Assignment 3

February 23, 2021 4:29 PM

1. IP: 192.168.0.171 Port: 63201
2. IP: 130.113.68.10 Port: 80
3. Sequence number is: 3308731073
4. Response sequence value is: 201117125 and acknowledgement number is: 3308731074. the server determined the value by adding 1 to the recieved sequence number from the sender. The flags (0x012) identifies it as a SYN,ACK segment

```
Transmission Control Protocol, Src Port: 63201, Dst Port: 80, Seq: 0, Len: 0
    Source Port: 63201
    Destination Port: 80
    [Stream index: 2]
    [TCP Segment Len: 0]
    Sequence Number: 0    (relative sequence number)
    Sequence Number (raw): 3308731073
    [Next Sequence Number: 1    (relative sequence number)]
    Acknowledgment Number: 0
    Acknowledgment number (raw): 0
    0111 .... = Header Length: 28 bytes (7)
  > Flags: 0x002 (SYN)
    Window: 64240
    [Calculated window size: 64240]
    Checksum: 0x0935 [unverified]
    [Checksum Status: Unverified]
    Urgent Pointer: 0
  > Options: (8 bytes), Maximum segment size, No-Operation (NOP), No-Operation (NOP), SACK permitted
  > [Timestamps]
```

```
Transmission Control Protocol, Src Port: 80, Dst Port: 63201, Seq: 0, Ack: 1, Len: 0
    Source Port: 80
    Destination Port: 63201
    [Stream index: 2]
    [TCP Segment Len: 0]
    Sequence Number: 0    (relative sequence number)
    Sequence Number (raw): 201117125
    [Next Sequence Number: 1    (relative sequence number)]
    Acknowledgment Number: 1    (relative ack number)
    Acknowledgment number (raw): 3308731074
    0111 .... = Header Length: 28 bytes (7)
  > Flags: 0x012 (SYN, ACK)
    Window: 5840
    [Calculated window size: 5840]
    Checksum: 0x1383 [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]
```

5. Sequence number is: 3308731074
6.

Sequence # (raw)	Sequence # (rel)	time sent (s)	ACK received (s)	RTT (s)	EstRTT (s)	α =	0.125
3308731074	1	0.017680	0.038906	0.021226	0.021226		
3308731826	753	0.018109	0.040646	0.022537	0.02139		
3308733286	2213	0.018109	0.040646	0.022537	0.021533		
3308734746	3673	0.018109	0.040646	0.022537	0.021659		
3308736206	5133	0.038942	0.055017	0.016075	0.020961		
3308737666	6593	0.040682	0.216236	0.175554	0.040285		

7. 752
   1460
   1460
   1460
   1460
   1460
8. The minimum available buffer space is 6768 and this relatively small buffer space caused the client to receive a [TCP Window Full] warning therefore throttling the data sent
9. No there was no retransmitting issues. No [TCP Retransmission] packets were sent
10. Normally the receiver ACKs 1460 bytes of data but there are cases of delayed ACKs where one ACK segment acknowledged two sets of 1460 bytes therefore 2920 bytes
11. The throughput should be measured by the size of the file the time it takes for the message to be sent. Therefore throughput is 532604 Bytes/s

```
    39 3.015892    192.168.0.171    130.113.68.10    TCP     806 63201 → 80 [PSH, ACK] Seq=1 Ack=1 Win=64240 Len=752 [TCP segment of a reassembled PDU]
    40 3.016321    192.168.0.171    130.113.68.10    TCP    1514 63201 → 80 [ACK] Seq=753 Ack=1 Win=64240 Len=1460 [TCP segment of a reassembled PDU]
    41 3.016321    192.168.0.171    130.113.68.10    TCP    1514 63201 → 80 [ACK] Seq=2213 Ack=1 Win=64240 Len=1460 [TCP segment of a reassembled PDU]
    42 3.016321    192.168.0.171    130.113.68.10    TCP    1514 63201 → 80 [ACK] Seq=3673 Ack=1 Win=64240 Len=1460 [TCP segment of a reassembled PDU]
    43 3.037118    130.113.68.10    192.168.0.171    TCP      54 80 → 63201 [ACK] Seq=1 Ack=753 Win=6768 Len=0
    44 3.037154    192.168.0.171    130.113.68.10    TCP    1514 63201 → 80 [ACK] Seq=5133 Ack=1 Win=64240 Len=1460 [TCP segment of a reassembled PDU]
    45 3.038858    130.113.68.10    192.168.0.171    TCP      54 80 → 63201 [ACK] Seq=1 Ack=2213 Win=10220 Len=0
    46 3.038858    130.113.68.10    192.168.0.171    TCP      54 80 → 63201 [ACK] Seq=1 Ack=3673 Win=13140 Len=0
    47 3.038858    130.113.68.10    192.168.0.171    TCP      54 80 → 63201 [ACK] Seq=1 Ack=5133 Win=16060 Len=0
    48 3.038894    192.168.0.171    130.113.68.10    TCP    1514 63201 → 80 [ACK] Seq=6593 Ack=1 Win=64240 Len=1460 [TCP segment of a reassembled PDU]
```

```
> Frame 39: 806 bytes on wire (6448 bits), 806 bytes captured (6448 bits) on interface \Device\NPF_{B4F11F1D-6D4B-4DC4-B4B6-2193FD20B85F}, id 0
> Ethernet II, Src: EdupInte_50:9d:e9 (e8:4e:06:50:9d:e9), Dst: 02:00:00:00:00:04 (02:00:00:00:00:04)
> Internet Protocol Version 4, Src: 192.168.0.171, Dst: 130.113.68.10
  Transmission Control Protocol, Src Port: 63201, Dst Port: 80, Seq: 1, Ack: 1, Len: 752
    Source Port: 63201
    Destination Port: 80
    [Stream index: 2]
    [TCP Segment Len: 752]
    Sequence Number: 1    (relative sequence number)
    Sequence Number (raw): 3308731074
    [Next Sequence Number: 753    (relative sequence number)]
    Acknowledgment Number: 1    (relative ack number)
    Acknowledgment number (raw): 201117126
    0101 .... = Header Length: 20 bytes (5)
  > Flags: 0x018 (PSH, ACK)
    Window: 64240
    [Calculated window size: 64240]
    [Window size scaling factor: -2 (no window scaling used)]
    Checksum: 0x9039 [unverified]
    [Checksum Status: Unverified]
    Urgent Pointer: 0
  > [SEQ/ACK analysis]
  v [Timestamps]
      [Time since first frame in this TCP stream: 0.017680000 seconds]
      [Time since previous frame in this TCP stream: 0.000388000 seconds]
```

```
0020  44 0a f6 e1 00 50 c5 37  3a c2 0b fc cd c6 50 18   D····P·7 :·····P·
0030  fa f0 90 39 00 00 50 4f  53 54 20 2f 7e 72 7a 68   ···9··PO ST /~rzh
0040  65 6e 67 2f 63 6f 75 72  73 65 2f 43 41 53 34 43   eng/cour se/CAS4C
0050  30 33 57 31 39 2f 4c 61  62 73 2f 54 43 50 2f 6c   03W19/La bs/TCP/l
0060  61 62 33 2d 31 2d 72 65  70 6c 79 2e 68 74 6d 6c   ab3-1-re ply.html
```

```
   117 3.230798    192.168.0.171    130.113.68.10    TCP    1514 63201 → 80 [ACK] Seq=72293 Ack=1 Win=64240 Len=1460 [TCP segment of a reassembled PDU]
   118 3.230798    192.168.0.171    130.113.68.10    TCP    1514 63201 → 80 [ACK] Seq=73753 Ack=1 Win=64240 Len=1460 [TCP segment of a reassembled PDU]
   119 3.232089    130.113.68.10    192.168.0.171    TCP      60 80 → 63201 [ACK] Seq=1 Ack=44553 Win=62780 Len=0
   120 3.232089    130.113.68.10    192.168.0.171    TCP      60 80 → 63201 [ACK] Seq=1 Ack=47473 Win=62780 Len=0
   121 3.232118    192.168.0.171    130.113.68.10    TCP    1514 63201 → 80 [ACK] Seq=75213 Ack=1 Win=64240 Len=1460 [TCP segment of a reassembled PDU]
   122 3.232118    192.168.0.171    130.113.68.10    TCP    1514 63201 → 80 [ACK] Seq=76673 Ack=1 Win=64240 Len=1460 [TCP segment of a reassembled PDU]
```

diff of 2920

```
Transmission Control Protocol, Src Port: 80, Dst Port: 63201, Seq: 1, Ack: 29953, Len: 0
    Source Port: 80
    Destination Port: 63201
    [Stream index: 2]
    [TCP Segment Len: 0]
    Sequence Number: 1    (relative sequence number)
    Sequence Number (raw): 201117126
    [Next Sequence Number: 1    (relative sequence number)]
    Acknowledgment Number: 29953    (relative ack number)
    Acknowledgment number (raw): 3308761026
    0101 .... = Header Length: 20 bytes (5)
  > Flags: 0x010 (ACK)
    Window: 62780
    [Calculated window size: 62780]
    [Window size scaling factor: -2 (no window scaling used)]
    Checksum: 0xecd9 [unverified]
    [Checksum Status: Unverified]
    Urgent Pointer: 0
  v [SEQ/ACK analysis]
      [This is an ACK to the segment in frame: 78]
      [The RTT to ACK the segment was: 0.014924000 seconds]
      [iRTT: 0.017292000 seconds]
```

Part 4

1. From the graph, we can see that after 0.2s, the window size of the TCP segments starts to increases more rapidly indicating that by that point, the slow start phase ends. The ideal behaviour of this graph would be the window size increasing without any drop but we can see that there is 1 drop in window size.