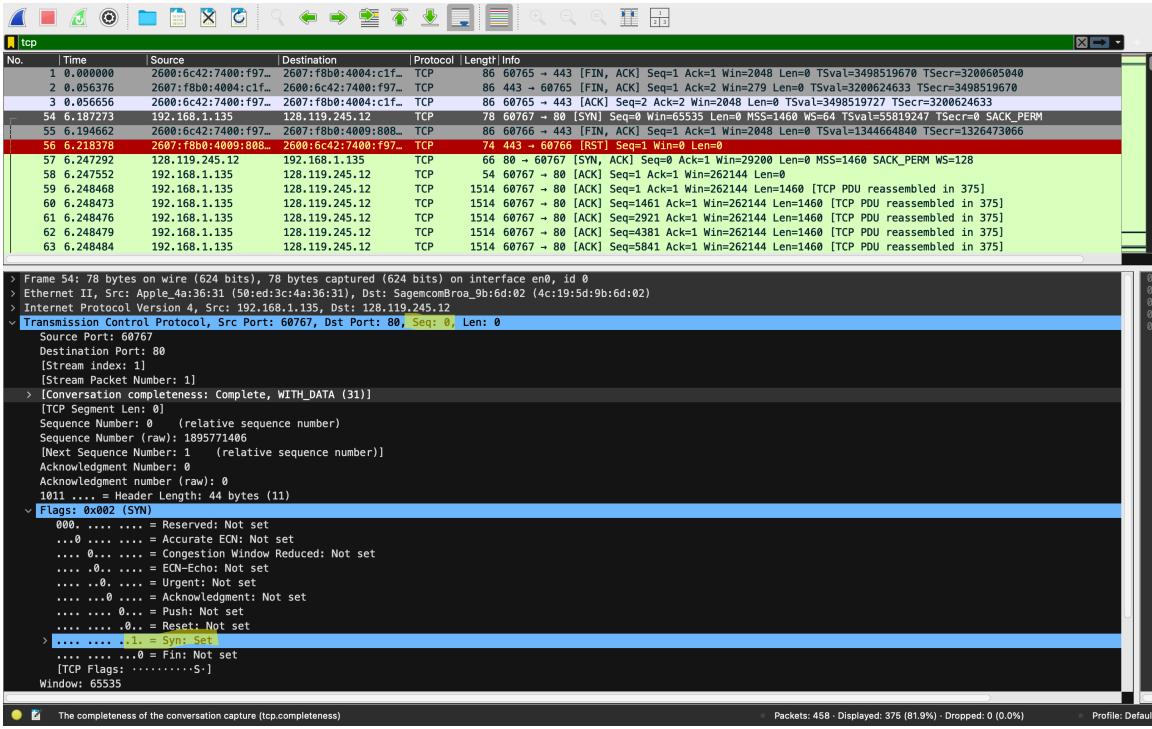
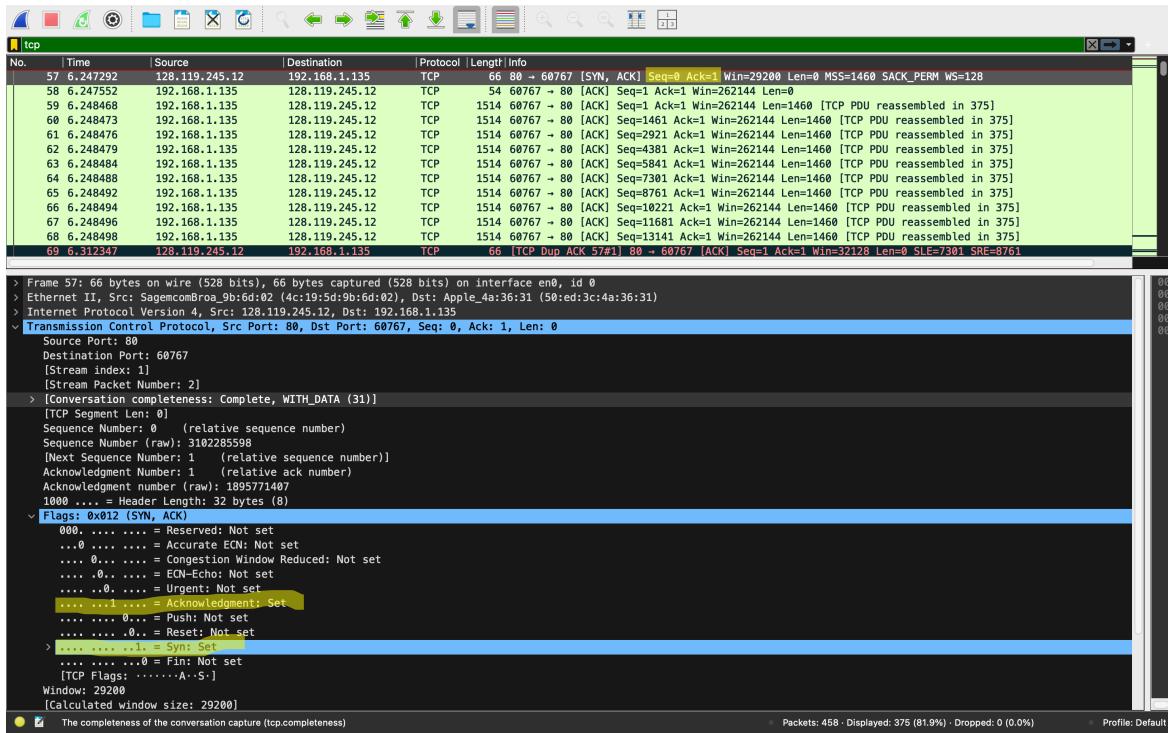


1. IP address: 192.168.1.135 Port #:60767

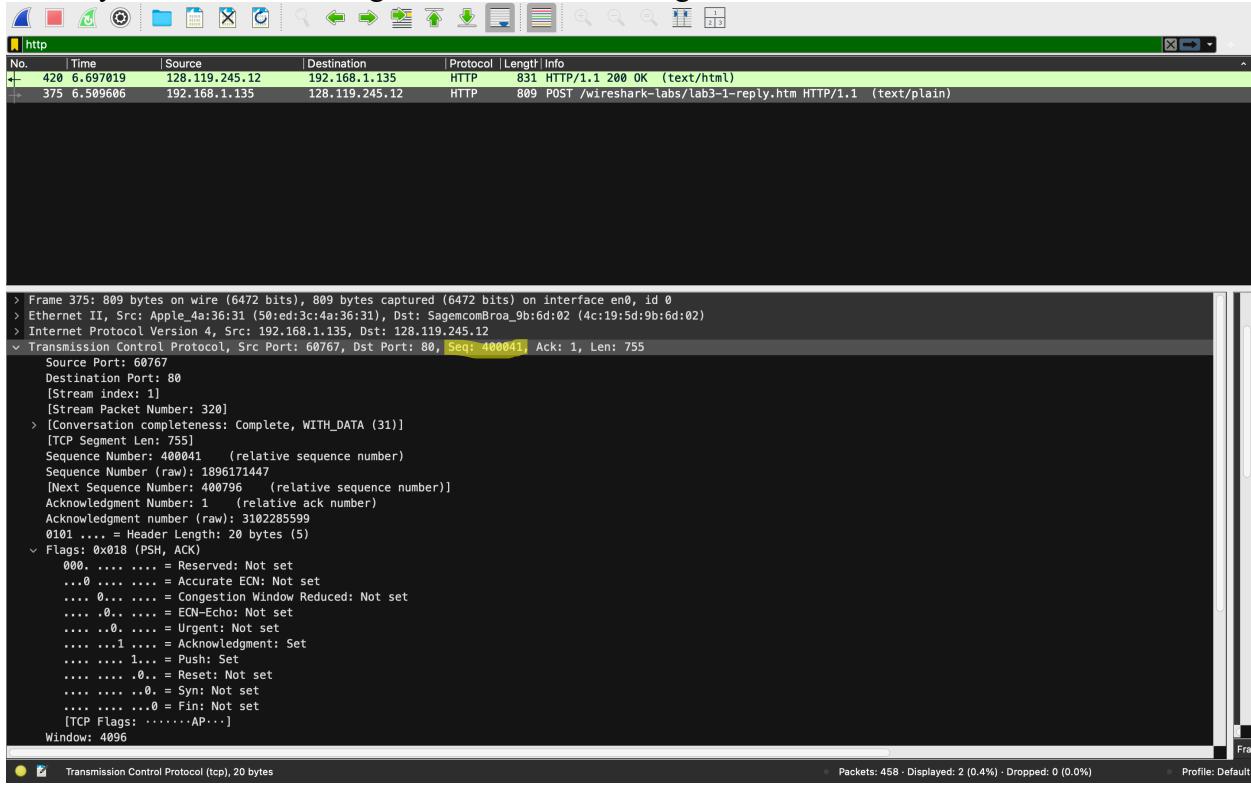
2. IP address: 128.119.245.12 Port #:80



3. seq=0, The SYN flag is set to 1 and it indicates that this segment is a SYN segment



4. seq=0, ack=1,ACK determined by adding 1 to the initial sequence number of SYN segment from the client computer, The SYN flag and Acknowledgement flag in the segment are set to 1 and they indicate that this segment is a SYNACK segment.



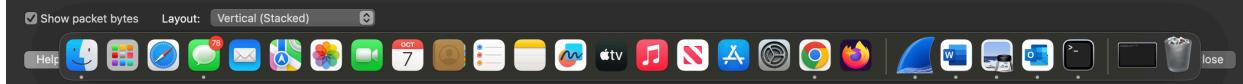
5. 400041

```

> Frame 59: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface en0, id 0
> Ethernet II, Src: Apple_4a:36:31 (50:ed:3c:4a:36:31), Dst: SagemcomB9a:9b:6d:02 (4c:19:5d:9b:6d:02)
> Destination: SagemcomB9a:9b:6d:02 (4c:19:5d:9b:6d:02)
> Source: Apple_4a:36:31 (50:ed:3c:4a:36:31)
Type: IPv4 (0x0800)
[Stream index: 0]
> Internet Protocol Version 4, Src: 192.168.1.135, Dst: 128.119.245.12
Source Port: 60767
Destination Port: 80
[Stream index: 1]
[Stream Packet Number: 4]
> [Conversation completeness: Complete, WITH_DATA (31)]
[TCP Segment Len: 1460]
Sequence Number: 1 (relative sequence number)
Sequence Number (raw): 18957771407
[Next Sequence Number: 1461 (relative sequence number)]
Acknowledgment Number: 1 (relative ack number)
Acknowledgment number (raw): 3102285599
0000 4c 19 5d 9b 6d 02 50 ed 3c 4a 36 31 08 00 45 00 L:-m-P->J61-E
0010 05 dc 00 00 40 00 40 06 fd 68 c0 a8 01 87 80 77 ...@:@-h---w
0020 f5 0c ed 5f 00 50 70 ff 2d 0f b8 e9 1f 1f 50 10 ....Pp--P-
0030 10 69 00 00 00 50 4f 53 54 20 2f 77 69 72 65 ....PO ST/wire
0040 68 61 72 6b 2d 6c 61 62 73 2f 61 61 62 32 2e shark-la bs/lab3-
0050 31 2d 72 65 70 6d 79 2a 68 74 6d 20 48 54 54 50 l-reply.htm HTTP
0060 2f 31 2e 31 0d 00 48 61 73 74 3a 20 67 69 61 /1.1-Ho st: gaia
0070 26 73 2e 75 6d 61 73 65 60 75 0d 08 55 .cs.umas.s.edu-U
0080 65 69 20 61 60 65 64 55 4d 70 67 69 61 62 setAgent:trivial
0090 6c 61 2f 35 28 30 20 28 4d 61 63 69 64 5f 23 la/5-(encuentos
0090 68 20 49 66 74 65 6c 20 4d 61 63 28 4f 53 20 Mac OS
0090 58 20 31 30 2e 31 35 3b 20 72 76 3a 31 33 30 2e X 10.15; rv:130.
0090 30 29 29 47 65 63 6b 6f 2f 32 30 31 30 31 30 0) Gecko /2010010
0090 31 20 46 69 72 65 66 6f 78 2f 31 33 30 2e 0d 1 Firefo x/130.0
0090 0a 41 63 63 65 70 74 3a 20 74 65 78 74 2f 68 74 Accept: text/ht
0090 6d 6c 2c 61 70 70 6c 69 63 61 74 66 6f 2f 78 ml,application/x
0100 68 74 6d 6c 2b 78 6d 6c 2c 61 70 70 69 63 61 html+xml,application/x
0110 74 69 6f 6e 2f 78 6d 6c 30 71 3d 30 2e 39 2c 69 tion/xml ;q=0.9,i
0120 66 61 67 65 2f 61 76 69 66 2c 69 6d 61 67 65 2f mage/avi,f,image/
0130 77 65 62 70 2c 69 6d 61 67 65 2f 70 66 67 2c 69 webp,image/png,1
0140 6d 61 67 65 2f 73 76 61 2b 78 6d 6c 2c 2f 2a mage/svg+xml,*/*
0150 61 66 67 75 61 67 65 2b 20 65 66 2d 55 53 2c 65 mime-type:en-US
0160 61 66 67 75 61 67 65 2b 20 65 66 2d 55 53 2c 65 mime-type:en-US
0170 6e 3b 71 3d 30 2e 35 0d 0a 41 63 63 65 70 74 2d n;q=0.5,-Accept-
0180 45 6e 63 6f 64 69 6e 67 3a 20 67 7a 69 70 2c 20 Encoding : gzip,
0190 64 66 66 6c 61 74 65 0d 0a 43 6f 6e 74 deflate Content

```

No.: 59 · Time: 6.248468 · Source: 192.168.1.135 · Destination: 128.119.245.12 · Protocol: TCP · Length: 1514 · Info: 60767 → 80 [ACK] Seq=1 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]



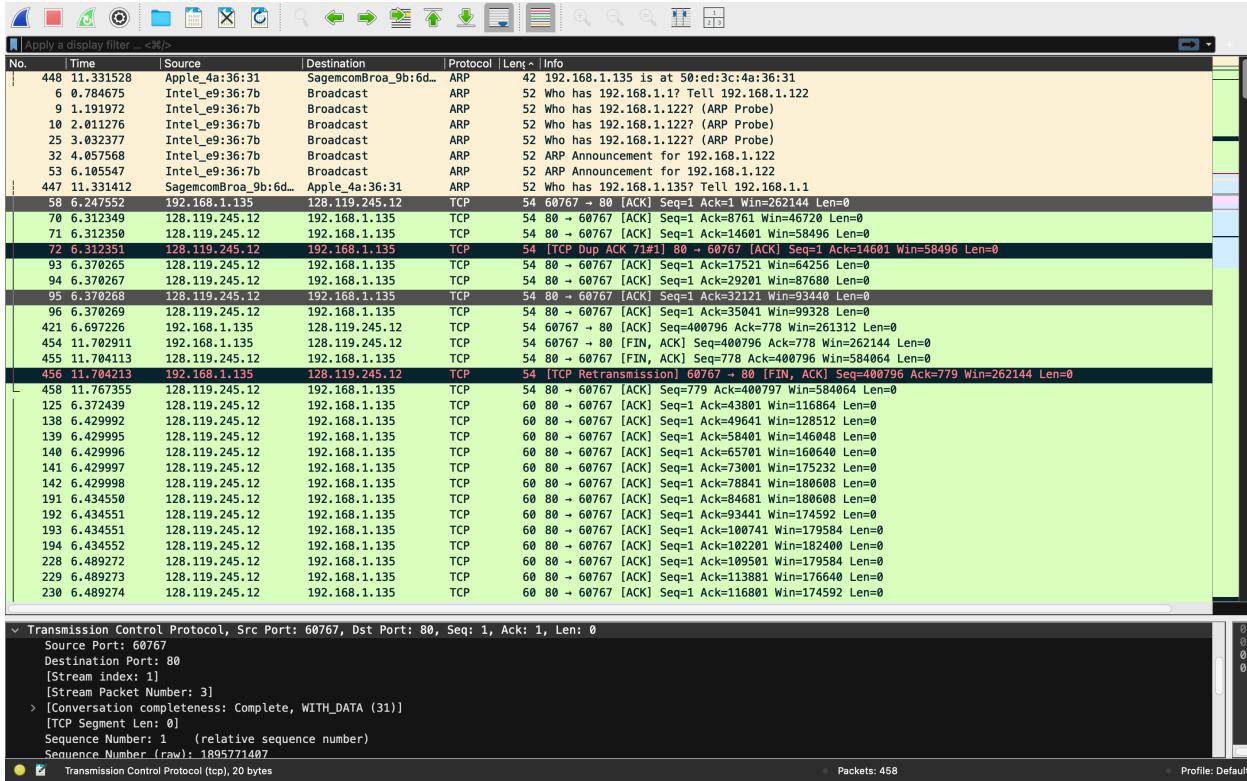
No.	Time	Source	Destination	Protocol	Len	Info
5	0.784673	192.168.1.1	255.255.255.255	DHCP	360	DHCP ACK - Transaction ID 0x60eec515
22	2.626683	192.168.1.24	224.0.0.251	MDNS	479	Standard query response 0x0000 PTR Sterling:;SternlingsDesktop._oculusal_sp._tcp.local SRV 0 0 49677
28	3.649762	192.168.1.24	224.0.0.251	MDNS	479	Standard query response 0x0000 PTR Sterling:;SternlingsDesktop._oculusal_sp._tcp.local SRV 0 0 49677
43	5.698365	192.168.1.24	224.0.0.251	MDNS	479	Standard query response 0x0000 PTR Sterling:;SternlingsDesktop._oculusal_sp._tcp.local SRV 0 0 49677
432	9.792979	192.168.1.24	224.0.0.251	MDNS	479	Standard query response 0x0000 PTR Sterling:;SternlingsDesktop._oculusal_sp._tcp.local SRV 0 0 49677
21	2.626627	192.168.1.24	224.0.0.251	MDNS	480	Standard query response 0x0000 PTR Sterling:;SternlingsDesktop._oculusal_sp_v2._tcp.local SRV 0 0 49677
29	3.649762	192.168.1.24	224.0.0.251	MDNS	480	Standard query response 0x0000 PTR Sterling:;SternlingsDesktop._oculusal_sp_v2._tcp.local SRV 0 0 49677
42	5.697156	192.168.1.24	224.0.0.251	MDNS	480	Standard query response 0x0000 PTR Sterling:;SternlingsDesktop._oculusal_sp_v2._tcp.local SRV 0 0 49677
433	9.792988	192.168.1.24	224.0.0.251	MDNS	480	Standard query response 0x0000 PTR Sterling:;SternlingsDesktop._oculusal_sp_v2._tcp.local SRV 0 0 49677
375	6.596966	192.168.1.133	128.119.245.12	HTTP	809	POST /wireshark-labs/lab3-1-reply.htm HTTP/1.1 (text/plain)
420	6.697919	128.119.245.12	192.168.1.135	HTTP	831	HTTP/1.1 200 OK (text/html)
59	6.248468	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=1 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
60	6.248473	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=1461 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
61	6.248476	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=2921 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
62	6.248479	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=4381 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
63	6.248484	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=5841 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
64	6.248488	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=7301 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
65	6.248492	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=8761 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
66	6.248494	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=10221 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
67	6.248496	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=11681 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
68	6.248498	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=13141 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
73	6.312522	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=14601 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
74	6.312617	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=16061 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
75	6.312621	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=17521 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
76	6.312623	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=18981 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
77	6.312628	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=20441 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
78	6.312635	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=21901 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
79	6.312637	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=23361 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
80	6.312642	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=24821 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
81	6.312646	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=26281 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
82	6.312651	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=27741 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
83	6.312653	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=29201 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
84	6.312657	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=30661 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
85	6.312719	192.168.1.135	128.119.245.12	TCP	1514	60767 → 80 [ACK] Seq=32121 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]

```

> Frame 59: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface en0, id 0
> Ethernet II, Src: Apple_A:36:31 (50:ed:3c:4a:36:31), Dst: SagemcomB9a:9b:6d:02 (4c:19:5d:9b:6d:02)
> Destination: SagemcomB9a:9b:6d:02 (4c:19:5d:9b:6d:02)
> Source: Apple_A:36:31 (50:ed:3c:4a:36:31)
Type: IPv4 (0x0800)
[Stream index: 0]
> Internet Protocol Version 4, Src: 192.168.1.135, Dst: 128.119.245.12
Source Port: 60767
Destination Port: 80, Seq: 1, Ack: 1, Len: 1460

```

Packets: 458 Profile: Default



6. The HTTP POST segment is considered as the first segment. Segments 1 – 6 are No. 59, 60, 61, 62, 63 and 64 in this trace respectively.

Segment 1 sequence number: 1

Segment 2 sequence number: 1461

Segment 3 sequence number: 2921

Segment 4 sequence number: 4381

Segment 5 sequence number: 5841

Segment 6 sequence number: 7301

	Sent time	ACK received time	RTT (seconds)
Segment 1	6.248468	6.312349	0.063881
Segment 2	6.248473	6.312350	0.063877
Segment 3	6.248476	6.370265	0.121789
Segment 4	6.248479	6.370267	0.121788
Segment 5	6.248484	6.370268	0.121784
Segment 6	6.248488	6.370269	0.121781

EstimatedRTT formula:

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

### EstimatedRTT after the receipt of the ACK of segment 1:

Given from the graph for Segment 1:

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

EstimatedRTT after the receipt of the ACK of segment 2:

$$\text{EstimatedRTT} = 0.875 * 0.02746 + 0.125 * 0.063877$$

$$\text{EstimatedRTT} = 0.0240225 + 0.007984625 = 0.032012 \text{ seconds}$$

EstimatedRTT after the receipt of the ACK of segment 3:

$$\text{EstimatedRTT} = 0.875 * 0.032012 + 0.125 * 0.121789$$

$$\text{EstimatedRTT} = 0.028511 + 0.015223625 = 0.043234 \text{ seconds}$$

EstimatedRTT after the receipt of the ACK of segment 4:

$$\text{EstimatedRTT} = 0.875 * 0.043234 + 0.125 * 0.121788$$

$$\text{EstimatedRTT} = 0.03783025 + 0.0152235 = 0.053053 \text{ seconds}$$

EstimatedRTT after the receipt of the ACK of segment 5:

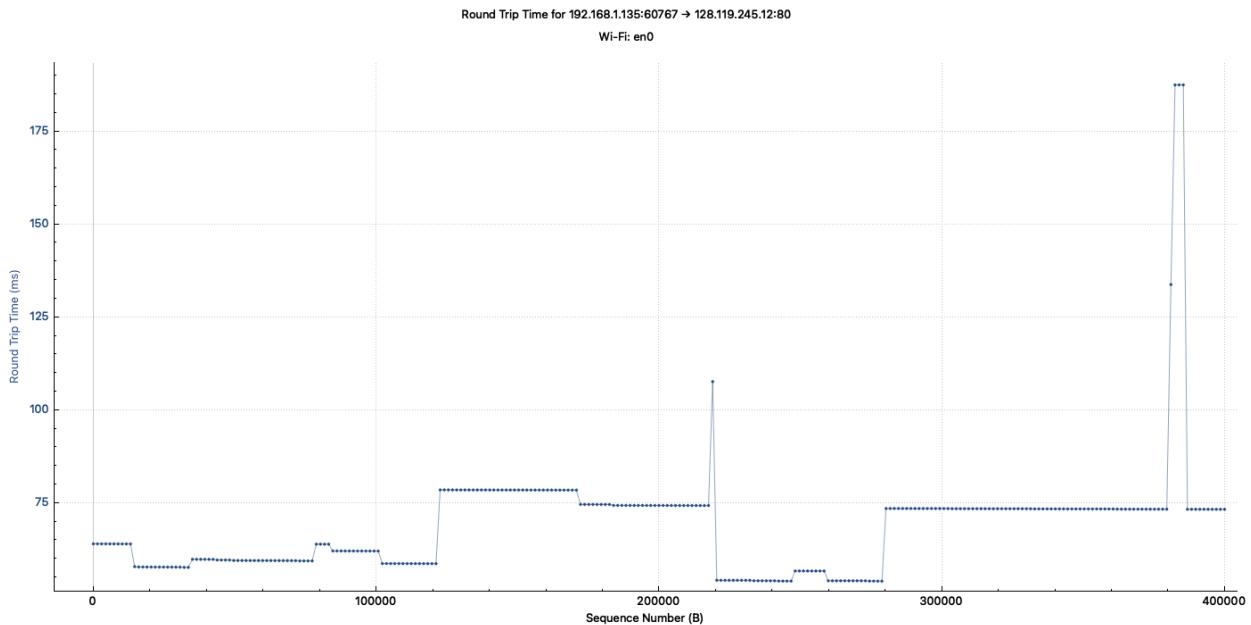
$$\text{EstimatedRTT} = 0.875 * 0.053053 + 0.125 * 0.121784$$

$$\text{EstimatedRTT} = 0.046419125 + 0.015223 = 0.061645 \text{ seconds}$$

EstimatedRTT after the receipt of the ACK of segment 6:

$$\text{EstimatedRTT} = 0.875 * 0.061645 + 0.125 * 0.121781$$

$$\text{EstimatedRTT} = 0.05393875 + 0.015222625 = 0.069161 \text{ seconds}$$



7. Length of the first TCP segment (containing the HTTP POST): 755 bytes Length of each of the other five TCP segments: 1460 bytes (MSS)

	Time	Source	Destination	Protocol	Len	Info
24	2.960518	fe80::181d:94e5%7e	ff02::fb	MDNS	283	Standard query response 0x0000 TXT, cache flush NSEC, cache flush Stuart's MacBook Air._companion-link
31	3.961608	fe80::181d:94e5%7e	ff02::fb	MDNS	283	Standard query response 0x0000 TXT, cache flush NSEC, cache flush Stuart's MacBook Air._companion-link
52	5.961820	fe80::181d:94e5%7e	ff02::fb	MDNS	283	Standard query response 0x0000 TXT, cache flush NSEC, cache flush Stuart's MacBook Air._companion-link
449	9.963229	fe80::181d:94e5%7e	ff02::fb	MDNS	283	Standard query response 0x0000 TXT, cache flush NSEC, cache flush Stuart's MacBook Air._companion-link
449	11.517766	192.168.1.78	192.168.1.135	SSDP	333	HTTP/1.1 200 OK
451	11.616524	192.168.1.78	192.168.1.135	SSDP	333	HTTP/1.1 200 OK
451	11.566516	192.168.1.78	192.168.1.135	SSDP	342	HTTP/1.1 200 OK
4	0.784671	0.0.0.0		DHCP	358	DHCP Request - Transaction ID 0x60eec515
5	0.784673	192.168.1.1		DHCP	360	DHCP ACK - Transaction ID 0x60eec515
22	2.626083	192.168.1.24	224.0.0.251	MDNS	479	Standard query response 0x0000 PTR Sterling::SterlingsDesktop._oculusal_sp._tcp.local SRV 0 0 49677 S
28	3.649762	192.168.1.24	224.0.0.251	MDNS	479	Standard query response 0x0000 PTR Sterling::SterlingsDesktop._oculusal_sp._tcp.local SRV 0 0 49677 S
43	5.698365	192.168.1.24	224.0.0.251	MDNS	479	Standard query response 0x0000 PTR Sterling::SterlingsDesktop._oculusal_sp._tcp.local SRV 0 0 49677 S
432	9.792979	192.168.1.24	224.0.0.251	MDNS	479	Standard query response 0x0000 PTR Sterling::SterlingsDesktop._oculusal_sp._tcp.local SRV 0 0 49677 S
21	2.626027	192.168.1.24	224.0.0.251	MDNS	488	Standard query response 0x0000 PTR Sterling::SterlingsDesktop._oculus_sp_v2._tcp.local SRV 0 0 4967
29	3.649762	192.168.1.24	224.0.0.251	MDNS	488	Standard query response 0x0000 PTR Sterling::SterlingsDesktop._oculus_sp_v2._tcp.local SRV 0 0 4967
42	5.697156	192.168.1.24	224.0.0.251	MDNS	488	Standard query response 0x0000 PTR Sterling::SterlingsDesktop._oculus_sp_v2._tcp.local SRV 0 0 4967
433	9.792980	192.168.1.24	224.0.0.251	MDNS	488	Standard query response 0x0000 PTR Sterling::SterlingsDesktop._oculus_sp_v2._tcp.local SRV 0 0 4967
375	6.509606	192.168.1.35	128.119.245.12	HTTP	809	POST /wireshark-labs/lab3-i-reply.htm HTTP/1.1 (text/plain)
420	6.697019	128.119.245.12	192.168.1.135	HTTP	831	HTTP/1.1 200 OK (text/html)
59	6.248468	192.168.1.135	128.119.245.12	TCP	1514	60767 -> 80 [ACK] Seq=1 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
60	6.248473	192.168.1.135	128.119.245.12	TCP	1514	60767 -> 80 [ACK] Seq=1461 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
61	6.248476	192.168.1.135	128.119.245.12	TCP	1514	60767 -> 80 [ACK] Seq=2921 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
62	6.248479	192.168.1.135	128.119.245.12	TCP	1514	60767 -> 80 [ACK] Seq=4381 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
63	6.248484	192.168.1.135	128.119.245.12	TCP	1514	60767 -> 80 [ACK] Seq=5841 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
64	6.248488	192.168.1.135	128.119.245.12	TCP	1514	60767 -> 80 [ACK] Seq=7301 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
65	6.248492	192.168.1.135	128.119.245.12	TCP	1514	60767 -> 80 [ACK] Seq=8761 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
66	6.248494	192.168.1.135	128.119.245.12	TCP	1514	60767 -> 80 [ACK] Seq=10221 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
67	6.248496	192.168.1.135	128.119.245.12	TCP	1514	60767 -> 80 [ACK] Seq=11681 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
68	6.248498	192.168.1.135	128.119.245.12	TCP	1514	60767 -> 80 [ACK] Seq=13141 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
73	6.312522	192.168.1.135	128.119.245.12	TCP	1514	60767 -> 80 [ACK] Seq=14601 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
74	6.312617	192.168.1.135	128.119.245.12	TCP	1514	60767 -> 80 [ACK] Seq=16061 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
75	6.312621	192.168.1.135	128.119.245.12	TCP	1514	60767 -> 80 [ACK] Seq=17521 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
76	6.312623	192.168.1.135	128.119.245.12	TCP	1514	60767 -> 80 [ACK] Seq=18981 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
77	6.312628	192.168.1.135	128.119.245.12	TCP	1514	60767 -> 80 [ACK] Seq=20441 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]

```
v Transmission Control Protocol, Src Port: 60767, Dst Port: 80, Seq: 400041, Ack: 1, Len: 755
    Source Port: 60767
    Destination Port: 80
    [Stream index: 1]
    [Stream Packet Number: 320]
> [Conversation completeness: Complete, WITH_DATA (31)]
    [TCP Segment Len: 755]
    Sequence Number: 400041  (relative sequence number)
```

• Packets: 458

Profile: Default

8

Apply a display filter ... <%>

No.	Time	Source	Destination	Protocol	Length	Info
57	6.247292	128.119.245.12	192.168.1.135	TCP	66 80	→ 60767 [SYN, ACK] Seq=1 Ack=1 Win=29200 Len=0 MSS=1460 SACK_PERM WS=128

> Frame 57: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface em0, id 0

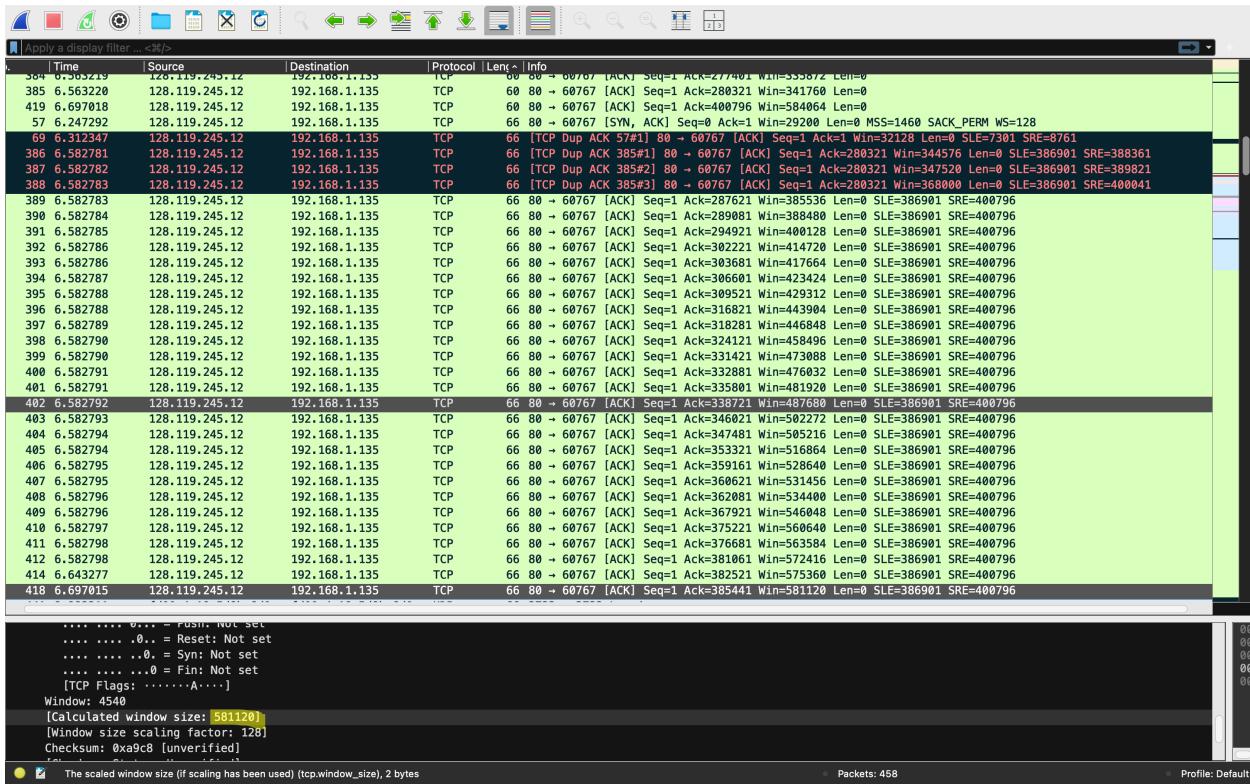
✓ Ethernet II, Src: SagemcomBra\_9b:6d:02 (4c:19:5d:9b:6d:02), Dst: Apple\_4a:36:31 (50:ed:3c:4a:36:31)  
  Destination: Apple\_4a:36:31 (50:ed:3c:4a:36:31)  
  Source: SagemcomBra\_9b:6d:02 (4c:19:5d:9b:6d:02)  
  Type: IPv4 (0x0800)  
  [Stream index: 0]

> Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.135

✓ Transmission Control Protocol, Src Port: 80, Dst Port: 60767, Seq: 0, Ack: 1, Len: 0

  Source Port: 80  
  Destination Port: 60767  
  [Stream index: 1]  
  [Stream Packet Number: 2]  
> [Conversation completeness: Complete, WITH\_DATA (31)]  
  [TCP Segment Len: 0]  
  Sequence Number: 0 (relative sequence number)  
  Sequence Number (raw): 3102285598  
  [Next Sequence Number: 1 (relative sequence number)]  
  Acknowledgment Number: 1 (relative ack number)  
  Acknowledgment number (raw): 1895771407  
  1000 .... = Header Length: 32 bytes (8)

✓ Flags: 0x012 (SYN, ACK)  
  000 ..... = Reserved: Not set  
  ...0 ..... = Accurate ECN: Not set  
  ...0 ..... = Congestion Window Reduced: 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: 29200  
  [Calculated window size: 29200]  
  Checksum: 0x6177 [unverified]  
  [Checksum Status: Unverified]  
  Urgent Pointer: 0  
> Options: (12 bytes), Maximum segment size, No-Operation (NOP), No-Operation (NOP), SACK permitted, No-Operation (NOP), Window scale  
> [Timestamps]  
> [SEQ/ACK analysis]



This receiver window grows steadily from a minimum receiver buffer size of 29200 until a maximum receiver buffer size of 581120 bytes. The sender is never throttled due to buffer continuing to grow by inspecting this trace.

9.

Apply a display filter: <%>/

No.	Time	Source	Destination	Protocol	Len	Info
448	11.331528	Apple_4a:36:31	SagemcomBra_9b:6d...	ARP	42	192.168.1.135 is at 50:ed:3c:4a:36:31
6	0.784675	Intel_e9:36:7b	Broadcast	ARP	52	Who has 192.168.1.1? Tell 192.168.1.122
9	1.191972	Intel_e9:36:7b	Broadcast	ARP	52	Who has 192.168.1.122? (ARP Probe)
10	2.011276	Intel_e9:36:7b	Broadcast	ARP	52	Who has 192.168.1.122? (ARP Probe)
25	3.032377	Intel_e9:36:7b	Broadcast	ARP	52	Who has 192.168.1.122? (ARP Probe)
32	4.057568	Intel_e9:36:7b	Broadcast	ARP	52	ARP Announcement for 192.168.1.122
53	6.105547	Intel_e9:36:7b	Broadcast	ARP	52	ARP Announcement for 192.168.1.122
447	11.331412	SagemcomBra_9b:6d...	Apple_4a:36:31	ARP	52	Who has 192.168.1.135? Tell 192.168.1.1
58	6.247552	192.168.1.135	128.119.245.12	TCP	54	60767 -> 80 [ACK] Seq=1 Ack=1 Win=262144 Len=0
70	6.312349	128.119.245.12	192.168.1.135	TCP	54	80 -> 60767 [ACK] Seq=1 Ack=8761 Win=46720 Len=0
71	6.312350	128.119.245.12	192.168.1.135	TCP	54	80 -> 60767 [ACK] Seq=1 Ack=14601 Win=58496 Len=0
72	6.312351	128.119.245.12	192.168.1.135	TCP	54	[TCP Dup ACK 73#1] 80 -> 60767 [ACK] Seq=1 Ack=14601 Win=58496 Len=0
93	6.370265	128.119.245.12	192.168.1.135	TCP	54	80 -> 60767 [ACK] Seq=1 Ack=17521 Win=64256 Len=0
94	6.370267	128.119.245.12	192.168.1.135	TCP	54	80 -> 60767 [ACK] Seq=1 Ack=29201 Win=87680 Len=0
95	6.370268	128.119.245.12	192.168.1.135	TCP	54	80 -> 60767 [ACK] Seq=1 Ack=32121 Win=93440 Len=0
96	6.370269	128.119.245.12	192.168.1.135	TCP	54	80 -> 60767 [ACK] Seq=1 Ack=35041 Win=99328 Len=0
421	6.697226	192.168.1.135	128.119.245.12	TCP	54	60767 -> 80 [ACK] Seq=408796 Ack=778 Win=261312 Len=0
454	11.702911	192.168.1.135	128.119.245.12	TCP	54	60767 -> 80 [FIN, ACK] Seq=400796 Ack=778 Win=262144 Len=0
455	11.702912	192.168.1.135	128.119.245.12	TCP	54	60767 -> 80 [FIN, ACK] Seq=770 Ack=400796 Win=584064 Len=0
456	11.704213	192.168.1.135	128.119.245.12	TCP	54	[TCP Retransmission] 60767 -> 80 [FIN, ACK] Seq=000796 Ack=779 Win=262144 Len=0
458	11.767355	128.119.245.12	192.168.1.135	TCP	54	80 -> 60767 [ACK] Seq=779 Ack=408797 Win=584064 Len=0
125	6.372439	128.119.245.12	192.168.1.135	TCP	60	80 -> 60767 [ACK] Seq=1 Ack=43801 Win=116864 Len=0
138	6.429992	128.119.245.12	192.168.1.135	TCP	60	80 -> 60767 [ACK] Seq=1 Ack=49641 Win=128512 Len=0
139	6.429995	128.119.245.12	192.168.1.135	TCP	60	80 -> 60767 [ACK] Seq=1 Ack=58401 Win=146048 Len=0
140	6.429996	128.119.245.12	192.168.1.135	TCP	60	80 -> 60767 [ACK] Seq=1 Ack=65701 Win=160640 Len=0
141	6.429997	128.119.245.12	192.168.1.135	TCP	60	80 -> 60767 [ACK] Seq=1 Ack=73001 Win=175232 Len=0
142	6.429998	128.119.245.12	192.168.1.135	TCP	60	80 -> 60767 [ACK] Seq=1 Ack=78841 Win=180608 Len=0
191	6.434550	128.119.245.12	192.168.1.135	TCP	60	80 -> 60767 [ACK] Seq=1 Ack=84681 Win=180608 Len=0
192	6.434551	128.119.245.12	192.168.1.135	TCP	60	80 -> 60767 [ACK] Seq=1 Ack=93441 Win=174592 Len=0
193	6.434551	128.119.245.12	192.168.1.135	TCP	60	80 -> 60767 [ACK] Seq=1 Ack=100741 Win=179584 Len=0
194	6.434552	128.119.245.12	192.168.1.135	TCP	60	80 -> 60767 [ACK] Seq=1 Ack=102201 Win=182400 Len=0
228	6.489272	128.119.245.12	192.168.1.135	TCP	60	80 -> 60767 [ACK] Seq=1 Ack=109501 Win=179584 Len=0
229	6.489273	128.119.245.12	192.168.1.135	TCP	60	80 -> 60767 [ACK] Seq=1 Ack=113881 Win=176640 Len=0
230	6.489274	128.119.245.12	192.168.1.135	TCP	60	80 -> 60767 [ACK] Seq=1 Ack=116801 Win=174592 Len=0
.....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: 4540						
[Calculated window size: 581120]						
The scaled window size (if scaling has been used) (tcp.window_size), 2 bytes						
Packets: 458						
Profile: Default						
No.	Time	Source	Destination	Protocol	Len	Info
345	6.599524	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=356241 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
346	6.599526	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=357701 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
347	6.599528	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=359161 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
348	6.599529	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=360021 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
349	6.599568	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=362881 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
350	6.599570	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=363541 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
351	6.599572	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=365081 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
352	6.599574	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=366461 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
353	6.599576	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=367921 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
354	6.599578	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=369381 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
355	6.599580	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=370841 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
356	6.599582	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=372301 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
357	6.599584	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=373761 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
358	6.599586	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=375221 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
359	6.599588	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=376681 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
360	6.599590	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=378141 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
361	6.599591	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=379601 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
362	6.599593	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=381861 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
363	6.599594	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=382521 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
364	6.599595	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=383981 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
365	6.599596	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=385441 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
366	6.599597	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=386901 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
367	6.599598	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=388361 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
368	6.599599	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=389821 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
369	6.599600	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=391281 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
370	6.599600	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=392741 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
371	6.599602	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=394201 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
372	6.599603	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=395661 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
373	6.599604	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=397121 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
374	6.599605	192.168.1.135	128.119.245.12	TCP	154	60767 -> 80 [ACK] Seq=398581 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
413	6.593651	192.168.1.135	128.119.245.12	TCP	1514	[TCP Retransmission] 60767 -> 80 [ACK] Seq=381061 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
415	6.643383	192.168.1.135	128.119.245.12	TCP	1514	[TCP Retransmission] 60767 -> 80 [ACK] Seq=382521 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
416	6.643417	192.168.1.135	128.119.245.12	TCP	1514	[TCP Retransmission] 60767 -> 80 [ACK] Seq=383981 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
417	6.643428	192.168.1.135	128.119.245.12	TCP	1514	[TCP Retransmission] 60767 -> 80 [ACK] Seq=385441 Ack=1 Win=262144 Len=1460 [TCP PDU reassembled in 375]
.....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: 4540						
[Calculated window size: 581120]						
The scaled window size (if scaling has been used) (tcp.window_size), 2 bytes						
Packets: 458						
Profile: Default						

Packets 413-417 and packet 456 are retransmission packets according to info category.

10.

In most cases, the receiver acknowledges 1,460 bytes of data per ACK. However, there are clear examples, such as packet 59 and 61, where the receiver acknowledges every other segment, effectively acknowledging 2,920 bytes of data in a single ACK.

11.

> Frame 59: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface en0, id 0  
> Ethernet II, Src: Apple\_4a:36:31 (50:ed:3c:4a:36:31), Dst: SagemcomBrosa\_9b:6d:02 (4c:19:5d:9b:6d:02)  
> Internet Protocol Version 4, Src: 192.168.1.135, Dst: 128.119.245.12  
Transmission Control Protocol, Src Port: 60767, Dst Port: 80, Seq: 1, Ack: 1, Len: 1460  
    Source Port: 60767  
    Destination Port: 80  
    [Stream index: 1]  
    [Stream Packet Number: 4]  
> [Conversation completeness: Complete, WITH\_DATA (31)]  
    [TCP Segment Len: 1460]  
    Sequence Number: 1 (relative sequence number)  
    Sequence Number (raw): 1895771407  
    [Next Sequence Number: 1461 (relative sequence number)]  
    Acknowledgment Number: 1 (relative ack number)  
    Acknowledgment number (raw): 3102285599  
    0x01 .... = Header Length: 20 bytes (5)  
    Flags: 0x010 (ACK)  
        000.... .... = Reserved: Not set  
        ...0.... .... = Accurate ECN: Not set  
        ....0.... .... = Congestion Window Reduced: 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: 4096  
    [Calculated window size: 262144]  
    [Window size scaling factor: 64]  
    Checksum: 0x9d08 [unverified]  
    [Checksum Status: Unverified]  
    Urgent Pointer: 0  
> [Timestamps]  
> [SEQ/ACK analysis]  
    TCP payload (1460 bytes)  
    [Reassembled PDU in frame: 375]  
    TCP segment data (1460 bytes)

```

No. | Time | Source | Destination | Protocol | Length | Info
+---+-----+-----+-----+-----+-----+
420 | 6.697019 | 128.119.245.12 | 192.168.1.135 | HTTP | 831 | HTTP/1.1 200 OK (text/html)

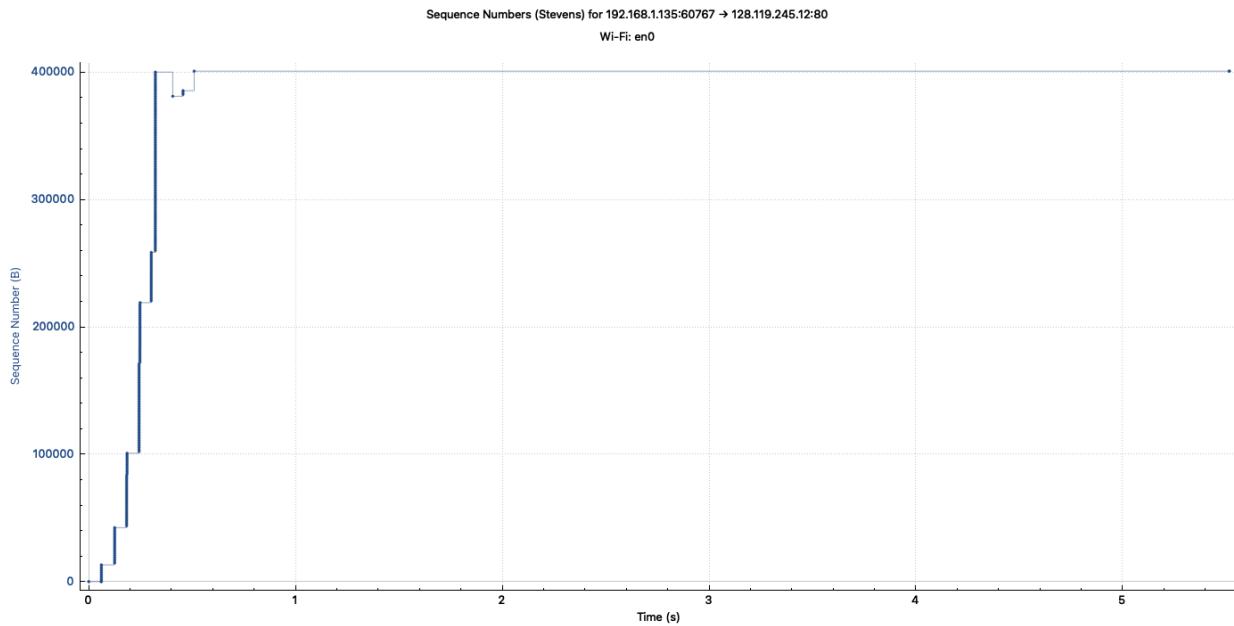
> Frame 420: 831 bytes on wire (6648 bits), 831 bytes captured (6648 bits) on interface en0, id 0
> Ethernet II, Src: SagemcomBraa_9b:6d:02 (4c:19:5d:9b:6d:02), Dst: Apple_4a:36:31 (50:ed:3c:4a:36:31)
> Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.135
> Transmission Control Protocol, Src Port: 80, Dst Port: 80767, Seq: 1, Ack: 400796, Len: 777
    Source Port: 80
    Destination Port: 80767
    [Stream index: 1]
    [Stream Packet Number: 365]
    > [Conversation completeness: Complete, WITH_DATA (31)]
        [TCP Segment Len: 777]
        Sequence Number: 1      (relative sequence number)
        Sequence Number (raw): 3102285599
        [Next Sequence Number: 778      (relative sequence number)]
        Acknowledgment Number: 400796      (relative ack number)
        Acknowledgment number (raw): 1896172202
        0101 .... = Header Length: 20 bytes (5)
        Flags: 0x18 (PSH, ACK)
            000. .... .... = Reserved: Not set
            ...0 .... .... = Accurate ECN: Not set
            .... 0.... .... = Congestion Window Reduced: Not set
            .... .0.... .... = ECN-Echo: Not set
            .... 0.... .... = Urgent: Not set
            .... ..1.... .... = Acknowledgment: Set
            .... .... 1... .... = Push: Set
            .... .... .0... .... = Reset: Not set
            .... .... ..0. .... = Syn: Not set
            .... .... ..00 = Fin: Not set
            [TCP Flags: .....AP....]
            Window: 4563
            [Calculated window size: 584064]
            [Window size scaling factor: 128]
            Checksum: 0x3835 [Unverified]
            [Checksum Status: Unverified]
            Urgent Pointer: 0
        > [Timestamps]
        > [SEQ/ACK analysis]
        TCP payload (777 bytes)
    > Hypertext Transfer Protocol
    > Line-based text data; text/html (11 lines)

Ethernet (eth), 14 bytes
Packets: 458
Profile: Default

```

The throughput for the TCP connection is calculated by first determining the time difference between Packet 59 and Packet 420. Packet 59 transferred 1,460 bytes at 6.248468 seconds, and Packet 420 transferred 777 bytes at 6.697010 seconds, resulting in a time difference of 0.448542 seconds. To calculate the raw throughput, we divide the 1,460 bytes transferred by Packet 59 by the time difference of 0.448542 seconds, which gives approximately 3,254 bytes per second. To account for retransmissions, we multiply this by 1.1, resulting in a final throughput of 3,579 bytes per second.

12.



The TCP slow start phase begins at the start of the graph and lasts until around 0.3 seconds, where there is a steep, exponential rise in sequence numbers. At 0.3 seconds, the curve becomes more gradual, indicating the end of slow start and the beginning of congestion avoidance, which continues as a steady linear increase for the rest of the connection.

13.

The measured data differs from the idealized TCP behavior in several ways: the slow start phase shows irregular, step-like growth instead of smooth exponential increase, likely due to network conditions. The transition to congestion avoidance is less consistent, affected by packet loss and variable round-trip times. Additionally, throughput in the real-world data is more variable, contrasting with the smooth increase expected in the idealized model, reflecting the complexity of real-world networks.