LAB3
Group-18
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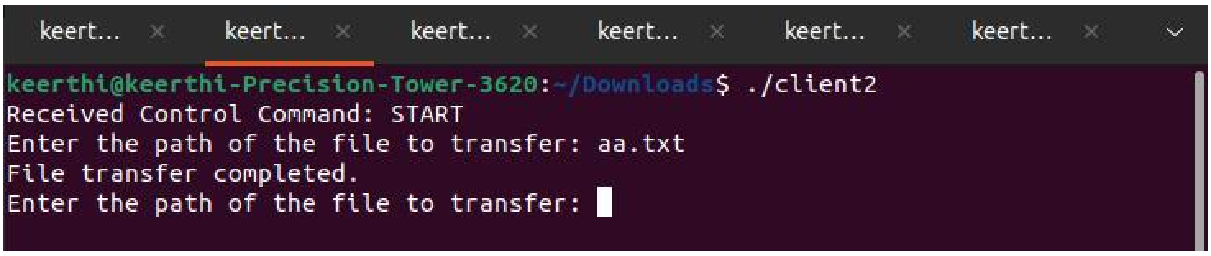
DriveLink:https://drive.google.com/drive/u/1/folders/1tRDTJQMYOreE4CXo-TUu_x7lZvSZSz7b

Comments/README for Question1

We designed a server which would monitor and control multiple drones(clients)
We used three types of communication:

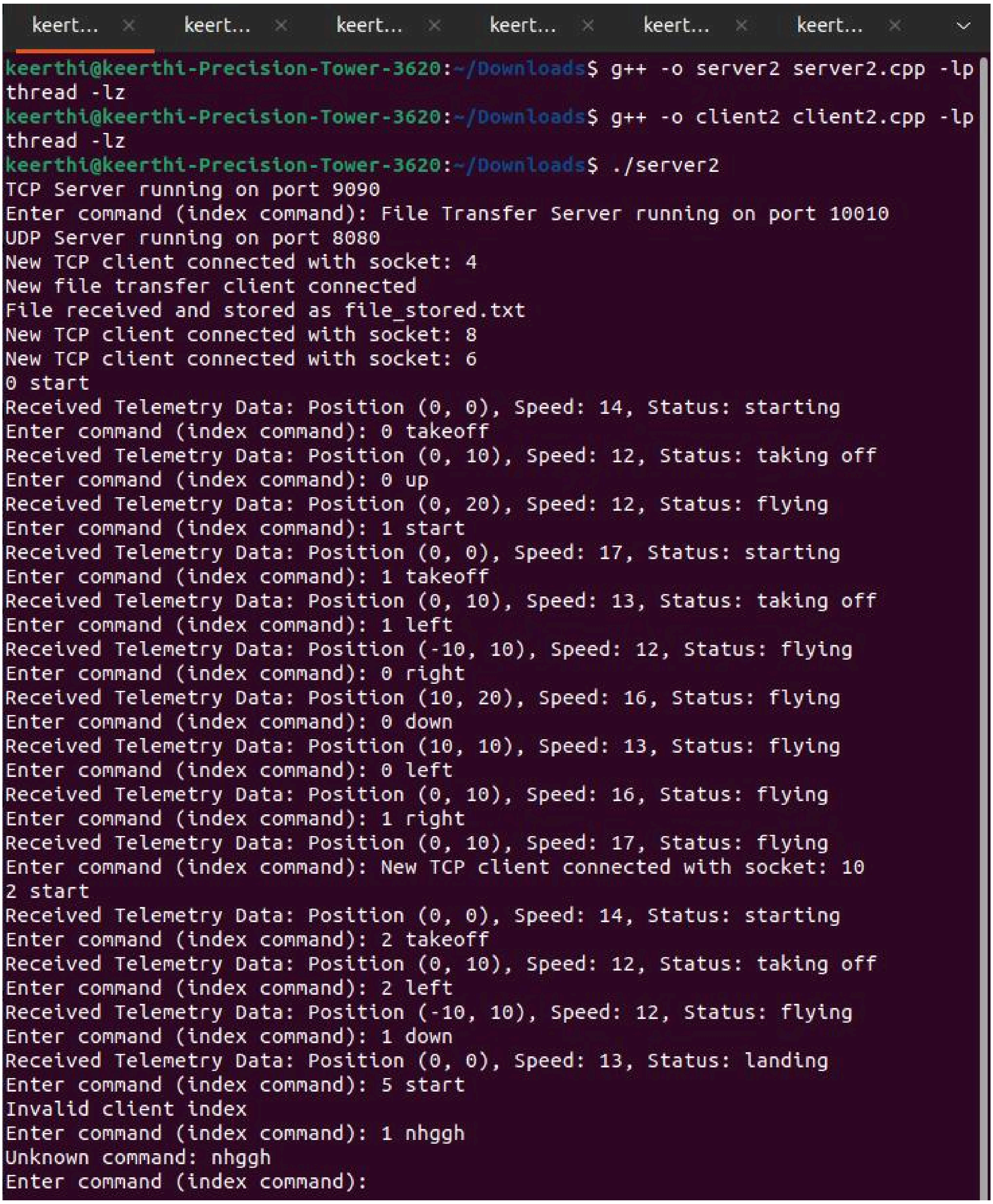
1) Control commands: Sent by server using UDP for minimal delay
2) Telemetry data periodically whenever there is a location change using TCP for reliable data
3) File Transfer: File is being sent from the client (here aa.txt) and it is being stored as file_stored.txt by server showing file transfer is successful.

All the messages are encrypted and decrypted using XOR



```
keerthi@keerthi-Precision-Tower-3620:~/Downloads$ ./client2
Received Control Command: START
Enter the path of the file to transfer: aa.txt
File transfer completed.
Enter the path of the file to transfer: 
```

File Transfer of aa.txt initiated from client



```
keerthi@keerthi-Precision-Tower-3620:~/Downloads$ g++ -o server2 server2.cpp -lp
thread -lz
keerthi@keerthi-Precision-Tower-3620:~/Downloads$ g++ -o client2 client2.cpp -lp
thread -lz
keerthi@keerthi-Precision-Tower-3620:~/Downloads$ ./server2
TCP Server running on port 9090
Enter command (index command): File Transfer Server running on port 10010
UDP Server running on port 8080
New TCP client connected with socket: 4
New file transfer client connected
File received and stored as file_stored.txt
New TCP client connected with socket: 8
New TCP client connected with socket: 6
0 start
Received Telemetry Data: Position (0, 0), Speed: 14, Status: starting
Enter command (index command): 0 takeoff
Received Telemetry Data: Position (0, 10), Speed: 12, Status: taking off
Enter command (index command): 0 up
Received Telemetry Data: Position (0, 20), Speed: 12, Status: flying
Enter command (index command): 1 start
Received Telemetry Data: Position (0, 0), Speed: 17, Status: starting
Enter command (index command): 1 takeoff
Received Telemetry Data: Position (0, 10), Speed: 13, Status: taking off
Enter command (index command): 1 left
Received Telemetry Data: Position (-10, 10), Speed: 12, Status: flying
Enter command (index command): 0 right
Received Telemetry Data: Position (10, 20), Speed: 16, Status: flying
Enter command (index command): 0 down
Received Telemetry Data: Position (10, 10), Speed: 13, Status: flying
Enter command (index command): 0 left
Received Telemetry Data: Position (0, 10), Speed: 16, Status: flying
Enter command (index command): 1 right
Received Telemetry Data: Position (0, 10), Speed: 17, Status: flying
Enter command (index command): New TCP client connected with socket: 10
2 start
Received Telemetry Data: Position (0, 0), Speed: 14, Status: starting
Enter command (index command): 2 takeoff
Received Telemetry Data: Position (0, 10), Speed: 12, Status: taking off
Enter command (index command): 2 left
Received Telemetry Data: Position (-10, 10), Speed: 12, Status: flying
Enter command (index command): 1 down
Received Telemetry Data: Position (0, 0), Speed: 13, Status: landing
Enter command (index command): 5 start
Invalid client index
Enter command (index command): 1 nhggh
Unknown command: nhggh
Enter command (index command):
```

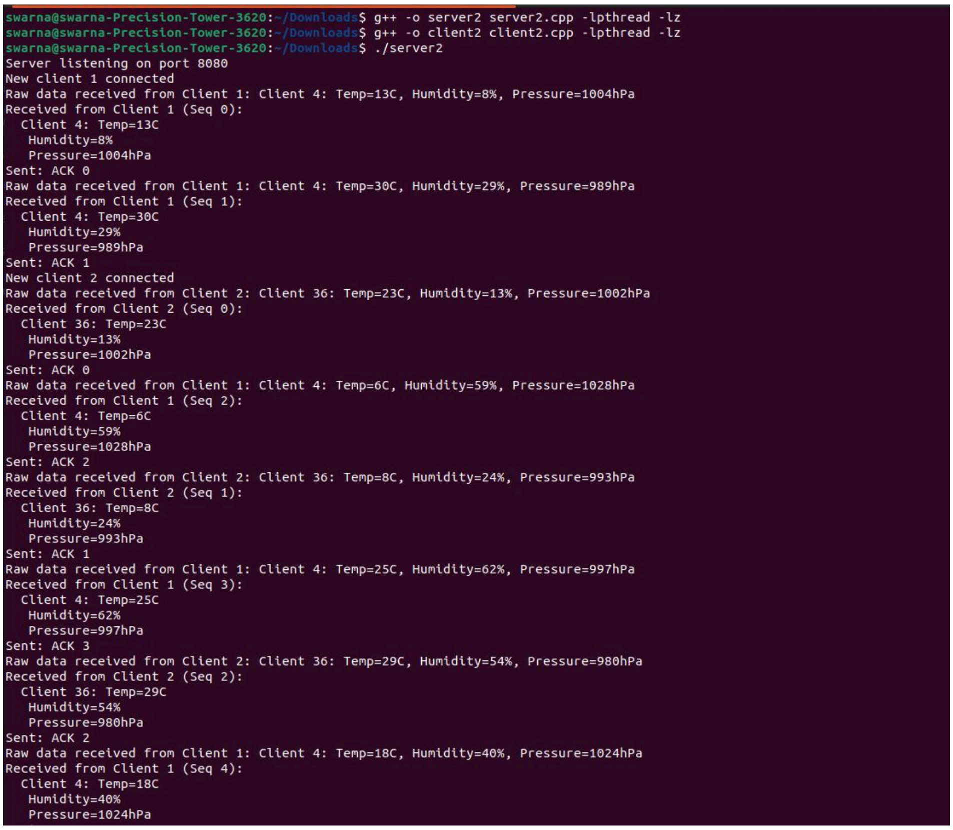
File Received in Server
Then we initiated 3 clients, which had indexes 0,1,2 where we got an output as “New TCP client connected”
We gave multiple commands for different drones respectively to start, takeoff, to move in different directions, then we received telemetry data from drone which are position, speed, status
If we gave invalid input or a client which wasn’t initialised (5 in our case, as we just initialised 3 drones) it prints invalid input

Comments/README for Question2

Server Code (server.cpp) Features:
- Handles incoming client connections and processes them in separate threads.
- Decompresses the received weather data using zlib and parses the data for display.
- Sends acknowledgments for each packet received unless simulated acknowledgment loss occurs.
- Displays weather information in a human-readable format.
- Parses weather data format: "Client <ID>: Temp=<Temp>C, Humidity=<Humidity>%, Pressure=<Pressure>hPa".

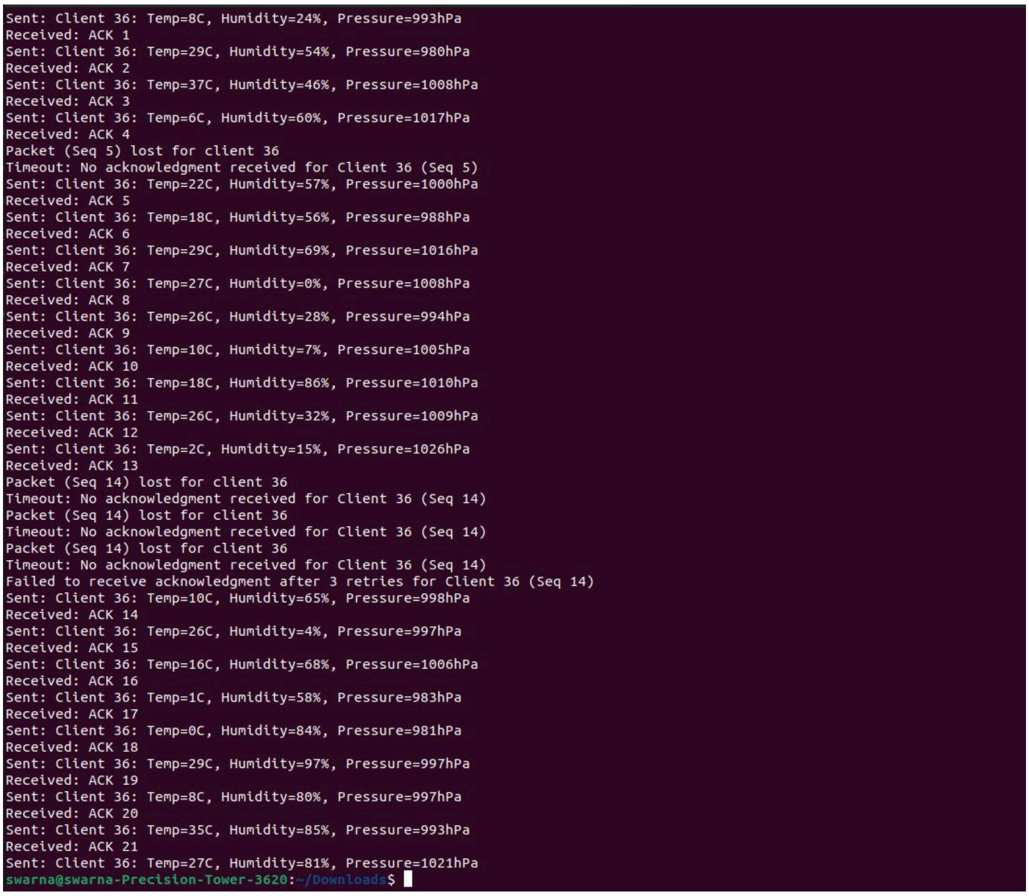
Client Code (client.cpp) Features:
- Randomly generates weather data simulating temperature, humidity, and pressure readings.
- Compresses the weather data using zlib before sending it to the server.
- Implements a simplified TCP Reno for congestion control, increasing the transmission window size unless packet loss occurs.
- Simulates packet loss with a **10%** chance for each packet sent.
- Retries sending data if no ACK is received, with a maximum of 3 retries before reporting failure.
- Periodically sends weather data to the server and simulates network delay.

Key Features:
- Data Compression: The client compresses weather data before sending it to reduce network load.
- Congestion Control: TCP Reno algorithm is simulated to manage the sending rate and handle congestion.
- Packet Loss Simulation: The client simulates packet loss and handles retransmissions if ACKs are not received.
- Acknowledgement Loss Simulation: The server simulates acknowledgment loss with a 10% chance.
- Multithreading: The server is capable of handling multiple clients concurrently using threads.
- Sequence Numbers: Each packet sent by the client has a sequence number to ensure data integrity and order.

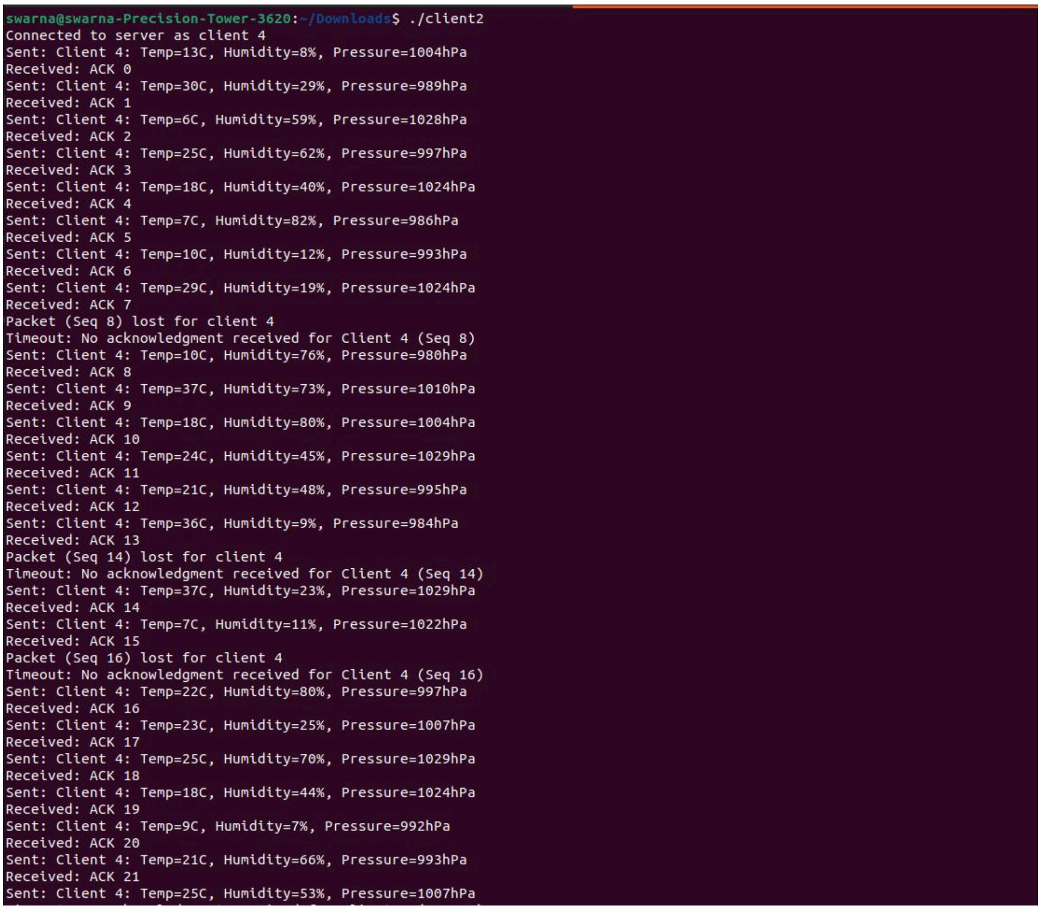


```
swarna@swarna-Precision-Tower-3620:~/Downloads$ g++ -o server2 server2.cpp -lpthread -lz
swarna@swarna-Precision-Tower-3620:~/Downloads$ g++ -o client2 client2.cpp -lpthread -lz
swarna@swarna-Precision-Tower-3620:~/Downloads$ ./server2
Server listening on port 8080
New client 1 connected
Raw data received from Client 1: Client 4: Temp=13C, Humidity=8%, Pressure=1004hPa
Received from Client 1 (Seq 0):
  Client 4: Temp=13C
   Humidity=8%
   Pressure=1004hPa
Sent: ACK 0
Raw data received from Client 1: Client 4: Temp=30C, Humidity=29%, Pressure=989hPa
Received from Client 1 (Seq 1):
  Client 4: Temp=30C
   Humidity=29%
   Pressure=989hPa
Sent: ACK 1
New client 2 connected
Raw data received from Client 2: Client 36: Temp=23C, Humidity=13%, Pressure=1002hPa
Received from Client 2 (Seq 0):
  Client 36: Temp=23C
   Humidity=13%
   Pressure=1002hPa
Sent: ACK 0
Raw data received from Client 1: Client 4: Temp=6C, Humidity=59%, Pressure=1028hPa
Received from Client 1 (Seq 2):
  Client 4: Temp=6C
   Humidity=59%
   Pressure=1028hPa
Sent: ACK 2
Raw data received from Client 2: Client 36: Temp=8C, Humidity=24%, Pressure=993hPa
Received from Client 2 (Seq 1):
  Client 36: Temp=8C
   Humidity=24%
   Pressure=993hPa
Sent: ACK 1
Raw data received from Client 1: Client 4: Temp=25C, Humidity=62%, Pressure=997hPa
Received from Client 1 (Seq 3):
  Client 4: Temp=25C
   Humidity=62%
   Pressure=997hPa
Sent: ACK 3
Raw data received from Client 2: Client 36: Temp=29C, Humidity=54%, Pressure=980hPa
Received from Client 2 (Seq 2):
  Client 36: Temp=29C
   Humidity=54%
   Pressure=980hPa
Sent: ACK 2
Raw data received from Client 1: Client 4: Temp=18C, Humidity=40%, Pressure=1024hPa
Received from Client 1 (Seq 4):
  Client 4: Temp=18C
   Humidity=40%
   Pressure=1024hPa
```

Server is sending ACKs to the client
And receives weather data from Client as shown



```
Sent: Client 36: Temp=8C, Humidity=24%, Pressure=993hPa
Received: ACK 1
Sent: Client 36: Temp=29C, Humidity=54%, Pressure=980hPa
Received: ACK 2
Sent: Client 36: Temp=37C, Humidity=46%, Pressure=1008hPa
Received: ACK 3
Sent: Client 36: Temp=6C, Humidity=60%, Pressure=1017hPa
Received: ACK 4
Packet (Seq 5) lost for client 36
Timeout: No acknowledgment received for Client 36 (Seq 5)
Sent: Client 36: Temp=22C, Humidity=57%, Pressure=1000hPa
Received: ACK 5
Sent: Client 36: Temp=18C, Humidity=56%, Pressure=988hPa
Received: ACK 6
Sent: Client 36: Temp=29C, Humidity=69%, Pressure=1016hPa
Received: ACK 7
Sent: Client 36: Temp=27C, Humidity=0%, Pressure=1008hPa
Received: ACK 8
Sent: Client 36: Temp=26C, Humidity=28%, Pressure=994hPa
Received: ACK 9
Sent: Client 36: Temp=10C, Humidity=7%, Pressure=1005hPa
Received: ACK 10
Sent: Client 36: Temp=18C, Humidity=86%, Pressure=1010hPa
Received: ACK 11
Sent: Client 36: Temp=26C, Humidity=32%, Pressure=1009hPa
Received: ACK 12
Sent: Client 36: Temp=2C, Humidity=15%, Pressure=1026hPa
Received: ACK 13
Packet (Seq 14) lost for client 36
Timeout: No acknowledgment received for Client 36 (Seq 14)
Packet (Seq 14) lost for client 36
Timeout: No acknowledgment received for Client 36 (Seq 14)
Packet (Seq 14) lost for client 36
Timeout: No acknowledgment received for Client 36 (Seq 14)
Failed to receive acknowledgment after 3 retries for Client 36 (Seq 14)
Sent: Client 36: Temp=10C, Humidity=65%, Pressure=998hPa
Received: ACK 14
Sent: Client 36: Temp=26C, Humidity=4%, Pressure=997hPa
Received: ACK 15
Sent: Client 36: Temp=16C, Humidity=68%, Pressure=1006hPa
Received: ACK 16
Sent: Client 36: Temp=1C, Humidity=58%, Pressure=983hPa
Received: ACK 17
Sent: Client 36: Temp=0C, Humidity=84%, Pressure=981hPa
Received: ACK 18
Sent: Client 36: Temp=29C, Humidity=97%, Pressure=997hPa
Received: ACK 19
Sent: Client 36: Temp=8C, Humidity=80%, Pressure=997hPa
Received: ACK 20
Sent: Client 36: Temp=35C, Humidity=85%, Pressure=993hPa
Received: ACK 21
Sent: Client 36: Temp=27C, Humidity=81%, Pressure=1021hPa
swarna@swarna-Precision-Tower-3620:~/Downloads$
```



```
swarna@swarna-Precision-Tower-3620:~/Downloads$ ./client2
Connected to server as client 4
Sent: Client 4: Temp=13C, Humidity=8%, Pressure=1004hPa
Received: ACK 0
Sent: Client 4: Temp=30C, Humidity=29%, Pressure=989hPa
Received: ACK 1
Sent: Client 4: Temp=6C, Humidity=59%, Pressure=1028hPa
Received: ACK 2
Sent: Client 4: Temp=25C, Humidity=62%, Pressure=997hPa
Received: ACK 3
Sent: Client 4: Temp=18C, Humidity=40%, Pressure=1024hPa
Received: ACK 4
Sent: Client 4: Temp=7C, Humidity=82%, Pressure=986hPa
Received: ACK 5
Sent: Client 4: Temp=10C, Humidity=12%, Pressure=993hPa
Received: ACK 6
Sent: Client 4: Temp=29C, Humidity=19%, Pressure=1024hPa
Received: ACK 7
Packet (Seq 8) lost for client 4
Timeout: No acknowledgment received for Client 4 (Seq 8)
Sent: Client 4: Temp=10C, Humidity=76%, Pressure=980hPa
Received: ACK 8
Sent: Client 4: Temp=37C, Humidity=73%, Pressure=1010hPa
Received: ACK 9
Sent: Client 4: Temp=18C, Humidity=80%, Pressure=1004hPa
Received: ACK 10
Sent: Client 4: Temp=24C, Humidity=45%, Pressure=1029hPa
Received: ACK 11
Sent: Client 4: Temp=21C, Humidity=48%, Pressure=995hPa
Received: ACK 12
Sent: Client 4: Temp=36C, Humidity=9%, Pressure=984hPa
Received: ACK 13
Packet (Seq 14) lost for client 4
Timeout: No acknowledgment received for Client 4 (Seq 14)
Sent: Client 4: Temp=37C, Humidity=23%, Pressure=1029hPa
Received: ACK 14
Sent: Client 4: Temp=7C, Humidity=11%, Pressure=1022hPa
Received: ACK 15
Packet (Seq 16) lost for client 4
Timeout: No acknowledgment received for Client 4 (Seq 16)
Sent: Client 4: Temp=22C, Humidity=80%, Pressure=997hPa
Received: ACK 16
Sent: Client 4: Temp=23C, Humidity=25%, Pressure=1007hPa
Received: ACK 17
Sent: Client 4: Temp=25C, Humidity=70%, Pressure=1029hPa
Received: ACK 18
Sent: Client 4: Temp=18C, Humidity=44%, Pressure=1024hPa
Received: ACK 19
Sent: Client 4: Temp=9C, Humidity=7%, Pressure=992hPa
Received: ACK 20
Sent: Client 4: Temp=21C, Humidity=66%, Pressure=993hPa
Received: ACK 21
Sent: Client 4: Temp=25C, Humidity=53%, Pressure=1007hPa
```

The above two screenshots belong to 2 different clients running at the same time
It sends Weather data to the server and receives ACKs and Packet loss is observed