of each ACK?

Ans. Estimated RTT of first segment is equal to sample RTT

Segment	Time (secs)	Time (ACK received) (secs)	Sample RTT (secs)	Estimated RTT (secs)
TCP Segment with HTTP post	4.081502	4.135716	0.53861	0.053861
TCP Segment 1	4.081503	4.135713	0.05421	0.053904
TCP Segment 2	4.081603	4.135716	0.054113	0.053930
TCP Segment 3	4.570373	4.646868	0.076518	0.056754

vii) Assume that the value of the EstimatedRTT is equal to the measured RTT for the first segment, and then is computed using the Estimated RTT equation on page 239 for all subsequent segments.

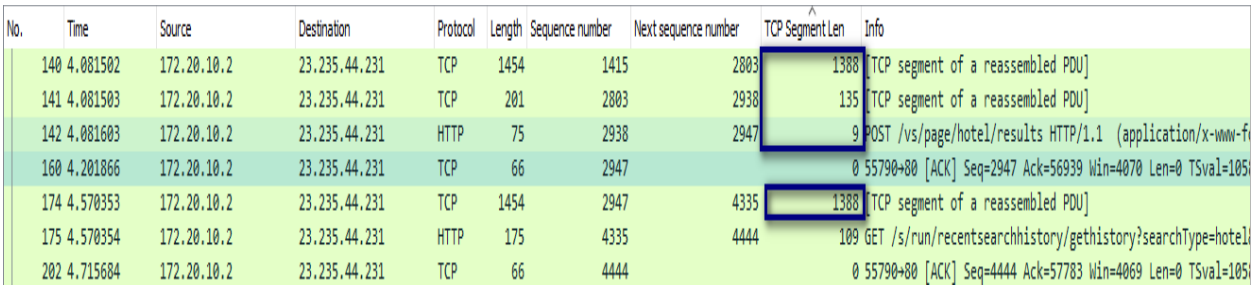
Ans.

Segment	Time (secs)	Time (ACK received) (secs)	Sample RTT (secs)	Estimated RTT (secs)
TCP Segment with HTTP post	4.081502	4.135716	0.53861	0.053861
TCP Segment 1	4.081503	4.135713	0.05421	0.053904
TCP Segment 2	4.081603	4.135716	0.054113	0.053930
TCP Segment 3	4.570373	4.646868	0.076518	0.056754

3. What is the length of each of the first four TCP segments?

Ans.

Segment	Length (bytes)	Column number	Sequence number
TCP Segment with HTTP post	1388	140	1415
TCP Segment 1	135	141	2803
TCP Segment 2	9	142	2938
TCP Segment 3	1388	174	4335



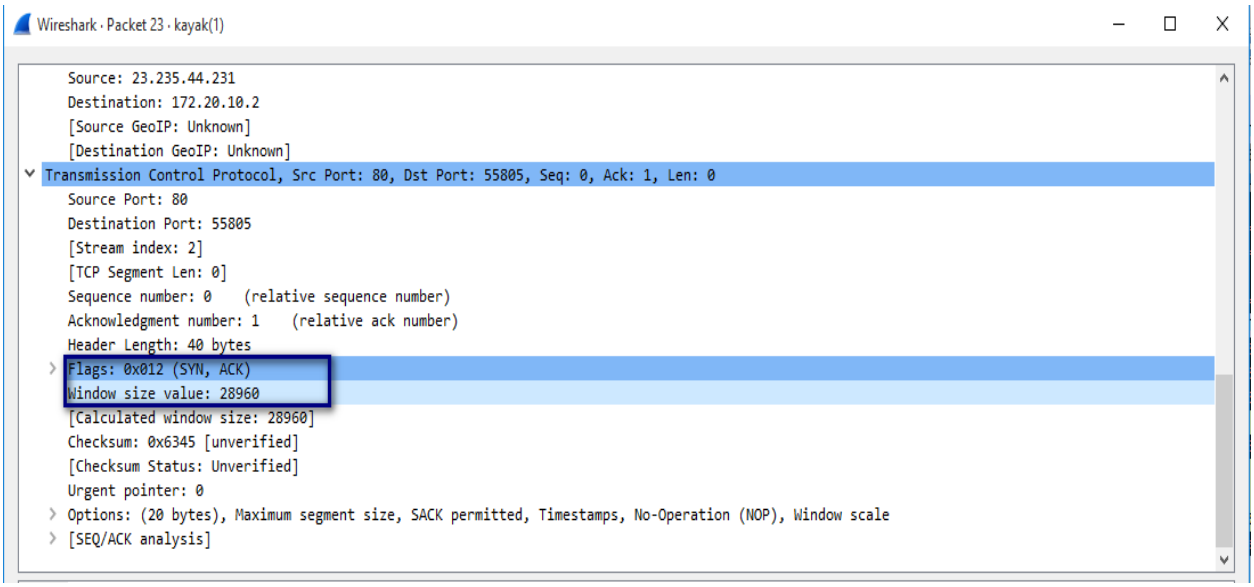
No.	Time	Source	Destination	Protocol	Length	Sequence number	Next sequence number	TCP Segment Len	Info
140	4.081502	172.20.10.2	23.235.44.231	TCP	1454	1415	2803	1388	[TCP segment of a reassembled PDU]
141	4.081503	172.20.10.2	23.235.44.231	TCP	201	2803	2938	135	[TCP segment of a reassembled PDU]
142	4.081603	172.20.10.2	23.235.44.231	HTTP	75	2938	2947	9	POST /vs/page/hotel/results HTTP/1.1 (application/x-www-f
160	4.201866	172.20.10.2	23.235.44.231	TCP	66	2947		0	55790→80 [ACK] Seq=2947 Ack=56939 Win=4070 Len=0 TSval=105
174	4.570353	172.20.10.2	23.235.44.231	TCP	1454	2947	4335	1388	[TCP segment of a reassembled PDU]
175	4.570354	172.20.10.2	23.235.44.231	HTTP	175	4335	4444	109	GET /s/run/recentsearchhistory/gethistory?searchType=hotel
202	4.715684	172.20.10.2	23.235.44.231	TCP	66	4444		0	55790→80 [ACK] Seq=4444 Ack=57783 Win=4069 Len=0 TSval=105

4. What is the minimum amount of available buffer space advertised at the receiver for the entire trace?

Ans. The first TCP [SYN, ACK] bit in the TCP segment gives the minimum amount of available buffer size.

Window Size: 28960

Packet number: 23



5. Does the lack of receiver buffer space ever throttle the sender?

Ans. The minimum amount of available buffer space advertised at the receiver for the entire trace is 28960 bytes (Packet number: 23).

No.	Time	Source	Destination	Protocol	Length	Sequence number	Window size value	Info
21	2.913690	172.20.10.2	23.235.44.231	TCP	78	0	65535	55805→80 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=32 TSval=105869757 TSecr=0…
22	3.004363	172.20.10.1	172.20.10.2	DNS	117			Standard query response 0x9cb8 A mathid-origin.mathtag.com A 74.121.139.80 …
23	3.005770	23.235.44.231	172.20.10.2	TCP	74	0	28960	80→55805 [SYN, ACK] Seq=0 Ack=1 Win=28960 Len=0 MSS=1400 SACK_PERM=1 TSval=…
24	3.005854	172.20.10.2	23.235.44.231	TCP	66	1	4120	55805→80 [ACK] Seq=1 Ack=1 Win=131840 Len=0 TSval=105869849 TSecr=335022886

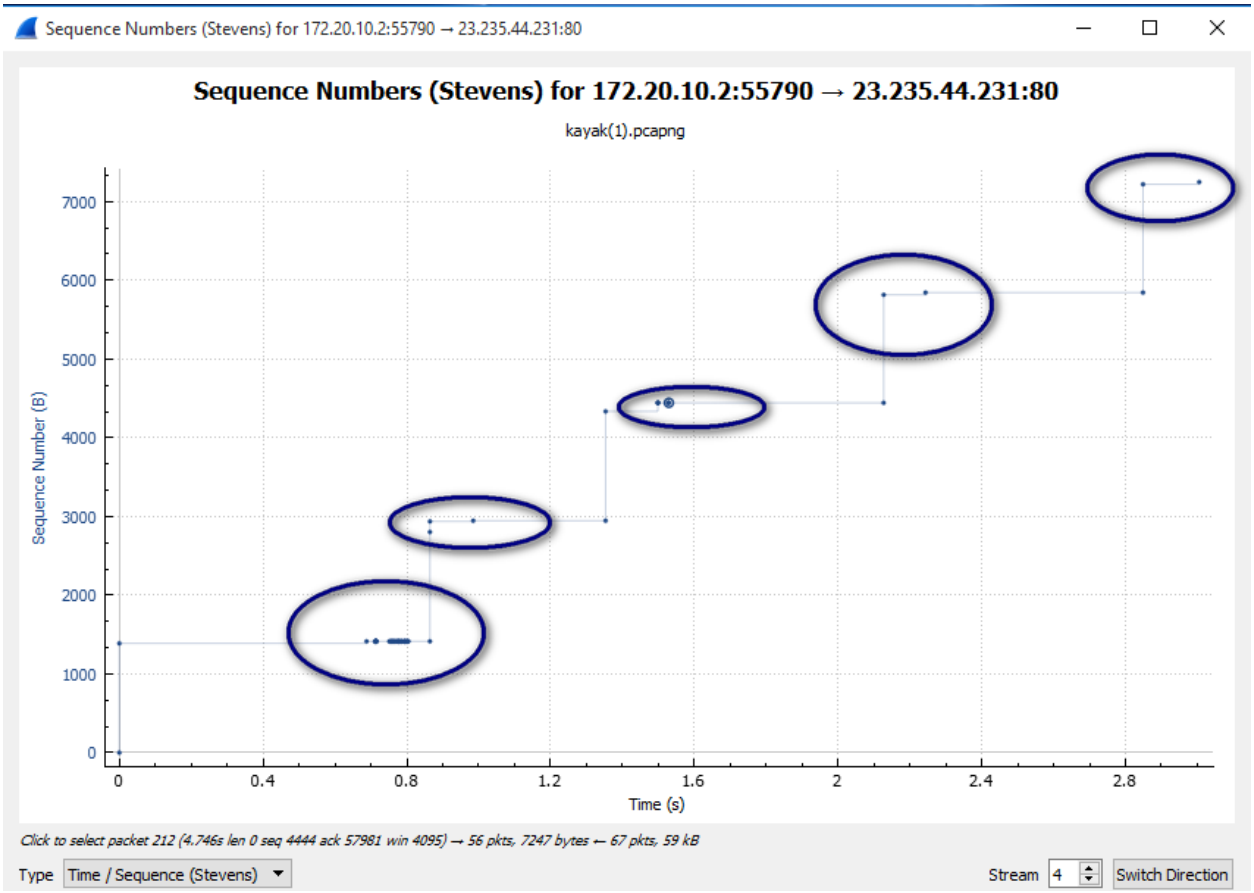
The maximum amount of available buffer space advertised at the receiver for the entire trace is 65535 bytes (Packet number: 1104).

No.	Time	Source	Destination	Protocol	Length	Sequence number	Window size value	Info
1113	9.821203	172.20.10.2	216.58.218.163	TCP	78	0	65535	55838→80 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=32 TSval=105876462 TSecr=0…
1104	9.800917	93.184.216.182	172.20.10.2	TCP	74	0	65535	80→55837 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1400 SACK_PERM=1 TSval=…
1103	9.783520	172.20.10.2	129.107.56.31	TCP	66	4948	65535	55827→80 [ACK] Seq=4948 Ack=1038 Win=65535 Len=0 TSval=105876428 TSecr=3732…

This receiver window grows until it reaches the maximum receiver buffer size. By examining the trace, the sender is never throttled due to lack of receiver buffer space. Even when the advertised receiver window is having its lowest value i.e. 28960, the sender is constrained by congestion window. Window size will increase up to 65535 bits, allowing sufficient buffer size for the sender to send the data.

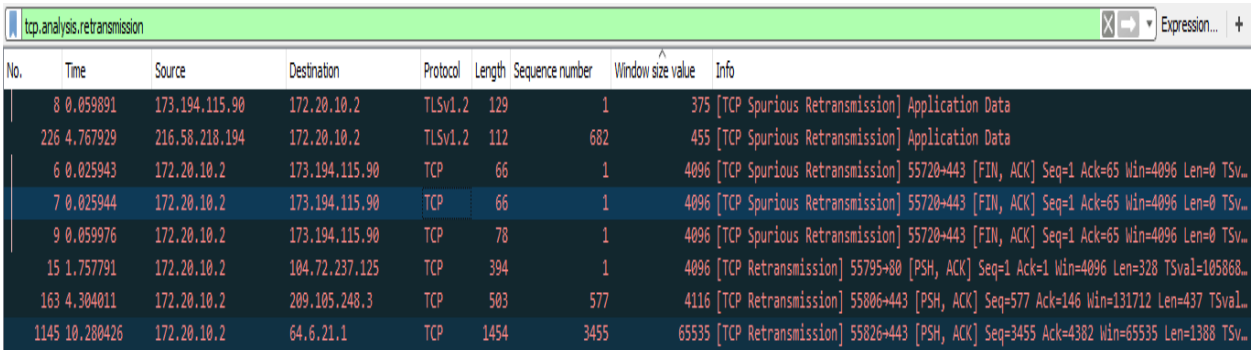
6. Are there any retransmitted segments in the trace file? What did you check for (in the trace) to answer this question?

Ans.



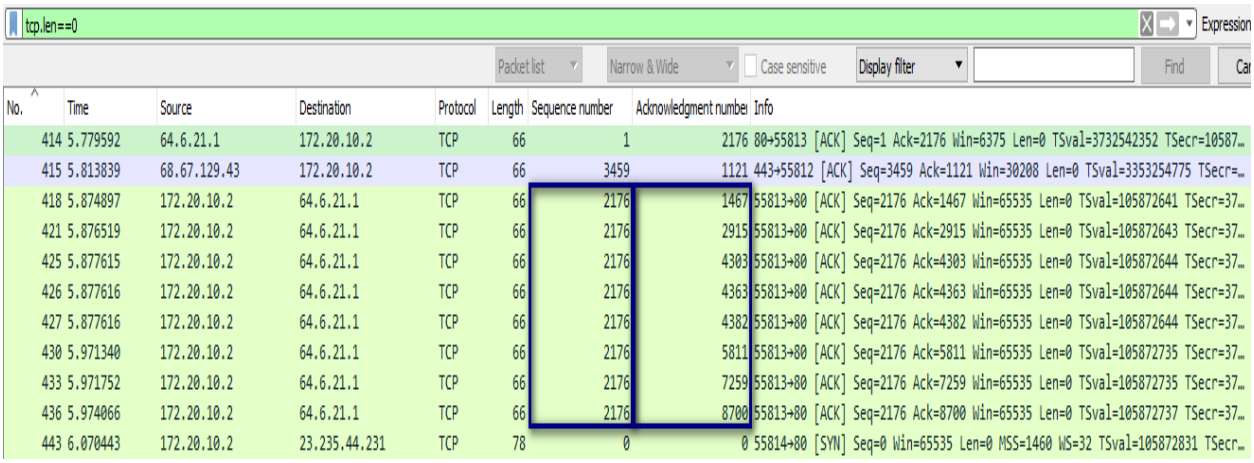
We have considered Stevens graph to check the retransmissions. In the above, graph it clearly represents the multiple re-transmissions of the same segment.

We have also used “tcp.analysis.retransmission” filter to find out the number of retransmissions.



7. How much data does the receiver typically acknowledge in an ACK? Can you identify cases where the receiver is ACK-ing every other received segment (see Table 3.2 on page 247 in the text)?

Ans. Typically, Acknowledge data size is as follows;

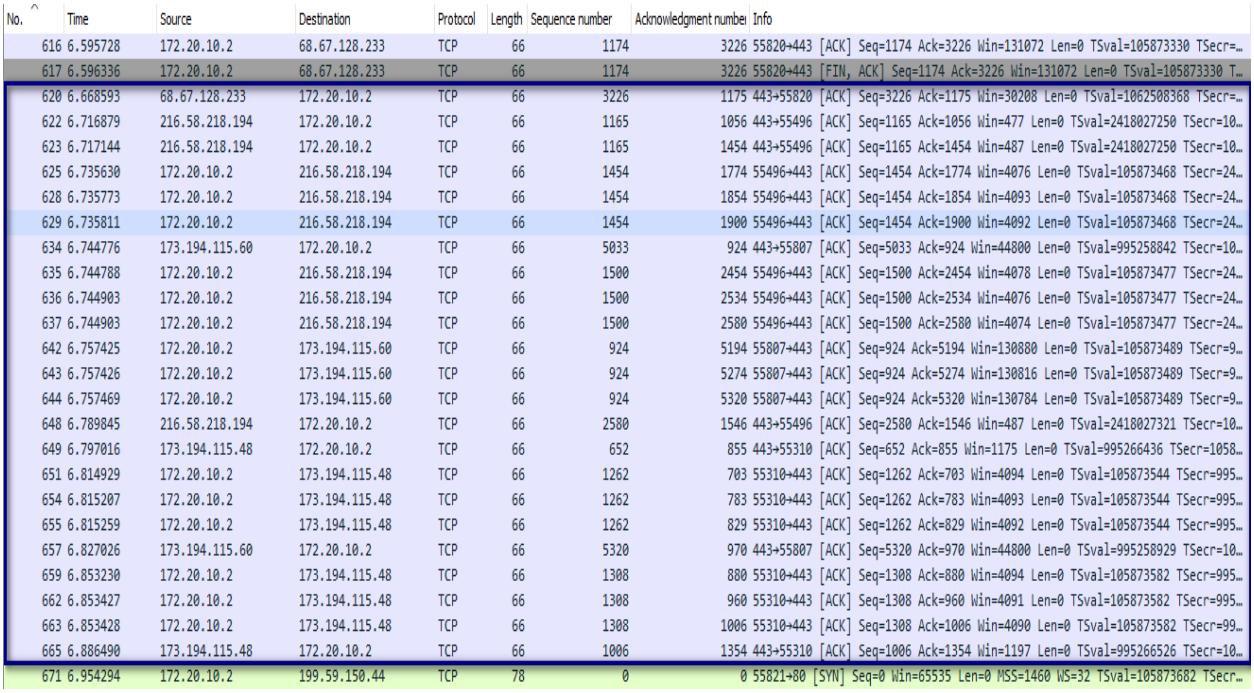


Packet number	Sequence number	Acknowledgment number	Acknowledgement data size (Next ACK number-ACK)
418	2176	1467	1467
421	2176	2915	1488
425	2176	4303	1388
426	2176	4363	60
427	2176	4382	19
430	2176	5811	1429
433	2176	7259	1488
436	2176	8700	1441

Approximately, 1097 is the Acknowledgment data size.

While examining the packets, we find that multiple acknowledgements has the same sequence number.

The following sample of data ACKs every other received segment:



No.	Time	Source	Destination	Protocol	Length	Sequence number	Acknowledgment numbe	Info
616	6.595728	172.20.10.2	68.67.128.233	TCP	66	1174	3226	55820→443 [ACK] Seq=1174 Ack=3226 Win=131072 Len=0 TSval=105873330 TSecr=…
617	6.596336	172.20.10.2	68.67.128.233	TCP	66	1174	3226	55820→443 [FIN, ACK] Seq=1174 Ack=3226 Win=131072 Len=0 TSval=105873330 T…
620	6.668593	68.67.128.233	172.20.10.2	TCP	66	3226	1175	443→55820 [ACK] Seq=3226 Ack=1175 Win=30208 Len=0 TSval=1062508368 TSecr=…
622	6.716879	216.58.218.194	172.20.10.2	TCP	66	1165	1056	443→55496 [ACK] Seq=1165 Ack=1056 Win=477 Len=0 TSval=2418027250 TSecr=10…
623	6.717144	216.58.218.194	172.20.10.2	TCP	66	1165	1454	443→55496 [ACK] Seq=1165 Ack=1454 Win=487 Len=0 TSval=2418027250 TSecr=10…
625	6.735630	172.20.10.2	216.58.218.194	TCP	66	1454	1774	55496→443 [ACK] Seq=1454 Ack=1774 Win=4076 Len=0 TSval=105873468 TSecr=24…
628	6.735773	172.20.10.2	216.58.218.194	TCP	66	1454	1854	55496→443 [ACK] Seq=1454 Ack=1854 Win=4093 Len=0 TSval=105873468 TSecr=24…
629	6.735811	172.20.10.2	216.58.218.194	TCP	66	1454	1900	55496→443 [ACK] Seq=1454 Ack=1900 Win=4092 Len=0 TSval=105873468 TSecr=24…
634	6.744776	173.194.115.60	172.20.10.2	TCP	66	5033	924	443→55807 [ACK] Seq=5033 Ack=924 Win=44800 Len=0 TSval=995258842 TSecr=10…
635	6.744788	172.20.10.2	216.58.218.194	TCP	66	1500	2454	55496→443 [ACK] Seq=1500 Ack=2454 Win=4078 Len=0 TSval=105873477 TSecr=24…
636	6.744903	172.20.10.2	216.58.218.194	TCP	66	1500	2534	55496→443 [ACK] Seq=1500 Ack=2534 Win=4076 Len=0 TSval=105873477 TSecr=24…
637	6.744903	172.20.10.2	216.58.218.194	TCP	66	1500	2580	55496→443 [ACK] Seq=1500 Ack=2580 Win=4074 Len=0 TSval=105873477 TSecr=24…
642	6.757425	172.20.10.2	173.194.115.60	TCP	66	924	5194	55807→443 [ACK] Seq=924 Ack=5194 Win=130880 Len=0 TSval=105873489 TSecr=9…
643	6.757426	172.20.10.2	173.194.115.60	TCP	66	924	5274	55807→443 [ACK] Seq=924 Ack=5274 Win=130816 Len=0 TSval=105873489 TSecr=9…
644	6.757469	172.20.10.2	173.194.115.60	TCP	66	924	5320	55807→443 [ACK] Seq=924 Ack=5320 Win=130784 Len=0 TSval=105873489 TSecr=9…
648	6.789845	216.58.218.194	172.20.10.2	TCP	66	2580	1546	443→55496 [ACK] Seq=2580 Ack=1546 Win=487 Len=0 TSval=2418027321 TSecr=10…
649	6.797016	173.194.115.48	172.20.10.2	TCP	66	652	855	443→55310 [ACK] Seq=652 Ack=855 Win=1175 Len=0 TSval=995266436 TSecr=1058…
651	6.814929	172.20.10.2	173.194.115.48	TCP	66	1262	703	55310→443 [ACK] Seq=1262 Ack=703 Win=4094 Len=0 TSval=105873544 TSecr=995…
654	6.815207	172.20.10.2	173.194.115.48	TCP	66	1262	783	55310→443 [ACK] Seq=1262 Ack=783 Win=4093 Len=0 TSval=105873544 TSecr=995…
655	6.815259	172.20.10.2	173.194.115.48	TCP	66	1262	829	55310→443 [ACK] Seq=1262 Ack=829 Win=4092 Len=0 TSval=105873544 TSecr=995…
657	6.827026	173.194.115.60	172.20.10.2	TCP	66	5320	970	443→55807 [ACK] Seq=5320 Ack=970 Win=44800 Len=0 TSval=995258929 TSecr=10…
659	6.853230	172.20.10.2	173.194.115.48	TCP	66	1308	880	55310→443 [ACK] Seq=1308 Ack=880 Win=4094 Len=0 TSval=105873582 TSecr=995…
662	6.853427	172.20.10.2	173.194.115.48	TCP	66	1308	960	55310→443 [ACK] Seq=1308 Ack=960 Win=4091 Len=0 TSval=105873582 TSecr=995…
663	6.853428	172.20.10.2	173.194.115.48	TCP	66	1308	1006	55310→443 [ACK] Seq=1308 Ack=1006 Win=4090 Len=0 TSval=105873582 TSecr=99…
665	6.886490	173.194.115.48	172.20.10.2	TCP	66	1006	1354	443→55310 [ACK] Seq=1006 Ack=1354 Win=1197 Len=0 TSval=995266526 TSecr=10…
671	6.954294	172.20.10.2	199.59.150.44	TCP	78	0	0	55821→80 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=32 TSval=105873682 TSecr…

8. What is the throughput (bytes transferred per unit time) for the TCP connection (Just consider a single connection)? Think on how to calculate the throughput!

Ans.

We consider TCP trace, first sequence number to be packet number 29, and the last packet to be packet number 464.

So, the Throughput = Size of the data/Time

Size of the data = Last ACK Sequence number – First Sequence number

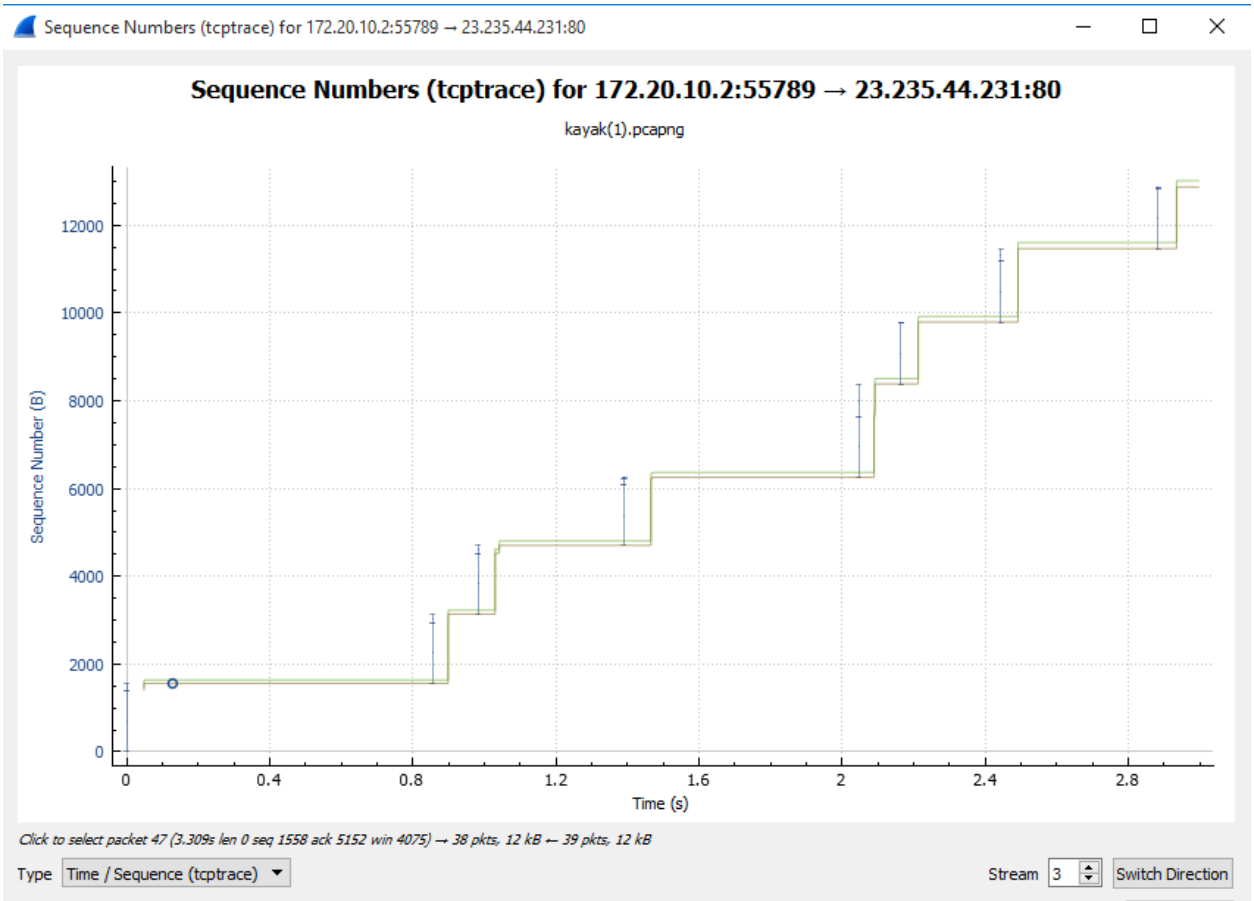
= 12870-1 = 12869

Time = 6.179502 – 3.180418

= 2.999

Throughput= 12869/2.999

= 4291 bytes/sec



9. Explain how you calculated this value.

Ans. We chose the first TCP packet with the Sequence and ACK number as 1.

By using the TCP trace report from **Statistics -> TCP Trace graphs -> TCP Trace** (as per the above image), we found that last ACK packet is 464 with the sequence number 12870.

In order to check the Throughput, we need the size of the data and the time taken.

Size of the data = Last ACK Sequence number – First Sequence number = 12870-1 = 12869

Total Time Taken = 6.179502 – 3.180418 = 2.999

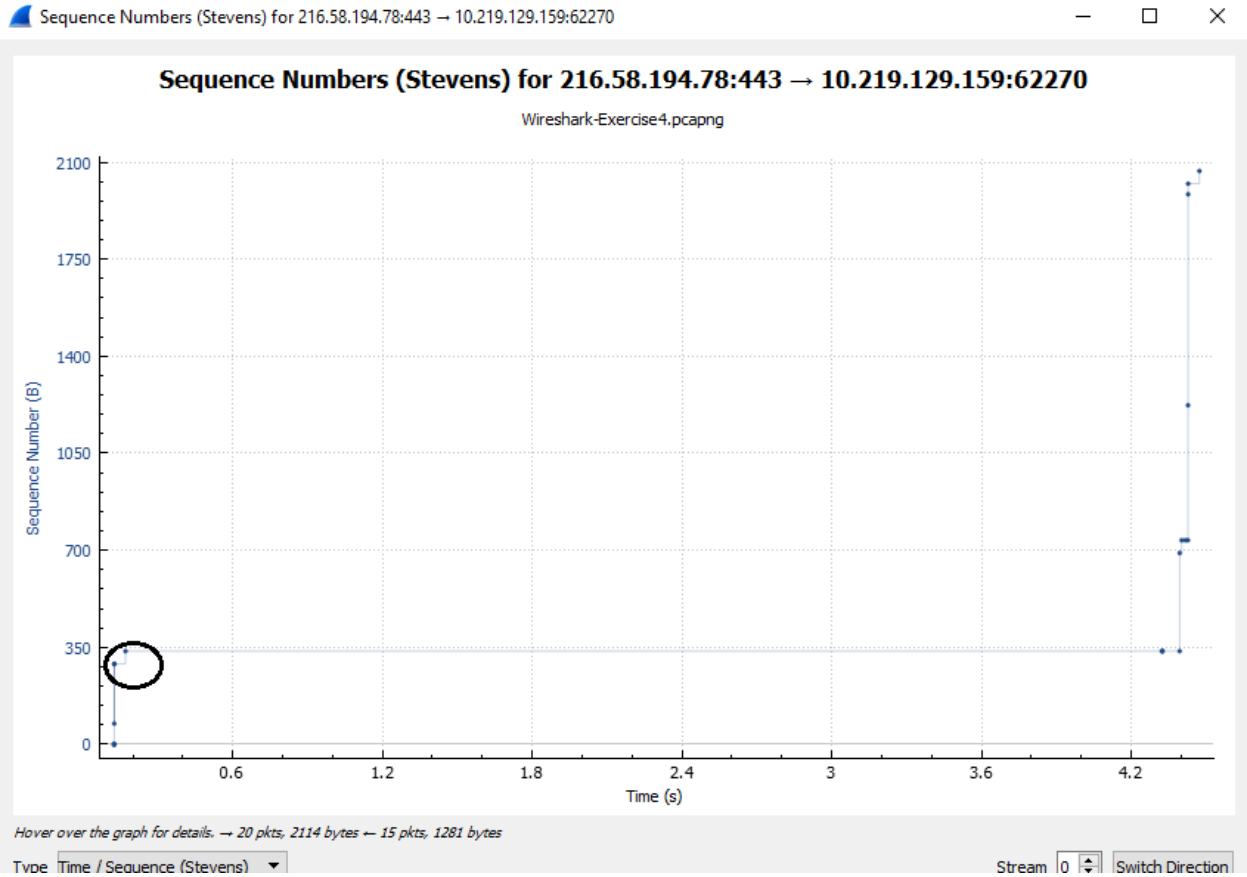
Throughput= 12869/2.999 = 4291 bytes/sec

Problem Set 4

Use the Time-Sequence-Graph(Stevens) plotting tool to view the sequence number versus time plot of segments being sent from youtube.com to your computer. Answer each of three questions below for the trace that you have gathered when you transferred a le to your computer from youtube.com.

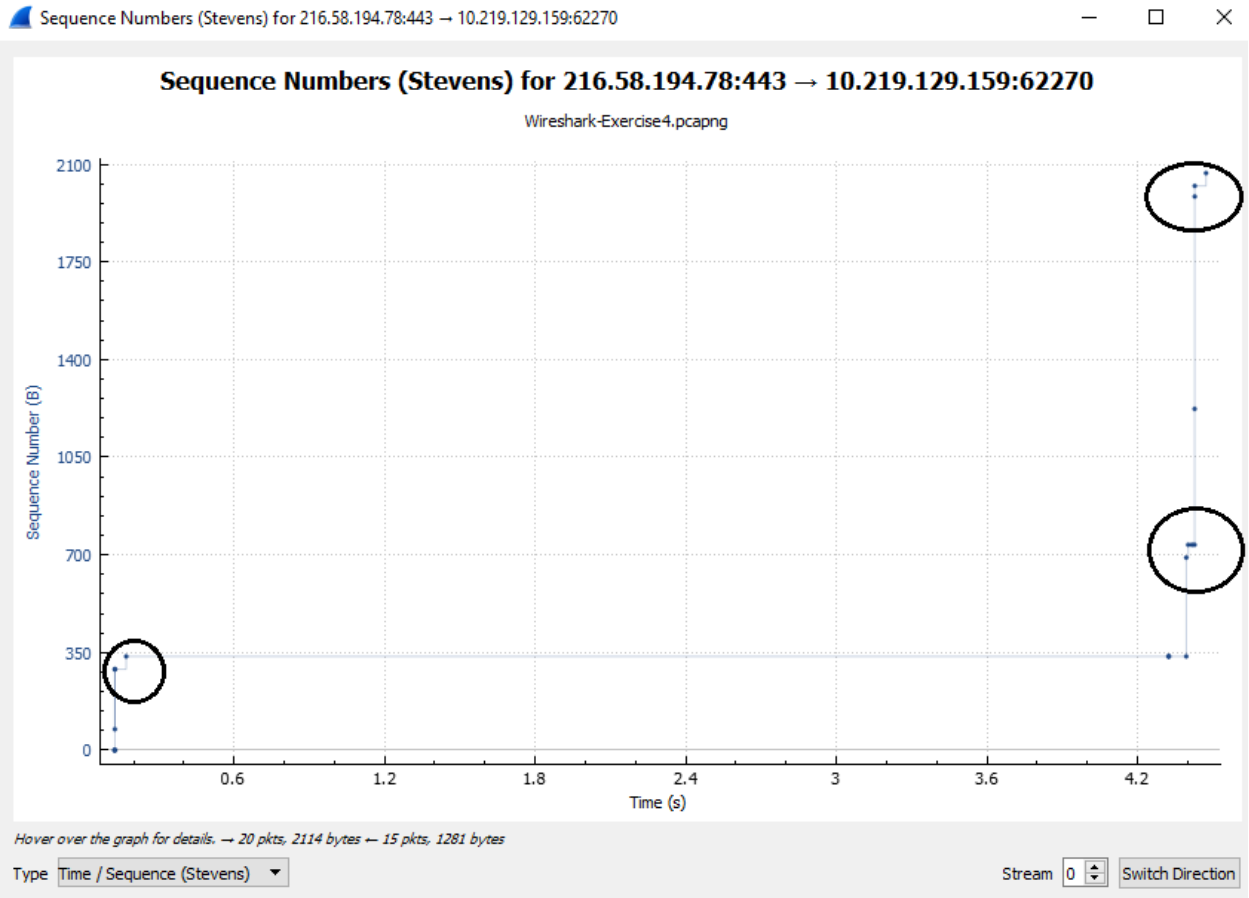
1. Can you identify where TCP's slow-start phase begins and ends.

Ans. TCP slow start phase begin from 0.1 secs



2. Where congestion avoidance takes over? Highlight these areas.

Ans. Congestion takes over at 0.1,4.45 secs and 4.5 secs



3. Comment on ways in which the measured data differs from the idealized behavior of TCP that we've studied in the text.

Ans. As per the ideal behavior of TCP, the sender is travelling in the same medium. Whereas, the data is travelled in multiple media. There can be more loss of data and retransmissions. And, practically TCP segments travel faster and aggressive in sending data.