



ECE361 COMPUTER NETWORKS

[Multi-Party Text Conferencing]



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PROFESSOR HAMID TIMORABADI

Objective

In this lab, you will use UNIX TCP sockets to implement a multi-party text conferencing application.

Reference

- The network socket programming “Beej’s Guide to Network Programming” available online at: <https://beej.us/guide/bgnet/>
- Section 2.4 and related sections on Berkeley API from Chapter 2 of the Communication Networks by Alberto Leon-Garcia and Indra Widjaja, McGraw Hill, 2nd Edition, 2004.

Assignment Description

In this assignment, you will need to implement a text conferencing application. It will consist of a server with registered users, and several client nodes which are the end-points for a conference session. The clients may be in different networks. TCP will be used to communicate between the clients and the server.

Each client will have a unique identifier (ID). The server is assumed to have a list of client IDs that it will accept, and each ID is associated with a password (perhaps taken through a user registration procedure). A client must first log into the server with its ID and the server’s IP address. Upon login by a client, the server will create a binding between the client and itself until the client exits.

When a client wishes to communicate with other clients, it must create a conference session (i.e. a chat room) on the server. A conference session is simply a list of clients that are sending text messages to one another. Any message sent by a single user is seen by all clients that are participating in the conference session. It is the server’s responsibility to multicast the text data to all participating clients.

You will implement both the server and the client processes.

Protocol

The following protocol is only a **suggestion**. **Feel free to amend, or even use a completely different protocol**, but you must implement the basic commands and functionalities specified in the next two sections. You are required to explain your protocol and its implementation in the lab session during your demo.

We use two categories of messages: data and control. Control messages are used for client-server binding, session creation, invitation, termination, and etc. Since you are using TCP, you do not need to use acknowledgements for reliability. You only need acknowledgements for success/failure conditions at the server (e.g. whether login is successful).

You **must** use the following structure for data and control messages:

```
struct message {
    unsigned int type;
    unsigned int size;
    unsigned char source[MAX_NAME];
    unsigned char data[MAX_DATA];
};
```

The type field indicates the type of the message, as described in the table below. The size field should be set to the length of the data. The source field contains ID of the client sending the message.

The following table shows all control packets that **must** be implemented:

type	packet data	Function
LOGIN	<client ID, password>	Login with the server
LO_ACK		Acknowledge successful login
LO_NAK	<reason for failure>	Negative acknowledgement of login
EXIT		Exit from the server
JOIN	<session ID>	Join a conference session
JN_ACK	<session ID>	Acknowledge successful conference session join
JN_NAK	<session ID, reason for failure>	Negative acknowledgement of joining the session
LEAVE_SESS		Leave a conference session
NEW_SESS		Create new conference session
NS_ACK	<session ID>	Acknowledge new conference session
MESSAGE	<message data>	Send a message to the session or display the message if it is received
QUERY		Get a list of online users and available sessions
QU_ACK	<users and sessions>	Reply followed by a list of users online

Section 1: Client & Server Description

Client Program (*client.c*):

You should implement a client program, called “*client.c*”, in C on a UNIX system. Its command line input should be as follows:

```
client
```

Upon execution, the client program will wait for further commands on the command line, and start a receive thread. You should have a strategy to deal with unavailable port numbers. For example, you can use the UNIX `netstat` command to find out which ports are available on the system.

The login process should be clear from the available messages and command parameters. You may assume that the passwords are sent and received in plain text. TCP is a bidirectional protocol, so once a connection has been established between the client and the server, communication may proceed.

The client must implement the following commands on the `stdin` file stream:

<code>/login <client ID> <password> <server-IP> <server-port></code>	Log into the server at the given address and port. The IP address is specified in the string dot format
<code>/logout</code>	Exit the server
<code>/joinsession <session ID></code>	Join the conference session with the given session id
<code>/leavesession</code>	Leave the currently established session
<code>/createsession <session ID></code>	Create a new conference session and join it
<code>/list</code>	Get the list of the connected clients and available sessions
<code>/quit</code>	Terminate the program
<code><text></code>	Send a message to the current conference session. The message is sent after the new line.

Here is an example of how clients in a session would work:

Client 1:

1. Run the program: `./client`
2. `/login jill eW94dsol 192.168.1.5 5000`
3. `/createsession lab_help`

Client 2:

1. Run the program: `./client`
2. `/login jack 432wIFd 192.168.1.55 5000`
3. `/list /* Returns a list of users and the sessions they joined */`
4. `/joinsession lab_help`
5. Hi Jill! This is Jack. How are TCP sockets different from UDP sockets?

Server Program (server.c):

You should implement a server program, named “server.c”, in C on a UNIX system. Its command input should be as follows:

```
server <TCP port number to listen on>
```

Upon execution, the server should wait for connections from the clients in the system. The server acts as both **a conference session router and a database**.

For the database part:

- The server **has access to a client list** with passwords (which can be hard coded into your program or kept as a database file).
- The server **should keep an up-to-date list** of all connected clients in the system, which consists of their session ID, their IP, and port addresses. The server should **delete** a conference session when the last user of the session leaves.

The server should acknowledge some client requests (i.e. login and join session). You should deal with the possibility of a client attempting to log in with an ID that is already connected.

The server implements the conference functionality of the system **by forwarding messages intended for a conference session to all the clients registered for that session**. This process should be transparent to the receiving clients.

Section 2: Additional Features

In this section, more possible functionalities are suggested. You could even design your own commands and implement them. **If you implement any of these, you should provide a text file to explain your design and implementation.**

- Allow a client to join multiple sessions. If so, you should clearly indicate on the client’s terminal the session identification of every message.
- Implement a procedure for a client to invite other clients into a session. If so, you must provide a protocol for a client to either accept or refuse an invitation.
- You may wish to use a timer with each client, to disconnect clients that have been inactive for a long time.

Deliverables

The following should be submitted and be available for your demo during the lab session:

- The client and server programs. All code must be readable, with meaningful comments. If you use encryption for the passwords, make sure you use simple passwords and make them available separately.
- It wouldn't be a bad idea to have a set of meaningful test cases or scenarios, which will test most of the functionality.
- Set of Makefiles and/or UNIX scripts that simplify the compilation.
- The file from Section 2 to explain the implementation of any additional features.

Notes

- This lab is long so you should allocate a proper amount of time for finishing it.
- For easy inspection, you may want to separate your code into more than two files; however, you will neither be punished nor rewarded for this.
- For electronic submission, only one person in the group should submit the file. You should create a tar ball (i.e. `a2.tar.gz`) with all the files needed to compile and run your programs. You should also include a Makefile in the tar ball that compiles all your source code into two executables: one named `server` and one named `client`.
- The following command can be used to tar your files:

```
tar -czvf a2.tar.gz <files or directory to tar>
```
- Use the following command on the eecg UNIX system to submit your code:

```
submitece361f 4 a2.tar.gz
```
- You can perform the electronic submission any number of times before the actual deadline. A resubmission of a file with the same name simply overwrites the old version. The following command lists the files you have submitted:

```
submitece361f -l 4
```
- You are expected to explain the design choices made in your code to the TAs during your demo lab session. The lab specifications are similar to but different from those in previous years in subtle ways. This will make it easy to spot plagiarized code.