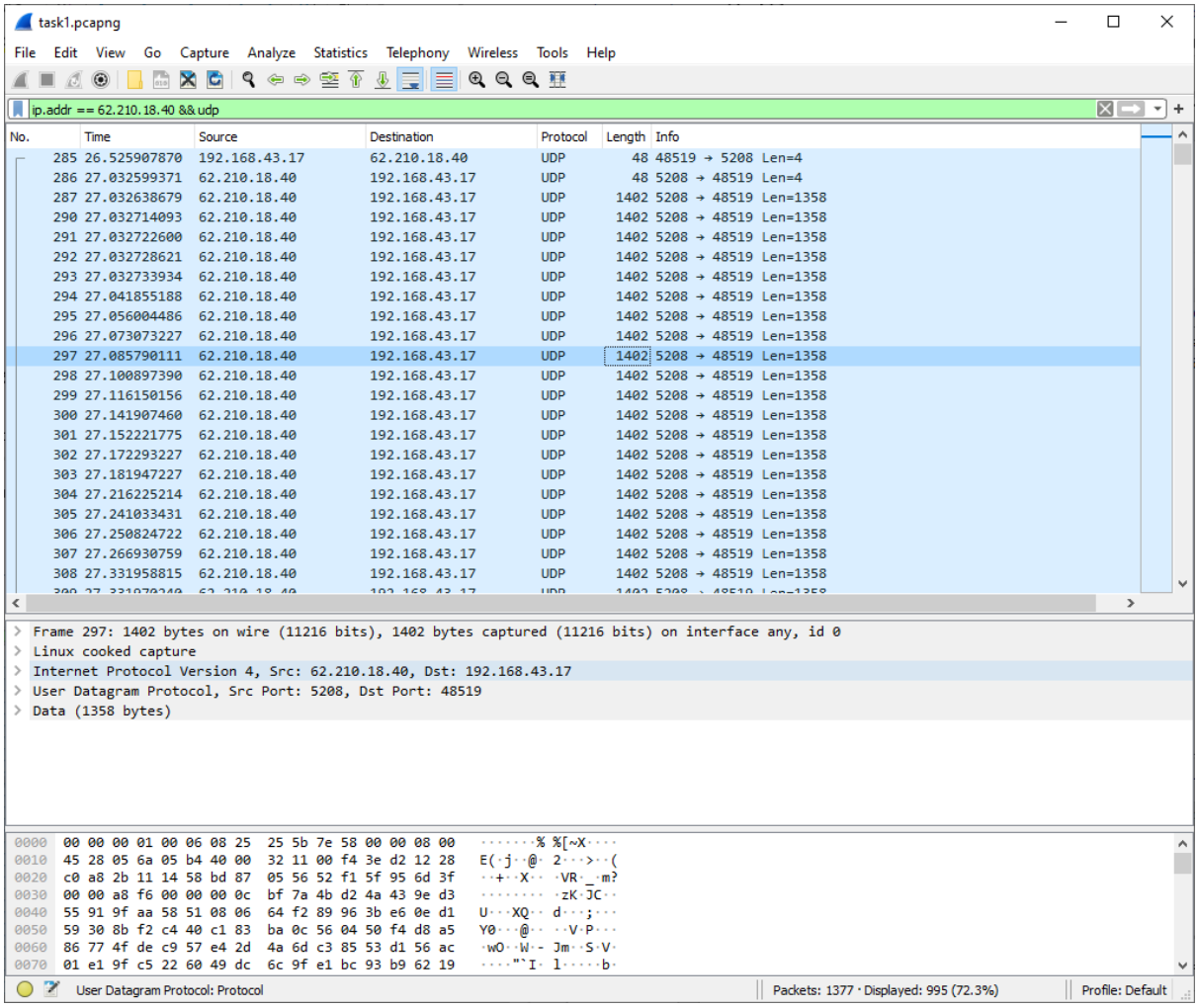
Task 1:

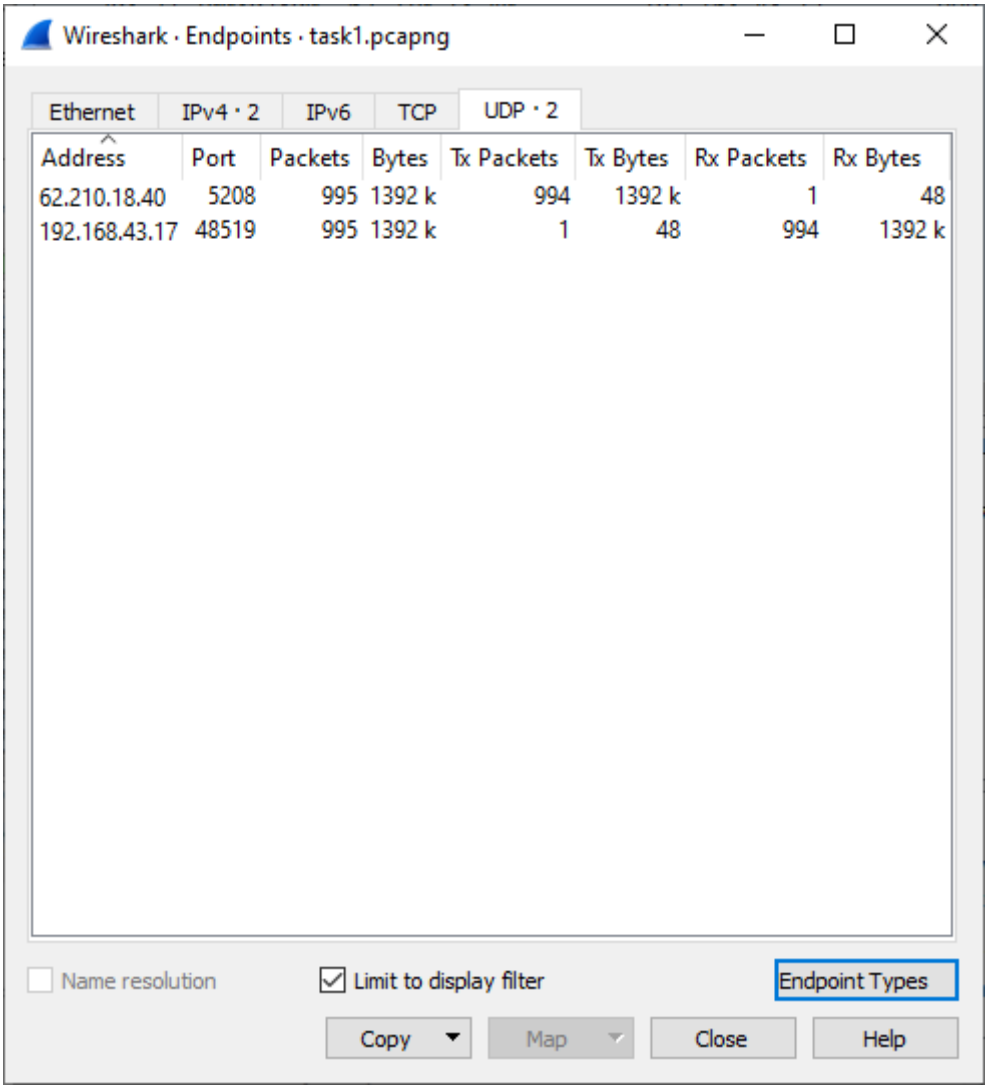
1. How many UDP packets are exchanged in this communication between iperf3 client and remote server ?

   We find that the IP address of ping.online.net is 62.210.18.40. We use the filter `ip.addr == 62.210.18.40 && udp` to filter out the UDP packets that are exchanged between client and server.

   We find 995 packets were exchanged between client and server and this can be seen in both the filtered list as well as the endpoints.

   Even though Wireshark shows multiple IPv4 frames using proto = UDP, these frames are combined to form a single UDP packet which we have counted here.





2. Who is sending bulk data to whom ? What is the average size of the packet sent?

   We use the filter `ip.addr == 62.210.18.40` to filter out packets that are transferred between client and server. We use conversation statistics to find the data transferred between the two.

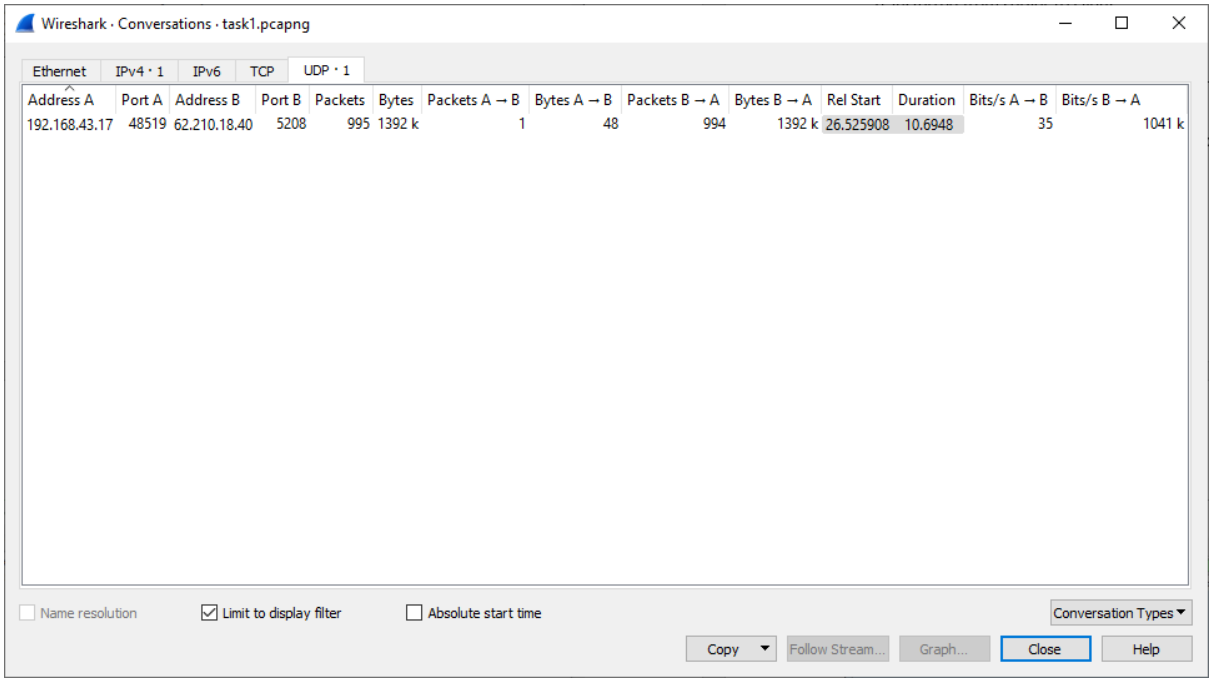
   We see that 48 bytes are transferred from A to B whereas 1392k bytes are transferred B to A where A is the client system and B is the server. We can conclude from this that a bulk of data is transferred from server to client.

   For packet size,

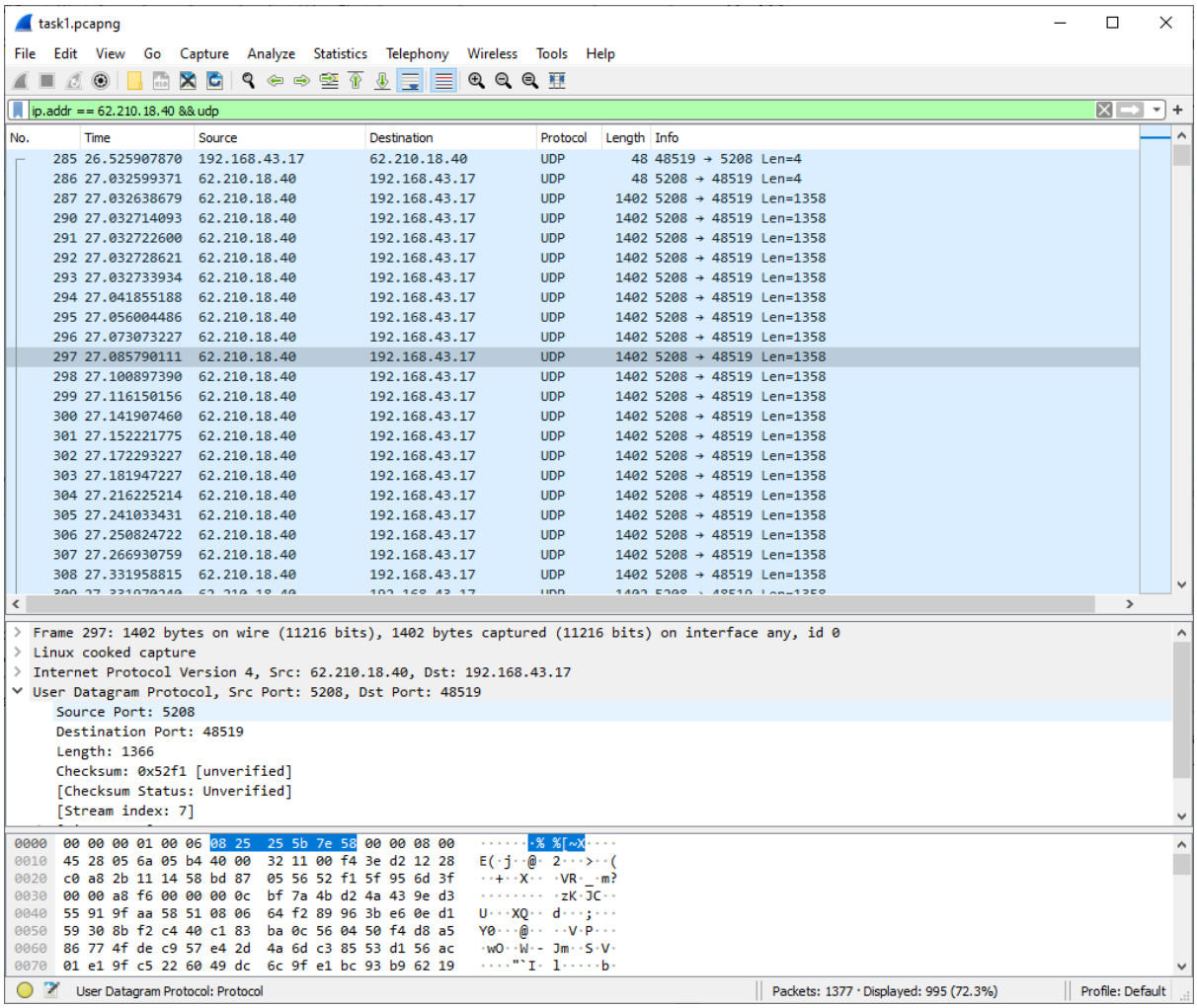
   we have 1 packet from client to server and 48 bytes of data is transferred. Therefore, the size of packet sent from client to server is 48 bytes.

   we have 995 packets from server to client and 1392k bytes of data is transferred. Therefore, size of packet from server to client is 1432.57 bytes.

   (1392k/995 => 1392 * 1024 / 995 => 1,432.57085427135678391959798994 97)



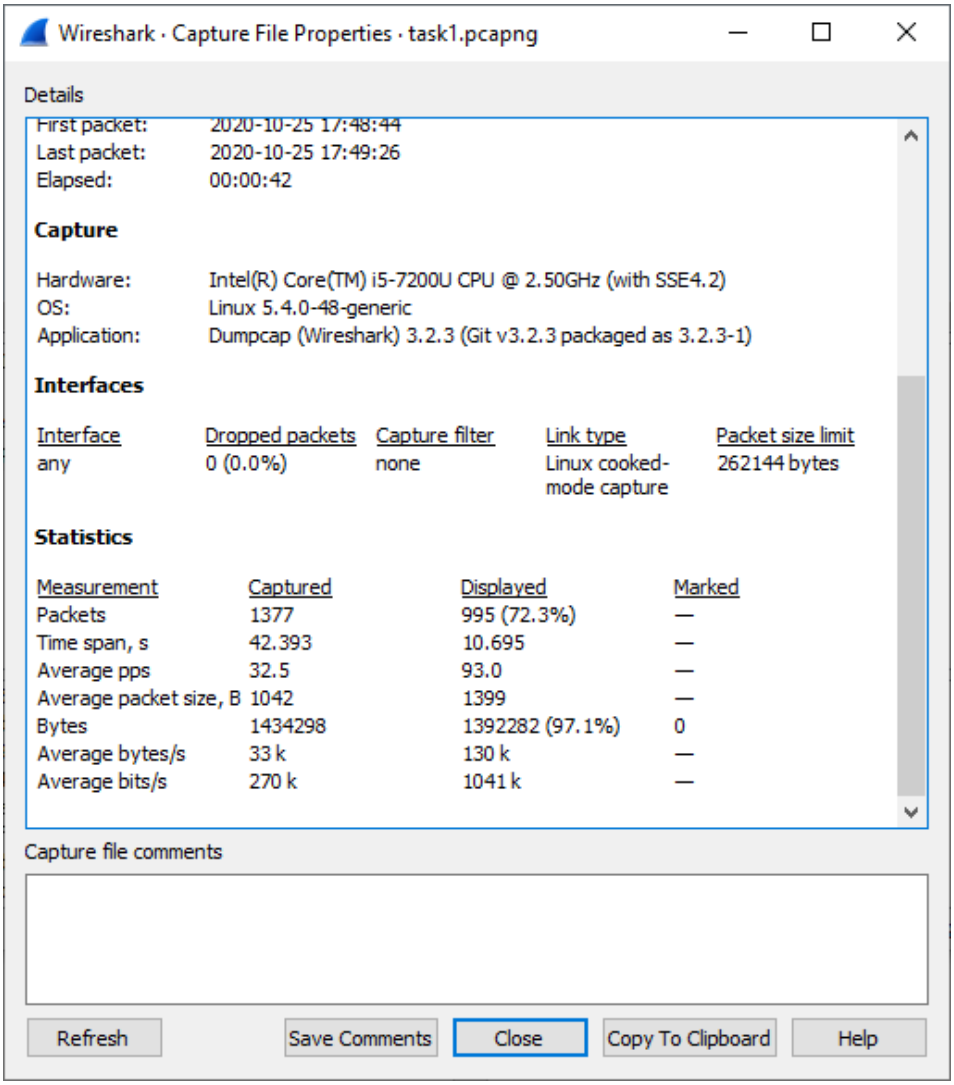
3. Calculate the throughput (bytes transferred per unit time) for this UDP conversation using UDP's length field. Explain how you calculated this value using Wireshark capture in this experiment along with relevant screenshots. Verify your calculation with the one done by Wireshark using "Capture File properties" as well with the one displayed by iperf3 terminal. If you observe the major difference in your calculation and with the other two listed here, comment why and how?



From the Wireshark capture we can see the length of each packet is 1366 bytes. Since we had 995 packets transferred the total data transferred is 1366 * 995 = 1359170 bytes.

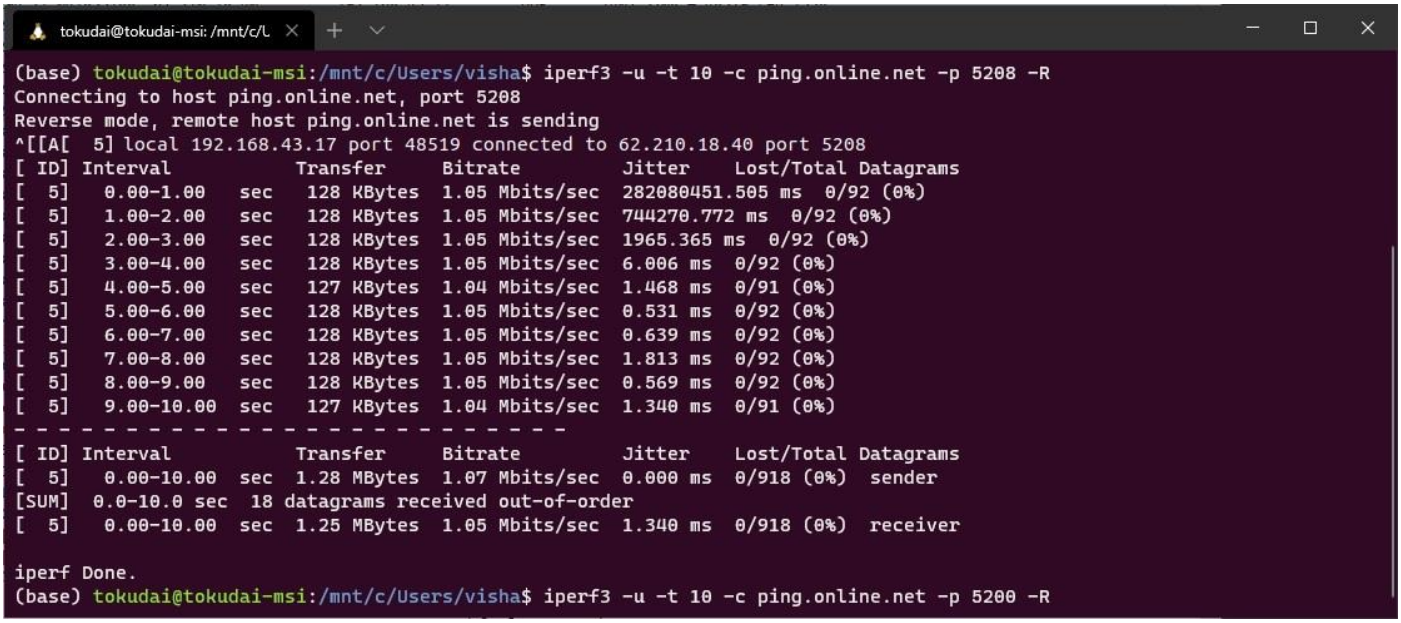
The time required for this transmission is 10 seconds (defined in the command executed).

Therefore, the throughput is 1359170 / (1024 * 10) = 132.7314453125 Kb/s



The same throughput of 130 k bytes/s is shown in Capture file properties as well.

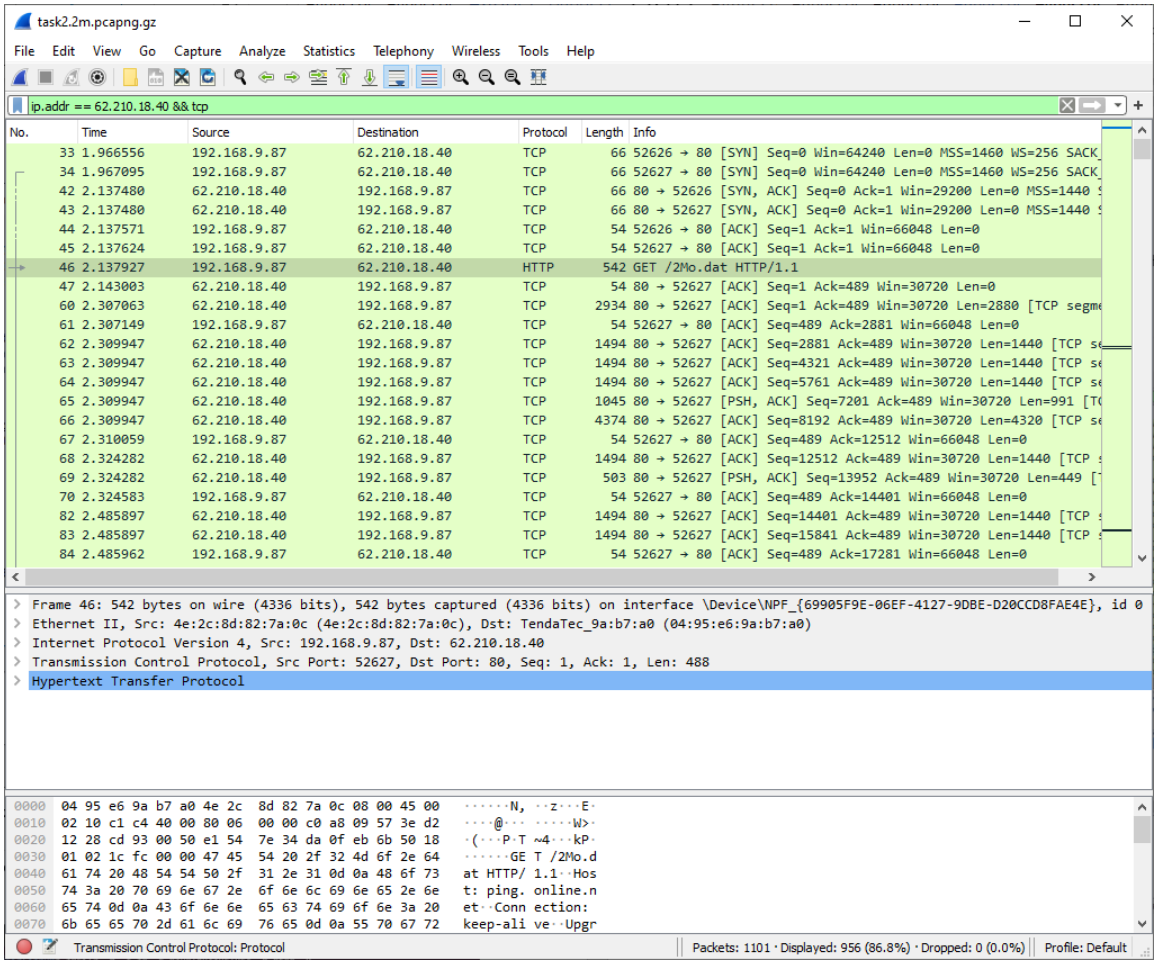
132.7314453125 Kbyte/s = 132.7314453125 * 8 / 1024 Mbits/sec = 1.03696441650390625 Mbits/s which is close to the throughput reported by iperf.

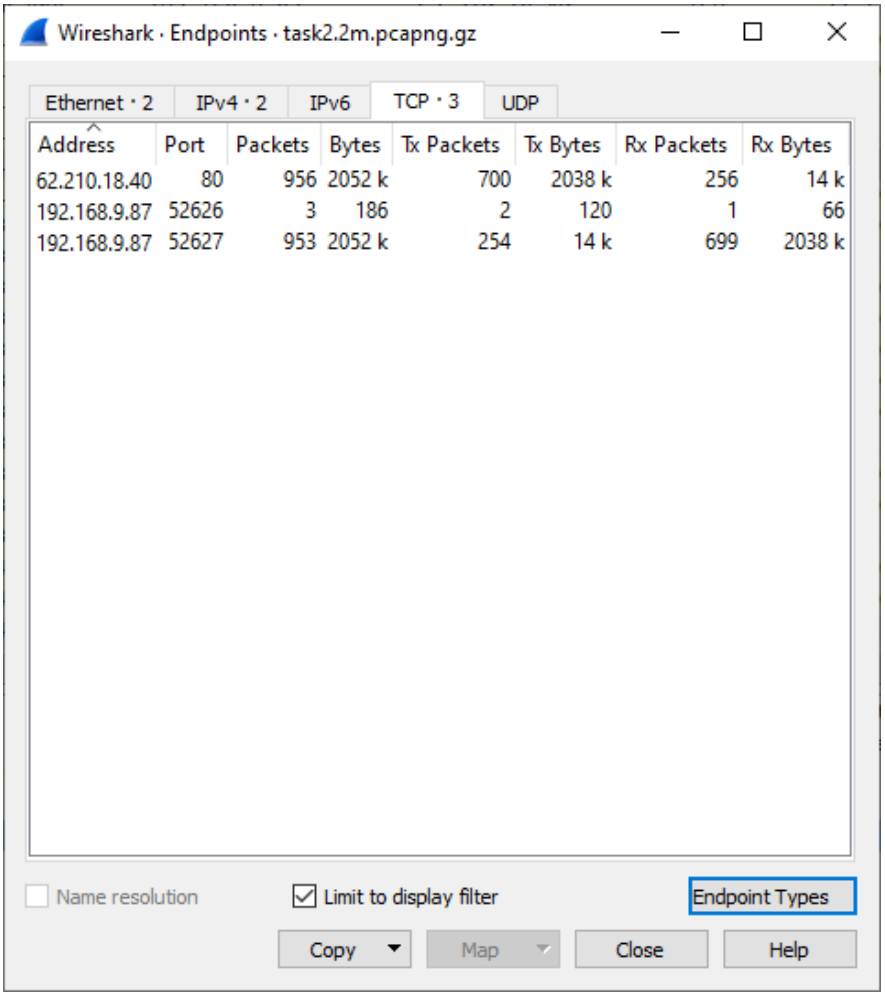

tokudai@tokudai-msi: /mnt/c/L
(base) tokudai@tokudai-msi:/mnt/c/Users/visha$ iperf3 -u -t 10 -c ping.online.net -p 5208 -R
Connecting to host ping.online.net, port 5208
Reverse mode, remote host ping.online.net is sending
^[[A[5] local 192.168.43.17 port 48519 connected to 62.210.18.40 port 5208
[ID] Interval Transfer Bitrate Jitter Lost/Total Datagrams
[5] 0.00-1.00 sec 128 KBytes 1.05 Mbits/sec 282080451.505 ms 0/92 (0%)
[5] 1.00-2.00 sec 128 KBytes 1.05 Mbits/sec 744270.772 ms 0/92 (0%)
[5] 2.00-3.00 sec 128 KBytes 1.05 Mbits/sec 1965.365 ms 0/92 (0%)
[5] 3.00-4.00 sec 128 KBytes 1.05 Mbits/sec 6.006 ms 0/92 (0%)
[5] 4.00-5.00 sec 127 KBytes 1.04 Mbits/sec 1.468 ms 0/91 (0%)
[5] 5.00-6.00 sec 128 KBytes 1.05 Mbits/sec 0.531 ms 0/92 (0%)
[5] 6.00-7.00 sec 128 KBytes 1.05 Mbits/sec 0.639 ms 0/92 (0%)
[5] 7.00-8.00 sec 128 KBytes 1.05 Mbits/sec 1.813 ms 0/92 (0%)
[5] 8.00-9.00 sec 128 KBytes 1.05 Mbits/sec 0.569 ms 0/92 (0%)
[5] 9.00-10.00 sec 127 KBytes 1.04 Mbits/sec 1.340 ms 0/91 (0%)
- -
[ID] Interval Transfer Bitrate Jitter Lost/Total Datagrams
[5] 0.00-10.00 sec 1.28 MBytes 1.07 Mbits/sec 0.000 ms 0/918 (0%) sender
[SUM] 0.0-10.0 sec 18 datagrams received out-of-order
[5] 0.00-10.00 sec 1.25 MBytes 1.05 Mbits/sec 1.340 ms 0/918 (0%) receiver
iperf Done.
(base) tokudai@tokudai-msi:/mnt/c/Users/visha$ iperf3 -u -t 10 -c ping.online.net -p 5200 -R

Task 2:

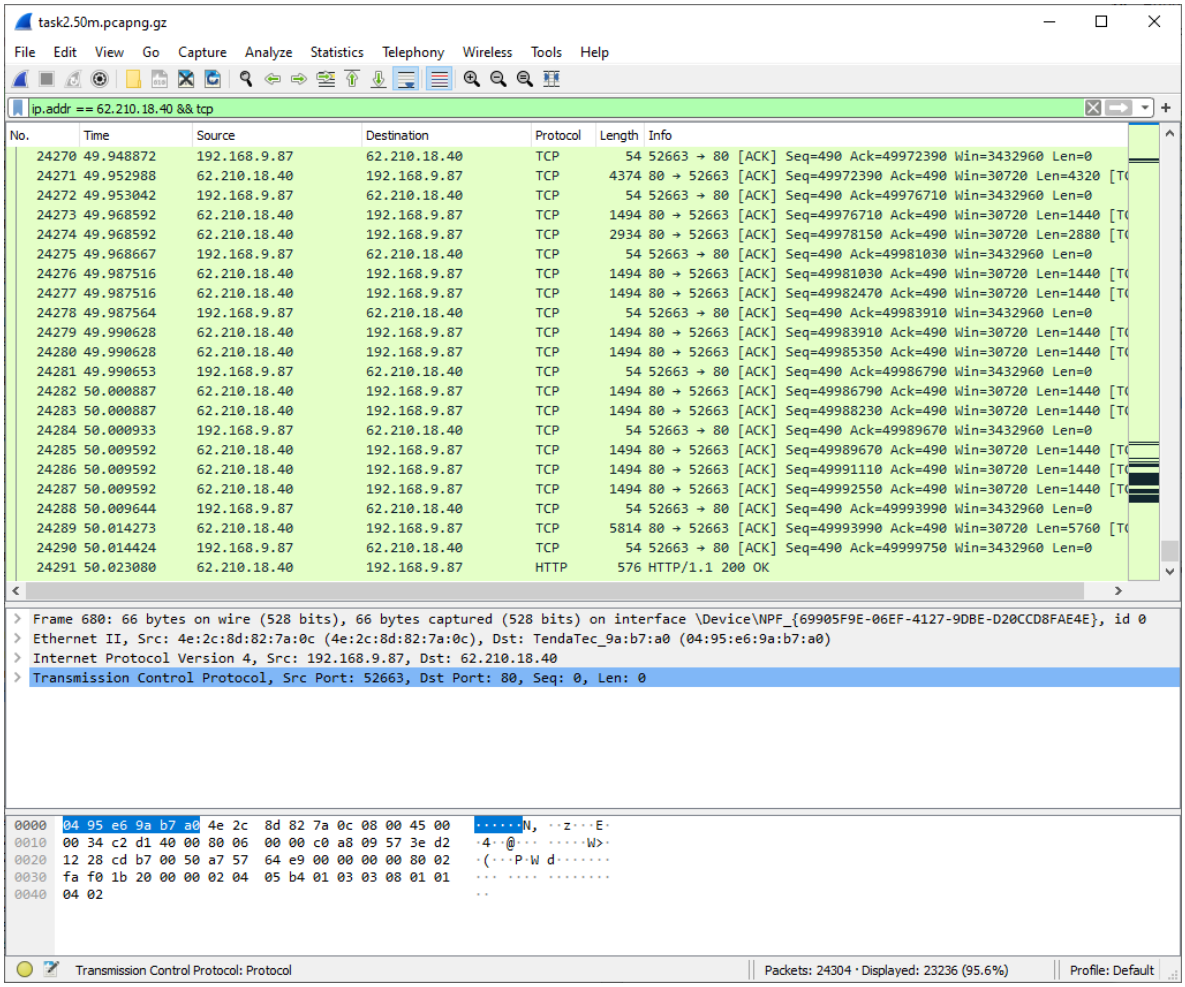
1. How many TCP packets are exchanged in this communication client and remote server?

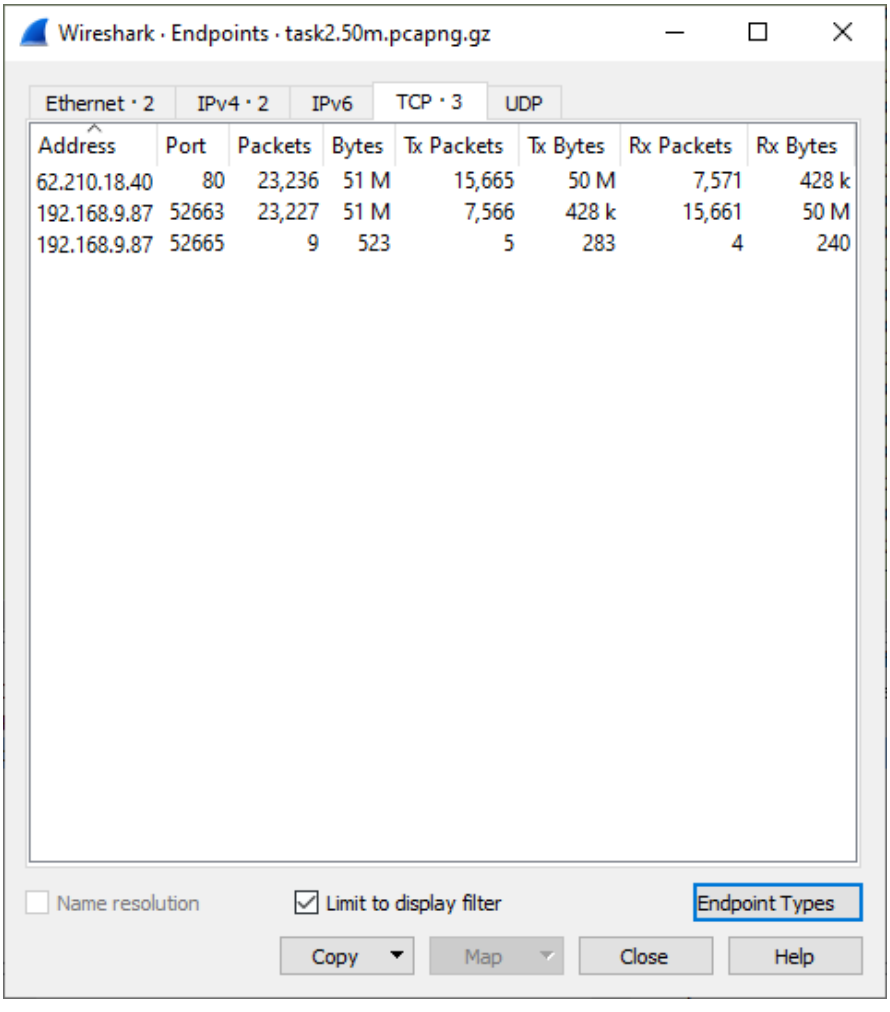
   We use the filter ip.addr == 62.210.18.40 && tcp to filter out the TCP packets transferred between server and client.
   For 2mb file, we find that a total of 956 packets are transferred between the client and server.



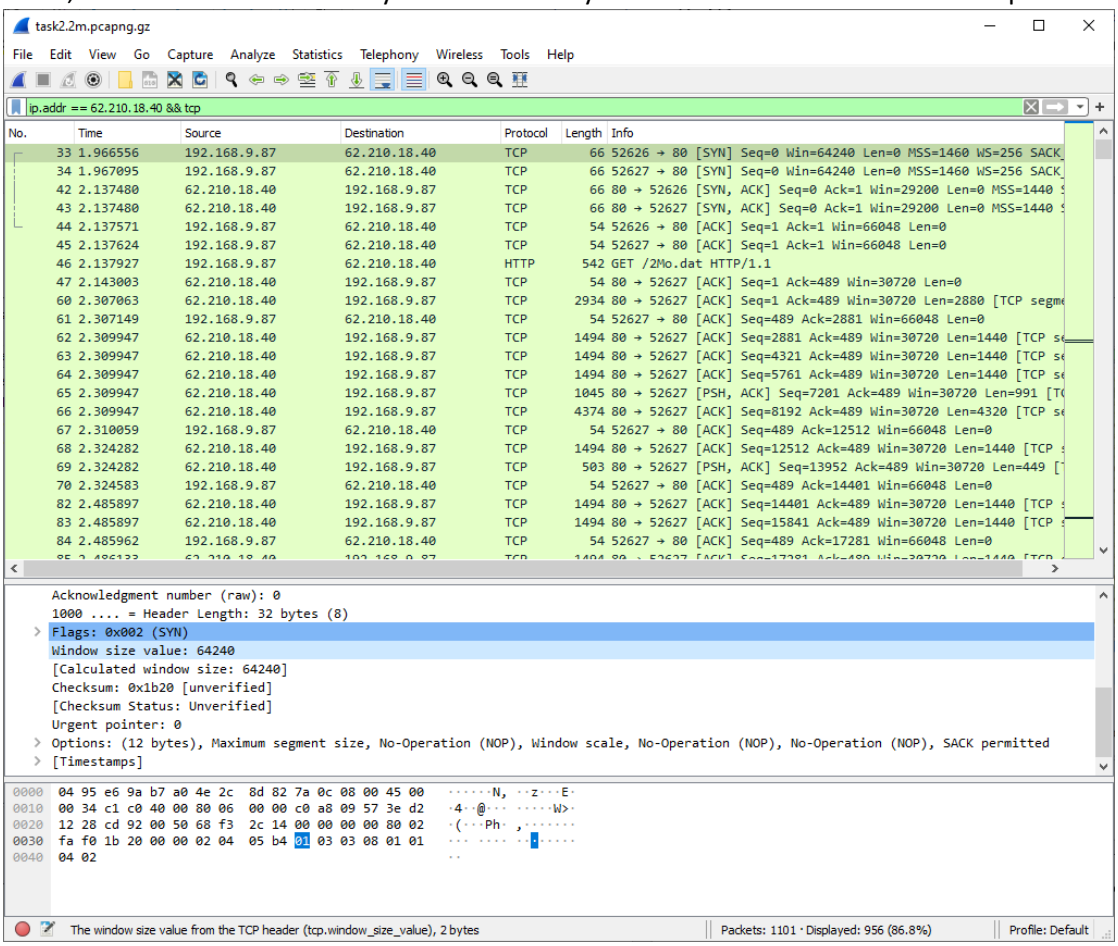


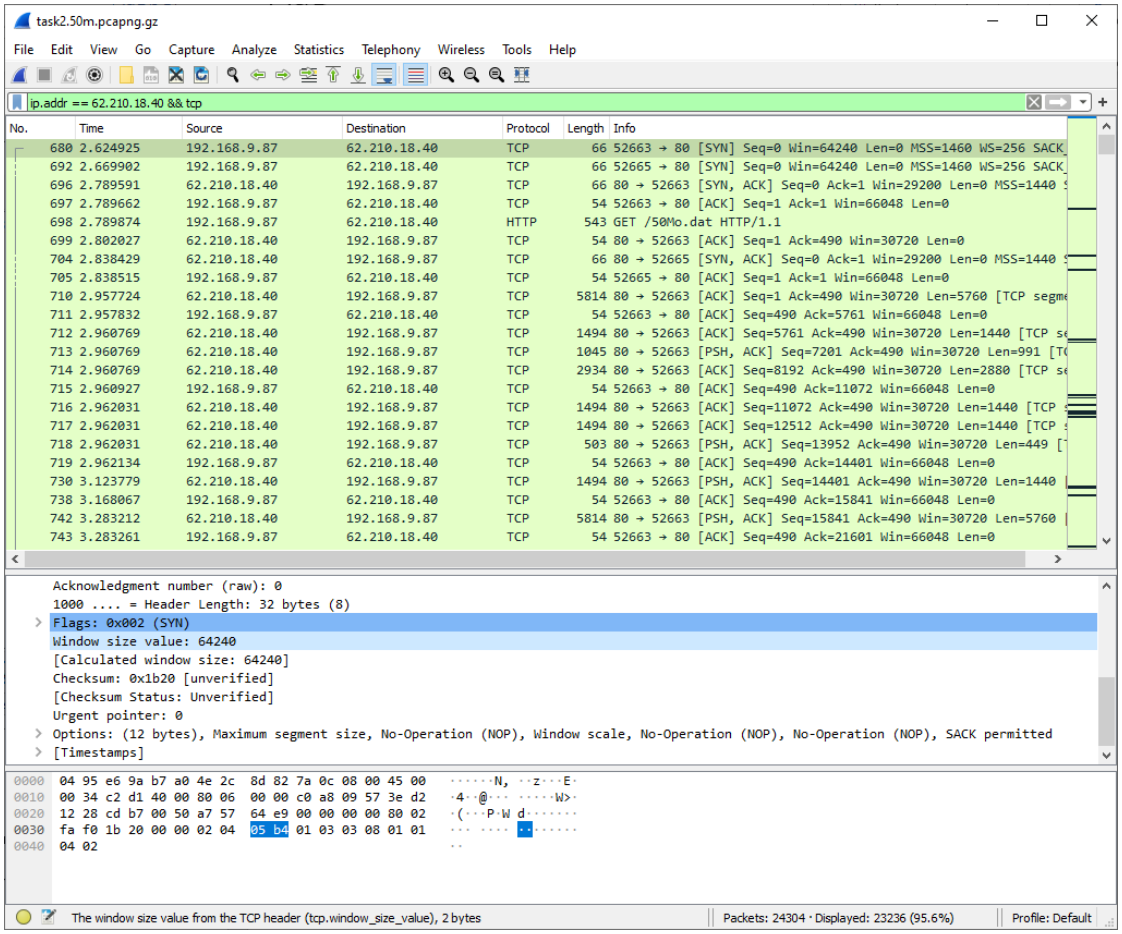
For 50 mb file, we find that a total of 23296 packets are transferred between the client and server.


task2.50m.pcapng.gz
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
ip.addr == 62.210.18.40 && tcp
No. Time Source Destination Protocol Length Info
24270 49.948872 192.168.9.87 62.210.18.40 TCP 54 52663 → 80 [ACK] Seq=490 Ack=49972390 Win=3432960 Len=0
24271 49.952988 62.210.18.40 192.168.9.87 TCP 4374 80 → 52663 [ACK] Seq=49972390 Ack=490 Win=30720 Len=4320 [T
24272 49.953042 192.168.9.87 62.210.18.40 TCP 54 52663 → 80 [ACK] Seq=490 Ack=49976710 Win=3432960 Len=0
24273 49.968592 62.210.18.40 192.168.9.87 TCP 1494 80 → 52663 [ACK] Seq=49976710 Ack=490 Win=30720 Len=1440 [T
24274 49.968592 62.210.18.40 192.168.9.87 TCP 2934 80 → 52663 [ACK] Seq=49978150 Ack=490 Win=30720 Len=2880 [T
24275 49.968667 192.168.9.87 62.210.18.40 TCP 54 52663 → 80 [ACK] Seq=490 Ack=49981030 Win=3432960 Len=0
24276 49.987516 62.210.18.40 192.168.9.87 TCP 1494 80 → 52663 [ACK] Seq=49981030 Ack=490 Win=30720 Len=1440 [T
24277 49.987516 62.210.18.40 192.168.9.87 TCP 1494 80 → 52663 [ACK] Seq=49982470 Ack=490 Win=30720 Len=1440 [T
24278 49.987564 192.168.9.87 62.210.18.40 TCP 54 52663 → 80 [ACK] Seq=490 Ack=49983910 Win=3432960 Len=0
24279 49.990628 62.210.18.40 192.168.9.87 TCP 1494 80 → 52663 [ACK] Seq=49983910 Ack=490 Win=30720 Len=1440 [T
24280 49.990628 62.210.18.40 192.168.9.87 TCP 1494 80 → 52663 [ACK] Seq=49985350 Ack=490 Win=30720 Len=1440 [T
24281 49.990653 192.168.9.87 62.210.18.40 TCP 54 52663 → 80 [ACK] Seq=490 Ack=49986790 Win=3432960 Len=0
24282 50.000887 62.210.18.40 192.168.9.87 TCP 1494 80 → 52663 [ACK] Seq=49986790 Ack=490 Win=30720 Len=1440 [T
24283 50.000887 62.210.18.40 192.168.9.87 TCP 1494 80 → 52663 [ACK] Seq=49988230 Ack=490 Win=30720 Len=1440 [T
24284 50.000933 192.168.9.87 62.210.18.40 TCP 54 52663 → 80 [ACK] Seq=490 Ack=49989670 Win=3432960 Len=0
24285 50.009592 62.210.18.40 192.168.9.87 TCP 1494 80 → 52663 [ACK] Seq=49989670 Ack=490 Win=30720 Len=1440 [T
24286 50.009592 62.210.18.40 192.168.9.87 TCP 1494 80 → 52663 [ACK] Seq=49991110 Ack=490 Win=30720 Len=1440 [T
24287 50.009592 62.210.18.40 192.168.9.87 TCP 1494 80 → 52663 [ACK] Seq=49992550 Ack=490 Win=30720 Len=1440 [T
24288 50.009644 192.168.9.87 62.210.18.40 TCP 54 52663 → 80 [ACK] Seq=490 Ack=49993990 Win=3432960 Len=0
24289 50.014273 62.210.18.40 192.168.9.87 TCP 5814 80 → 52663 [ACK] Seq=49993990 Ack=490 Win=30720 Len=5760 [T
24290 50.014424 192.168.9.87 62.210.18.40 TCP 54 52663 → 80 [ACK] Seq=490 Ack=49999750 Win=3432960 Len=0
24291 50.023080 62.210.18.40 192.168.9.87 HTTP 576 HTTP/1.1 200 OK
Frame 680: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface \Device\NPF_{69905F9E-06EF-4127-9DBE-D20CCD8FAE4E}, id 0
Ethernet II, Src: 4e:2c:8d:82:7a:0c (4e:2c:8d:82:7a:0c), Dst: TendaTec_9a:b7:a0 (04:95:e6:9a:b7:a0)
Internet Protocol Version 4, Src: 192.168.9.87, Dst: 62.210.18.40
Transmission Control Protocol, Src Port: 52663, Dst Port: 80, Seq: 0, Len: 0
0000 04 95 e6 9a b7 a0 4e 2c 8d 82 7a 0c 08 00 45 00
0010 00 34 c2 d1 40 00 80 06 00 00 c0 a8 09 57 3e d2
0020 12 28 cd b7 00 50 a7 57 64 e9 00 00 00 00 80 02
0030 fa f0 1b 20 00 00 02 04 05 b4 01 03 03 08 01 01
0040 04 02
Transmission Control Protocol: Protocol
Packets: 24304 · Displayed: 23236 (95.6%)
Profile: Default

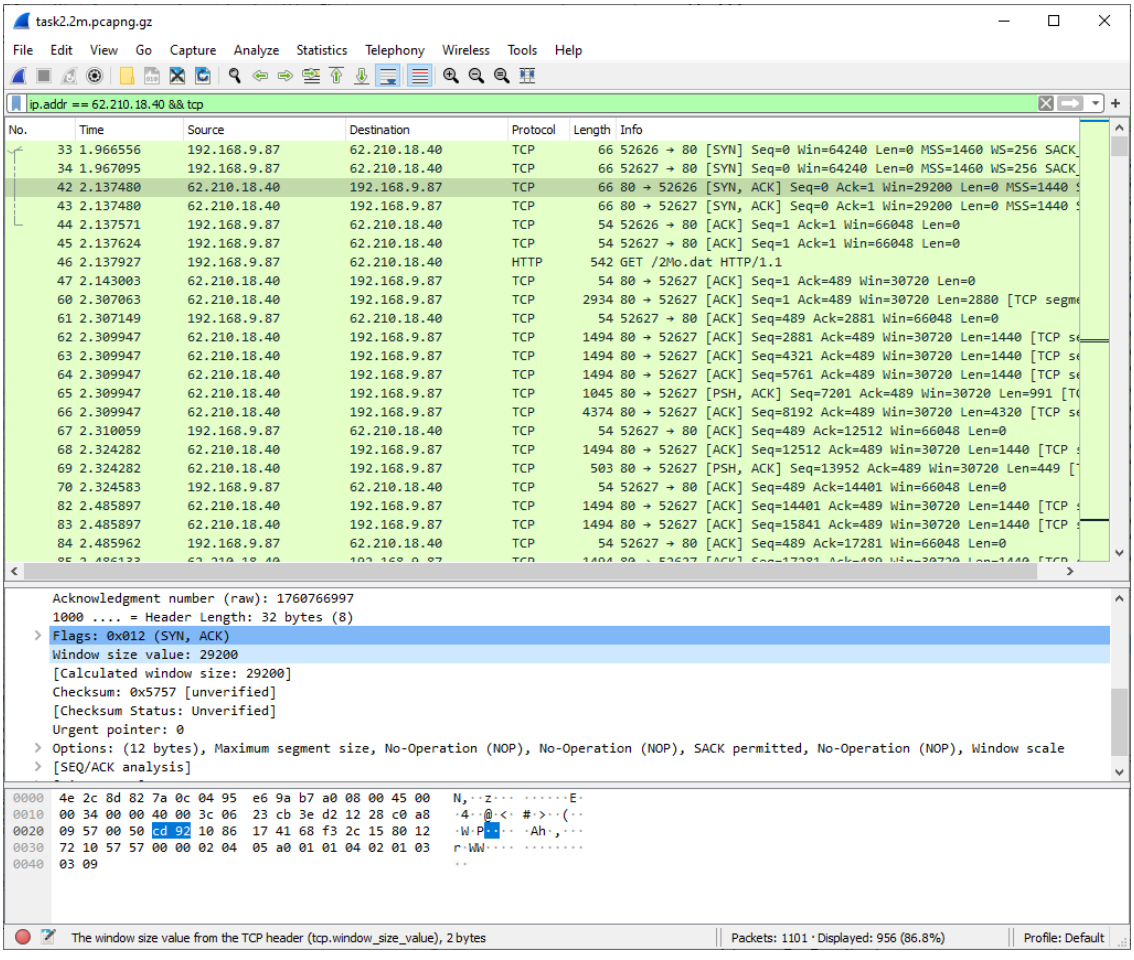

Wireshark · Endpoints · task2.50m.pcapng.gz
Ethernet · 2 IPv4 · 2 IPv6 TCP · 3 UDP
Address Port Packets Bytes Tx Packets Tx Bytes Rx Packets Rx Bytes
62.210.18.40 80 23,236 51 M 15,665 50 M 7,571 428 k
192.168.9.87 52663 23,227 51 M 7,566 428 k 15,661 50 M
192.168.9.87 52665 9 523 5 283 4 240
Name resolution
Limit to display filter
Endpoint Types
Copy
Map
Close
Help

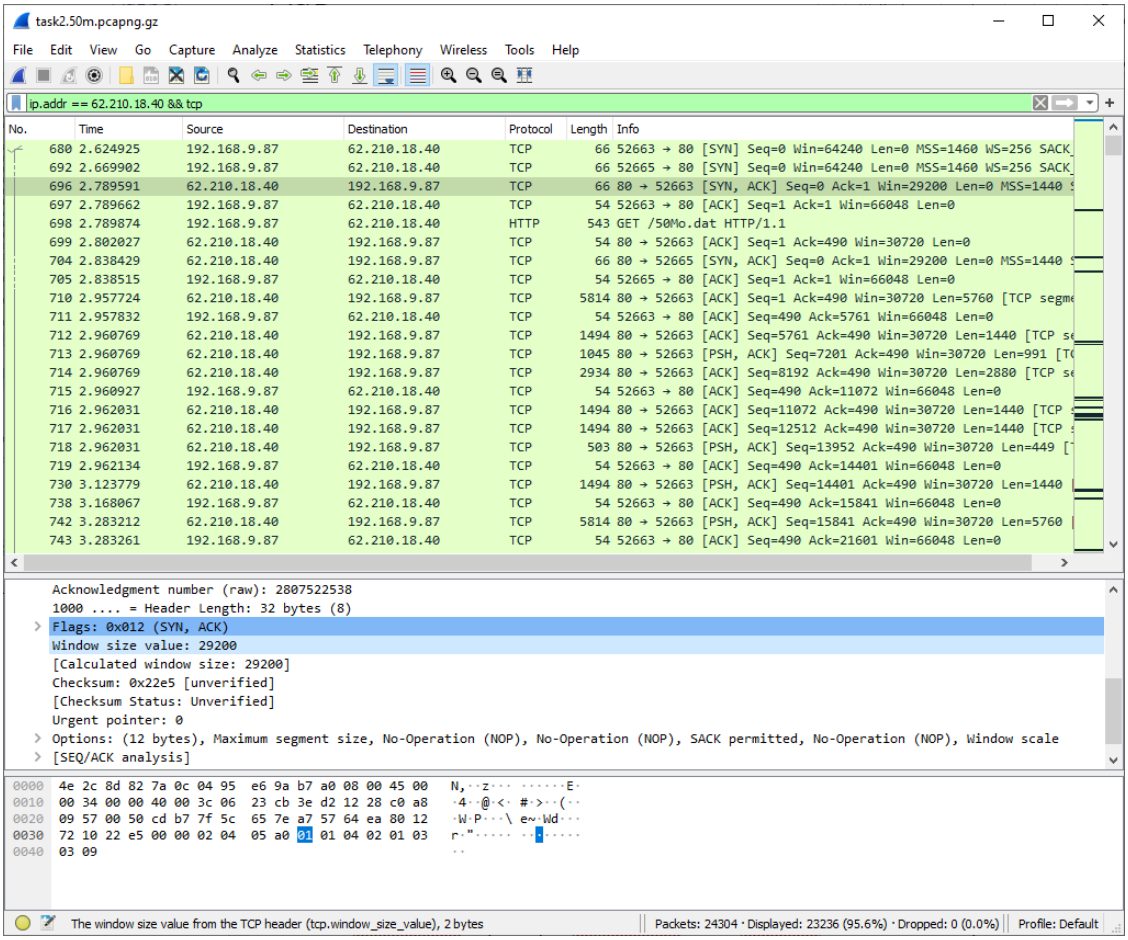
2. What is the minimum amount of available buffer space advertised at the client/receiver for the entire trace?
   The minimum buffer space is advertised in the first SYN packet for client side and SYN, ACK packet for the server side.
   For both the 2mb file and 50mb file, the buffer size at both server and client is the same.
   For the client, the buffer size is 64240 bytes are shown by the window size value in first SYN packet.





For the server, the buffer size is 29200 bytes as shown by the window size value in first SYN, ACK packet.



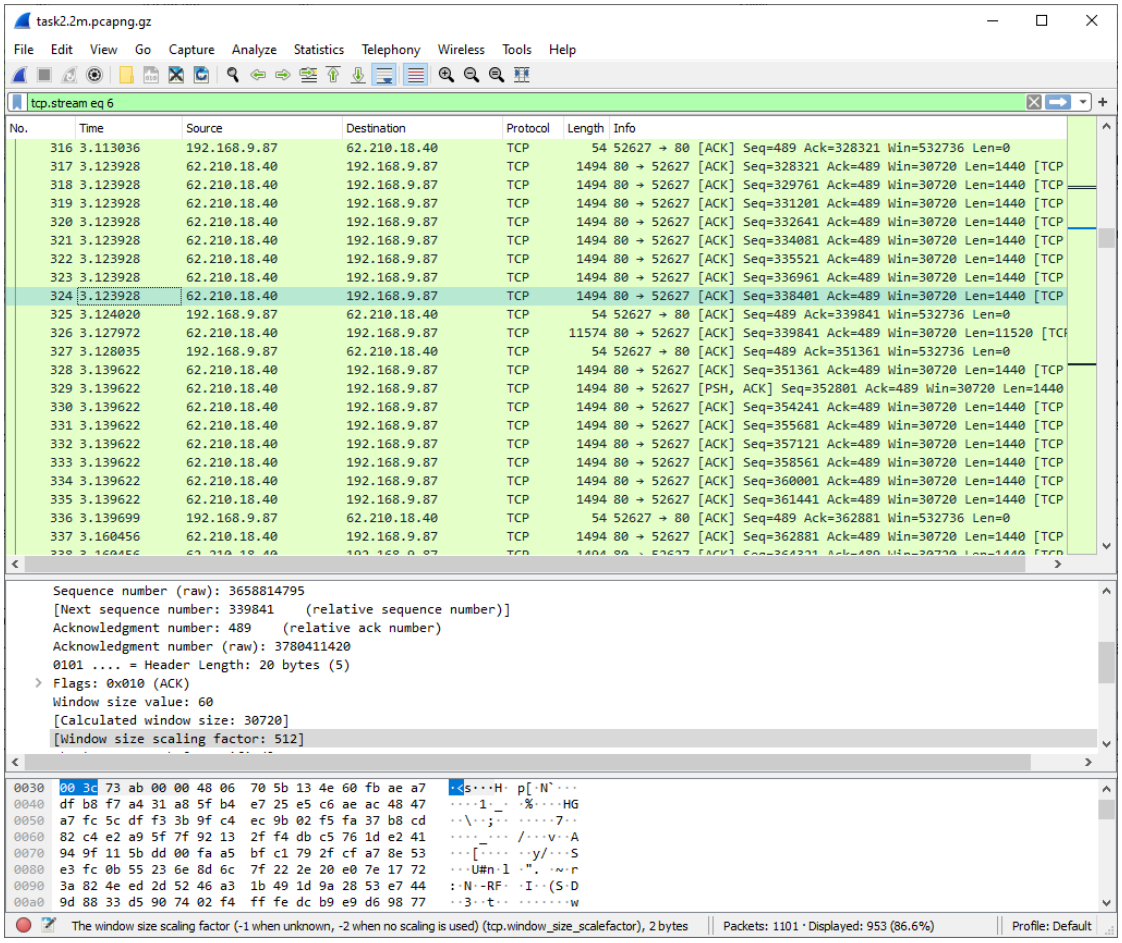


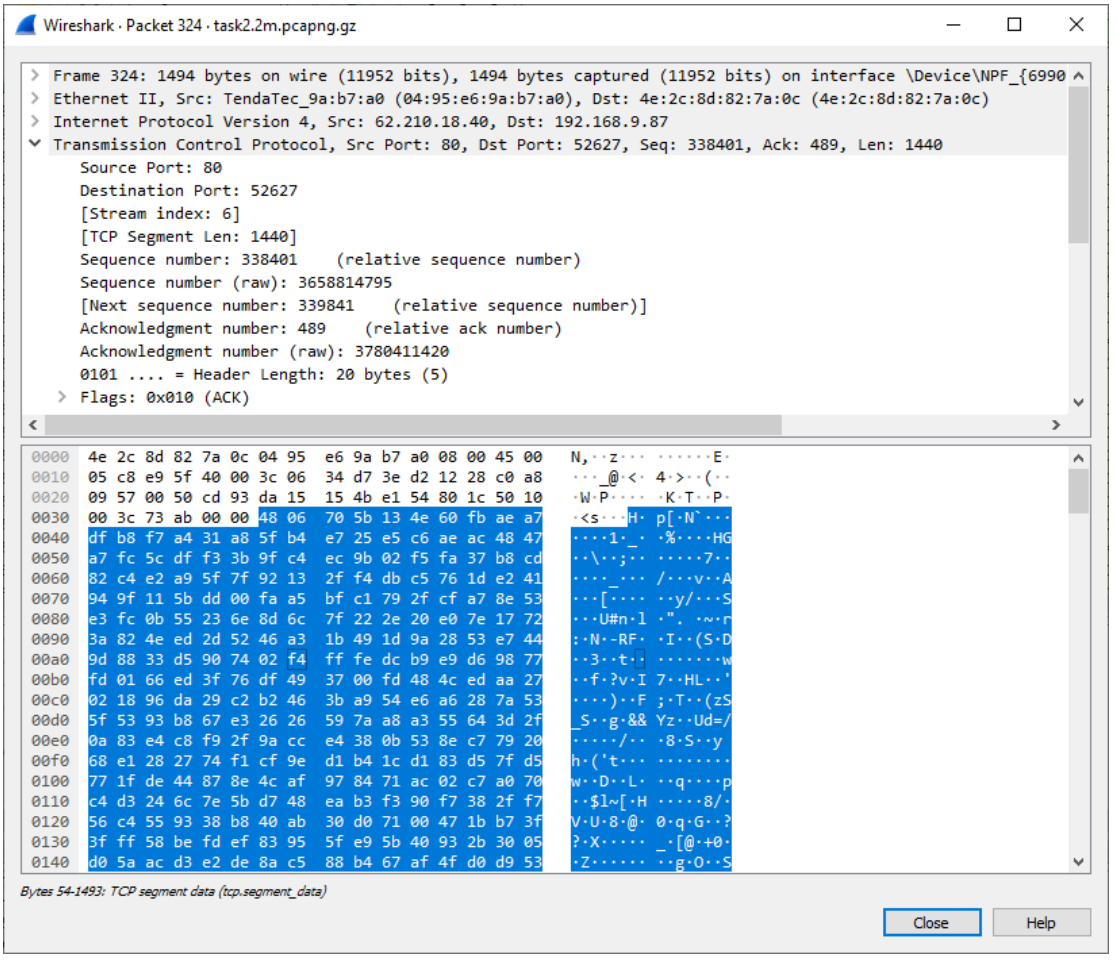
3. Pick any 5 TCP segments from server to client which are not part of initial TCP connection establishment and final connection termination.

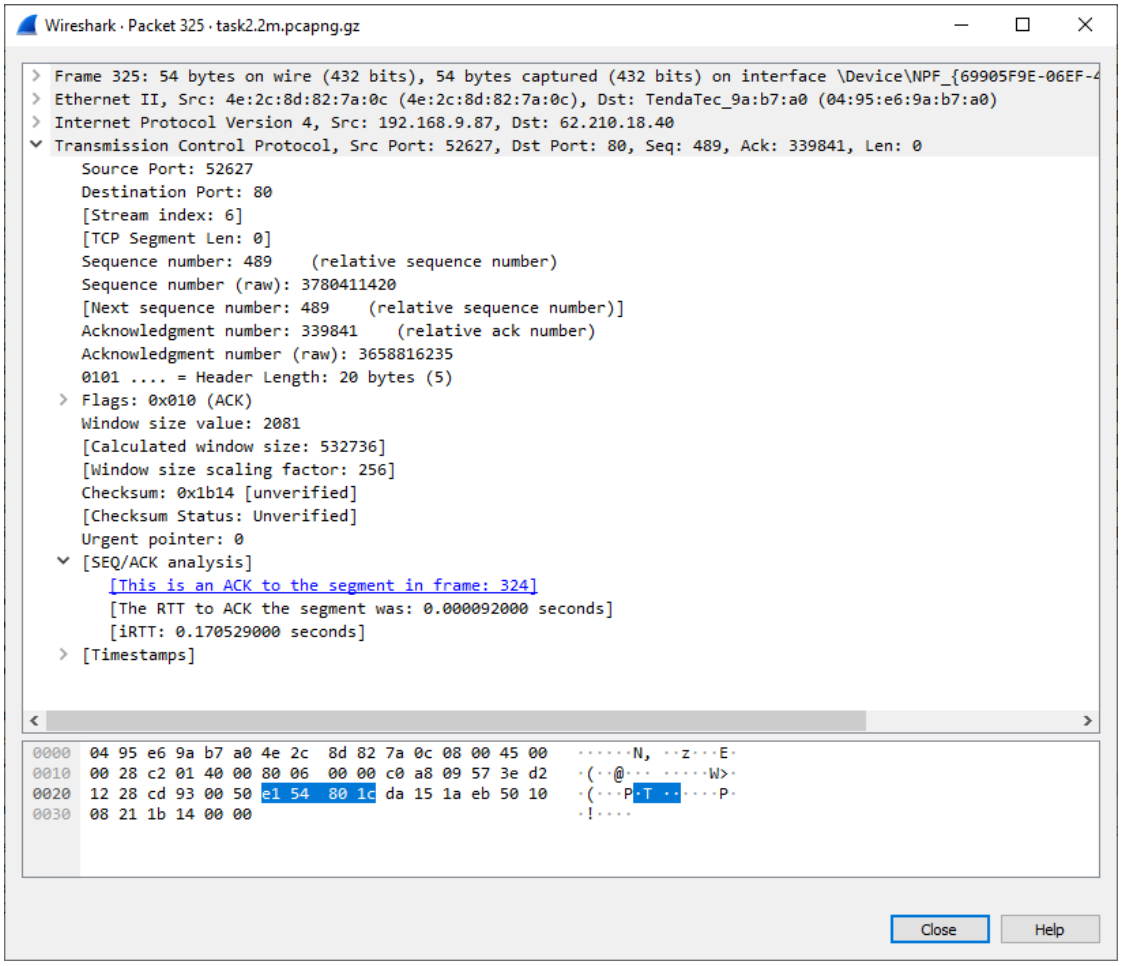
   1. Make a table listing for each of these segments, the length of each of these TCP segments, the sequence number, time when the segment was sent, time when the respective ACK for each segment was received, length of the respective ACK segment. Place the screenshot of Wireshark of at least one such segment with respective ACK as a proof of observation and calculation. What is the maximum length out of all?

   For the 2m file,

Segment no	Length of segment	Sequence no (relative)	Time when segment sent	Time of ACK	Length of ACK
315	1494	326881	3.112960	3.113096	54
324	1494	338401	3.123928	3.124020	54
326	11574	339841	3.128035	3.128035	54
335	1494	362881	3.139622	3.139699	54
338	1494	364321	3.160456	3.160504	54

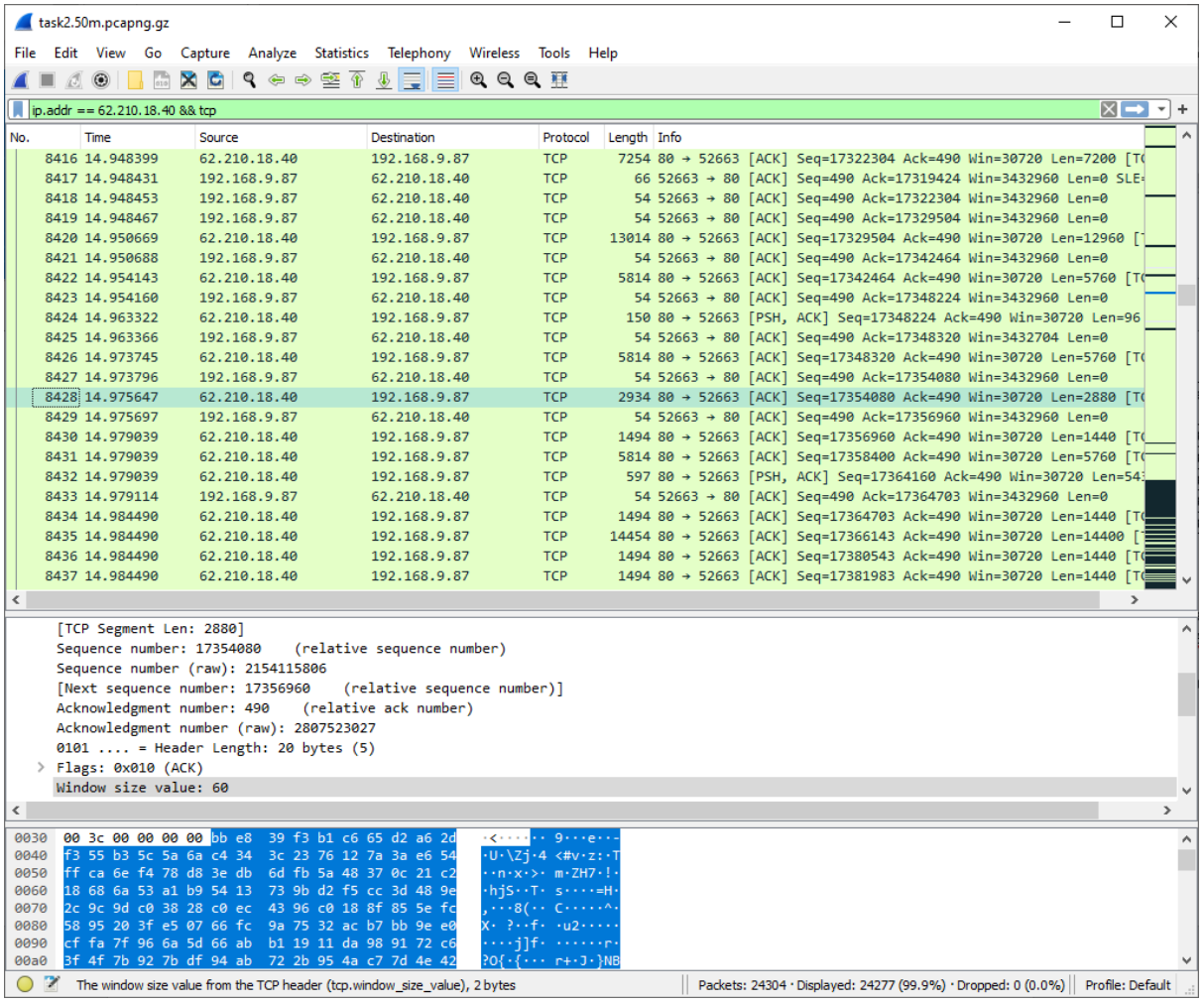

task2.2m.pcapng.gz
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
tcp.stream eq 6
No. Time Source Destination Protocol Length Info
316 3.113036 192.168.9.87 62.210.18.40 TCP 54 52627 → 80 [ACK] Seq=489 Ack=328321 Win=532736 Len=0
317 3.123928 62.210.18.40 192.168.9.87 TCP 1494 80 → 52627 [ACK] Seq=328321 Ack=489 Win=30720 Len=1440 [TCP
318 3.123928 62.210.18.40 192.168.9.87 TCP 1494 80 → 52627 [ACK] Seq=329761 Ack=489 Win=30720 Len=1440 [TCP
319 3.123928 62.210.18.40 192.168.9.87 TCP 1494 80 → 52627 [ACK] Seq=331201 Ack=489 Win=30720 Len=1440 [TCP
320 3.123928 62.210.18.40 192.168.9.87 TCP 1494 80 → 52627 [ACK] Seq=332641 Ack=489 Win=30720 Len=1440 [TCP
321 3.123928 62.210.18.40 192.168.9.87 TCP 1494 80 → 52627 [ACK] Seq=334081 Ack=489 Win=30720 Len=1440 [TCP
322 3.123928 62.210.18.40 192.168.9.87 TCP 1494 80 → 52627 [ACK] Seq=335521 Ack=489 Win=30720 Len=1440 [TCP
323 3.123928 62.210.18.40 192.168.9.87 TCP 1494 80 → 52627 [ACK] Seq=336961 Ack=489 Win=30720 Len=1440 [TCP
324 3.123928 62.210.18.40 192.168.9.87 TCP 1494 80 → 52627 [ACK] Seq=338401 Ack=489 Win=30720 Len=1440 [TCP
325 3.124020 192.168.9.87 62.210.18.40 TCP 54 52627 → 80 [ACK] Seq=489 Ack=339841 Win=532736 Len=0
326 3.127972 62.210.18.40 192.168.9.87 TCP 11574 80 → 52627 [ACK] Seq=339841 Ack=489 Win=30720 Len=11520 [TCP
327 3.128035 192.168.9.87 62.210.18.40 TCP 54 52627 → 80 [ACK] Seq=489 Ack=351361 Win=532736 Len=0
328 3.139622 62.210.18.40 192.168.9.87 TCP 1494 80 → 52627 [ACK] Seq=351361 Ack=489 Win=30720 Len=1440 [TCP
329 3.139622 62.210.18.40 192.168.9.87 TCP 1494 80 → 52627 [PSH, ACK] Seq=352801 Ack=489 Win=30720 Len=1440
330 3.139622 62.210.18.40 192.168.9.87 TCP 1494 80 → 52627 [ACK] Seq=354241 Ack=489 Win=30720 Len=1440 [TCP
331 3.139622 62.210.18.40 192.168.9.87 TCP 1494 80 → 52627 [ACK] Seq=355681 Ack=489 Win=30720 Len=1440 [TCP
332 3.139622 62.210.18.40 192.168.9.87 TCP 1494 80 → 52627 [ACK] Seq=357121 Ack=489 Win=30720 Len=1440 [TCP
333 3.139622 62.210.18.40 192.168.9.87 TCP 1494 80 → 52627 [ACK] Seq=358561 Ack=489 Win=30720 Len=1440 [TCP
334 3.139622 62.210.18.40 192.168.9.87 TCP 1494 80 → 52627 [ACK] Seq=360001 Ack=489 Win=30720 Len=1440 [TCP
335 3.139622 62.210.18.40 192.168.9.87 TCP 1494 80 → 52627 [ACK] Seq=361441 Ack=489 Win=30720 Len=1440 [TCP
336 3.139699 192.168.9.87 62.210.18.40 TCP 54 52627 → 80 [ACK] Seq=489 Ack=362881 Win=532736 Len=0
337 3.160456 62.210.18.40 192.168.9.87 TCP 1494 80 → 52627 [ACK] Seq=362881 Ack=489 Win=30720 Len=1440 [TCP
Sequence number (raw): 3658814795
[Next sequence number: 339841 (relative sequence number)]
Acknowledgment number: 489 (relative ack number)
Acknowledgment number (raw): 3780411420
0101 .... = Header Length: 20 bytes (5)
Flags: 0x010 (ACK)
Window size value: 60
[Calculated window size: 30720]
[Window size scaling factor: 512]
0030 00 3c 73 ab 00 00 48 06 70 5b 13 4e 60 fb ae a7
0040 df b8 f7 a4 31 a8 5f b4 e7 25 e5 c6 ae ac 48 47
0050 a7 fc 5c df f3 3b 9f c4 ec 9b 02 f5 fa 37 b8 cd
0060 82 c4 e2 a9 5f 7f 92 13 2f f4 db c5 76 1d e2 41
0070 94 9f 11 5b dd 00 fa a5 bf c1 79 2f cf a7 8e 53
0080 e3 fc 0b 55 23 6e 8d 6c 7f 22 2e 20 e0 7e 17 72
0090 3a 82 4e ed 2d 52 46 a3 1b 49 1d 9a 28 53 e7 44
00a0 9d 88 33 d5 90 74 02 f4 ff fe dc b9 e9 d6 98 77
The window size scaling factor (-1 when unknown, -2 when no scaling is used) (tcp.window_size_scalefactor), 2 bytes
Packets: 1101 · Displayed: 953 (86.6%)
Profile: Default

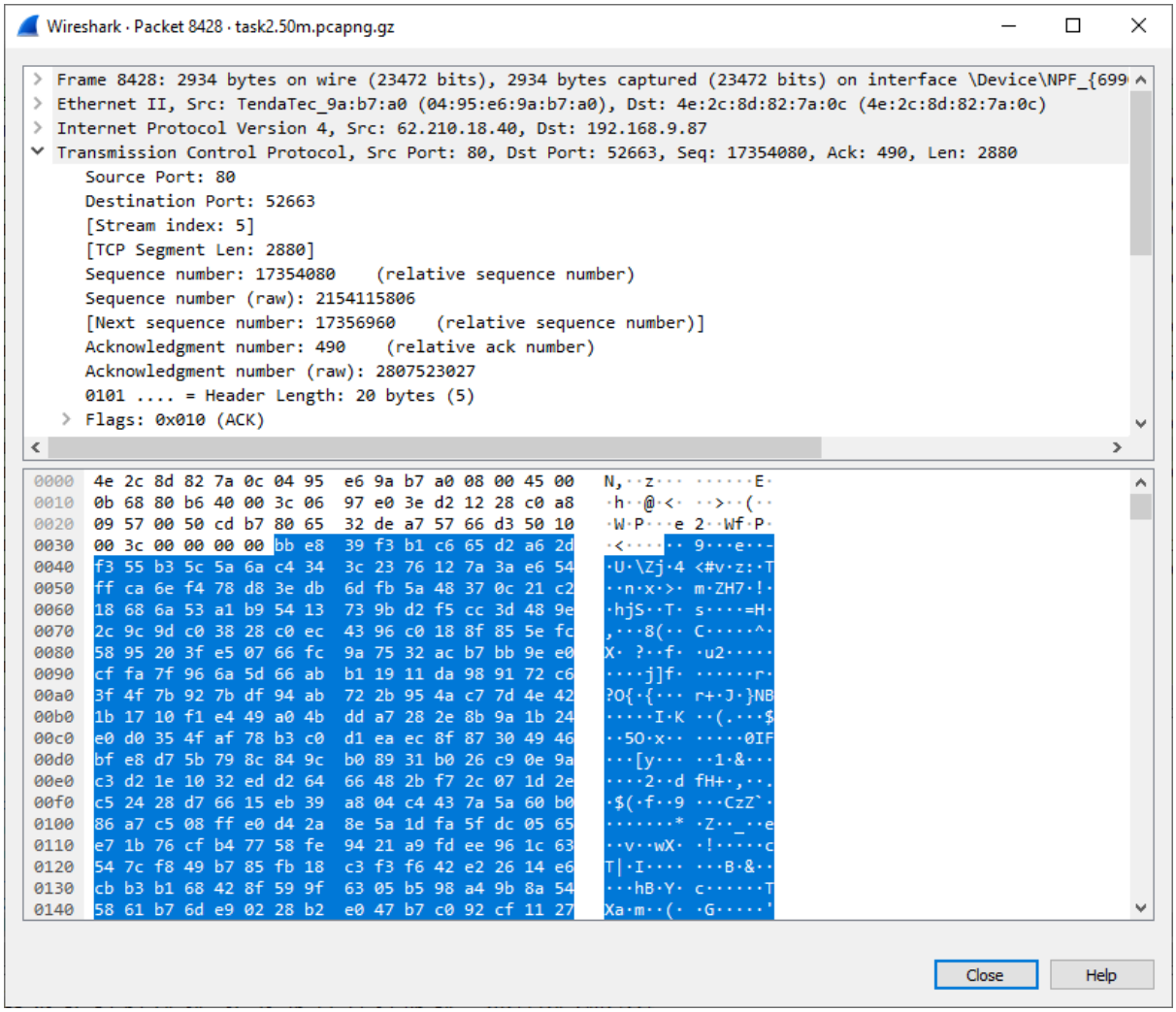

Wireshark · Packet 324 · task2.2m.pcapng.gz
Frame 324: 1494 bytes on wire (11952 bits), 1494 bytes captured (11952 bits) on interface \Device\NPF_{6990
Ethernet II, Src: TendaTec_9a:b7:a0 (04:95:e6:9a:b7:a0), Dst: 4e:2c:8d:82:7a:0c (4e:2c:8d:82:7a:0c)
Internet Protocol Version 4, Src: 62.210.18.40, Dst: 192.168.9.87
Transmission Control Protocol, Src Port: 80, Dst Port: 52627, Seq: 338401, Ack: 489, Len: 1440
Source Port: 80
Destination Port: 52627
[Stream index: 6]
[TCP Segment Len: 1440]
Sequence number: 338401 (relative sequence number)
Sequence number (raw): 3658814795
[Next sequence number: 339841 (relative sequence number)]
Acknowledgment number: 489 (relative ack number)
Acknowledgment number (raw): 3780411420
0101 .... = Header Length: 20 bytes (5)
Flags: 0x010 (ACK)
0000 4e 2c 8d 82 7a 0c 04 95 e6 9a b7 a0 08 00 45 00
0010 05 c8 e9 5f 40 00 3c 06 34 d7 3e d2 12 28 c0 a8
0020 09 57 00 50 cd 93 da 15 15 4b e1 54 80 1c 50 10
0030 00 3c 73 ab 00 00 48 06 70 5b 13 4e 60 fb ae a7
0040 df b8 f7 a4 31 a8 5f b4 e7 25 e5 c6 ae ac 48 47
0050 a7 fc 5c df f3 3b 9f c4 ec 9b 02 f5 fa 37 b8 cd
0060 82 c4 e2 a9 5f 7f 92 13 2f f4 db c5 76 1d e2 41
0070 94 9f 11 5b dd 00 fa a5 bf c1 79 2f cf a7 8e 53
0080 e3 fc 0b 55 23 6e 8d 6c 7f 22 2e 20 e0 7e 17 72
0090 3a 82 4e ed 2d 52 46 a3 1b 49 1d 9a 28 53 e7 44
00a0 9d 88 33 d5 90 74 02 f4 ff fe dc b9 e9 d6 98 77
00b0 fd 01 66 ed 3f 76 df 49 37 00 fd 48 4c ed aa 27
00c0 02 18 96 da 29 c2 b2 46 3b a9 54 e6 a6 28 7a 53
00d0 5f 53 93 b8 67 e3 26 26 59 7a a8 a3 55 64 3d 2f
00e0 0a 83 e4 c8 f9 2f 9a cc e4 38 0b 53 8e c7 79 20
00f0 68 e1 28 27 74 f1 cf 9e d1 b4 1c d1 83 d5 7f d5
0100 77 1f de 44 87 8e 4c af 97 84 71 ac 02 c7 a0 70
0110 c4 d3 24 6c 7e 5b d7 48 ea b3 f3 90 f7 38 2f f7
0120 56 c4 55 93 38 b8 40 ab 30 d0 71 00 47 1b b7 3f
0130 3f ff 58 be fd ef 83 95 5f e9 5b 40 93 2b 30 05
0140 d0 5a ac d3 e2 de 8a c5 88 b4 67 af 4f d0 d9 53
Bytes 54-1493: TCP segment data (tcp.segment_data)
Close
Help



For the 50m file,

Segment no	Length of segment	Sequence no	Time when segment sent	Time of ACK	Length of ACK
8422	5814	17342464	14.954143	14.954160	54
8426	5814	17348320	14.973745	14.973796	54
8428	2934	17354080	14.975647	14.975697	54
8432	597	17364160	14.979039	14.979114	54
8441	1494	17389183	14.984490	14.984552	54


task2.50m.pcapng.gz
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
ip.addr == 62.210.18.40 && tcp
No. Time Source Destination Protocol Length Info
8416 14.948399 62.210.18.40 192.168.9.87 TCP 7254 80 → 52663 [ACK] Seq=17322304 Ack=490 Win=30720 Len=7200 [T
8417 14.948431 192.168.9.87 62.210.18.40 TCP 66 52663 → 80 [ACK] Seq=490 Ack=17319424 Win=3432960 Len=0 SLE
8418 14.948453 192.168.9.87 62.210.18.40 TCP 54 52663 → 80 [ACK] Seq=490 Ack=17322304 Win=3432960 Len=0
8419 14.948467 192.168.9.87 62.210.18.40 TCP 54 52663 → 80 [ACK] Seq=490 Ack=17329504 Win=3432960 Len=0
8420 14.950669 62.210.18.40 192.168.9.87 TCP 13014 80 → 52663 [ACK] Seq=17329504 Ack=490 Win=30720 Len=12960 [
8421 14.950688 192.168.9.87 62.210.18.40 TCP 54 52663 → 80 [ACK] Seq=490 Ack=17342464 Win=3432960 Len=0
8422 14.954143 62.210.18.40 192.168.9.87 TCP 5814 80 → 52663 [ACK] Seq=17342464 Ack=490 Win=30720 Len=5760 [T
8423 14.954160 192.168.9.87 62.210.18.40 TCP 54 52663 → 80 [ACK] Seq=490 Ack=17348224 Win=3432960 Len=0
8424 14.963322 62.210.18.40 192.168.9.87 TCP 150 80 → 52663 [PSH, ACK] Seq=17348224 Ack=490 Win=30720 Len=96
8425 14.963366 192.168.9.87 62.210.18.40 TCP 54 52663 → 80 [ACK] Seq=490 Ack=17348320 Win=3432704 Len=0
8426 14.973745 62.210.18.40 192.168.9.87 TCP 5814 80 → 52663 [ACK] Seq=17348320 Ack=490 Win=30720 Len=5760 [T
8427 14.973796 192.168.9.87 62.210.18.40 TCP 54 52663 → 80 [ACK] Seq=490 Ack=17354080 Win=3432960 Len=0
8428 14.975647 62.210.18.40 192.168.9.87 TCP 2934 80 → 52663 [ACK] Seq=17354080 Ack=490 Win=30720 Len=2880 [T
8429 14.975697 192.168.9.87 62.210.18.40 TCP 54 52663 → 80 [ACK] Seq=490 Ack=17356960 Win=3432960 Len=0
8430 14.979039 62.210.18.40 192.168.9.87 TCP 1494 80 → 52663 [ACK] Seq=17356960 Ack=490 Win=30720 Len=1440 [T
8431 14.979039 62.210.18.40 192.168.9.87 TCP 5814 80 → 52663 [ACK] Seq=17358400 Ack=490 Win=30720 Len=5760 [T
8432 14.979039 62.210.18.40 192.168.9.87 TCP 597 80 → 52663 [PSH, ACK] Seq=17364160 Ack=490 Win=30720 Len=54
8433 14.979114 192.168.9.87 62.210.18.40 TCP 54 52663 → 80 [ACK] Seq=490 Ack=17364703 Win=3432960 Len=0
8434 14.984490 62.210.18.40 192.168.9.87 TCP 1494 80 → 52663 [ACK] Seq=17364703 Ack=490 Win=30720 Len=1440 [T
8435 14.984490 62.210.18.40 192.168.9.87 TCP 14454 80 → 52663 [ACK] Seq=17366143 Ack=490 Win=30720 Len=14400 [
8436 14.984490 62.210.18.40 192.168.9.87 TCP 1494 80 → 52663 [ACK] Seq=17380543 Ack=490 Win=30720 Len=1440 [T
8437 14.984490 62.210.18.40 192.168.9.87 TCP 1494 80 → 52663 [ACK] Seq=17381983 Ack=490 Win=30720 Len=1440 [T
[TCP Segment Len: 2880]
Sequence number: 17354080 (relative sequence number)
Sequence number (raw): 2154115806
[Next sequence number: 17356960 (relative sequence number)]
Acknowledgment number: 490 (relative ack number)
Acknowledgment number (raw): 2807523027
0101 .... = Header Length: 20 bytes (5)
Flags: 0x010 (ACK)
Window size value: 60
0030 00 3c 00 00 00 00 bb e8 39 f3 b1 c6 65 d2 a6 2d
0040 f3 55 b3 5c 5a 6a c4 34 3c 23 76 12 7a 3a e6 54
0050 ff ca 6e f4 78 d8 3e db 6d fb 5a 48 37 0c 21 c2
0060 18 68 6a 53 a1 b9 54 13 73 9b d2 f5 cc 3d 48 9e
0070 2c 9c 9d c0 38 28 c0 ec 43 96 c0 18 8f 85 5e fc
0080 58 95 20 3f e5 07 66 fc 9a 75 32 ac b7 bb 9e e0
0090 cf fa 7f 96 6a 5d 66 ab b1 19 11 da 98 91 72 c6
00a0 3f 4f 7b 92 7b df 94 ab 72 2b 95 4a c7 7d 4e 42
The window size value from the TCP header (tcp.window_size_value), 2 bytes
Packets: 24304 · Displayed: 24277 (99.9%) · Dropped: 0 (0.0%)
Profile: Default



2 .Given the difference between when each TCP segment was sent, and when its acknowledgement was received, what is the RTT value for each of these segments? What is the *EstimatedRTT* value after the receipt of each ACK? Assume that the value of the *EstimatedRTT* is equal to the measured RTT for the first segment, and then is computed using the *EstimatedRTT* equation for all subsequent segments.

Place these calculated values appropriately in the table formed in #b above. *EstimatedRTT = (1 – α) × EstimatedRTT + α × SampleRTT where α = 0.125 (that is, 1/8) [RFC 6298]*

For 2m capture,

Sequence no.	RTT	Estimated RTT
315	0.000136	0.000136
324	0.000092	0.000130
326	0.000063	0.000122
335	0.000077	0.000116
338	0.000048	0.000108

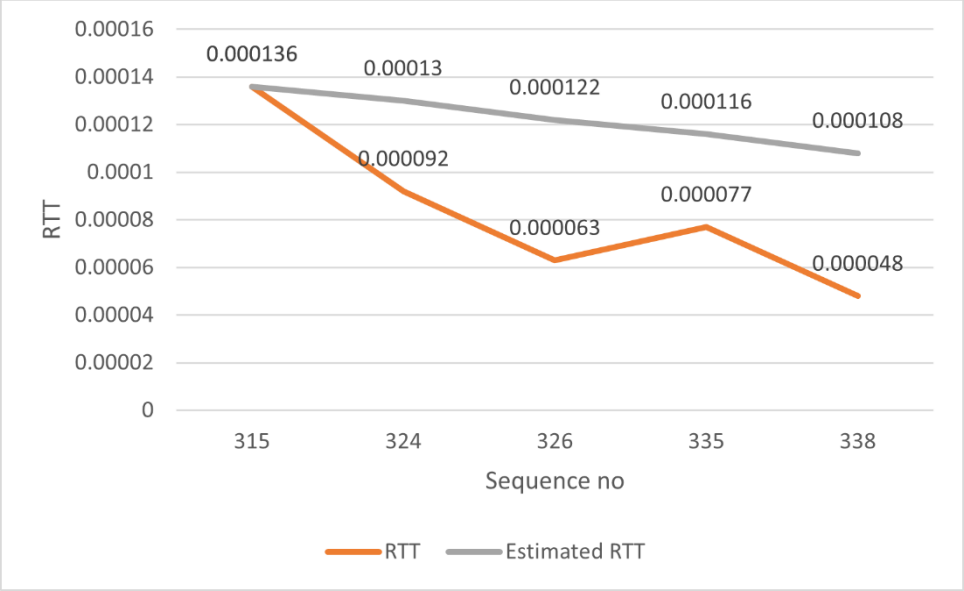
For 50m capture,

Sequence no.	RTT	Estimated RTT
8422	0.000017	0.000017

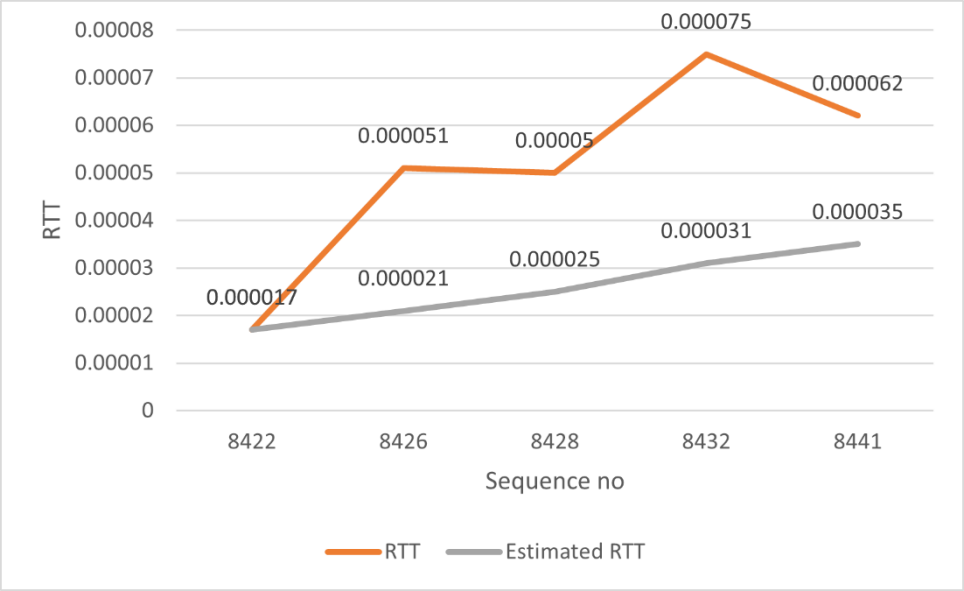
8426	0.000051	0.000021
8428	0.000050	0.000025
8432	0.000075	0.000031
8441	0.000062	0.000035

3. Plot the RTT Graph for any TCP segment out of these using the graph feature of Wireshark. Plot another graph manually from the table above for Sample RTT and estimated RTT.

For 2m capture,



For 50m capture,



4. Comment on your understanding of Estimated RTT calculation and plotted RTT graphs.

We find that RTT time is increasing/ decreasing which may show increasing / decreasing congestion. This may be due to network congestion or CPU bottlenecks where the system may be busy with other tasks and as such not able to provide response immediately.

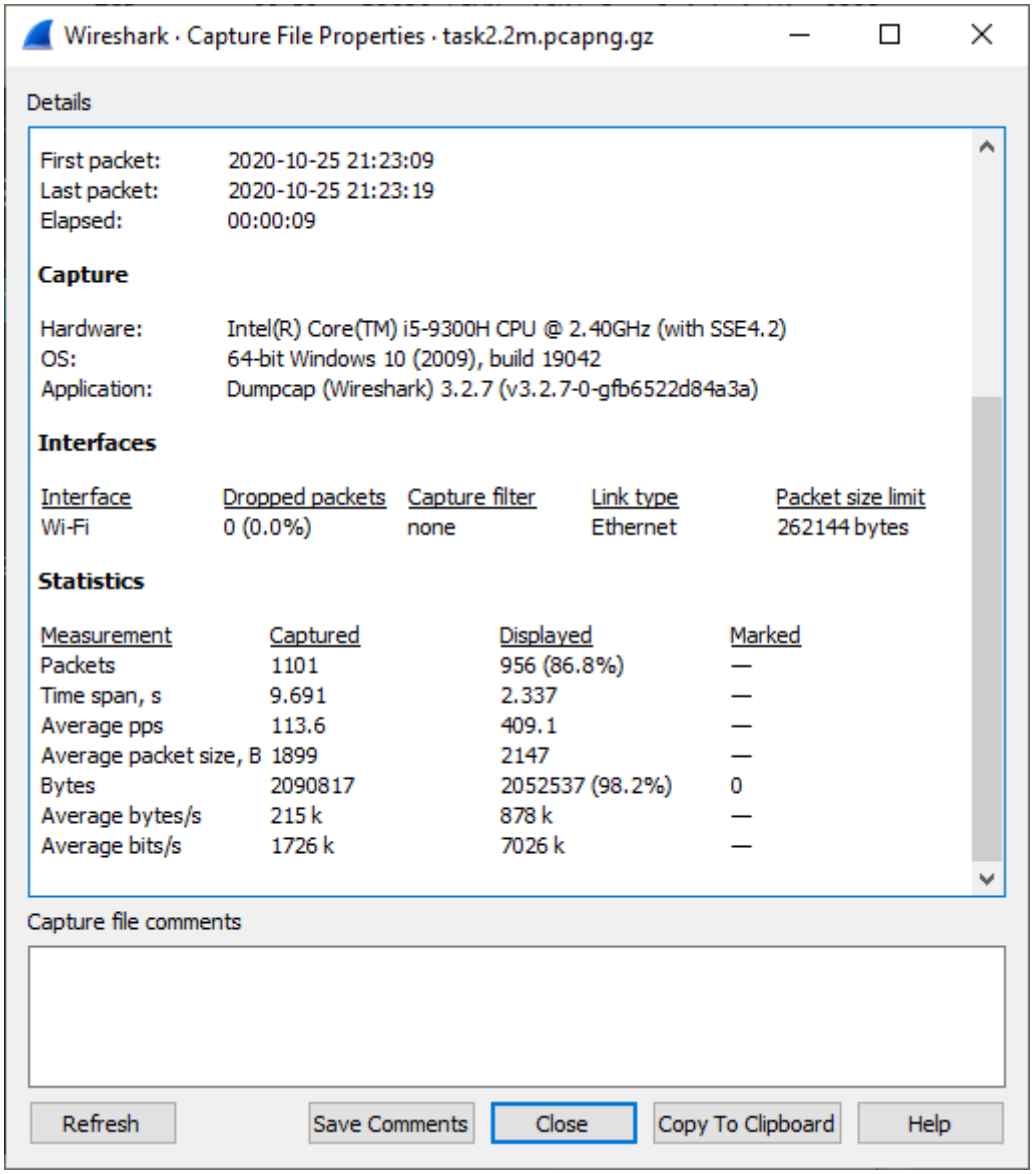
4. Calculate the overall throughput (bytes transferred per unit time) for this TCP conversation using different fields of TCP from the captured file. Explain how you calculated this value using Wireshark capture in this experiment along with relevant screenshots. Verify your calculation with the one done by Wireshark using “Capture File properties”. If you observe the major difference in your calculation and one calculated by Wireshark, comment why and how ?

   The total data transmitted can be computed by the difference between the sequence number of first TCP segment and last segment divided by the time difference between those segments.

   For 2m file, first sequence number is 1 and last segment is 1998721. The data is 1998721 – 1 = 1998720 bytes.

   The transmission time is the time difference of time instant of first TCP segment and last ACK segment. The total time is 4.303398 – 2.307063 = 1.996335 seconds.

   Therefore, the throughput for the TCP transmission is 1998720 / 1.996335 = 10,01,194.689268083763496607533304 8 bytes / second = 977.729 Kbytes / second.

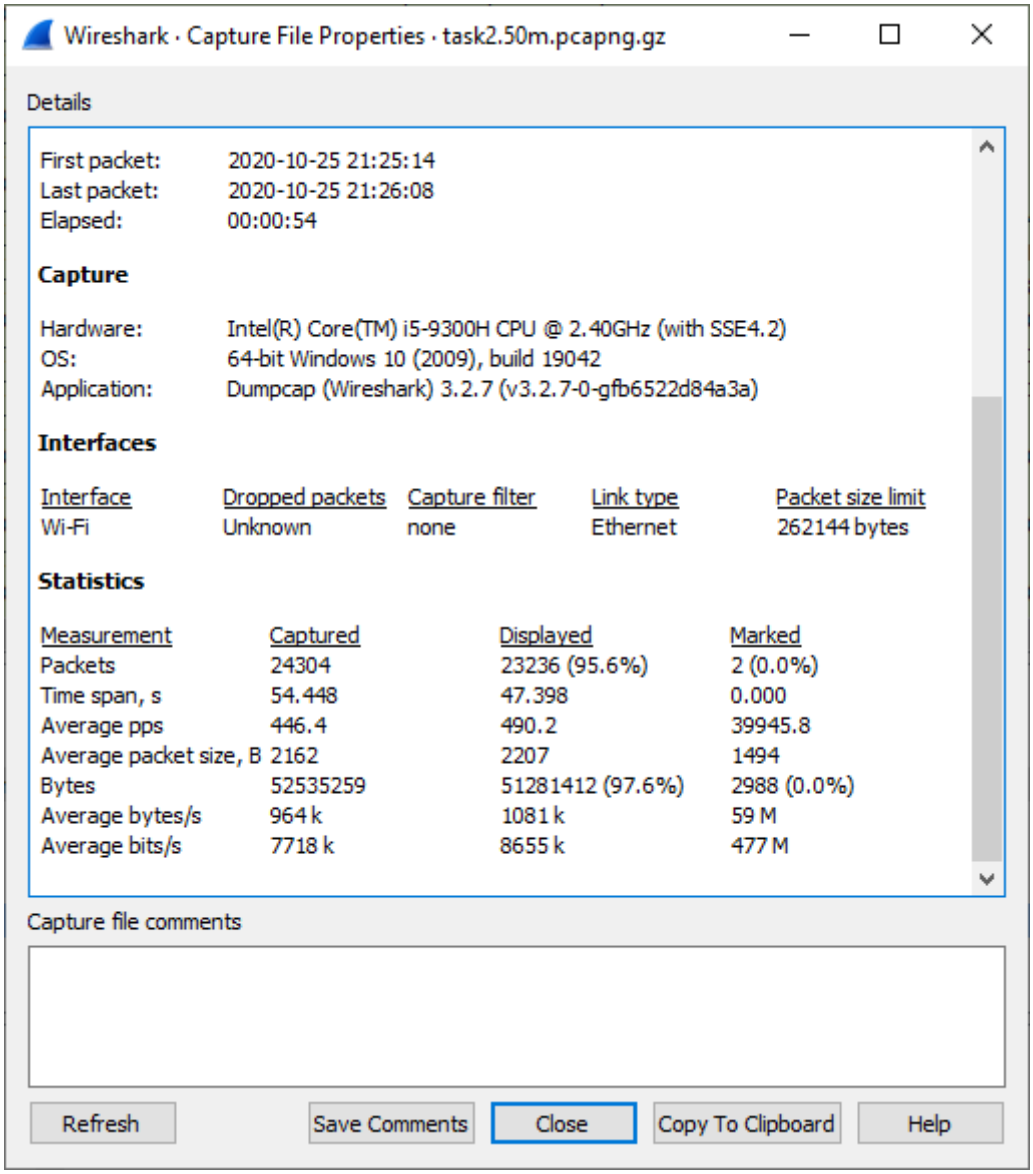


   Comparing this to wireshark file properties,the reported value is close to the calculated value.

   For 50m file, first sequence number is 1 and last segment is 49993990. The data is 49993990 – 1 = 49993989 bytes.

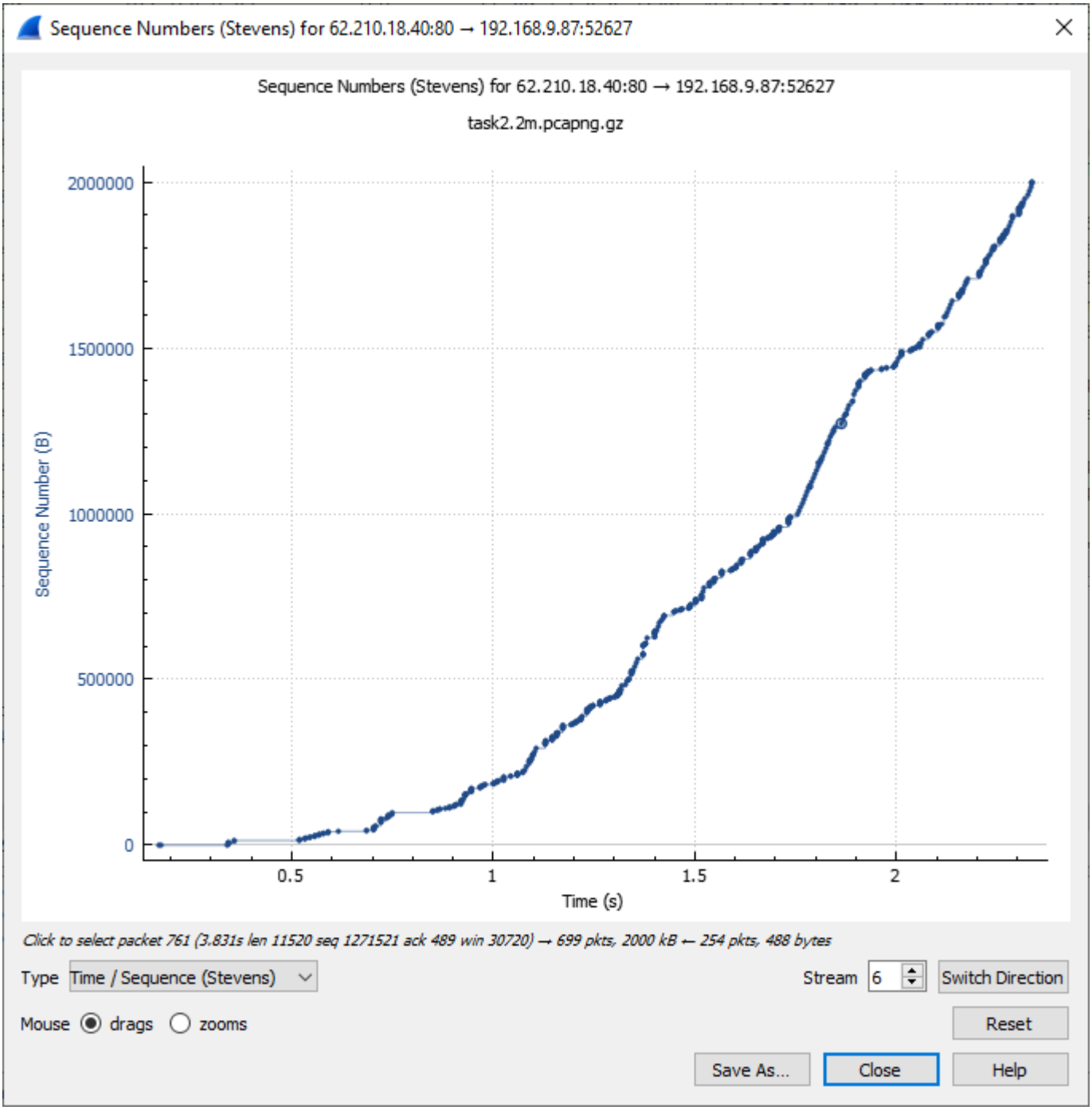
   The transmission time is the time difference of time instant of first TCP segment and last ACK segment. The total time is 50.014273 – 2.957724 = 47.056549 seconds.

Therefore, the throughput for the TCP transmission is 49993989 / 47.056549 = 10,62,423.617167506269956175494297 3 bytes / second = 1,037.523 Kbytes / second.

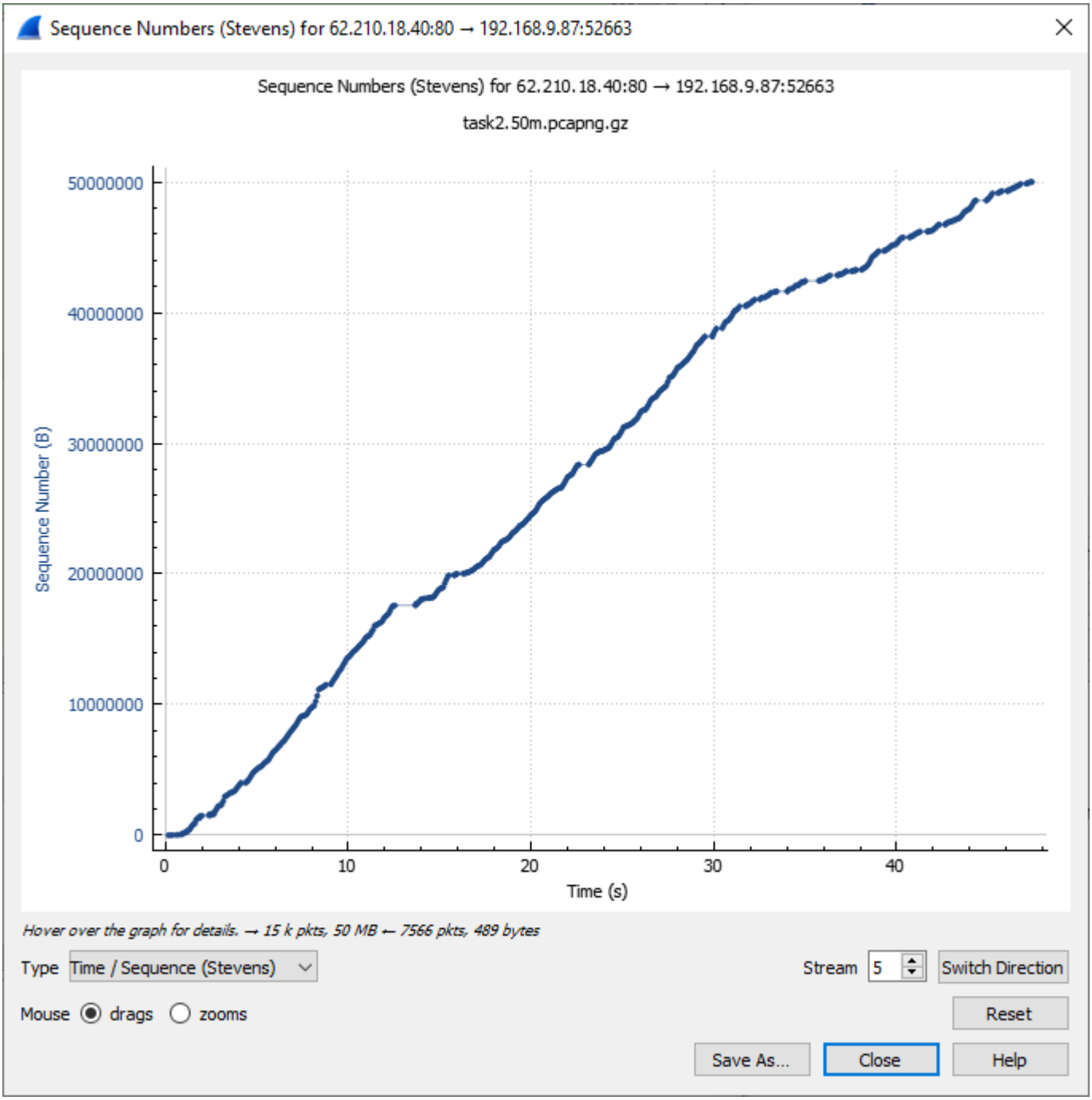


Comparing this to wireshark file properties, the reported value is close to the calculated value.

5. Using any active TCP segment (pick the packet of bulk data length, e.g: 5668) involved in the download process from server to client, capture the TCP's functioning using the Time-Sequence-Graph (Stevens) plotting tool to view the sequence number versus time plot of segments being sent from the server to the client. Can you identify where TCP's slow start phase begins and ends, and where congestion avoidance takes over? If not possible, why?


Sequence Numbers (Stevens) for 62.210.18.40:80 → 192.168.9.87:52627
Sequence Numbers (Stevens) for 62.210.18.40:80 → 192.168.9.87:52627
task2.2m.pcapng.gz
2000000
1500000
1000000
500000
0
Sequence Number (B)
0.5
1
1.5
2
Time (s)
Click to select packet 761 (3.831s len 11520 seq 1271521 ack 489 win 30720) → 699 pkts, 2000 kB ← 254 pkts, 488 bytes
Type
Time / Sequence (Stevens)
Stream
6
Switch Direction
Mouse
drags
zooms
Reset
Save As...
Close
Help

For 50m file,



We see that there are some places the distance between packets increase rapidly. This can be considered as a congestion control where the segments are stopped to avoid congestion. When we zoom in, we see the distance decreasing slowly showing the multiplicative increase.

6. Only for #c above, observe and clearly explain with screenshots, how TCP connection gets terminated in this case, as well as which fields of TCP influence this, due to cancelling of the download in between.

When a download is stopped midway, we see that there are a few a few packets missing where segment is not captured. Also we find that there is no HTTP/1.1 200 OK packet received from the server which can be found in other files where download is completed properly.

I certify that this assignment/report is my own work, based on my personal study and/or research and that I have acknowledged all material and sources used in its preparation, whether they be books, articles, reports, lecture notes, and any other kind of document, electronic or personal communication. I also certify that this assignment/report has not previously been submitted for assessment in any other course, except where specific permission has been granted from all course instructors involved, or at any other time in this course, and that I

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