==========

Assignment 3: TCP Sockets Submission:

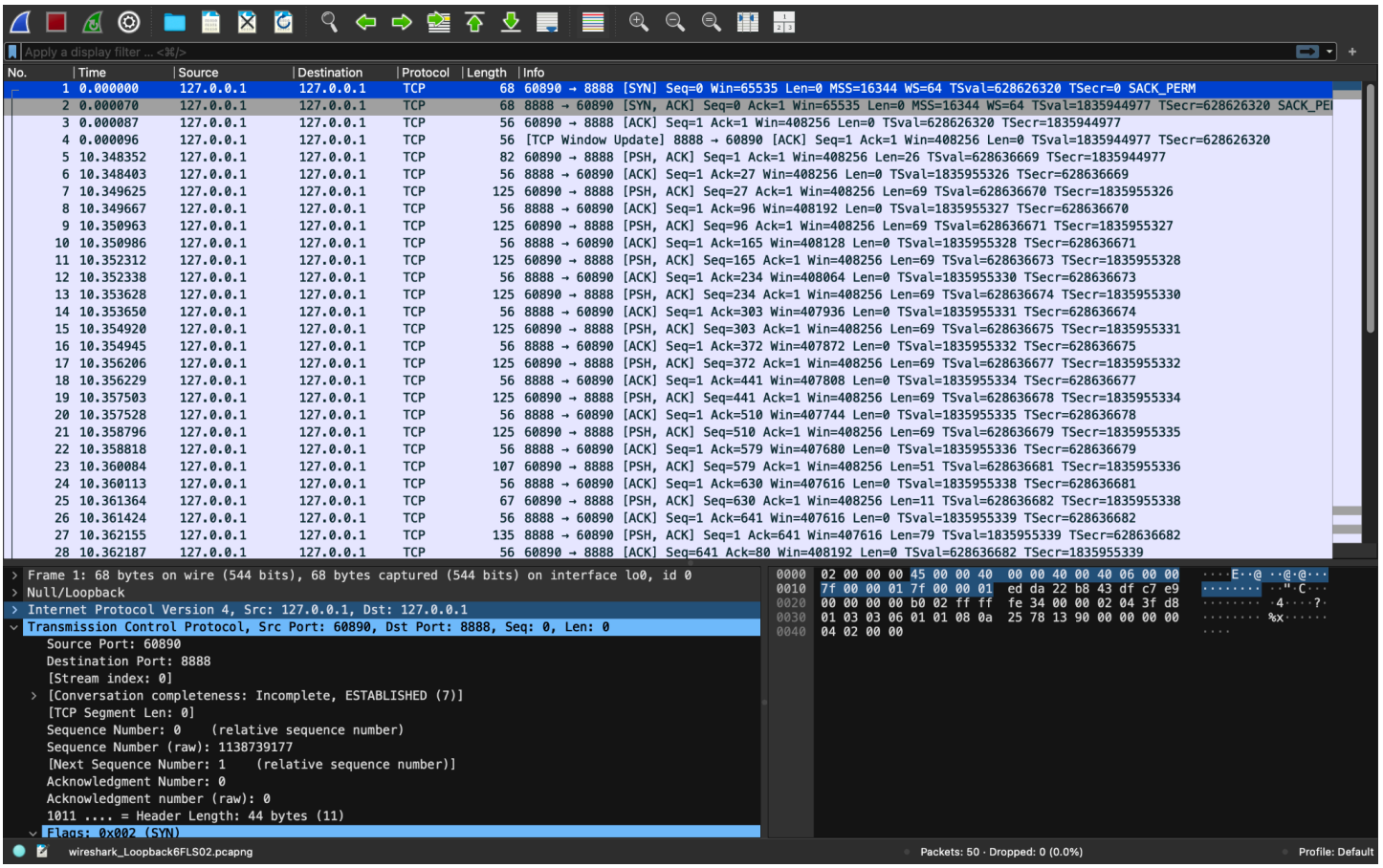
Name: Chandransh Singh

Roll number: 22CS30017

Link of the pcap file: TCP_packets

==========

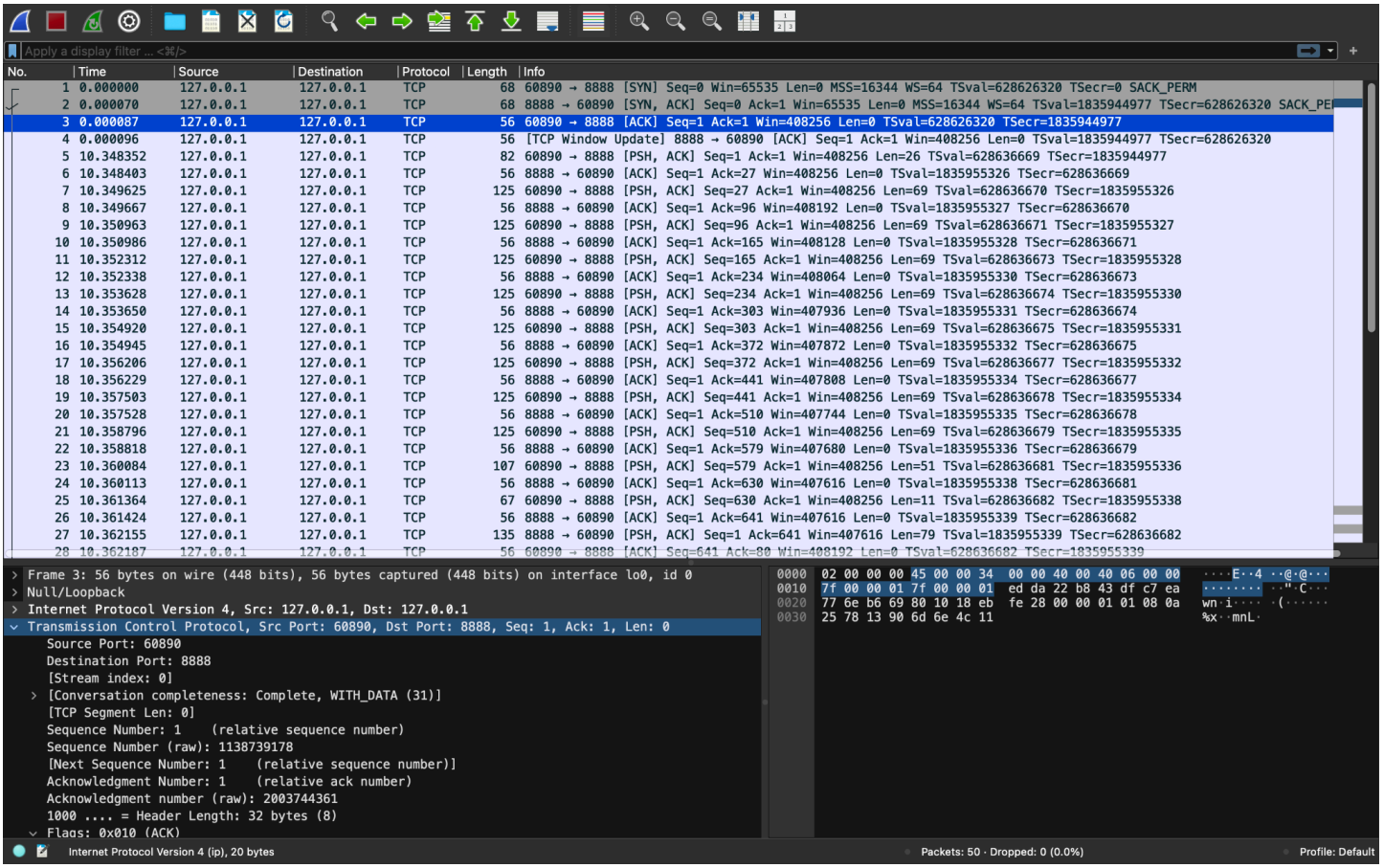
1. What are the source and destination IP addresses and ports? Share the screenshots to justify your answer.



From the above screenshot, we can see the first SYN packet where:

- Source (client):
  - Address: `127.0.0.1`
  - Port: `60890`
- Destination (server):
  - Address: `127.0.0.1`
  - Port: `8888`

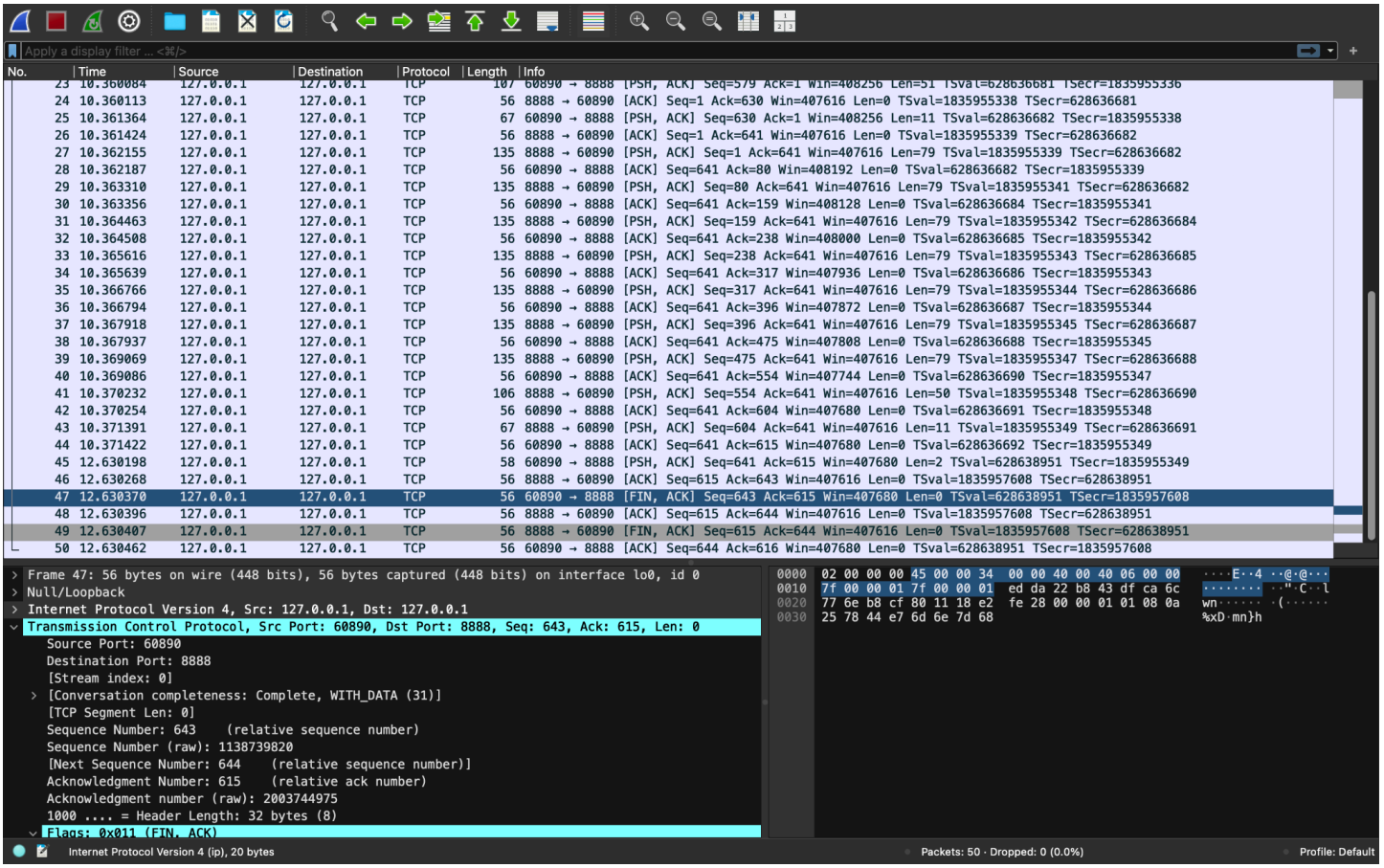
2. Inspect the Three-way handshaking procedure and capture all packets exchanged for it. Attach the necessary screenshots to demonstrate it



Three-way Handshake:

- Look for the **first three** packets in the above screenshot:
  - SYN (Client → Server)
  - SYN-ACK (Server → Client)
  - ACK (Client → Server)

3. Inspect the connection closure procedure and capture all packets exchanged for it. Attach the necessary screenshots to demonstrate it.



We can find the sequence **at the end**:

- FIN (Client → Server) → **No.47**
- ACK (Server → Client) → **No.48**
- FIN (Server → Client) → **No.49**
- ACK (Client → Server) → **No.50**

4. Inspect the traffic and count the number of packets exchanged for the transfer of a file(related to data only) between client and server. Plot a graph ‘file size vs the number of packets’ clearly based on your observation.

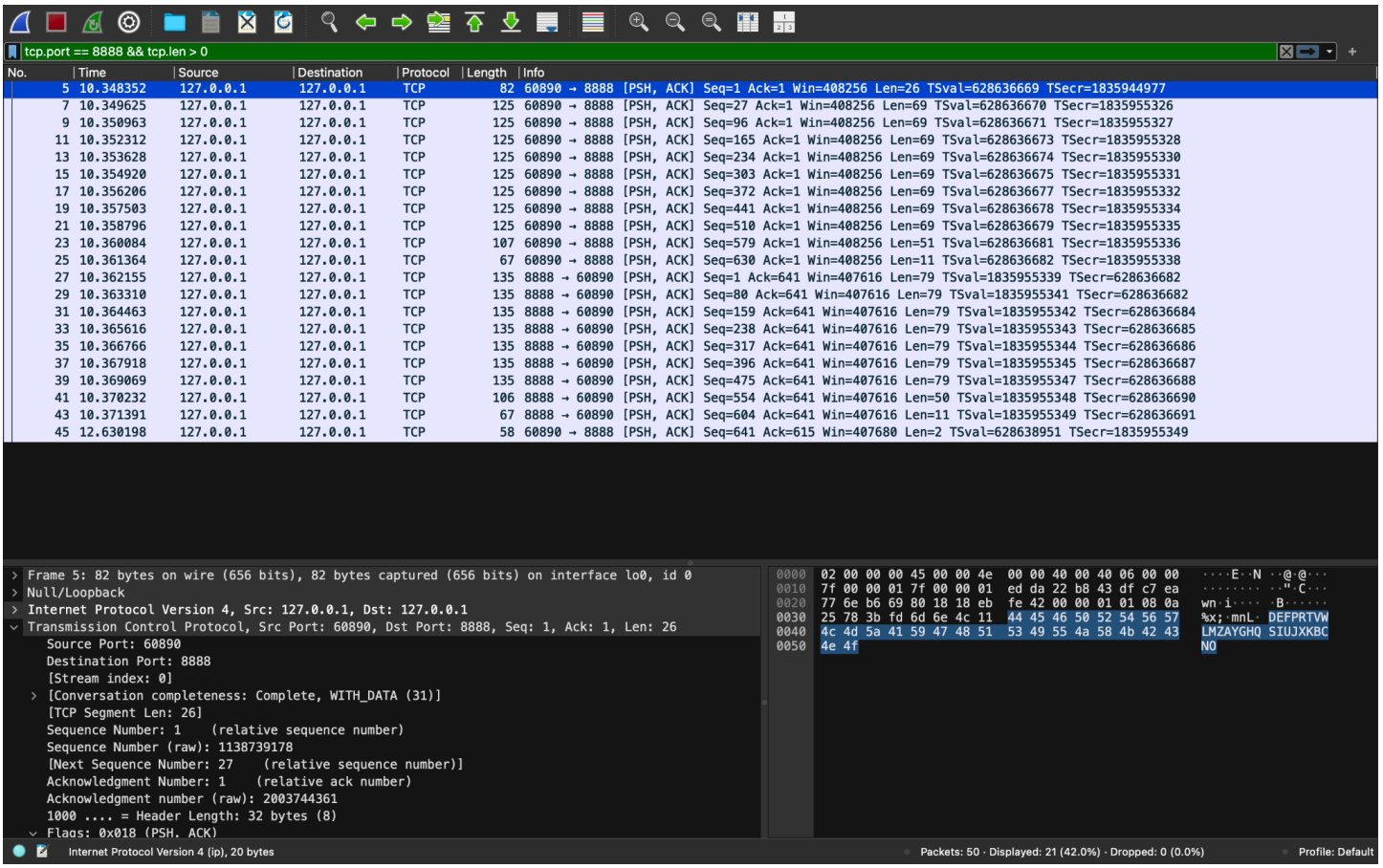
To count data packets, I used:

- Filter: `tcp.port == 8888 && tcp.len > 0`
- This shows only packets containing data

Note:

- Client sends file in chunks of max size = 70 bytes
- Server sends file in chunks of max size = 80 bytes

But for receiving a chuck, both use a buffer of size 100 bytes, because we were stated that chuck size will not be greater than 100 bytes. So, whatever be the size of the chunk used to send, the other server/client can receive it in a single packet.



In the above screenshot,

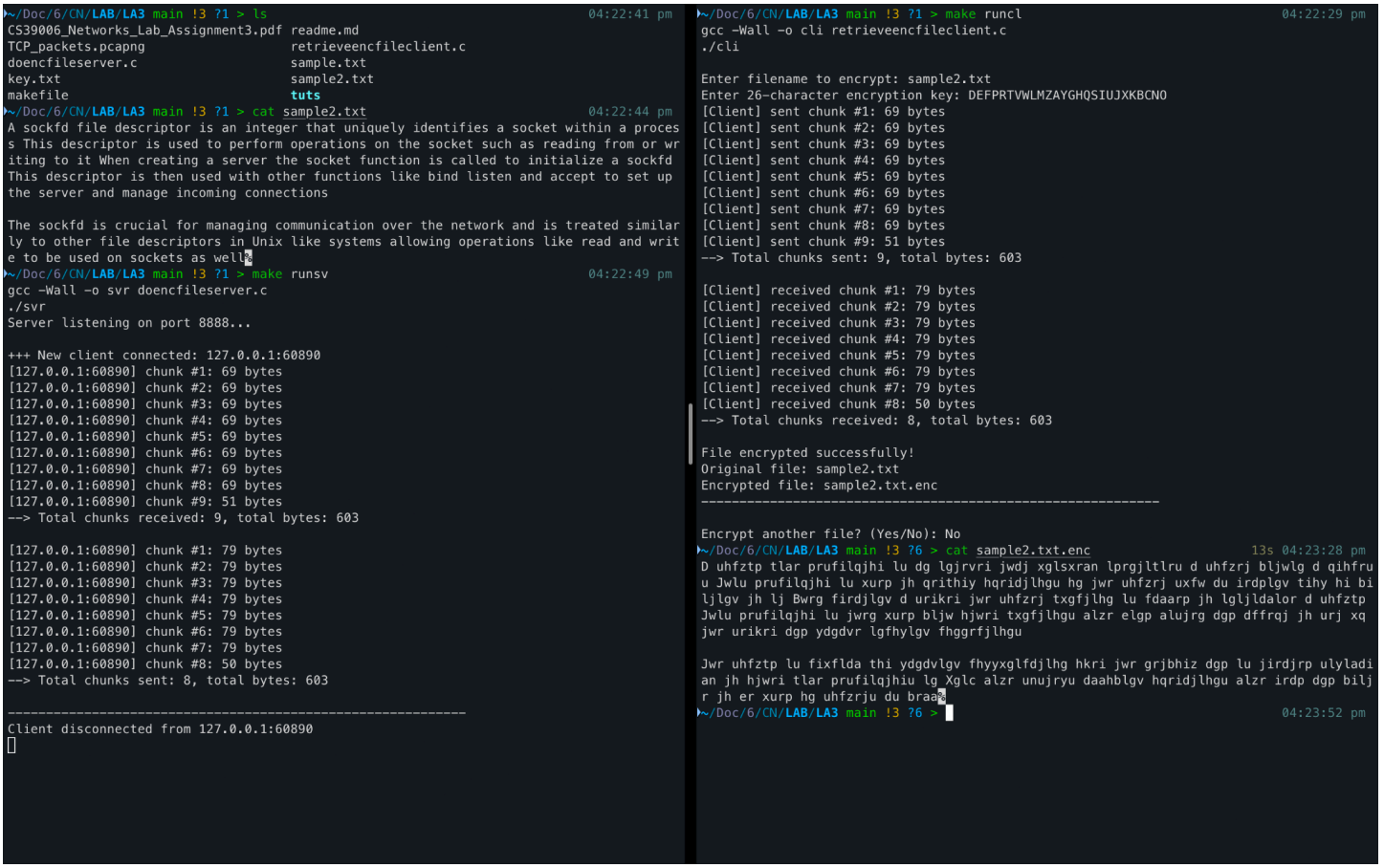
- No.5 is the KEY packet
- **From No.7 to No.23 are the packets from client to server of the original file**
- No.25 is the END_OF_FILE
- **From No.27 to No.41 are the packets from server to client of the encrypted file**
- No.43 is the END_OF_FILE
- No.45 is the “No” from the client to close the connection

Total number of packets exchanged for the transfer of a file(related to data only) between client and server:
9 (from client to server) + 8(from server to client) = 17 packets

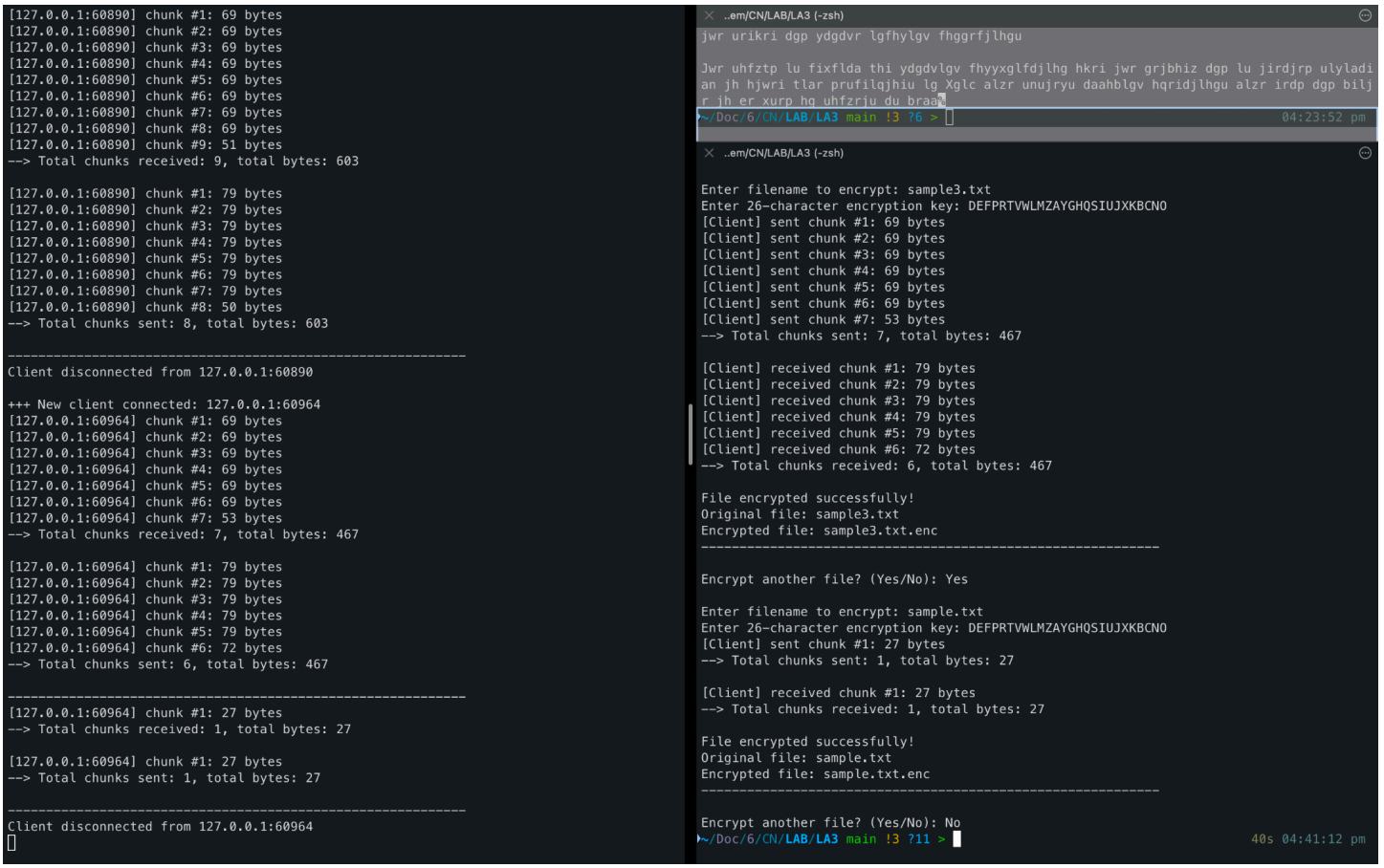
File size = sum of the data size of each packet sent by client = sum of data size of each packet sent by server
= 69 + 69 + 69 + 69 + 69 + 69 + 69 + 69 + 51 = 603 bytes
= 79 + 79 + 79 + 79 + 79 + 79 + 79 + 50 = 603 bytes

I have also implemented the function to print the chunk number and the size of each chunk:
So the overall statistics can also be seen from the terminal

Terminal 👩‍💻

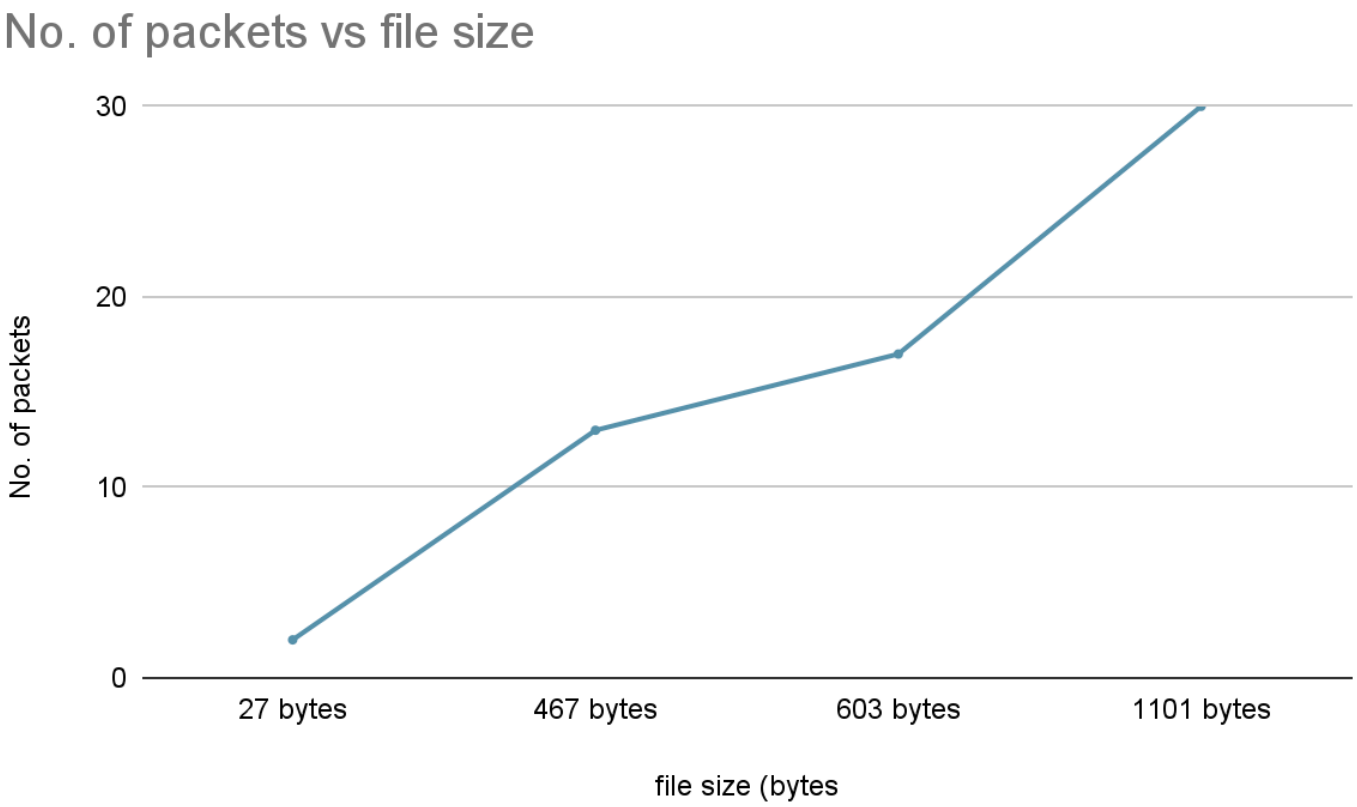


Plot a graph ‘file size vs the number of packets’ clearly based on your observation:

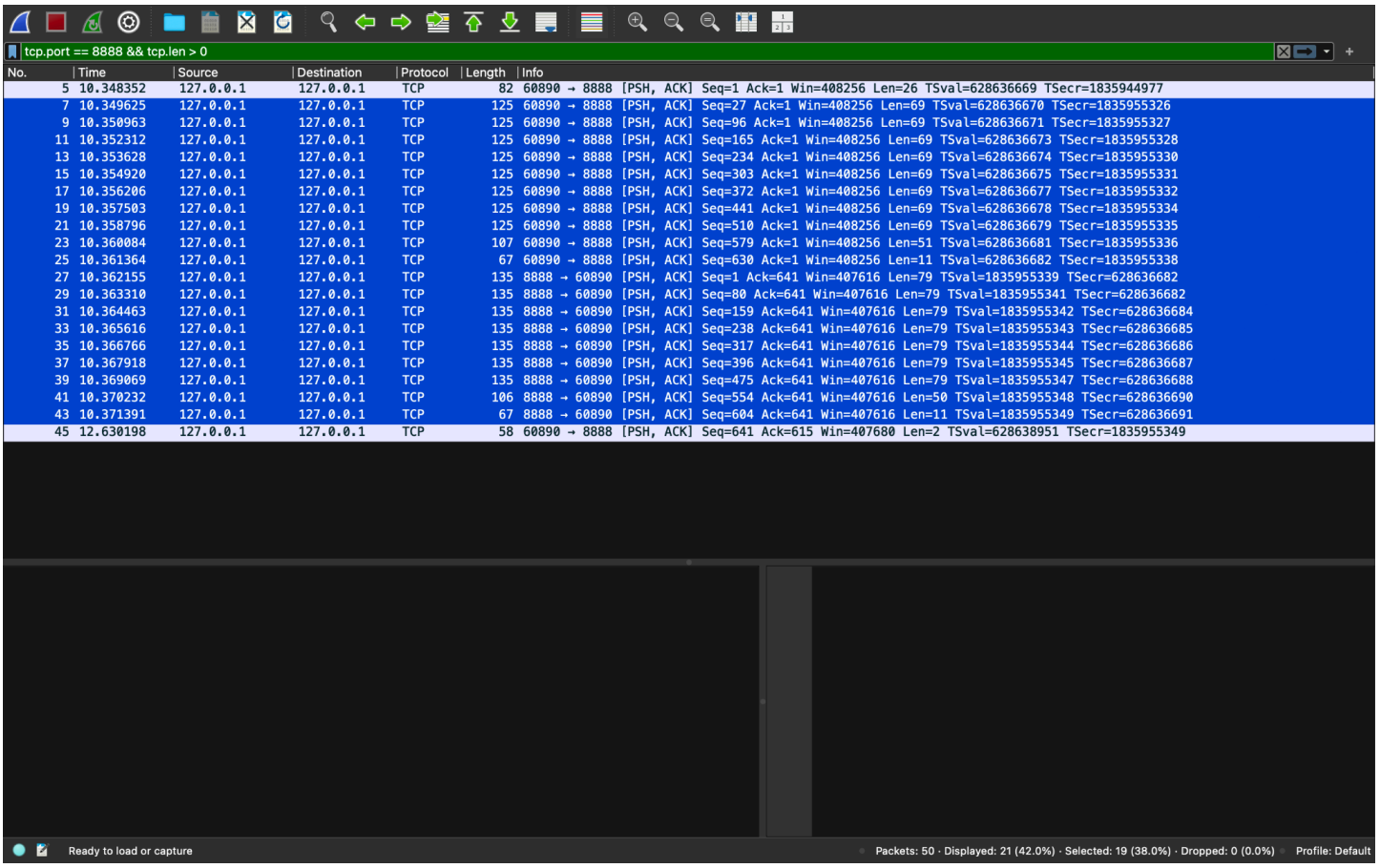


From the above three sample files:
1) 603 bytes -> 17 packets
2) 467 bytes -> 13 packets
3) 27 bytes -> 2 packets
4) 1101 bytes -> 30 packets

Mathematically: for a file of size B bytes
→ Client will send *ceil(B/69)* packets
→ Server will send *ceil(B/79)* packets



5. Measure the total time taken for the file transfer , its encryption and send it back from server to the client. Plot a graph ‘file size vs time’ clearly based on your observation and also attach the necessary screenshots.



tcp.port == 8888 && tcp.len > 0

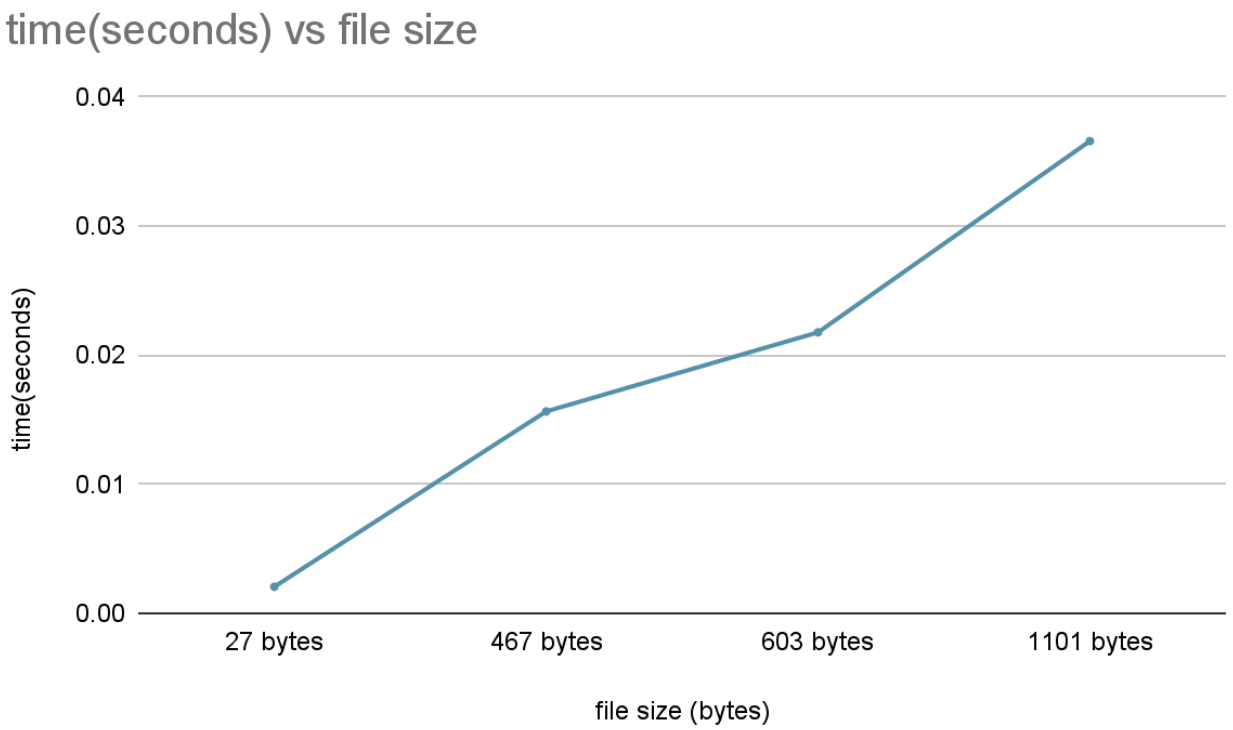
No.	Time	Source	Destination	Protocol	Length	Info
5	10.348352	127.0.0.1	127.0.0.1	TCP	82	60890 → 8888 [PSH, ACK] Seq=1 Ack=1 Win=408256 Len=26 TSval=628636669 TSecr=1835944977
7	10.349625	127.0.0.1	127.0.0.1	TCP	125	60890 → 8888 [PSH, ACK] Seq=27 Ack=1 Win=408256 Len=69 TSval=628636670 TSecr=1835955326
9	10.350963	127.0.0.1	127.0.0.1	TCP	125	60890 → 8888 [PSH, ACK] Seq=96 Ack=1 Win=408256 Len=69 TSval=628636671 TSecr=1835955327
11	10.352312	127.0.0.1	127.0.0.1	TCP	125	60890 → 8888 [PSH, ACK] Seq=165 Ack=1 Win=408256 Len=69 TSval=628636673 TSecr=1835955328
13	10.353628	127.0.0.1	127.0.0.1	TCP	125	60890 → 8888 [PSH, ACK] Seq=234 Ack=1 Win=408256 Len=69 TSval=628636674 TSecr=1835955330
15	10.354920	127.0.0.1	127.0.0.1	TCP	125	60890 → 8888 [PSH, ACK] Seq=303 Ack=1 Win=408256 Len=69 TSval=628636675 TSecr=1835955331
17	10.356206	127.0.0.1	127.0.0.1	TCP	125	60890 → 8888 [PSH, ACK] Seq=372 Ack=1 Win=408256 Len=69 TSval=628636677 TSecr=1835955332
19	10.357503	127.0.0.1	127.0.0.1	TCP	125	60890 → 8888 [PSH, ACK] Seq=441 Ack=1 Win=408256 Len=69 TSval=628636678 TSecr=1835955334
21	10.358796	127.0.0.1	127.0.0.1	TCP	125	60890 → 8888 [PSH, ACK] Seq=510 Ack=1 Win=408256 Len=69 TSval=628636679 TSecr=1835955335
23	10.360084	127.0.0.1	127.0.0.1	TCP	107	60890 → 8888 [PSH, ACK] Seq=579 Ack=1 Win=408256 Len=51 TSval=628636681 TSecr=1835955336
25	10.361364	127.0.0.1	127.0.0.1	TCP	67	60890 → 8888 [PSH, ACK] Seq=630 Ack=1 Win=408256 Len=11 TSval=628636682 TSecr=1835955338
27	10.362155	127.0.0.1	127.0.0.1	TCP	135	8888 → 60890 [PSH, ACK] Seq=1 Ack=641 Win=407616 Len=79 TSval=1835955339 TSecr=628636682
29	10.363310	127.0.0.1	127.0.0.1	TCP	135	8888 → 60890 [PSH, ACK] Seq=80 Ack=641 Win=407616 Len=79 TSval=1835955341 TSecr=628636682
31	10.364463	127.0.0.1	127.0.0.1	TCP	135	8888 → 60890 [PSH, ACK] Seq=159 Ack=641 Win=407616 Len=79 TSval=1835955342 TSecr=628636684
33	10.365616	127.0.0.1	127.0.0.1	TCP	135	8888 → 60890 [PSH, ACK] Seq=238 Ack=641 Win=407616 Len=79 TSval=1835955343 TSecr=628636685
35	10.366766	127.0.0.1	127.0.0.1	TCP	135	8888 → 60890 [PSH, ACK] Seq=317 Ack=641 Win=407616 Len=79 TSval=1835955344 TSecr=628636686
37	10.367918	127.0.0.1	127.0.0.1	TCP	135	8888 → 60890 [PSH, ACK] Seq=396 Ack=641 Win=407616 Len=79 TSval=1835955345 TSecr=628636687
39	10.369069	127.0.0.1	127.0.0.1	TCP	135	8888 → 60890 [PSH, ACK] Seq=475 Ack=641 Win=407616 Len=79 TSval=1835955347 TSecr=628636688
41	10.370232	127.0.0.1	127.0.0.1	TCP	106	8888 → 60890 [PSH, ACK] Seq=554 Ack=641 Win=407616 Len=50 TSval=1835955348 TSecr=628636690
43	10.371391	127.0.0.1	127.0.0.1	TCP	67	8888 → 60890 [PSH, ACK] Seq=604 Ack=641 Win=407616 Len=11 TSval=1835955349 TSecr=628636691
45	12.630198	127.0.0.1	127.0.0.1	TCP	58	60890 → 8888 [PSH, ACK] Seq=641 Ack=615 Win=407680 Len=2 TSval=628638951 TSecr=1835955349

Ready to load or capture

Packets: 50 · Displayed: 21 (42.0%) · Selected: 19 (38.0%) · Dropped: 0 (0.0%)

Profile: Default

- Total Time taken for the file transfer of size 603 bytes = 10.371391- 10.349626 = 0.0217652 seconds
- More observations (can be verified with the attached pcap files)
    - 467 bytes → 10.577517 - 10.561878 = 0.015639 seconds
    - 27 bytes → 0.003645 - 0.001589 = 0.002056 seconds
    - 1101 bytes → 0.037686 - 0.001100 = 0.036586 seconds



6. Calculate the average size packet exchanged during the data communication? Take reference of the plotted graph in the above question.

Using the Statistics button in wireshark to find the **average packet length**
To count data packets, I used:

- Filter: `tcp.port == 8888 && tcp.len > 0 && tcp.len != 11`
- This shows only packets containing data
- Excluded the END_OF_FILE packet
- Considering the KEY packet in data communication
- So, the count of packets in the below statistics is: no. of packets answered in Q4 + 1(for key)
- *As the Q4 asked about the comparison about file size, but here we have data communication*

For file size 27 bytes: **82.67 bytes**

```
================================================================================================================
====================================
Packet Lengths:
Topic / Item       Count         Average       Min Val       Max Val       Rate (ms)     Percent       Burst Rate    Burst Start
----------------------------------------------------------------------------------------------------------------------------------
Packet Lengths     3             82.67         82            83            0.8230        100%          0.0300        0.000
 0-19              0             -             -             -             0.0000        0.00%         -             -
 20-39             0             -             -             -             0.0000        0.00%         -             -
 40-79             0             -             -             -             0.0000        0.00%         -             -
 80-159            3             82.67         82            83            0.8230        100.00%       0.0300        0.000
 160-319           0             -             -             -             0.0000        0.00%         -             -
 320-639           0             -             -             -             0.0000        0.00%         -             -
 640-1279          0             -             -             -             0.0000        0.00%         -             -
 1280-2559         0             -             -             -             0.0000        0.00%         -             -
 2560-5119         0             -             -             -             0.0000        0.00%         -             -
 5120 and greater  0             -             -             -             0.0000        0.00%         -             -

----------------------------------------------------------------------------------------------------------------------------------
```

For file size 467 bytes: **124.57 bytes**

```
================================================================================================================
================================================
Packet Lengths:
Topic / Item       Count         Average       Min Val       Max Val       Rate (ms)     Percent       Burst Rate    Burst
Start
----------------------------------------------------------------------------------------------------------------------------------
Packet Lengths     14            124.57        82            135           0.8378        100%          0.1400        10.561
 0-19              0             -             -             -             0.0000        0.00%         -             -
 20-39             0             -             -             -             0.0000        0.00%         -             -
 40-79             0             -             -             -             0.0000        0.00%         -             -
 80-159            14            124.57        82            135           0.8378        100.00%       0.1400        10.561
 160-319           0             -             -             -             0.0000        0.00%         -             -
 320-639           0             -             -             -             0.0000        0.00%         -             -
 640-1279          0             -             -             -             0.0000        0.00%         -             -
 1280-2559         0             -             -             -             0.0000        0.00%         -             -
 2560-5119         0             -             -             -             0.0000        0.00%         -             -
 5120 and greater  0             -             -             -             0.0000        0.00%         -             -

----------------------------------------------------------------------------------------------------------------------------------
```

For file size 603 bytes: **124.44 bytes**

==========

Packet Lengths:

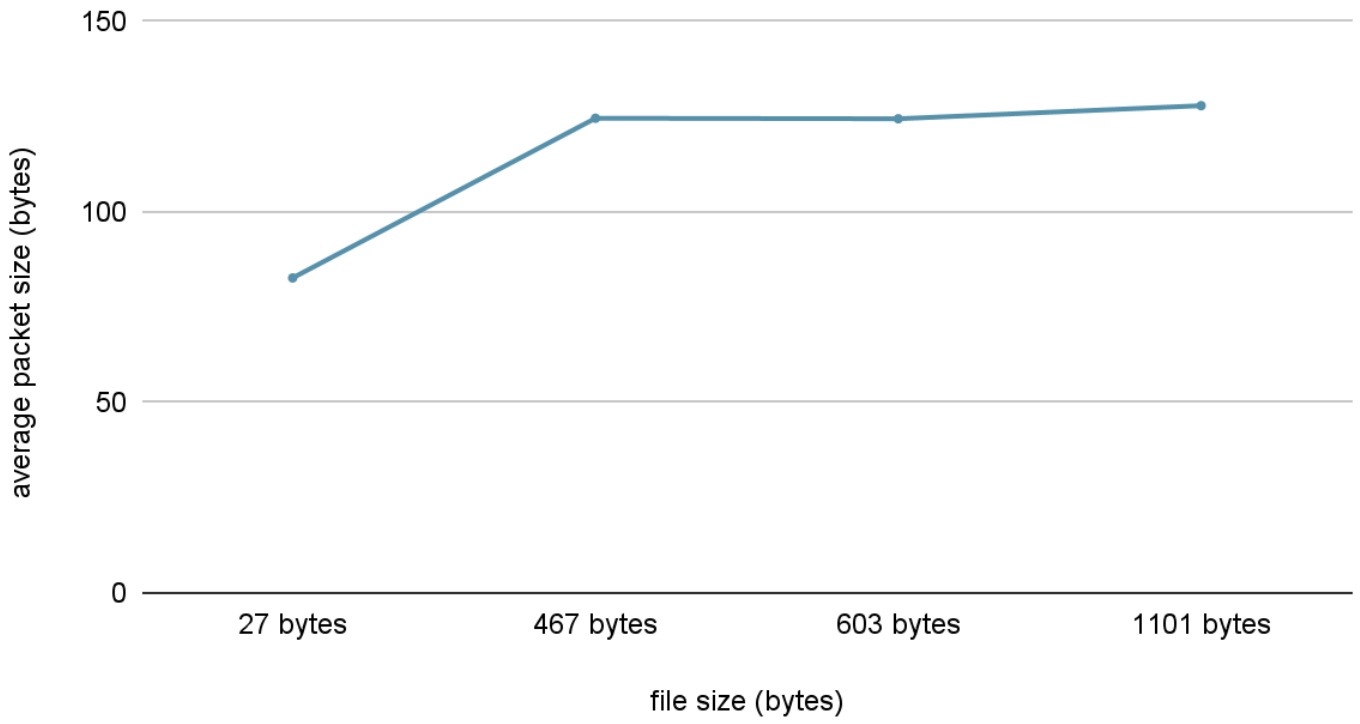
Topic / Item	Count	Average	Min Val	Max Val	Rate (ms)	Percent	Burst Rate	Burst Start
Packet Lengths	18	124.44	82	135	0.8227	100%	0.1800	10.348
0-19	0	-	-	-	0.0000	0.00%	-	-
20-39	0	-	-	-	0.0000	0.00%	-	-
40-79	0	-	-	-	0.0000	0.00%	-	-
80-159	18	124.44	82	135	0.8227	100.00%	0.1800	10.348
160-319	0	-	-	-	0.0000	0.00%	-	-
320-639	0	-	-	-	0.0000	0.00%	-	-
640-1279	0	-	-	-	0.0000	0.00%	-	-
1280-2559	0	-	-	-	0.0000	0.00%	-	-
2560-5119	0	-	-	-	0.0000	0.00%	-	-
5120 and greater	0	-	-	-	0.0000	0.00%	-	-

For file size 1101 bytes: **127.87 bytes**

==========

Packet Lengths:

Topic / Item	Count	Average	Min Val	Max Val	Rate (ms)	Percent	Burst Rate	Burst Start
Packet Lengths	31	127.87	82	135	0.8226	100%	0.3100	0.000
0-19	0	-	-	-	0.0000	0.00%	-	-
20-39	0	-	-	-	0.0000	0.00%	-	-
40-79	0	-	-	-	0.0000	0.00%	-	-
80-159	31	127.87	82	135	0.8226	100.00%	0.3100	0.000
160-319	0	-	-	-	0.0000	0.00%	-	-
320-639	0	-	-	-	0.0000	0.00%	-	-
640-1279	0	-	-	-	0.0000	0.00%	-	-
1280-2559	0	-	-	-	0.0000	0.00%	-	-
2560-5119	0	-	-	-	0.0000	0.00%	-	-
5120 and greater	0	-	-	-	0.0000	0.00%	-	-


Average packet size vs file size
150
100
50
0
average packet size (bytes)
27 bytes
467 bytes
603 bytes
1101 bytes
file size (bytes)