

- IP address of source – 10.200.93.135

- TCP port number - 13898

2. From the above screenshot we can see

- IP address of destination (gaia.cs.umass.edu) - 128.119.245.12
- Dst port number – 80

PART – 3

1.

No.	Time	Source	Destination	Protocol	Length	Info
1	2024-02-07 22:25:40.950567	10.200.93.135	128.119.245.12	TCP	54	13879 → 80 [FIN, ACK] Seq=1 Ack=1 Win=512 Len=0
2	2024-02-07 22:25:41.051119	10.200.93.135	128.119.245.12	TCP	66	13898 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM
3	2024-02-07 22:25:41.099450	10.200.93.135	34.120.214.181	TCP	55	13693 → 443 [ACK] Seq=1 Ack=1 Min=510 Len=1 [TCP segment of a reassembled PDU]
4	2024-02-07 22:25:41.119834	34.120.214.181	10.200.93.135	TCP	66	443 → 13693 [ACK] Seq=1 Ack=2 Win=442 Len=0 SLE=1 SRE=2

<p>Frame 2: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface \Device\NPF_{B1B1DFC0-E836-4891-8518-352EF97D00E3}, id 0</p> <p>Ethernet II, Src: AzureWaveTec_04:70:4d (48:e7:da:0d:70:4d), Dst: Cisco_6d:ff:ff (b0:8b:d0:6d:ff:ff)</p> <p>Internet Protocol Version 4, Src: 10.200.93.135, Dst: 128.119.245.12</p> <p>Transmission Control Protocol, Src Port: 13906, Dst Port: 80, Seq: 0, Len: 0</p> <p>Source Port: 13906</p> <p>Destination Port: 80</p> <p>[Stream index: 1]</p> <p>[Conversation completeness: Incomplete, ESTABLISHED (7)]</p> <p>[TCP Segment Len: 0]</p> <p>Sequence Number: 0 (relative sequence number)</p> <p>Sequence Number (raw): 2765832202</p> <p>[Next Sequence Number: 1 (relative sequence number)]</p> <p>Acknowledgment Number: 0</p> <p>Acknowledgment number (raw): 0</p> <p>1000 = Header Length: 32 bytes (8)</p> <p>Flags: 0x002 (SYN)</p> <p>Window: 64240</p> <p>[Calculated window size: 64240]</p> <p>Checksum: 0x7ac4 [unverified]</p> <p>[Checksum Status: Unverified]</p> <p>Urgent Pointer: 0</p> <p>Options: (12 bytes), Maximum segment size, No-Operation (NOP), Window scale, No-Operation (NOP), No-Operation (NOP), SACK permitted</p> <p>[Timestamps]</p>

- Sequence number (Seq = 0) is used to initiate the TCP connection between client and destination (gain.cs.umass.edu)
- With the help of Flags we can identify this TCP segment as SYN segment

2.

No.	Time	Source	Destination	Protocol	Length	Info
1	2024-02-07 22:25:48.950567	10.200.93.135	128.119.245.12	TCP	54	13879 → 80 [FIN, ACK] Seq=1 Ack=1 Win=512 Len=0
2	2024-02-07 22:25:48.951119	10.200.93.135	128.119.245.12	TCP	66	13906 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM
3	2024-02-07 22:25:41.099450	10.200.93.135	34.120.214.181	TCP	55	13693 → 443 [ACK] Seq=1 Ack=1 Win=510 Len=1 [TCP segment of a reassembled PDU]
4	2024-02-07 22:25:41.119334	34.120.214.181	10.200.93.135	TCP	66	443 → 13693 [ACK] Seq=1 Ack=2 Win=442 Len=0 SILENT SILENT
5	2024-02-07 22:25:41.410978	128.119.245.12	10.200.93.135	TCP	66	80 → 13906 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1250 SACK_PERM WS=128
6	2024-02-07 22:25:41.411131	10.200.93.135	128.119.245.12	TCP	54	13906 → 80 [ACK] Seq=1 Ack=1 Win=131072 Len=0
7	2024-02-07 22:25:41.438201	128.119.245.12	10.200.93.135	TCP	54	80 → 13879 [ACK] Seq=1 Ack=2 Win=229 Len=0


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Frame 5: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface \Device\NPF_{B181DFC0-E836-4891-8518-352EF97000E3}, id 0
Ethernet II, Src: Cisco_13:2a:c2 (f8:7a:41:13:2a:c2), Dst: AzureWaveTec_0d:70:4d (48:e7:da:0d:70:4d)
Internet Protocol Version 4, Src: 128.119.245.12, Dst: 10.200.93.135
Transmission Control Protocol, Src Port: 80, Dst Port: 13906, Seq: 0, Ack: 1, Len: 0
  Source Port: 80
  Destination Port: 13906
  [Stream index: 1]
  [Conversation completeness: Incomplete, ESTABLISHED (?) ]
  [TCP Segment Len: 0]
  Sequence Number: 0 (relative sequence number)
  Sequence Number (raw): 3283237858
  [Next Sequence Number: 1 (relative sequence number)]
  Acknowledgment Number: 1 (relative ack number)
  Acknowledgment number (raw): 2765832203
  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
  * ....0... = SYN Set
    ....0... = FIN: Not set
  [TCP Flags: .....A..S..]
  Window: 29200
  [calculated window size: 29200]

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- Sequence number of the SYNACK segment is 0 (Seq = 0)
- With the help of Flags in the headers and info we can identify this TCP segment as [SYN, ACK] segment
- Value of the Acknowledgement field (Ack = 1)
- ACK = SEQ+1 [SEQ from [SYN] packet]

3.

No.	Time	Source	Destination	Protocol	Length	Info
31	2024-02-07 22:25:43.044588	10.200.93.135	128.119.245.12	TCP	665	13898 → 80 [PSH, ACK] Seq=1 Ack=1 Win=512 Len=611 [TCP segment of a reassembled PDU]
32	2024-02-07 22:25:43.046282	10.200.93.135	128.119.245.12	TCP	1304	13898 → 80 [ACK] Seq=612 Ack=1 Win=512 Len=1250 [TCP segment of a reassembled PDU]
33	2024-02-07 22:25:43.046282	10.200.93.135	128.119.245.12	TCP	1304	13898 → 80 [ACK] Seq=1862 Ack=1 Win=512 Len=1250 [TCP segment of a reassembled PDU]
34	2024-02-07 22:25:43.046282	10.200.93.135	128.119.245.12	TCP	1304	13898 → 80 [ACK] Seq=3112 Ack=1 Win=512 Len=1250 [TCP segment of a reassembled PDU]
35	2024-02-07 22:25:43.046282	10.200.93.135	128.119.245.12	TCP	1304	13898 → 80 [ACK] Seq=4362 Ack=1 Win=512 Len=1250 [TCP segment of a reassembled PDU]
36	2024-02-07 22:25:43.046282	10.200.93.135	128.119.245.12	TCP	1304	13898 → 80 [ACK] Seq=5612 Ack=1 Win=512 Len=1250 [TCP segment of a reassembled PDU]
37	2024-02-07 22:25:43.046282	10.200.93.135	128.119.245.12	TCP	1304	13898 → 80 [ACK] Seq=6862 Ack=1 Win=512 Len=1250 [TCP segment of a reassembled PDU]
38	2024-02-07 22:25:43.046282	10.200.93.135	128.119.245.12	TCP	1304	13898 → 80 [ACK] Seq=8112 Ack=1 Win=512 Len=1250 [TCP segment of a reassembled PDU]
39	2024-02-07 22:25:43.046282	10.200.93.135	128.119.245.12	TCP	1304	13898 → 80 [ACK] Seq=9362 Ack=1 Win=512 Len=1250 [TCP segment of a reassembled PDU]
40	2024-02-07 22:25:43.046282	10.200.93.135	128.119.245.12	TCP	1304	13898 → 80 [ACK] Seq=10612 Ack=1 Win=512 Len=1250 [TCP segment of a reassembled PDU]
41	2024-02-07 22:25:43.325544	128.119.245.12	10.200.93.135	TCP	54	80 → 13898 [ACK] Seq=1 Ack=612 Win=238 Len=0
42	2024-02-07 22:25:43.325544	128.119.245.12	10.200.93.135	TCP	54	80 → 13898 [ACK] Seq=1 Ack=1862 Win=414 Len=0
43	2024-02-07 22:25:43.325673	10.200.93.135	128.119.245.12	TCP	1304	13898 → 80 [ACK] Seq=11862 Ack=1 Win=512 Len=1250 [TCP segment of a reassembled PDU]
44	2024-02-07 22:25:43.325693	10.200.93.135	128.119.245.12	TCP	1304	13898 → 80 [ACK] Seq=13112 Ack=1 Win=512 Len=1250 [TCP segment of a reassembled PDU]


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Frame 31: 665 bytes on wire (5320 bits), 665 bytes captured (5320 bits) on interface \Device\NPF_{B181DFC0-E836-4891-8518-352EF97000E3}, id 0
Ethernet II, Src: AzureWaveTec_0d:70:4d (48:e7:da:0d:70:4d), Dst: Cisco_0d:ff:ff (08:0d:0d:0d:ff:ff)
Internet Protocol Version 4, Src: 10.200.93.135, Dst: 128.119.245.12
Transmission Control Protocol, Src Port: 13898, Dst Port: 80, Seq: 1, Ack: 1, Len: 611
  Source Port: 13898
  Destination Port: 80
  [Stream index: 7]
  [Conversation completeness: Incomplete (12)]
  [TCP Segment Len: 611]
  Sequence Number: 1 (relative sequence number)
  Sequence Number (raw): 380595024
  [Next Sequence Number: 612 (relative sequence number)]
  Acknowledgment Number: 1 (relative ack number)
  Acknowledgment number (raw): 3077423707
  0101 .... = Header Length: 20 bytes (5)
  * Flags: 0x01B (PSH, ACK)
    Window: 512
    [calculated window size: 512]
    [Window size scaling factor: -1 (unknown)]
    Checksum: 0x4f0f [unverified]
    [Checksum Status: Unverified]
    Urgent Pointer: 0
  [Timestamps]
  [SEQ/ACK analysis]
  TCP payload (611 bytes)
  TCP segment data (611 bytes)

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- Sequence number of the TCP segment is 1 (Seq = 01)
- Bytes of data contained in the payload (data) field of this TCP segment is 611 bytes
- No, it is segmented into 54 segments

4.

- I) First segment in the data-transfer part is – 22:25:43.044588
- II) Time at which ACK for this first data-containing segment received – 22:25:43.325544
- III) The RTT to ACK the segment was: 0.280956000 seconds
- IV) RTT value of the second data-carrying TCP segment and its ACK

[The RTT to ACK the segment was: 0.279262000 seconds]

5.

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> Frame 90: 773 bytes on wire (6184 bits), 773 bytes captured (6184 bits) on interface \Device\NPF_{B181DFC0-E8...
> Ethernet II, Src: AzureWaveTec_0d:70:4d (48:e7:da:0d:70:4d), Dst: Cisco_60:ff:ff (b0:8b:d0:60:ff:ff)
> Internet Protocol Version 4, Src: 10.200.93.135, Dst: 128.119.245.12
> Transmission Control Protocol, Src Port: 13898, Dst Port: 80, Seq: 65612, Ack: 1, Len: 719
▼ [54 Reassembled TCP Segments (66330 bytes): #31(611), #32(1250), #33(1250), #34(1250), #35(1250), #36(1250), #37(1250), #38(1250), #39(1250), #40(1250), #41(1250), #42(1250), #43(1250), #44(1250), #45(1250), #46(1250), #47(1250), #48(1250), #49(1250), #50(1250), #51(1250), #52(1250), #53(1250), #54(1250), #55(1250), #56(1250), #57(1250), #58(1250), #59(1250), #60(1250), #61(1250), #62(1250), #63(1250), #64(1250), #65(1250), #66(1250), #67(1250), #68(1250), #69(1250), #70(1250), #71(1250), #72(1250), #73(1250), #74(1250), #75(1250), #76(1250), #77(1250), #78(1250), #79(1250), #80(1250), #81(1250), #82(1250), #83(1250), #84(1250), #85(1250), #86(1250), #87(1250), #88(1250), #89(1250), #90(1250), #91(1250), #92(1250), #93(1250), #94(1250), #95(1250), #96(1250), #97(1250), #98(1250), #99(1250), #100(1250), #101(1250), #102(1250), #103(1250), #104(1250), #105(1250), #106(1250), #107(1250), #108(1250), #109(1250), #110(1250), #111(1250), #112(1250), #113(1250), #114(1250), #115(1250), #116(1250), #117(1250), #118(1250), #119(1250), #120(1250), #121(1250), #122(1250), #123(1250), #124(1250), #125(1250), #126(1250), #127(1250), #128(1250), #129(1250), #130(1250), #131(1250), #132(1250), #133(1250), #134(1250), #135(1250), #136(1250), #137(1250), #138(1250), #139(1250), #140(1250), #141(1250), #142(1250), #143(1250), #144(1250), #145(1250), #146(1250), #147(1250), #148(1250), #149(1250), #150(1250), #151(1250), #152(1250), #153(1250), #154(1250), #155(1250), #156(1250), #157(1250), #158(1250), #159(1250), #160(1250), #161(1250), #162(1250), #163(1250), #164(1250), #165(1250), #166(1250), #167(1250), #168(1250), #169(1250), #170(1250), #171(1250), #172(1250), #173(1250), #174(1250), #175(1250), #176(1250), #177(1250), #178(1250), #179(1250), #180(1250), #181(1250), #182(1250), #183(1250), #184(1250), #185(1250), #186(1250), #187(1250), #188(1250), #189(1250), #190(1250), #191(1250), #192(1250), #193(1250), #194(1250), #195(1250), #196(1250), #197(1250), #198(1250), #199(1250), #200(1250), #201(1250), #202(1250), #203(1250), #204(1250), #205(1250), #206(1250), #207(1250), #208(1250), #209(1250), #210(1250), #211(1250), #212(1250), #213(1250), #214(1250), #215(1250), #216(1250), #217(1250), #218(1250), #219(1250), #220(1250), #221(1250), #222(1250), #223(1250), #224(1250), #225(1250), #226(1250), #227(1250), #228(1250), #229(1250), #230(1250), #231(1250), #232(1250), #233(1250), #234(1250), #235(1250), #236(1250), #237(1250), #238(1250), #239(1250), #240(1250), #241(1250), #242(1250), #243(1250), #244(1250), #245(1250), #246(1250), #247(1250), #248(1250), #249(1250), #250(1250), #251(1250), #252(1250), #253(1250), #254(1250), #255(1250), #256(1250), #257(1250), #258(1250), #259(1250), #260(1250), #261(1250), #262(1250), #263(1250), #264(1250), #265(1250), #266(1250), #267(1250), #268(1250), #269(1250), #270(1250), #271(1250), #272(1250), #273(1250), #274(1250), #275(1250), #276(1250), #277(1250), #278(1250), #279(1250), #280(1250), #281(1250), #282(1250), #283(1250), #284(1250), #285(1250), #286(1250), #287(1250), #288(1250), #289(1250), #290(1250), #291(1250), #292(1250), #293(1250), #294(1250), #295(1250), #296(1250), #297(1250), #298(1250), #299(1250), #300(1250), #301(1250), #302(1250), #303(1250), #304(1250), #305(1250), #306(1250), #307(1250), #308(1250), #309(1250), #310(1250), #311(1250), #312(1250), #313(1250), #314(1250), #315(1250), #316(1250), #317(1250), #318(1250), #319(1250), #320(1250), #321(1250), #322(1250), #323(1250), #324(1250), #325(1250), #326(1250), #327(1250), #328(1250), #329(1250), #330(1250), #331(1250), #332(1250), #333(1250), #334(1250), #335(1250), #336(1250), #337(1250), #338(1250), #339(1250), #340(1250), #341(1250), #342(1250), #343(1250), #344(1250), #345(1250), #346(1250), #347(1250), #348(1250), #349(1250), #350(1250), #351(1250), #352(1250), #353(1250), #354(1250), #355(1250), #356(1250), #357(1250), #358(1250), #359(1250), #360(1250), #361(1250), #362(1250), #363(1250), #364(1250), #365(1250), #366(1250), #367(1250), #368(1250), #369(1250), #370(1250), #371(1250), #372(1250), #373(1250), #374(1250), #375(1250), #376(1250), #377(1250), #378(1250), #379(1250), #380(1250), #381(1250), #382(1250), #383(1250), #384(1250), #385(1250), #386(1250), #387(1250), #388(1250), #389(1250), #390(1250), #391(1250), #392(1250), #393(1250), #394(1250), #395(1250), #396(1250), #397(1250), #398(1250), #399(1250), #400(1250), #401(1250), #402(1250), #403(1250), #404(1250), #405(1250), #406(1250), #407(1250), #408(1250), #409(1250), #410(1250), #411(1250), #412(1250), #413(1250), #414(1250), #415(1250), #416(1250), #417(1250), #418(1250), #419(1250), #420(1250), #421(1250), #422(1250), #423(1250), #424(1250
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- Length of first data carrying TCP segment – Header (20) + Payload (611) = 631
- Length of 2nd, 3rd, 4th data carrying TCP segments – Header (20) + Payload (1250) = 1270

6.

[illegible]

- Window size: 512, There is enough receiver buffer space, but the TCP Payload is 1250 bytes. It doesn't throttle the sender.

7.

tcp.analysis.retransmission						
No.	Time	Source	Destination	Protocol	Length	Info

NO, there are no retransmitted segments in the trace file. We can check this by searching for tcp.analysis.retransmission in the filter

8. For the First ten packets – $1250 * 9 + 611 = 11861$ bytes

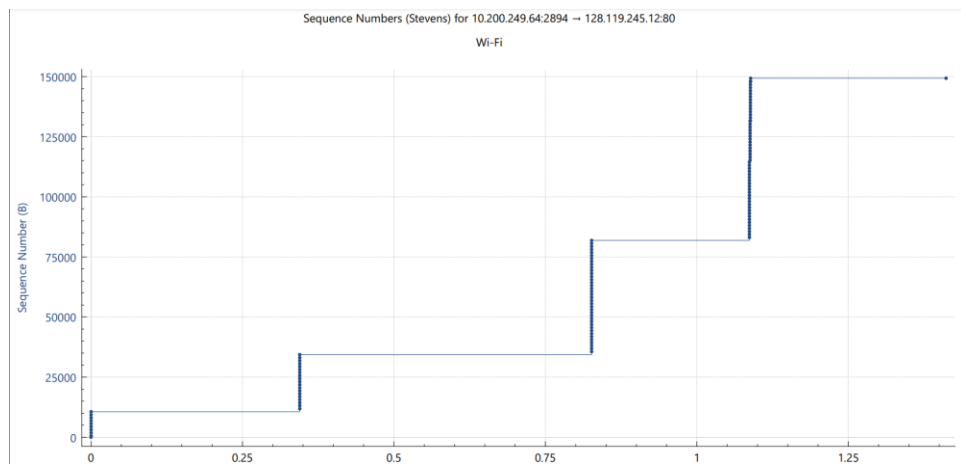
9. Throughput = Content Length / Time taken

Throughput = $149321 / (0.39717 - 0.18018)$

= $149321 / 0.21699 \Rightarrow 688146.919$ bytes per sec

It is calculated by dividing total data with time difference between first data packet sent and last ACK received.

PART – 4



Slow start phase begins at $t=0$ s and ends at $t=1.25$ s (roughly). Congestion avoidance takes place at $t=1.25$ s.