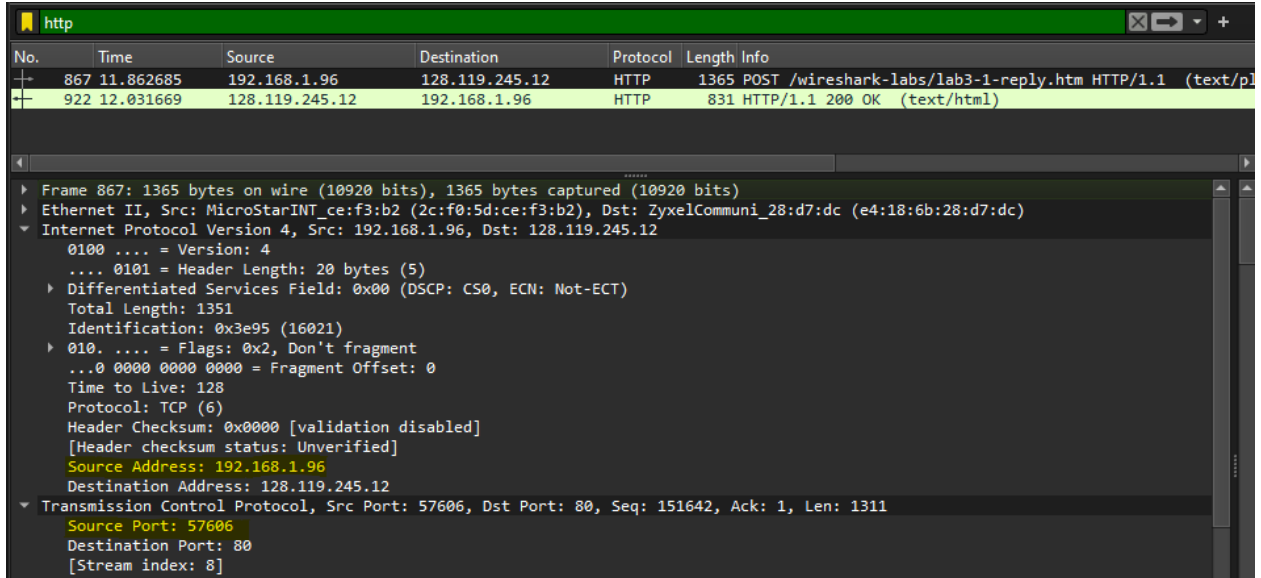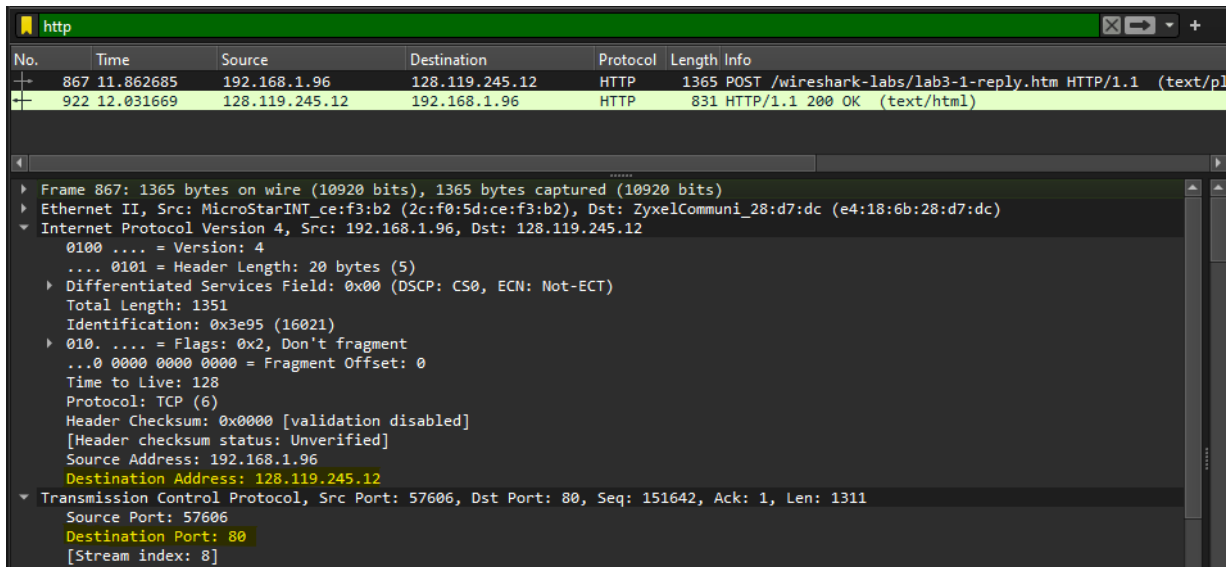# WSA3

2448025

1.1. Source Address: 192.168.1.96

1.2. Source Port: 57606

2.1. Destination Address: 128.119.245.12

2.2. Destination Port: 80

3.1. Sequence Number: 346340459

3.2. Flags: 0x002 (SYN). This means that SYN flag is set to 1.

3.3. We can observe that the TCP receiver in this session can employ Selective Acknowledgement

4.1. Sequence Number: 1354301674

4.2. Flags: 0x012 (SYN, ACK). Both are set to one in flags section.

4.3. Acknowledgment Number: 3463400460

4.4. The server adds 1 to the SYN segment from the client computer's beginning sequence number. The value of the Acknowledgement field in the SYNACK segment is 1 since the beginning sequence number of the SYN segment from the client is 0.

5.1. Sequence Number: 346340460

5.2. TCP payload (633 bytes). No. The alice.txt file is larger, and so multiple TCP segments will be needed.

6.1. The initial segment of the data-transfer portion of the TCP connection was sent at 11.378048.

6.2. The ACK for the first data-data containing segment was received at 11.539276

6.3. For the first data-containing segment, the RTT = 11.539276 - 11.378048 = 0.161228.

6.4. For the second data-containing segment, the estimated RTT = 11.539332 – 11.378357 = 0.160975.

6.5. EstimatedRTT = 0.875 * EstimatedRTT + 0.125 * SampleRTT

= 0.875 * 0.161228 + 0.125 * 0.160975 = 0.161196375 s
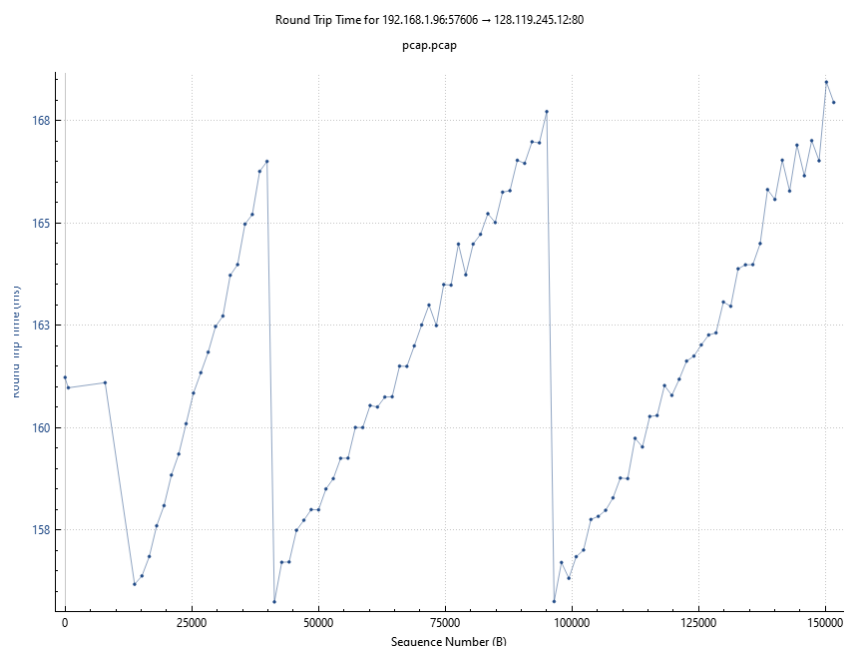
7.0. The first TCP segment is 687 bytes long, while the second TCP segment is 13122 bytes, third 1506 bytes, fourth 14574 bytes long.

773 11.301072	192.168.1.96	159.146.119.34	TCP	55 57565 → 443 [ACK] Seq=1 Ack=1 Win=2060 Len=1 [TCP
774 11.313970	159.146.119.34	192.168.1.96	TCP	66 443 → 57565 [ACK] Seq=1 Ack=2 Win=501 Len=0 SLE=1
775 11.377752	128.119.245.12	192.168.1.96	TCP	66 80 → 57606 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0
776 11.377813	192.168.1.96	128.119.245.12	TCP	54 57606 → 80 [ACK] Seq=1 Ack=1 Win=132096 Len=0
777 11.378048	192.168.1.96	128.119.245.12	TCP	687 57606 → 80 [PSH, ACK] Seq=1 Ack=1 Win=132096 Len=
778 11.378357	192.168.1.96	128.119.245.12	TCP	13122 57606 → 80 [ACK] Seq=634 Ack=1 Win=132096 Len=130
779 11.379671	128.119.245.12	192.168.1.96	TCP	60 443 → 57602 [ACK] Seq=1 Ack=2 Win=260 Len=0
780 11.396631	192.168.1.96	20.223.36.55	TCP	55 57563 → 443 [ACK] Seq=1 Ack=1 Win=516 Len=1 [TCP
781 11.458998	20.223.36.55	192.168.1.96	TCP	66 443 → 57563 [ACK] Seq=1 Ack=2 Win=1021 Len=0 SLE=
782 11.539276	128.119.245.12	192.168.1.96	TCP	60 80 → 57606 [ACK] Seq=1 Ack=634 Win=30592 Len=0
783 11.539301	192.168.1.96	128.119.245.12	TCP	1506 57606 → 80 [ACK] Seq=13702 Ack=1 Win=132096 Len=1
784 11.539332	128.119.245.12	192.168.1.96	TCP	60 80 → 57606 [ACK] Seq=1 Ack=7894 Win=45056 Len=0
785 11.539337	192.168.1.96	128.119.245.12	TCP	14574 57606 → 80 [PSH, ACK] Seq=15154 Ack=1 Win=132096
786 11.539456	128.119.245.12	192.168.1.96	TCP	60 80 → 57606 [ACK] Seq=1 Ack=13702 Win=56704 Len=0
787 11.539461	192.168.1.96	128.119.245.12	TCP	11670 57606 → 80 [PSH, ACK] Seq=29674 Ack=1 Win=132096
788 11.599011	192.168.1.96	195.175.179.91	TCP	55 57557 → 443 [ACK] Seq=1 Ack=1 Win=514 Len=1 [TCP
789 11.613990	195.175.179.91	192.168.1.96	TCP	66 443 → 57557 [ACK] Seq=1 Ack=2 Win=501 Len=0 SLE=1

8.1. 132096 Bytes are the minimum amount of available buffer space among these first four data carrying TCP segments to the clients.

8.2. No, for these initial four data carrying segments, the sender is never throttled due to a lack of receiver buffer space.

777 11.378048	192.168.1.96	128.119.245.12	TCP	687 57606 → 80 [PSH, ACK] Seq=1 Ack=1 Win=132096 Len=633 [TCP segment of
778 11.378357	192.168.1.96	128.119.245.12	TCP	13122 57606 → 80 [ACK] Seq=634 Ack=1 Win=132096 Len=13068 [TCP segment of a
779 11.379671	128.119.245.12	192.168.1.96	TCP	60 443 → 57602 [ACK] Seq=1 Ack=2 Win=260 Len=0
780 11.396631	192.168.1.96	20.223.36.55	TCP	55 57563 → 443 [ACK] Seq=1 Ack=1 Win=516 Len=1 [TCP segment of a reassem
781 11.458998	20.223.36.55	192.168.1.96	TCP	66 443 → 57563 [ACK] Seq=1 Ack=2 Win=1021 Len=0 SLE=1 SRE=2
782 11.539276	128.119.245.12	192.168.1.96	TCP	60 80 → 57606 [ACK] Seq=1 Ack=634 Win=30592 Len=0
783 11.539301	192.168.1.96	128.119.245.12	TCP	1506 57606 → 80 [ACK] Seq=13702 Ack=1 Win=132096 Len=1452 [TCP segment of
784 11.539332	128.119.245.12	192.168.1.96	TCP	60 80 → 57606 [ACK] Seq=1 Ack=7894 Win=45056 Len=0
785 11.539337	192.168.1.96	128.119.245.12	TCP	14574 57606 → 80 [PSH, ACK] Seq=15154 Ack=1 Win=132096 Len=14520 [TCP segme

9.1. No, there were no some segments retransmitted.

9.2. The trace file's TCP segment sequence numbers can be used to see this. Based on Stevens' methodology, the Time-Sequence Graph shows a steady, monotonic growth in sequence numbers over time. Should a segment be retransmitted, the sequence number linked to it must be less than the sequence numbers of the segments that come before it.

Sequence Numbers (Stevens) for 192.168.1.96:57606 → 128.119.245.12:80
pcap.pcap
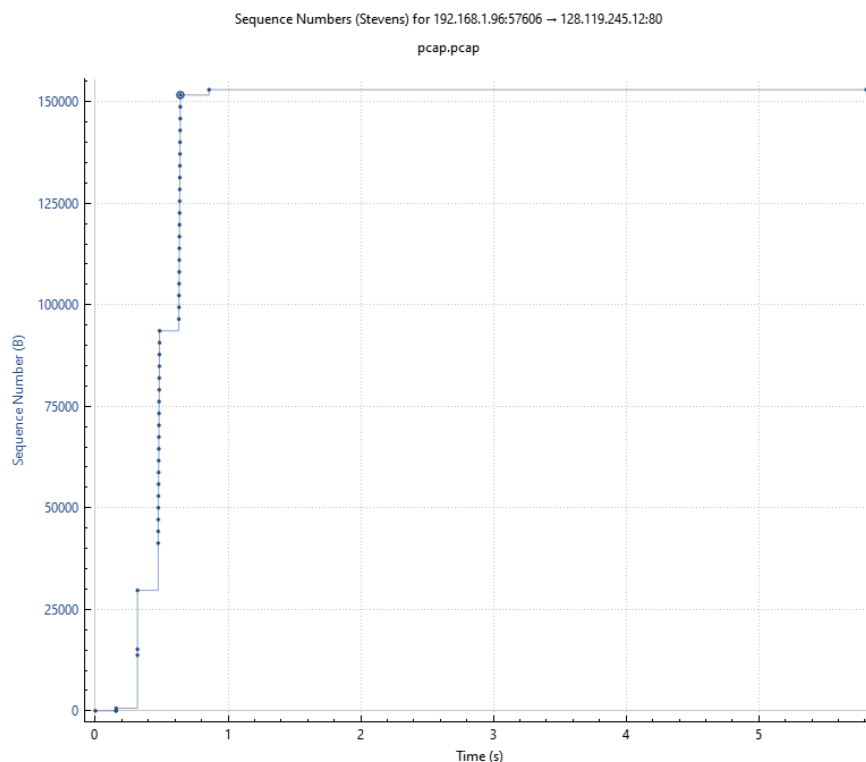
10.1. 2904

10.2. No, among these first ten data-carrying segments, the receiver is not acknowledging each and every other received segment. They are all sequential.

	ACKed Sequence Number	ACKed Data
ACK1	1	633
ACK2	634	13608
ACK3	13702	1452
ACK4	15154	14520
ACK5	29674	11616
ACK6	41290	2904
ACK7	44194	2904
ACK8	47098	2904
ACK9	50002	2904
ACK10	52906	2904

```
775 11.377752   128.119.245.12   192.168.1.96      TCP      66 80 → 57606 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1452 SACK_PERM WS=128
776 11.377813   192.168.1.96     128.119.245.12    TCP      54 57606 → 80 [ACK] Seq=1 Ack=1 Win=132096 Len=0
777 11.378048   192.168.1.96     128.119.245.12    TCP     687 57606 → 80 [PSH, ACK] Seq=1 Ack=1 Win=132096 Len=633 [TCP segment of a reassembled PDU]
778 11.378357   192.168.1.96     128.119.245.12    TCP   13122 57606 → 80 [ACK] Seq=634 Ack=1 Win=132096 Len=13068 [TCP segment of a reassembled PDU]
779 11.379671   128.119.245.12   192.168.1.96      TCP      60 443 → 57602 [ACK] Seq=1 Ack=2 Win=260 Len=0
780 11.396631   192.168.1.96     20.223.36.55      TCP      55 57563 → 443 [ACK] Seq=1 Ack=1 Win=516 Len=1 [TCP segment of a reassembled PDU]
781 11.458998   20.223.36.55     192.168.1.96      TCP      66 443 → 57563 [ACK] Seq=1 Ack=2 Win=1021 Len=0 SLE=1 SRE=2
782 11.539276   128.119.245.12   192.168.1.96      TCP      60 80 → 57606 [ACK] Seq=1 Ack=634 Win=30592 Len=0
783 11.539301   192.168.1.96     128.119.245.12    TCP    1506 57606 → 80 [ACK] Seq=13702 Ack=1 Win=132096 Len=1452 [TCP segment of a reassembled PDU]
784 11.539332   128.119.245.12   192.168.1.96      TCP      60 80 → 57606 [ACK] Seq=1 Ack=7894 Win=45056 Len=0
785 11.539337   192.168.1.96     128.119.245.12    TCP   14574 57606 → 80 [PSH, ACK] Seq=15154 Ack=1 Win=132096 Len=14520 [TCP segment of a reassembled PDU]
786 11.539456   128.119.245.12   192.168.1.96      TCP      60 80 → 57606 [ACK] Seq=1 Ack=13702 Win=56704 Len=0
787 11.539461   192.168.1.96     128.119.245.12    TCP   11670 57606 → 80 [PSH, ACK] Seq=29674 Ack=1 Win=132096 Len=11616 [TCP segment of a reassembled PDU]
788 11.599011   192.168.1.96     195.175.179.91    TCP      55 57557 → 443 [ACK] Seq=1 Ack=1 Win=514 Len=1 [TCP segment of a reassembled PDU]
789 11.613090   195.175.179.91   192.168.1.96      TCP      66 443 → 57557 [ACK] Seq=1 Ack=2 Win=501 Len=0 SLE=1 SRE=2
790 11.695474   128.119.245.12   192.168.1.96      TCP      60 80 → 57606 [ACK] Seq=1 Ack=15154 Win=59648 Len=0
791 11.695484   192.168.1.96     128.119.245.12    TCP    2958 57606 → 80 [ACK] Seq=41290 Ack=1 Win=132096 Len=2904 [TCP segment of a reassembled PDU]
792 11.695714   128.119.245.12   192.168.1.96      TCP      60 80 → 57606 [ACK] Seq=1 Ack=16606 Win=62464 Len=0
793 11.695720   192.168.1.96     128.119.245.12    TCP    2958 57606 → 80 [ACK] Seq=44194 Ack=1 Win=132096 Len=2904 [TCP segment of a reassembled PDU]
794 11.696189   128.119.245.12   192.168.1.96      TCP      60 80 → 57606 [ACK] Seq=1 Ack=18058 Win=65408 Len=0
795 11.696196   192.168.1.96     128.119.245.12    TCP    2958 57606 → 80 [PSH, ACK] Seq=47098 Ack=1 Win=132096 Len=2904 [TCP segment of a reassembled PDU]
796 11.696939   128.119.245.12   192.168.1.96      TCP      60 80 → 57606 [ACK] Seq=1 Ack=19510 Win=68352 Len=0
797 11.696945   192.168.1.96     128.119.245.12    TCP    2958 57606 → 80 [ACK] Seq=50002 Ack=1 Win=132096 Len=2904 [TCP segment of a reassembled PDU]
798 11.697432   128.119.245.12   192.168.1.96      TCP      60 80 → 57606 [ACK] Seq=1 Ack=20962 Win=71296 Len=0
799 11.697436   192.168.1.96     128.119.245.12    TCP    2958 57606 → 80 [ACK] Seq=52906 Ack=1 Win=132096 Len=2904 [TCP segment of a reassembled PDU]
800 11.698178   128.119.245.12   192.168.1.96      TCP      60 80 → 57606 [ACK] Seq=1 Ack=22414 Win=74240 Len=0
801 11.698182   192.168.1.96     128.119.245.12    TCP    2958 57606 → 80 [ACK] Seq=55810 Ack=1 Win=132096 Len=2904 [TCP segment of a reassembled PDU]
```

11.1. 315.601161 KBps

11.2. The acknowledgement number of 152952 in the HTTP POST packet, which is compatible with the file size of alice.txt, indicates that 152952 bytes were acknowledged.

Throughput   = Amount of data transmitted / time incurred

Amount of data transmitted = 152952 bytes = 152.952 KB

Time incurred = (Last ACK) - (First TCP segment) = 11.862685 - 11.378048 = 0.484637s

Throughput = 152.952 KB / 0.484637s = 315.601161 KBps

```
No.     Time          Source            Destination        Protocol  Length Info
        867 11.862685   192.168.1.96      128.119.245.12     HTTP     1365 POST /wireshark-labs/lab3-1-reply.htm HTTP/1.1  (text/plain)
        922 12.031669   128.119.245.12    192.168.1.96       HTTP      831 HTTP/1.1 200 OK  (text/html)

Frame 867: 1365 bytes on wire (10920 bits), 1365 bytes captured (10920 b   0000  e4 18 6b 28 d7 dc 2c f0  5d ce f3 b2 08 00 45 00
Ethernet II, Src: MicroStarINT_ce:f3:b2 (2c:f0:5d:ce:f3:b2), Dst: Zyxel(  0010  05 47 3e 95 40 00 80 06  00 00 c0 a8 01 60 80 77
Internet Protocol Version 4, Src: 192.168.1.96, Dst: 128.119.245.12        0020  f5 0c e1 06 00 50 14 a7  0c c5 50 b9 00 eb 50 18
Transmission Control Protocol, Src Port: 57606, Dst Port: 80, Seq: 15164   0030  02 04 3c c6 00 00 6c 65  2e 0d 0a 0d 0a 20 20 53
[44 Reassembled TCP Segments (152952 bytes): #777(633), #778(13068), #78   0040  6f 20 73 68 65 20 73 61  74 20 6f 6e 2c 20 77 69
Hypertext Transfer Protocol                                                0050  74 68 20 63 6c 6f 6f 73  65 20 65 79 65 73 2c 20
MIME Multipart Media Encapsulation, Type: multipart/form-data, Boundary:   0060  61 6e 64 20 68 61 6c 66  20 62 65 6c 69 65 76 65
    [Type: multipart/form-data]                                           0070  64 20 68 65 72 73 65 6c  66 20 69 6e 0d 0a 57 6f
    First boundary: ------WebKitFormBoundarynmgfqK8BgToK0Skx\r\n           0080  6e 64 65 72 6c 61 6e 64  2c 20 74 68 6f 75 67 68
    Encapsulated multipart part:  (text/plain)                            0090  20 73 68 65 20 6b 6e 65  77 20 73 68 65 20 68 61
    Last boundary: \r\n------WebKitFormBoundarynmgfqK8BgToK0Skx--\r\n      00a0  64 20 62 75 74 20 74 6f  20 6f 70 65 6e 20 74 68
                                                                          00b0  65 6d 20 61 67 61 69 6e  20 2c 20 61 6e 64 0d 0a 61
                                                                          00c0  6c 6c 20 77 6f 75 6c 64  20 63 68 61 6e 67 65 20
                                                                          00d0  74 6f 20 64 75 6c 6c 20  72 65 61 6c 69 74 79 2d
                                                                          00e0  2d 74 68 65 20 67 72 61  73 73 20 77 6f 75 6c 64
                                                                          00f0  20 62 65 20 6f 6e 6c 79  0d 0a 72 75 73 74 6c 69
                                                                          0100  6e 67 20 69 6e 20 74 68  65 20 77 69 6e 64 2c 20

Frame (1365 bytes)   Reassembled TCP (152952 bytes)
Hypertext Transfer Protocol: Protocol        Packets: 983 · Displayed: 2 (0.2%)        Profile: Default
```

12. Since the buffer size is sufficient for our data and the number of packets in the fleets is growing over time, TCP is currently in its slow start phase.

The RTT between the sender and the recipient, which I calculated to be approximately 0.16 seconds earlier, roughly corresponds to the period.

Sequence Numbers (Stevens) for 192.168.1.96:57606 → 128.119.245.12:80
pcap.pcap