

### **Average Response time:**

#### **Seller (1 instance | 10 instances | 100 instances):**

1. Create an account - 147.3 ms | 87.1 ms | 82.4 ms
2. Login - 106.7 ms | 79.7 ms | 81.9 ms
3. Logout - 232.0 ms | 176.4 ms | 179 ms
4. Get seller rating - 166.7 ms | 138.1 ms | 129.3 ms
5. Put an item for sale - 122.4 ms | 104.7 ms | 101.3 ms
6. Change the sale price - 172.3 ms | 142.4 ms | 139.4 ms
7. Remove an item - 104.8 ms | 95.8 ms | 93.2 ms
8. Display items - 280 ms | 262.6 ms | 272.8 ms

#### **Buyer (1 instance | 10 instances | 100 instances):**

1. Create an account - 809.2 ms | 82.6 ms | 85.8 ms
2. Login - 150.9 ms | 131.3 ms | 126.2 ms
3. Logout - 173.7 ms | 149.3 ms | 129.6 ms
4. Add item to the shopping cart - 243.6 ms | 224.5 ms | 218.3 ms
5. Remove item from the shopping cart - 154.1 ms | 141.4 ms | 137.8 ms
6. Clear the shopping cart - 124.6 ms | 110.4 ms | 106.9 ms
7. Display shopping cart - 118.6 ms | 108.9 ms | 103.6 ms
8. Provide feedback - 40.4 ms | 34.6 ms | 36.8 ms
9. Get seller rating - 103.5 ms | 79.4 ms | 71.6 ms
10. Search for Item - 400.6 ms | 370.2 ms | 352.1 ms
11. Get Purchase History - 242.1 ms | 171.7 ms | 172.9 ms
12. Make purchase - 236.3 ms | 201.3 ms | 198.2 ms

With the increase in no of clients, since both servers used threading to handle multiple clients and provide response, there is a trend of faster response time for many of the functions.

### **Average Throughputs:**

1. Seller Server:
  - a. 1 instance of client - 5.16 operations per second
  - b. 10 instances of client - 30.15 operations per second
  - c. 100 instances of client - 54.47 operations per second
2. Buyer Server:
  - a. 1 instance of client - 2.84 operations per second
  - b. 10 instances of client - 10.33 operations per second
  - c. 100 instances of client - 16.83 operations per second

We can observe that with an increase in the number of clients, both the servers are able to perform more operations per second, thus increasing the throughput. This increase in throughput with the increase in number of clients is due to the ability of handling multiple requests using multithreading by grpc.

Also, Buyer server has lesser throughput than seller server. This can be due to the following reasons. In the make purchase method, we are calling soap service to get the transaction status, and then updating the database to remove the items quantities that are purchased, and also there are few methods in buyer where we are updating multiple tables in a single remote procedure call. Due to the above reasons, buyer server has lesser throughput compared to seller server.

Compared to the performance of TCP communication between client and server, Performance of the servers and clients is faster with REST and GRPC communication.