CS-315 Computer Networks Lab-5 (TCP)

PART-2

```
1434 20:55:17.072434 192.168.0.194        128.119.245.12      HTTP    1995 POST /wireshark-labs/lab3-1-reply.htm HTTP/1.1  (text/plain)
1443 20:55:17.333281 128.119.245.12       192.168.0.194       HTTP     831 HTTP/1.1 200 OK  (text/html)
```

```
Transmission Control Protocol, Src Port: 51133, Dst Port: 80, Seq: 15110
    Source Port: 51133
    Destination Port: 80
    [Stream index: 67]
>   [Conversation completeness: Incomplete (30)]
    [TCP Segment Len: 1941]
    Sequence Number: 151102     (relative sequence number)
    Sequence Number (raw): 3589631583
    [Next Sequence Number: 153043     (relative sequence number)]
    Acknowledgment Number: 1     (relative ack number)
    Acknowledgment number (raw): 480144611
    0101 .... = Header Length: 20 bytes (5)
```

1. Source IP address = 192.168.0.194
   TCP Port Number = 51133
2. Gaia.cs.umass.edu IP address = 128.119.245.112
   TCP Port Number = 80

PART-3

```
1065 20:55:09.743236 192.168.0.194        128.119.245.12      TCP     66 51165 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM
```

```
Transmission Control Protocol, Src Port: 51165, Dst Port: 80, Seq: 0, Le
    Source Port: 51165
    Destination Port: 80
    [Stream index: 53]
>   [Conversation completeness: Incomplete, ESTABLISHED (7)]
    [TCP Segment Len: 0]
    Sequence Number: 0     (relative sequence number)
    Sequence Number (raw): 3654052047
    [Next Sequence Number: 1     (relative sequence number)]
    Acknowledgment Number: 0
    Acknowledgment number (raw): 0
    1000 .... = Header Length: 32 bytes (8)
>   Flags: 0x002 (SYN)
```

1. Sequence number of TCP SYN segment = 0(Relative) and 3654052047(raw).
   The segment that identifies the segment as SYN is the SYN flag(0x002), as we can see from the screenshot above.
2. Sequence number of TCP SYNACK segment = 0(Relative) and 2783335425(raw).
   The flags segment contains the SYN and ACK flags (0x012 – set to 1) which identify the TCP packet(from the screenshot) as the SYNACK.

```
Transmission Control Protocol, Src Port: 80, Dst Port: 51165, Seq: 0, Ac
    Source Port: 80
    Destination Port: 51165
    [Stream index: 53]
  > [Conversation completeness: Incomplete, ESTABLISHED (7)]
    [TCP Segment Len: 0]
    Sequence Number: 0      (relative sequence number)
    Sequence Number (raw): 2783335425
    [Next Sequence Number: 1      (relative sequence number)]
    Acknowledgment Number: 1      (relative ack number)
    Acknowledgment number (raw): 3654052048
    1000 .... = Header Length: 32 bytes (8)
  > Flags: 0x012 (SYN, ACK)
    Window: 29200
    [Calculated window size: 29200]
    Checksum: 0xc14f [unverified]
    [Checksum Status: Unverified]
    Urgent Pointer: 0
```

   Value of acknowledgement field = 1(relative) and 3654052048(raw).
   By adding 1 to the initial sequence number of the SYN segment from the client computer, gaia.cs.umass.edu calculates the value of the Acknowledgement field in the SYNACK segment.
3. Sequence Number = 1(Relative) and 3589480482(raw).
   TCP Payload contains 721 bytes of data.
   No, all of the data in the transferred file alice.txt did not fit into this single segment. There are a total of 55 segments.
4. (i) Time = 7th Feb, 2024 20:55:14.415125 IST

```
1274 20:55:14.415125 192.168.0.194      128.119.245.12      TCP      775 51133 → 80 [PSH, ACK] Seq=1 Ack=1 Win=513 Len=721 [TCP segment of a reassembled PDU]
```

   (ii) Time = 7th Feb, 2024 20:55:14.699291 IST

| 1293 20:55:14.699291 128.119.245.12 | 192.168.0.194 | TCP | 54 80 → 51133 [ACK] Seq=1 Ack=722 Win=30720 Len=0 |
| 1274 20:55:14.415125 192.168.0.194 | 128.119.245.12 | TCP | 775 51133 → 80 [PSH, ACK] Seq=1 Ack=1 Win=513 Len=721 [TCP segment of a reassembled PDU] |

```
Sequence Number: 1      (relative sequence number)
Sequence Number (raw): 3589480482
[Next Sequence Number: 722      (relative sequence number)]
Acknowledgment Number: 1      (relative ack number)
Acknowledgment number (raw): 480144611
0101 .... = Header Length: 20 bytes (5)
> Flags: 0x018 (PSH, ACK)
Window: 513
[Calculated window size: 513]
[Window size scaling factor: -1 (unknown)]
Checksum: 0x39da [unverified]
[Checksum Status: Unverified]
Urgent Pointer: 0
∨ [Timestamps]
    [Time since first frame in this TCP stream: 3.180880000 seconds]
    [Time since previous frame in this TCP stream: 3.180818000 seconds]
∨ [SEQ/ACK analysis]
    [Bytes in flight: 721]
    [Bytes sent since last PSH flag: 721]
TCP payload (721 bytes)
[Reassembled PDU in frame: 1434]
TCP segment data (721 bytes)
```

```
0000  e0 1c fc ed 68 1e 20 c1  9b 1f 79 8a 08 00 45 00   ····h· ···y···E·
0010  02 f9 ee 10 40 00 80 06  00 00 c0 a8 00 c2 80 77   ····@· ·······w
0020  f5 0c c7 bd 00 50 d5 f3  20 22 1c 9e 6c e3 50 18   ·····P·  "··l·P·
0030  02 01 39 da 00 00 50 4f  53 54 20 2f 77 69 72 65   ··9···PO ST /wire
0040  73 68 61 72 6b 2d 6c 61  62 73 2f 6c 61 62 33 2d   shark-la bs/lab3-
0050  31 2d 72 65 70 6c 79 2e  68 74 6d 20 48 54 54 50   1-reply. htm HTTP
0060  2f 31 2e 31 0d 0a 48 6f  73 74 3a 20 67 61 69 61   /1.1··Ho st: gaia
0070  2e 63 73 2e 75 6d 61 73  73 2e 65 64 75 0d 0a 43   .cs.umas s.edu··C
0080  6f 6e 6e 65 63 74 69 6f  6e 3a 20 6b 65 65 70 2d   onnectio n: keep-
0090  61 6c 69 76 65 0d 0a 43  6f 6e 74 65 6e 74 2d 4c   alive··C ontent-L
00a0  65 6e 67 74 68 3a 20 31  35 32 33 32 31 0d 0a 43   ength: 1 52321··C
00b0  61 63 68 65 2d 43 6f 6e  74 72 6f 6c 3a 20 6d 61   ache-Con trol: ma
00c0  78 2d 61 67 65 3d 30 0d  0a 55 70 67 72 61 64 65   x-age=0· ·Upgrade
00d0  2d 49 6e 73 65 63 75 72  65 2d 52 65 71 75 65 73   -Insecur e-Reques
00e0  74 73 3a 20 31 0d 0a 4f  72 69 67 69 6e 3a 20 68   ts: 1··O rigin: h
00f0  74 74 70 3a 2f 2f 67 61  69 61 2e 63 73 2e 75 6d   ttp://ga ia.cs.um
0100  61 73 73 2e 65 64 75 0d  0a 43 6f 6e 74 65 6e 74   ass.edu· ·Content
0110  2d 54 79 70 65 3a 20 6d  75 6c 74 69 70 61 72 74   -Type: m ultipart
0120  2f 66 6f 72 6d 2d 64 61  74 61 3b 20 62 6f 75 6e   /form-da ta; boun
0130  64 61 72 79 3d 2d 2d 2d  2d 57 65 62 4b 69 74 46   dary=--- -WebKitF
0140  6f 72 6d 42 6f 75 6e 64  61 72 79 77 77 51 41 41 6e ormBound arywwQAAn
0150  4a 72 50 59 58 73 43 4b  57 7a 71 0d 0a 55 73 65   JrPYXsCK Wzq··Use
0160  72 2d 41 67 65 6e 74 3a  20 4d 6f 7a 69 6c 6c 61   r-Agent:  Mozilla
0170  2f 35 2e 30 20 28 57 69  6e 64 6f 77 73 20 4e 54   /5.0 (Wi ndows NT
0180  20 31 30 2e 30 3b 20 57  69 6e 36 34 3b 20 78 36    10.0; W in64; x6
0190  34 29 20 41 70 70 6c 65  57 65 62 4b 69 74 2f 35   4) Apple WebKit/5
01a0  33 37 2e 33 36 20 28 4b  48 54 4d 4c 2c 20 6c 69   37.36 (K HTML, li
01b0  6b 65 20 47 65 63 6b 6f  29 20 43 68 72 6f 6d 65   ke Gecko ) Chrome
```

Bytes 54-774: TCP segment data (tcp.segment_data)   Packets: 8795 · Displayed: 126 (1.4%) · Dropped: 0 (0.0%)   Profile:

(iii) RTT for this first data-containing segment = 0.284166 seconds

```
[The RTT to ACK the segment was: 0.284166000 seconds]
```

(iv) RTT for 2nd data-carrying TCP segment and its ACK = 0.284011 seconds

```
[The RTT to ACK the segment was: 0.284011000 seconds]
```

5.

```
[55 Reassembled TCP Segments (153042 bytes): #1274(721), #1276(13140), #1297(27740), #1304(1460), #1316(14
    [Frame: 1274, payload: 0-720 (721 bytes)]
    [Frame: 1276, payload: 721-13860 (13140 bytes)]
    [Frame: 1297, payload: 13861-41600 (27740 bytes)]
>   [Frame: 1304, payload: 13861-15320 (1460 bytes)]
>   [Frame: 1316, payload: 13861-15320 (1460 bytes)]
>   [Frame: 1308, payload: 15321-16780 (1460 bytes)]
>   [Frame: 1323, payload: 15321-16780 (1460 bytes)]
>   [Frame: 1309, payload: 18241-19700 (1460 bytes)]
>   [Frame: 1312, payload: 21161-22620 (1460 bytes)]
>   [Frame: 1313, payload: 22621-24080 (1460 bytes)]
>   [Frame: 1332, payload: 22621-24080 (1460 bytes)]
```

Header length = 20 bytes

1st segment = 721 + 20 = 741 bytes

2nd segment = 13140 + 20 = 13160 bytes

3rd segment = 27740 + 20 = 27760 bytes

4th segment = 1460 + 20 = 1480 bytes

6. Minimum amount of available buffer space = 513 bytes [can be seen from the screenshot from win field: Win=513]. No, the lack of receiver buffer space never throttles the sender for these first four data-carrying segments.

7. Yes,

By typing "tcp.analysis.retransmission" in the filter field.

8. 1460 bytes,

Yes, the receiver is ACKing every other received segment among these first ten data-carrying segments. The difference between the acknowledged sequence numbers of two consecutive ACKs indicates the data received by the server between these two ACKs. By inspecting the amount of acknowledged data by each ACK, there are cases where the receiver is ACKing every other segment.

9. Throughput = Total data sent / Total time

$$= (152562\text{-}1) / (17.331907 - 14.415125)$$

$$= 152561 / 2.916782$$

$$= 52{,}304.560299673 \text{ bytes per second}$$

$$\sim 52.3 \text{ KB/s}$$

To calculate this, find the total data transmitted which can be computed by the difference between the sequence number of the first TCP segment(=1) and the acknowledged sequence number of the last ACK(=152562). The time taken will be the time between the first segment and the last segment.

PART-4

Sequence Numbers (Stevens) for ... Wi-Fi
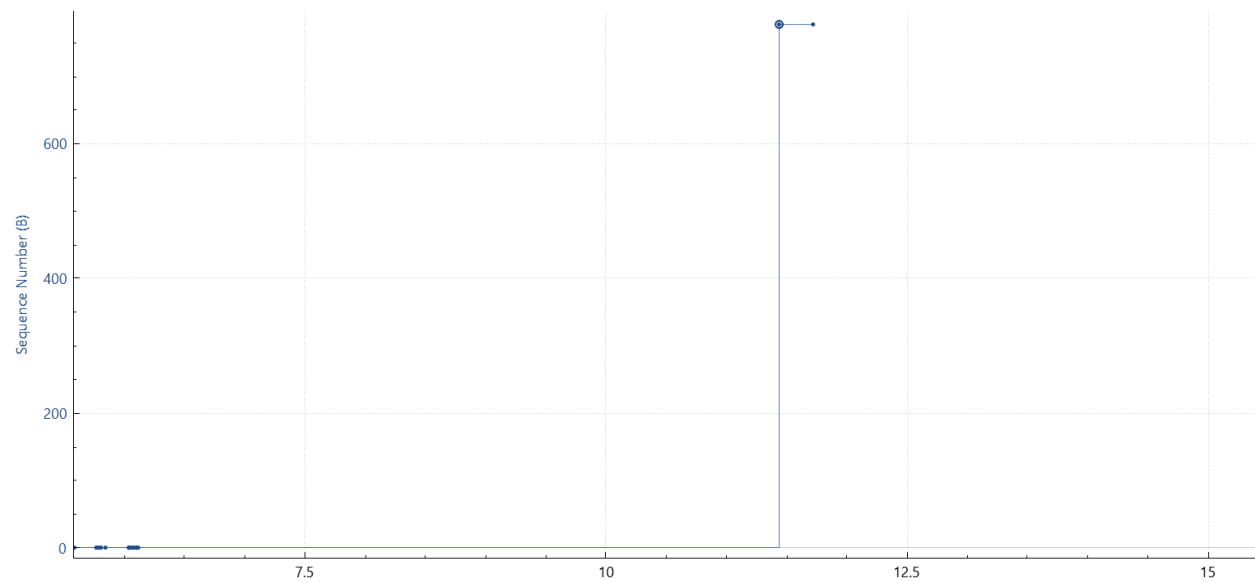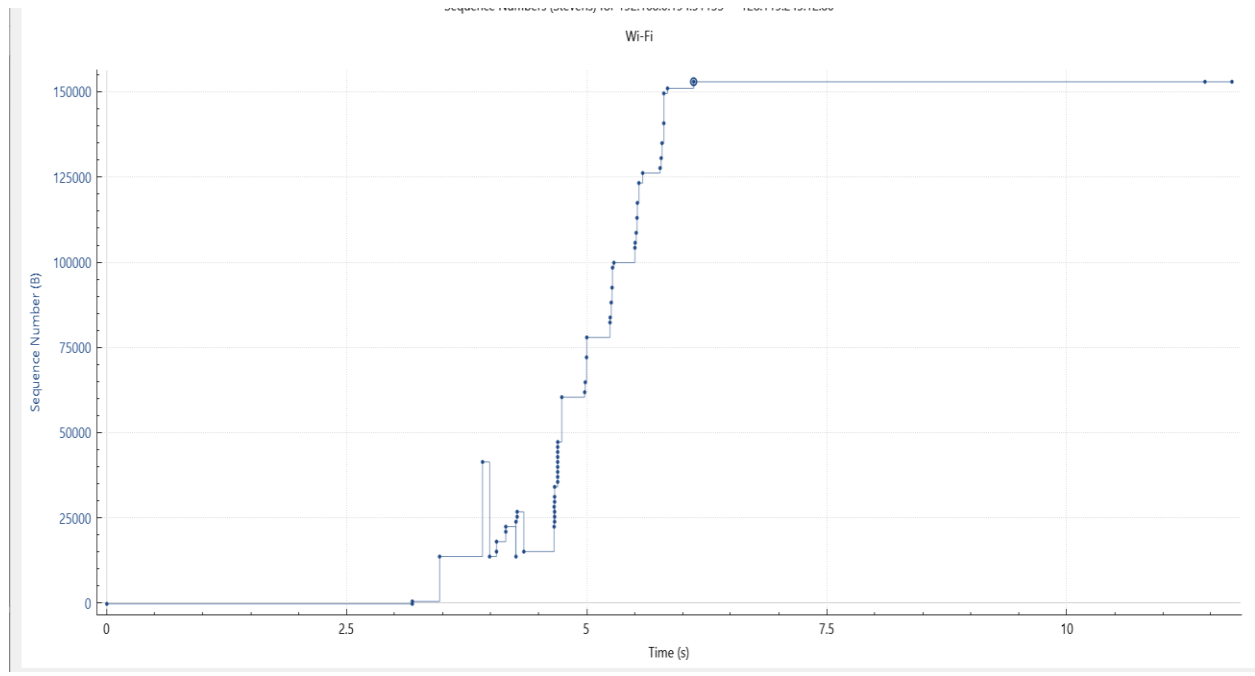
The slow start phase begins at t=0 and ends at roughly t=11.5 seconds

So, congestion avoidance takes over at t=11.5 seconds.