

CS447 P2 REPORT

Introduction

The objective of this assignment is to develop a robust Internet Relay Chat (IRC) application that leverages both Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) for communication. TCP is utilized for core IRC functionalities such as command execution and message delivery, ensuring reliable and orderly transmission. Conversely, UDP enhances real-time features like heartbeat signals, server statistics broadcasting, and notifications, offering faster data transmission with lower latency. This project aims to deepen the understanding of TCP and UDP differences, adhere to RFC 2812 specifications, and explore concurrent programming to manage multiple clients efficiently.

Design Overview

The IRC application integrates TCP and UDP protocols to manage client-server interactions and maintain real-time communication, adhering to RFC 2812 standards for command processing and responses.

System Architecture

Client-Server Model:

Server: Central hub managing client connections, channels, and message routing. It handles multiple clients concurrently using the select system call for efficient I/O multiplexing.
Client: Text-based interface for users to connect to the server, execute IRC commands, and communicate through channels or direct messages.

Protocol Utilization:

TCP: Used for core IRC functionalities such as command execution, message delivery, and client registration, ensuring reliable and ordered message transmission.

UDP: Employed for out-of-band communications, including heartbeat signals to verify client activity and broadcasting server statistics to clients, leveraging UDP's low-latency transmission.

Core Components and Functionalities

Client Management:

Maintains a clients map linking client file descriptors to ClientInfo structures containing nickname, IP address, UDP port, registration status, and heartbeat timestamps. Handles

client registration via NICK and USER commands, ensuring nickname uniqueness and validity.

Channel Management:

Manages channels using a channels map, associating channel names with sets of client file descriptors. Supports channel operations such as JOIN, PART, TOPIC, LIST, and NAMES, enforcing channel modes like private or secret.

Heartbeat Mechanism:

Server Side: A dedicated heartbeatThread periodically sends "HEARTBEAT" messages via UDP to each registered client's UDP port, monitoring responsiveness and disconnecting inactive clients after $2 * \text{HEARTBEAT_INTERVAL}$ seconds.

Client Side: The receiveBroadcasts function listens for "HEARTBEAT" messages and responds with "HEARTBEAT_RESPONSE" to confirm activity.

Server Statistics Broadcasting:

Implements broadcastServerStats, which periodically sends server statistics (e.g., number of connected users and active channels) to all registered clients via UDP.

Command Handling:

The handleCommand function parses incoming messages and routes them to specific handlers based on the command type, ensuring case-insensitive processing as per IRC standards.

Concurrency and Thread Safety:

Utilizes C++ threads to handle concurrent operations such as client message processing, heartbeat management, and statistics broadcasting. Employs a std::mutex (client_mutex) to synchronize access to shared data structures, ensuring thread safety.

Protocol's Reply Codes Implementation

Adhering to RFC 2812, the application implements essential numeric reply codes for standardized client-server communications:

Success Codes:

001 (RPL_WELCOME): Sent upon successful connection and registration.

002 (RPL_YOURHOST): Provides server host and version information.

004 (RPL_MYINFO): Shares server information and capabilities.

322 (RPL_LIST): Details available channels during the LIST command.

323 (RPL_LISTEND): Indicates the end of the channel list.

301 (RPL_AWAY): Notifies that a user is marked as away.

Error Codes:

401 (ERR_NOSUCHNICK): No such nickname exists.

403 (ERR_NOSUCHCHANNEL): No such channel exists.

404 (ERR_CANNOTSENDTOCHAN): Cannot send message to channel.

431 (ERR_NONICKNAMEGIVEN): No nickname provided.

432 (ERR_ERRONEUSNICKNAME): Invalid nickname format.

433 (ERR_NICKNAMEINUSE): Nickname already in use.

461 (ERR_NEEDMOREPARAMS): Insufficient parameters for a command.

501 (ERR_UMODEUNKNOWNFLAG): Unknown user mode flag.

502 (ERR_USERSDONTMATCH): Cannot change mode for other users.

Added 221 (RPL_UMODEIS) ensures compliance with IRC protocol standards for acknowledging user mode changes. It provides clear and immediate feedback to clients about their current mode settings, enhancing user experience and interface consistency.

These codes facilitate clear communication and error reporting between the server and clients.

Heartbeat and Client Timeout Mechanism

To maintain active client connections:

Heartbeat Implementation:

Server Side: The heartbeatThread sends "HEARTBEAT" messages via UDP at intervals defined by HEARTBEAT_INTERVAL. It logs each heartbeat sent and updates client heartbeat timestamps upon receiving responses.

Client Side: The receiveBroadcasts function listens for "HEARTBEAT" messages and responds with "HEARTBEAT_RESPONSE", logging each interaction.

Timeout Detection:

The server monitors each client's last_heartbeat. If a client fails to respond within $2 * \text{HEARTBEAT_INTERVAL}$ seconds, the server disconnects the client, removes them from channels, and logs the event.

Concurrency and Thread Management

Multithreading:

Separate threads handle heartbeat management (heartbeatThread), heartbeat responses (receiveHeartbeatResponses), and statistics broadcasting (broadcastServerStats).

Synchronization:

A std::mutex (client_mutex) ensures safe access to shared data structures, preventing race conditions.

Error Handling and Robustness

Command Validation:

Validates incoming commands for correct syntax and sufficient parameters, returning appropriate error codes upon failure.

Socket Operations:

Monitors and handles errors during socket operations, logging issues for diagnostics.

Graceful Disconnections:

Implements the QUIT command, allowing clients to disconnect gracefully, ensuring resource cleanup.

Compliance with Assignment Requirements

The IRC application meets the project specifications by:

Protocol Adherence:

Conforms to RFC 2812 standards for IRC command processing and response formatting.

Command Support:

Implements essential IRC commands (NICK, USER, MODE, JOIN, PART, TOPIC, LIST, NAMES, PRIVMSG, QUIT) with appropriate handling and response codes.

Heartbeat and Statistics:

Incorporates a heartbeat mechanism for active client monitoring and broadcasts server statistics via UDP.

Client Implementation:

Provides a text-based client that connects to the server, sends commands, and displays received messages and statistics, utilizing a fixed offset strategy for UDP port allocation.

Configuration Management:

Utilizes server.conf and client.conf files to specify runtime parameters like TCP ports and heartbeat intervals.

Concurrency and Scalability:

Employs multithreading and efficient I/O handling to manage multiple concurrent client connections, ensuring scalability.

Summary

The developed IRC application successfully integrates TCP and UDP protocols to facilitate reliable and efficient real-time communication. By adhering to RFC 2812 specifications and implementing essential IRC functionalities, the application provides a robust foundation for an IRC-based chat system. The design choices, particularly the dual-protocol strategy and effective concurrency management, ensure scalability and responsiveness, setting the stage for future enhancements and feature expansions.

Issues

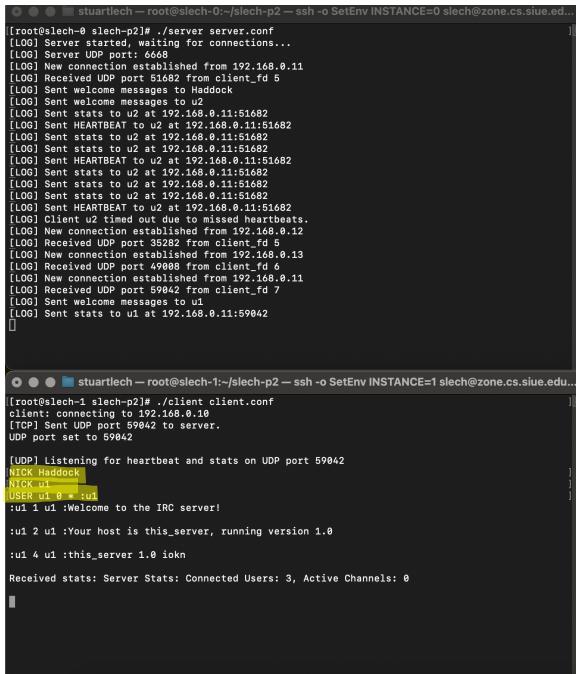
The server is experiencing intermittent crashes accompanied by error messages such as "recv: Connection reset by peer" and "recv: Bad file descriptor." These unexpected terminations disrupt service availability and negatively impact user experience. To thoroughly assess the server's stability and identify the root causes, it is essential to perform periodic reruns of both the server and client applications, systematically testing all functionalities and monitoring for error codes.

Suspected Reasons for Crashes include improper handling of client disconnections, where abrupt disconnects may cause the server to operate on closed sockets; race conditions in multithreading, leading to inconsistent states due to unsynchronized access to shared resources like the clients map; resource leaks from inadequate release of memory or file descriptors, potentially exhausting system resources; unhandled exceptions triggered by malformed or unexpected client inputs; and socket configuration issues, such as incorrect socket options or improper management of the fd_set during the select loop, resulting in invalid file descriptor states.

Additionally, when a user issues the QUIT command, the server treats it as a logout action without retaining the user's username and real name information. Only the user's nickname is released, allowing it to be claimed by another user if desired upon rejoining the IRC server.

Sample Run

NICK and USER



The screenshot shows two terminal windows. The top window is titled 'stuarttech - root@slech-0:~/slech-p2' and contains the server log. The bottom window is titled 'stuarttech - root@slech-1:~/slech-p2' and contains the client log.

```
[root@slech-0 slech-p2]# ./server server.conf
[LOG] Server started, waiting for connections...
[LOG] Server UDP port: 6668
[LOG] New connection established from 192.168.0.11
[LOG] Received UDP port 51682 from client_fd 5
[LOG] Sent welcome message to Haddock
[LOG] Sent welcome messages to u2
[LOG] Sent stats to u2 at 192.168.0.11:51682
[LOG] Sent HEARTBEAT to u2 at 192.168.0.11:51682
[LOG] Sent stats to u2 at 192.168.0.11:51682
[LOG] Sent stats to u2 at 192.168.0.11:51682
[LOG] Sent HEARTBEAT to u2 at 192.168.0.11:51682
[LOG] Sent stats to u2 at 192.168.0.11:51682
[LOG] Sent stats to u2 at 192.168.0.11:51682
[LOG] Sent stats to u2 at 192.168.0.11:51682
[LOG] Client u2 timed out due to missed heartbeats.
[LOG] New connection established from 192.168.0.12
[LOG] Received UDP port 38510 from client_fd 6
[LOG] New connection established from 192.168.0.13
[LOG] Received UDP port 49888 from client_fd 8
[LOG] New connection established from 192.168.0.11
[LOG] Received UDP port 59842 from client_fd 7
[LOG] Sent welcome messages to u1
[LOG] Sent stats to u1 at 192.168.0.11:59842
```



```
[root@slech-1 slech-p2]# ./client client.conf
client: connecting to 192.168.0.10
[TCP] Sent UDP port 59842 to server.
UDP port set to 59842

[UDP] Listening for heartbeat and stats on UDP port 59842
NICK Haddock
NICK u1
USER u1 B * :u1
:u1 1 u1 :Welcome to the IRC server!
:u1 2 u1 :Your host is this_server, running version 1.0
:u1 4 u1 :this_server 1.0 iokn
Received stats: Server Stats: Connected Users: 3, Active Channels: 0
```

JOIN and PART

TOPIC

LIST

```
[LOG] Sent stats to u1 at 192.168.0.12:37595
[LOG] Sent HEARTBEAT to u1 at 192.168.0.11:68828
[LOG] Sent HEARTBEAT to u2 at 192.168.0.12:37596
[LOG] Set mode +s for channel c1
[LOG] Sent stats to u1 at 192.168.0.11:68828
[LOG] Sent stats to u1 at 192.168.0.12:37595
[LOG] Sent stats to u1 at 192.168.0.12:37595
+-----+
stuartlech - root@slech-1:/slech-p2 - ssh -o SetEnv INSTANCE=1 slech@zone.cs.siu.edu...
+-----+
~ -root@slech-1:/slech-p2 - ssh -o SetEnv INSTANCE=1 slech@zone.cs.siu.edu

[UODP] Received HEARTBEAT from server.
[UODP] Sent HEARTBEAT_RESPONSE to server.
LIST
323 u1 :End of LIST

NAMES c1Received stats: Server Stats: Connected Users: 2, Active Channels: 1

403 :No such channel

JOIN c1
Cannot join c1 due to restricted mode

Received stats: Server Stats: Connected Users: 2, Active Channels: 1

[UODP] Received HEARTBEAT from server.
[UODP] Sent HEARTBEAT_RESPONSE to server.
LIST
322 u1 c1 :Public channel
323 u1 :End of LIST

Received stats: Server Stats: Connected Users: 2, Active Channels: 1
+-----+
stuartlech - root@slech-2:/slech-p2 - ssh -o SetEnv INSTANCE=2 slech@zone.cs.siu.edu - 103x...
+-----+
:u2 u2 :Welcome to the IRC server!
:u2 u2 :Your host is this_server, running version 1.0
:u2 u2 :this_server iokn

JOIN c1
322 u2 c1 :You have joined the channel

[UODP] Received HEARTBEAT from server.
[UODP] Sent HEARTBEAT_RESPONSE to server.
MODE c1 +s
221 c1 :+s

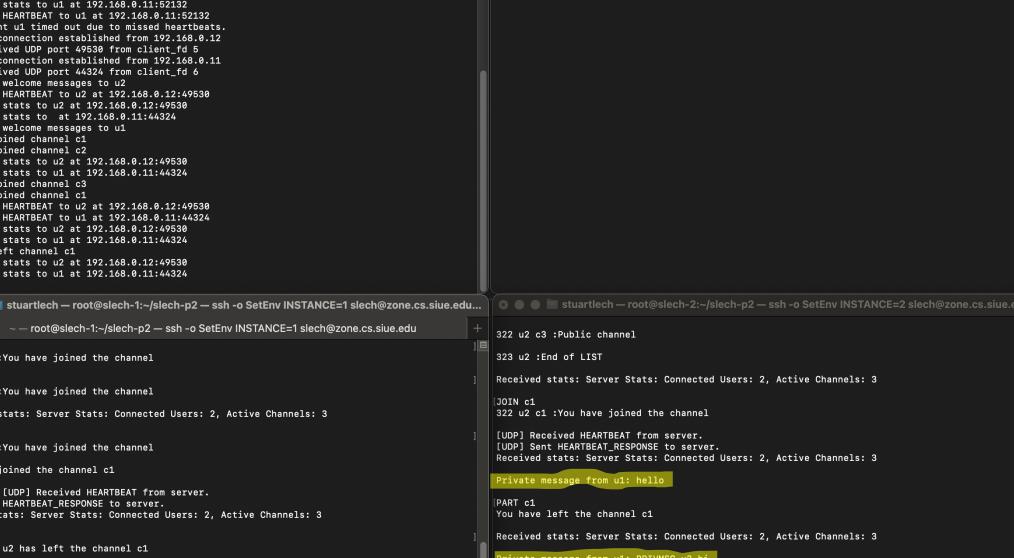
Received stats: Server Stats: Connected Users: 2, Active Channels: 1

Received stats: Server Stats: Connected Users: 2, Active Channels: 1

[UODP] Received HEARTBEAT from server.
[UODP] Sent HEARTBEAT_RESPONSE to server.
MODE c1 +s
221 c1 :+s

Received stats: Server Stats: Connected Users: 2, Active Channels: 1
```

PRIVMSG(for channel and user)



The image shows a Mac OS X desktop environment with two terminal windows open and the Dock at the bottom.

Terminal 1 (Left):

```
[LOG] Sent HEARTBEAT to u1 at 192.168.0.11:52132
[LOG] Sent stats to u1 at 192.168.0.11:52132
[LOG] Sent stats to u1 at 192.168.0.11:52132
[LOG] Sent stats to u1 at 192.168.0.11:52132
[LOG] Sent HEARTBEAT to u1 at 192.168.0.11:52132
[LOG] Client u1 timed out due to missed heartbeats.
[LOG] New connection established from 192.168.0.12
[LOG] Received UDP port 49530 from client_fd 5
[LOG] New connection established from 192.168.0.11
[LOG] Received UDP port 49530 from client_fd 6
[LOG] Sent welcome messages to u2
[LOG] Sent HEARTBEAT to u2 at 192.168.0.12:49530
[LOG] Sent stats to u2 at 192.168.0.12:49530
[LOG] Sent stats to u2 at 192.168.0.11:44324
[LOG] Sent stats to u2 at 192.168.0.11:44324
[LOG] u1 joined channel c1
[LOG] u1 joined channel c2
[LOG] Sent stats to u2 at 192.168.0.12:49530
[LOG] Sent stats to u1 at 192.168.0.11:44324
[LOG] u2 joined channel c1
[LOG] u2 joined channel c1
[LOG] Sent HEARTBEAT to u2 at 192.168.0.12:49530
[LOG] Sent HEARTBEAT to u1 at 192.168.0.11:44324
[LOG] Sent stats to u2 at 192.168.0.12:49530
[LOG] Sent stats to u1 at 192.168.0.11:44324
[LOG] u2 left channel c1
[LOG] Sent stats to u2 at 192.168.0.12:49530
[LOG] Sent stats to u1 at 192.168.0.11:44324
[LOG]
```

Terminal 2 (Right):

```
[root@slech-3 ~]# 
[root@slech-3 ~]# stuarttech — root@slech-3:~/slech-p2 — ssh -o SetEnv INSTANCE=3 slech@zone.cs.siue.edu — 103x...
[LOG] Sent HEARTBEAT to u1 at 192.168.0.11:52132
[LOG] Sent stats to u1 at 192.168.0.11:52132
[LOG] Sent stats to u1 at 192.168.0.11:52132
[LOG] Sent stats to u1 at 192.168.0.11:52132
[LOG] Sent HEARTBEAT to u1 at 192.168.0.11:52132
[LOG] Client u1 timed out due to missed heartbeats.
[LOG] New connection established from 192.168.0.12
[LOG] Received UDP port 49530 from client_fd 5
[LOG] New connection established from 192.168.0.11
[LOG] Received UDP port 49530 from client_fd 6
[LOG] Sent welcome messages to u2
[LOG] Sent HEARTBEAT to u2 at 192.168.0.12:49530
[LOG] Sent stats to u2 at 192.168.0.12:49530
[LOG] Sent stats to u2 at 192.168.0.11:44324
[LOG] Sent stats to u2 at 192.168.0.11:44324
[LOG] u1 joined channel c1
[LOG] u1 joined channel c2
[LOG] Sent stats to u2 at 192.168.0.12:49530
[LOG] Sent stats to u1 at 192.168.0.11:44324
[LOG] u2 joined channel c1
[LOG] u2 joined channel c1
[LOG] Sent HEARTBEAT to u2 at 192.168.0.12:49530
[LOG] Sent HEARTBEAT to u1 at 192.168.0.11:44324
[LOG] Sent stats to u2 at 192.168.0.12:49530
[LOG] Sent stats to u1 at 192.168.0.11:44324
[LOG] u2 left channel c1
[LOG] Sent stats to u2 at 192.168.0.12:49530
[LOG] Sent stats to u1 at 192.168.0.11:44324
[LOG]
```

Terminal 3 (Bottom Left):

```
JOIN c1
322 u1 c1 :You have joined the channel

JOIN c2
322 u1 c2 :You have joined the channel

JReceived stats: Server Stats: Connected Users: 2, Active Channels: 3

QIN c3
322 u1 c3 :You have joined the channel

PRIVMSG c1 :You have joined the channel

PRIVMSG c1 [UDP] Received HEARTBEAT from server.
[UDC] Sent HEARTBEAT_RESPONSE to server.
Received stats: Server Stats: Connected Users: 2, Active Channels: 3

hello
PRIVMSG u2 u2 has left the channel c1

PRIVMSG Received stats: Server Stats: Connected Users: 2, Active Channels: 3

u2 hi
```

Terminal 4 (Bottom Right):

```
322 u2 c3 :Public channel
323 u2 :End of LIST

Received stats: Server Stats: Connected Users: 2, Active Channels: 3

JOIN c1
322 u2 c1 :You have joined the channel

[UDP] Received HEARTBEAT from server.
[UDC] Sent HEARTBEAT_RESPONSE to server.
Received stats: Server Stats: Connected Users: 2, Active Channels: 3

Private message from u1: hello
PART c1
You have left the channel c1

Received stats: Server Stats: Connected Users: 2, Active Channels: 3

Private message from u1: PRIVMSG u2 hi
```

The Dock at the bottom contains icons for various applications including Finder, Mail, Safari, and others.

NAMES

```

stuarttech - root@slech-1:~/slech-p2 - ssh -o SetEnv INSTANCE=1 slech@zone.cs.siu.edu...
-- root@slech-1:~/slech-p2 - ssh -o SetEnv INSTANCE=1 slech@zone.cs.siu.edu...
:u1 1 u1 :Welcome to the IRC server!
:u1 2 u1 :Your host is this_server, running version 1.0
:u1 4 u1 :this_server 1.0 iokn
Received stats: Server Stats: Connected Users: 2, Active Channels: 0
LIST
323 u1 :End of LIST
JOIN c1
322 u1 c1 :You have joined the channel
u2 has joined the channel c1
NAMESc[UPD] Received HEARTBEAT from server.
[UPD] Sent HEARTBEAT_RESPONSE to server.
NAMES
Users in channel c1:
u1 u2

```

```

stuarttech - root@slech-2:~/slech-p2 - ssh -o SetEnv INSTANCE=2 slech@zone.cs.siu.edu - 103x.
[root@slech-2 slech-p2]# ./client client.conf
client: connecting to 192.168.0.10
[TCP] Sent UDP port 57868 to server.
[UDP] Listening for heartbeat and stats on UDP port 57868
UDP port set to 57868
NICK u2
USER u2 0 * :u2
:u2 1 u2 :Welcome to the IRC server!
:u2 2 u2 :Your host is this server, running version 1.0
:u2 4 u2 :this_server 1.0 iokn
Received stats: Server Stats: Connected Users: 2, Active Channels: 0
JOIN c1
322 u2 c1 :You have joined the channel
[UPD] Received HEARTBEAT from server.
[UPD] Sent HEARTBEAT_RESPONSE to server.
Received stats: Server Stats: Connected Users: 2, Active Channels: 1

```

MODE

note In adherence to **RFC 2812**, which outlines the specifications for the Internet Relay Chat (IRC) protocol, the inclusion of the numeric reply code 221 (RPL_UMODEIS) is both appropriate and essential for comprehensive mode management within the IRC server application.

USER:

‘a’ away mode notifies the other that user is away in PRIVMSG

```

stuarttech - root@slech-1:~/slech-p2 - ssh -o SetEnv INSTANCE=1 slech@zone.cs.siu.edu...
-- root@slech-1:~/slech-p2 - ssh -o SetEnv INSTANCE=1 slech@zone.cs.siu.edu...
[UPD] Listening for heartbeat and stats on UDP port 49472
UDP port set to 49472
NICK u1
USER u1 0 * :u1
:u1 1 u1 :Welcome to the IRC server!
:u1 2 u1 :Your host is this_server, running version 1.0
:u1 4 u1 :this_server 1.0 iokn
[UPD] Received HEARTBEAT from server.
[UPD] Sent HEARTBEAT_RESPONSE to server.
MODE u1 +a
221 u1 :+a
Received stats: Server Stats: Connected Users: 3, Active Channels: 0
Private message from u2: hi
MODE u1 -a
221 u1 :+a
Received stats: Server Stats: Connected Users: 3, Active Channels: 0
Private message from u2: hi

```

```

stuarttech - root@slech-2:~/slech-p2 - ssh -o SetEnv INSTANCE=2 slech@zone.cs.siu.edu - 103x.
[root@slech-2 slech-p2]# ./client client.conf
client: connecting to 192.168.0.10
[TCP] Sent UDP port 49494 to server.
[UDP] Listening for heartbeat and stats on UDP port 49494
49494
NICK u2
USER u2 0 * :u2
:u2 1 u2 :Welcome to the IRC server!
:u2 2 u2 :Your host is this_server, running version 1.0
:u2 4 u2 :this_server 1.0 iokn
Received stats: Server Stats: Connected Users: 3, Active Channels: 0
PRIVMSG u1 hi
301 u1 User is away
PRIVMSG u1 hi

```

‘i’ invisible mode allows users in NAMES c1 when other user is not in channel

```

RECEIVED stats: Server Stats: Connected Users: 2, Active Channels: 0
[UPD] Received HEARTBEAT from server.
[UPD] Sent HEARTBEAT_RESPONSE to server.
NAReceived stats: Server Stats: Connected Users: 2, Active Channels: 1
NAMES c1
Users in channel c1:
MODE u1 +w
221 u1 :+w
NAMES c1
Users in channel c1:
u2

```

```

JOINRECEIVED stats: Server Stats: Connected Users: 2, Active Channels: 0
c1
322 u2 c1 :You have joined the channel
MODE u1 [UPD] Received HEARTBEAT from server.
[UPD] Sent HEARTBEAT_RESPONSE to server.
+i
502 :Cannot change modes for other users
MODE u2 +i
221 u2 :+i
Received stats: Server Stats: Connected Users: 2, Active Channels: 1

```

‘w’ wallops mode allows users in NAMES c1 when other users invisible mode

```

RECEIVED stats: Server Stats: Connected Users: 2, Active Channels: 0
[UPD] Received HEARTBEAT from server.
[UPD] Sent HEARTBEAT_RESPONSE to server.
NAReceived stats: Server Stats: Connected Users: 2, Active Channels: 1
NAMES c1
Users in channel c1:
MODE u1 +w
221 u1 :+w
NAMES c1
Users in channel c1:
u2

```

```

JOINRECEIVED stats: Server Stats: Connected Users: 2, Active Channels: 0
c1
322 u2 c1 :You have joined the channel
MODE u1 [UPD] Received HEARTBEAT from server.
[UPD] Sent HEARTBEAT_RESPONSE to server.
+i
502 :Cannot change modes for other users
MODE u2 +i
221 u2 :+i
Received stats: Server Stats: Connected Users: 2, Active Channels: 1

```

CHANNEL:

‘a’ anonymous changes all users in NAMES to anonymous

```
[JOIN c1
322 u1 c1 :You have joined the channel

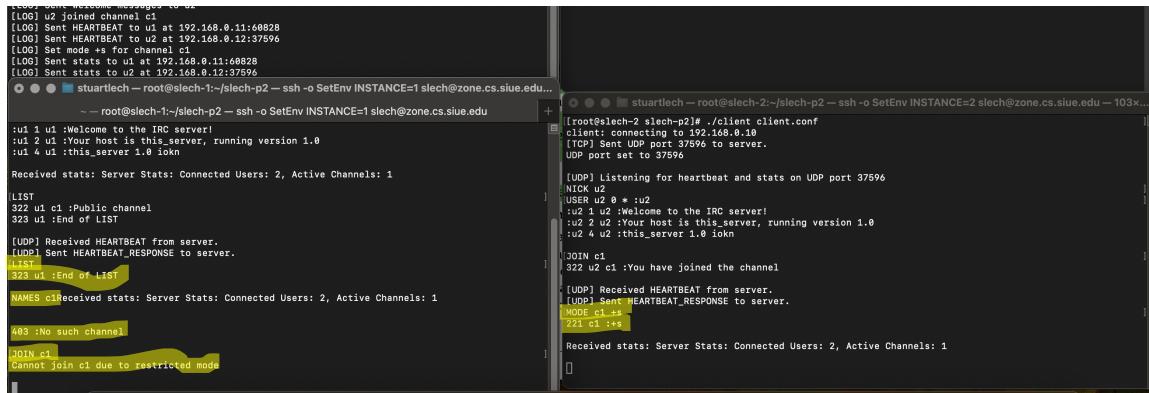
[NAMES c1
Users in channel c1:
u1

MODE c1 +a[UDP] Received HEARTBEAT from server.
[UDP] Sent HEARTBEAT_RESPONSE to server.

221 c1 ::+a

[NAMES c1
Users in channel c1:
anonymous
```

‘s’ Secret mode hides channel from LIST and NAMES and restricts users joining



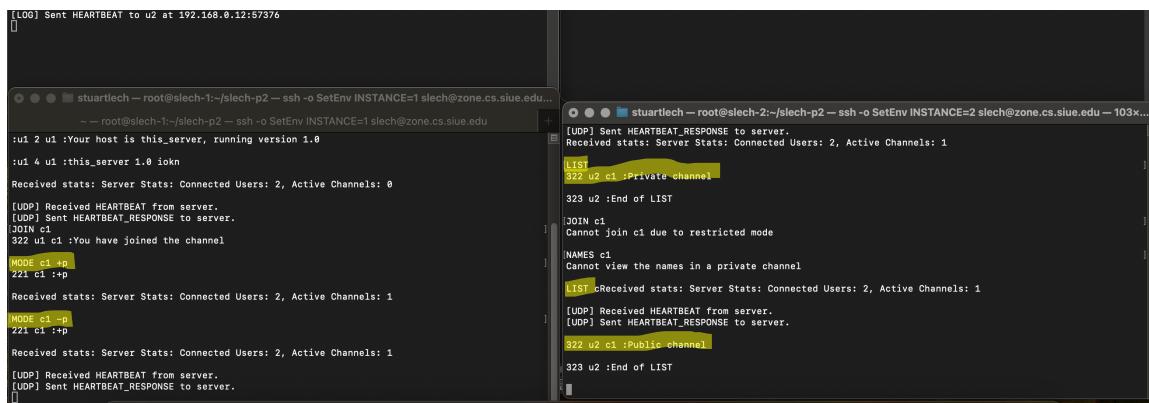
```
[LOG] u2 joined channel c1
[LOG] Sent HEARTBEAT to u1 at 192.168.0.11:60828
[LOG] Sent HEARTBEAT to u2 at 192.168.0.12:37596
[LOG] Set mode +s for u1
[LOG] Sent stats to u1 at 192.168.0.11:60828
[LOG] Sent stats to u2 at 192.168.0.12:37596
[LOG] Sent stats to u2 at 192.168.0.12:37596

stuarttech - root@slech-1:~/slech-p2 -- ssh -o SetEnv INSTANCE=1 slech@zone.cs.siue.edu...
~ - root@slech-1:~/slech-p2 -- ssh -o SetEnv INSTANCE=1 slech@zone.cs.siue.edu
:u1 1 u1 :Welcome to the IRC server!
:u1 2 u1 :Your host is this_server, running version 1.0
:u1 4 u1 :this_server 1.0 iohn
Received stats: Server Stats: Connected Users: 2, Active Channels: 1
LIST
322 u1 c1 :Public channel
323 u1 :End of LIST
[UDP] Received HEARTBEAT from server.
[UDP] Sent HEARTBEAT_RESPONSE to server.
LIST
323 u1 :End of LIST
NAMES c1Received stats: Server Stats: Connected Users: 2, Active Channels: 1
403 :No such channel
JOIN c1
Cannot join c1 due to restricted mode

[LOG] Listening for heartbeat and stats on UDP port 37596
NICK u2
USER u2 0 * :u2
:u2 1 u2 :Welcome to the IRC server!
:u2 2 u2 :Your host is this_server, running version 1.0
:u2 4 u2 :this_server 1.0 iohn
:JOIN c1
322 u2 c1 :You have joined the channel
[UDP] Received HEARTBEAT From server.
[UDP] Sent HEARTBEAT_RESPONSE to server.
MODE c1 +s
221 c1 ::+s

Received stats: Server Stats: Connected Users: 2, Active Channels: 1
```

‘p’ private mode just restricts users from joining channel



```
[LOG] Sent HEARTBEAT to u2 at 192.168.0.12:57376
[LOG] Sent HEARTBEAT_RESPONSE to server.
Received stats: Server Stats: Connected Users: 2, Active Channels: 1
LIST
322 u2 c1 :Private channel
323 u2 :End of LIST
:JOIN c1
Cannot join c1 due to restricted mode
NAMES c1
Cannot view the names in a private channel
LISTReceived stats: Server Stats: Connected Users: 2, Active Channels: 1
[UDP] Received HEARTBEAT from server.
[UDP] Sent HEARTBEAT_RESPONSE to server.
322 u2 c1 :Public channel
323 u2 :End of LIST
```

QUIT *Note* Check Issues section in regards to user and realname not being retained.

REPLY CODES

001 (RPL_WELCOME): Welcome message upon successful connection.

002 (RPL_YOURHOST): Server host and version information.

004 (RPL MYINFO): Server information.

```
[root@slech-0 slech-p2]# ./server server.conf
[LOG] Server started, waiting for connections...
[LOG] New connection established from 192.168.0.11
[LOG] Received UDP port 51482 from client_fd 5
[LOG] Sent welcome messages to Haddock
[LOG] Sent welcome messages to u2
[LOG] Sent state to u2 at 192.168.0.11:51482
[LOG] Sent heartbeat to u2 at 192.168.0.11:51482
[LOG] Sent stats to u2 at 192.168.0.11:51482
[LOG] Sent stats to u2 at 192.168.0.11:51482
[LOG] Sent heartbeat to u2 at 192.168.0.11:51482
[LOG] Sent state to u2 at 192.168.0.11:51482
[LOG] Sent state to u2 at 192.168.0.11:51482
[LOG] Sent stats to u2 at 192.168.0.11:51482
[LOG] Sent stats to u2 at 192.168.0.11:51482
[LOG] Sent heartbeat to u2 at 192.168.0.11:51482
[LOG] Sent state to u1 at 192.168.0.11:59042
[LOG] Sent heartbeat to u1 at 192.168.0.11:59042
[LOG] New connection established from 192.168.0.12
[LOG] Received UDP port 35282 from client_fd 5
[LOG] New connection established from 192.168.0.13
[LOG] Received UDP port 49098 from client_fd 6
[LOG] New connection established from 192.168.0.11
[LOG] Received UDP port 59042 from client_fd 7
[LOG] Sent welcome messages to u1
[LOG] Sent stats to u1 at 192.168.0.11:59042

[stuarttech ~]# ./client client.conf
client: connecting to 192.168.0.10
[TCP] Sent UDP port 59042 to server.
UDP port set to 59042

[UDP] Listening for heartbeat and stats on UDP port 59042
NICK Haddock
NICK u1
USER u1 0 * :u1
:u1 1 u1 :Welcome to the IRC server!
:u1 2 u1 :Your host is this server, running version 1.8
:u1 4 u1 :this server 1.8 John

Received stats: Server Stats: Connected Users: 3, Active Channels: 0
```

301 (RPL_AWAY): User is marked as away.

```

stuarttech - root@slech-1:~/slech-p2 - ssh -o SetEnv INSTANCE=1 slech@zone.cs.siu.edu...
-- root@slech-1:~/slech-p2 - ssh -o SetEnv INSTANCE=1 slech@zone.cs.siu.edu
[UDP] Listening for heartbeat and stats on UDP port 49472
UDP port set to 49472
NICK u1
USER u1 0 * :u1
:u1 1 u1 :Welcome to the IRC server!
:u1 2 u1 :Your host is this_server, running version 1.0
:u1 4 u1 :this_server 1.0 iokn
[UDP] Received HEARTBEAT from server.
[UDP] Sent HEARTBEAT_RESPONSE to server.
MODE u1 +=a
221 u1 :+a
Received stats: Server Stats: Connected Users: 3, Active Channels: 0
Private message from u2: hi
MODE u1 -=a
221 u1 :+a
Private message from u2: hi

```

322 (RPL_LIST): Channel information (from LIST command).

323 (RPL_LISTEND): End of channel list (from LIST command).

```

[LOG] Set mode +s for channel c1
[LOG] Set stats to u1 at 192.168.0.11:60828
[LOG] Sent stats to u2 at 192.168.0.12:37596
[LOG] Set stats to u2 at 192.168.0.12:37596
stuarttech - root@slech-1:~/slech-p2 - ssh -o SetEnv INSTANCE=1 slech@zone.cs.siu.edu...
-- root@slech-1:~/slech-p2 - ssh -o SetEnv INSTANCE=1 slech@zone.cs.siu.edu
[UDP] Received HEARTBEAT from server.
[UDP] Sent HEARTBEAT_RESPONSE to server.
LIST
323 u1 :End of LIST
NAMES c1Received stats: Server Stats: Connected Users: 2, Active Channels: 1
403 :No such channel
JOIN c1
Cannot join c1 due to restricted mode
Received stats: Server Stats: Connected Users: 2, Active Channels: 1
[UDP] Received HEARTBEAT from server.
[UDP] Sent HEARTBEAT_RESPONSE to server.
LIST
322 u1 c1 :Public channel
323 u1 :End of LIST
Received stats: Server Stats: Connected Users: 2, Active Channels: 1

```

```

:u2 1 u2 :Welcome to the IRC server!
:u2 2 u2 :Your host is this_server, running version 1.0
:u2 4 u2 :this_server 1.0 iokn
JOIN c1
322 u2 c1 :You have joined the channel
[UDP] Received HEARTBEAT from server.
[UDP] Sent HEARTBEAT_RESPONSE to server.
MODE c1 +=s
221 c1 :+s
Received stats: Server Stats: Connected Users: 2, Active Channels: 1
Received stats: Server Stats: Connected Users: 2, Active Channels: 1
[UDP] Received HEARTBEAT from server.
[UDP] Sent HEARTBEAT_RESPONSE to server.
MODE c1 -=s
221 c1 :+s
Received stats: Server Stats: Connected Users: 2, Active Channels: 1

```

- 401 (ERR_NOSUCHNICK): No such nickname exists.

- 403 (ERR_NOSUCHCHANNEL): No such channel exists.

```

stuartlech — root@slech-0:~/slech-p2 — ssh -o SetEnv INSTANCE=0 slech@zone.cs.siue.edu
[[root@slech-0 slech-p2]# ./server server.conf
[LOG] Server started, waiting for connections...
[LOG] Server UDP port: 6668
[LOG] New connection established from 192.168.0.11
[LOG] Received UDP port 48186 from client_fd 5
[LOG] Sent welcome messages to u1
[LOG] Sent stats to u1 at 192.168.0.11:48186
[LOG] Sent HEARTBEAT to u1 at 192.168.0.11:48186
]

stuartlech — root@slech-1:~/slech-p2 — ssh -o SetEnv INSTANCE=1 slech@zone.cs.siue.edu
~ — root@slech-1:~/slech-p2 — ssh -o SetEnv INSTANCE=1 slech@zone.cs.siue.edu
UDP port set to 48186

[NICK u1
[USER u1
461 USER :Not enough parameters

[USER u1 0 * :u1
:u1 1 u1 :Welcome to the IRC server!

:u1 2 u1 :Your host is this_server, running version 1.0
:u1 4 u1 :this_server 1.0 iokn

[PRIVMMSG u2 hi
401/403 u1 :No such nick/channel

PRIVMMSGReceived stats: Server Stats: Connected Users: 1, Active Channels: 0

[ c1 hi
401/403 u1 :No such nick/channel

[UDP] Received HEARTBEAT from server.
[UDP] Sent HEARTBEAT_RESPONSE to server.

```

- 404 (ERR_CANNOTSENDTOCHAN): Cannot send message to channel.

```

stuarttech - root@slech-1:~/slech-p2 - ssh -o SetEnv INSTANCE=1 slech@zone.cs.siue.edu...
-- root@slech-1:~/slech-p2 - ssh -o SetEnv INSTANCE=1 slech@zone.cs.siue.edu...
[roote@slech-1 slech-p2]# ./client client.conf
client: connecting to 192.168.0.10
[TCP] Sent UDP port 58468 to server.
UDP port set to 58468
[UDP] Listening for heartbeat and stats on UDP port 58468
[NICK u1]
[USER u1 * * :u1
:u1 1 u1 :Welcome to the IRC server!
:u1 2 u1 :Your host is this_server 1.0 iokn
:u1 4 u1 :this_server 1.0 iokn
PRIVMSG c3 [UDP] Received HEARTBEAT from server.
[UDP] Sent HEARTBEAT_RESPONSE to server.
Received stats: Server Stats: Connected Users: 2, Active Channels: 2
hi
404 :Cannot send to channel (not a member)

[TCP] Sent UDP port 43278 to server.
[UDP] Listening for heartbeat and stats on UDP port 43278
[NICK u2]
[USER u2 0 * :u2
:u2 1 u2 :Welcome to the IRC server!
:u2 2 u2 :Your host is this_server, running version 1.0
:u2 4 u2 :this server 1.0 iokn
Received stats: Server Stats: Connected Users: 2, Active Channels: 1
JOIN c3
322 u2 c3 :You have joined the channel
MODE c3 [UDP] Received HEARTBEAT from server.
[UDP] Sent HEARTBEAT_RESPONSE to server.
Received stats: Server Stats: Connected Users: 2, Active Channels: 2
:u2 4 u2 :+p
221 c3 :+p

```

- 431 (ERR_NICKNAMEGIVEN): No nickname given.

```

Received stats: Server Stats: Connected Users: 2, Active Channels: 2
hi
404 :Cannot send to channel (not a member)
Received stats: Server Stats: Connected Users: 2, Active Channels: 2
[UDP] Received HEARTBEAT from server.
[UDP] Sent HEARTBEAT_RESPONSE to server.
Received stats: Server Stats: Connected Users: 2, Active Channels: 2
[NICK ]
431 NICK :No nickname given.

Received stats: Server Stats: Connected Users: 2, Active Channels: 2
[UDP] Received HEARTBEAT from server.
[UDP] Sent HEARTBEAT_RESPONSE to server.
Received stats: Server Stats: Connected Users: 2, Active Channels: 2
[NICK u1]

```

- 432 (ERR_ERRONEUSNICKNAME): Erroneous nickname.

```

stuarttech - root@slech-1:~/slech-p2 - ssh -o SetEnv INSTANCE=1 slech@zone.cs.siue.edu...
-- root@slech-1:~/slech-p2 - ssh -o SetEnv INSTANCE=1 slech@zone.cs.siue.edu...
[roote@slech-1 slech-p2]# ./client client.conf
client: connecting to 192.168.0.10
[TCP] Sent UDP port 36202 to server.
UDP port set to 36202

[UDP] Listening for heartbeat and stats on UDP port 36202
[NICK !#$%^
432 !#$%^ :Erroneous nickname


```

- 433 (ERR_NICKNAMEINUSE): Nickname is already in use.

```

stuarttech - root@slech-1:~/slech-p2 - ssh -o SetEnv INSTANCE=1 slech@zone.cs.siue.edu...
-- root@slech-1:~/slech-p2 - ssh -o SetEnv INSTANCE=1 slech@zone.cs.siue.edu...
[roote@slech-1 slech-p2]# ./client client.conf
client: connecting to 192.168.0.10
[TCP] Sent UDP port 47380 to server.
[UDP] Listening for heartbeat and stats on UDP port 47380
UDP port set to 47380
[NICK u1]
[USER u1
461 USER :Not enough parameters

[roote@slech-2 slech-p2]# ./client client.conf
client: connecting to 192.168.0.10
[TCP] Sent UDP port 34474 to server.
UDP port set to 34474
[UDP] Listening for heartbeat and stats on UDP port 34474
[NICK v1]
433 Nickname is already in use


```

461 (ERR_NEEDMOREPARAMS): Not enough parameters provided for command.

```
stuartlech — root@slech-1:~/slech-p2 — ssh -o SetEnv INSTANCE=1 slech@zone.cs.siue.edu...
~ — root@slech-1:~/slech-p2 — ssh -o SetEnv INSTANCE=1 slech@zone.cs.siue.edu
[[root@slech-1 slech-p2]# ./client client.conf
client: connecting to 192.168.0.10
[TCP] Sent UDP port 47380 to server.
[UDP] Listening for heartbeat and stats on UDP port 47380
UDP port set to 47380

[NICK u1
[USER u1
461 USER :Not enough parameters
```

501 (ERR_UMODEUNKNOWNFLAG): Unknown user mode flag.

```
stuartlech — root@slech-3:~/slech-p2 — ssh -o SetEnv INSTANCE=3 slech@zone.cs.siue.edu
[root@slech-3 slech-p2]# ./client client.conf
client: connecting to 192.168.0.10
[TCP] Sent UDP port 61118 to server.
UDP port set to 61118

[UDP] Listening for heartbeat and stats on UDP port 61118
[NICK u3
[USER u3 0 * :u3
:u3 1 u3 :Welcome to the IRC server!

:u3 2 u3 :Your host is this_server, running version 1.0
:u3 4 u3 :this_server 1.0 iokn

MODE [UDP] Received HEARTBEAT from server.
[UDP] Sent HEARTBEAT_RESPONSE to server.
[mode u3 +z
501 :Unknown user mode flag

JOIN cReceived stats: Server Stats: Connected Users: 3, Active Channels: 0

2
322 u3 c2 :You have joined the channel

MODE c2 +h
501 :Unknown channel mode flag
```

502 (ERR_USERSDONTMATCH): Cannot change mode for other users.

```
[NICK u3
[USER u3 0 * :u3
:u3 1 u3 :Welcome to the IRC server!

:u3 2 u3 :Your host is this_server, running version 1.0
:u3 4 u3 :this_server 1.0 iokn

MODE [UDP] Received HEARTBEAT from server.
[UDP] Sent HEARTBEAT_RESPONSE to server.
emode u3 +z
501 :Unknown user mode flag

JOIN cReceived stats: Server Stats: Connected Users: 3, Active Channels: 0

2
322 u3 c2 :You have joined the channel

[MODE c2 +h
501 :Unknown channel mode flag

[UDP] Received HEARTBEAT from server.
[UDP] Sent HEARTBEAT_RESPONSE to server.
Received stats: Server Stats: Connected Users: 3, Active Channels: 1

[MODE u1 +w
502 :Cannot change modes for other users
```