**Conversation Design**

We try to emulate the design of the web-based Google Talk client. The client displays a list of online users. If a user wants to start a conversation with some set of users of size greater than or equal to one, he clicks on one of the desired users in the online users list and a chat window appears. To add any additional users to the conversation, the initiating user (or any other user currently in the conversation) simply needs to hit the "plus" button in the chat window and select the handle(s) of these users from a list of all online users who are not currently in the conversation. Conversations do not have user-visible names or IDs, so individuals not currently in a conversation cannot add themselves to it – they must be added by a current communicant. Furthermore, a user cannot deny a conversation – if a message is sent to them in a new conversation, a new chat window automatically appears. When the initiating user sends the first message to the server for this conversation, the client first asks the server for a conversation ID. Once the ID is received, the message is sent to the server, along with the ID, the initiating user's handle, and the list of handles of all users in the conversation. The server stores the list of communicants and then forwards the message to every communicant. In all future messages sent from clients for this conversation, only the ID, the sender's handle, and the message contents need to be sent to the server, since the server knows all of the communicants in a conversation with given ID.

*Classes:*

1. Datatypes for server-to-client messages
    a. Classes that represent server-to-client messages all implement the interface SMessage with the following method
        i. accept(SMessageVisitor)
    b. The class SMessageImpls contains as static inner classes all of the classes that implement SMessage, which are (these represent each of the possibilities for SC_MESSAGE in the server-to-client grammar)
        i. OnlineUserList, a container (I use container to mean a class that simply stores data and has little additional functionality) with one variable: List<String> of handles
        ii. InitialMessage, a container with the following variables (InitialMessage also implements CMessage, see 2)
            1. Long id
            2. String senderHandle
            3. List<String> allCommunicants
            4. String textMessage
        iii. NormalAction, a container with the following variables (NormalAction also implements CMessage, see 2)
            1. Long id
            2. String senderHandle
            3. Action action; Action is a container with the following variables

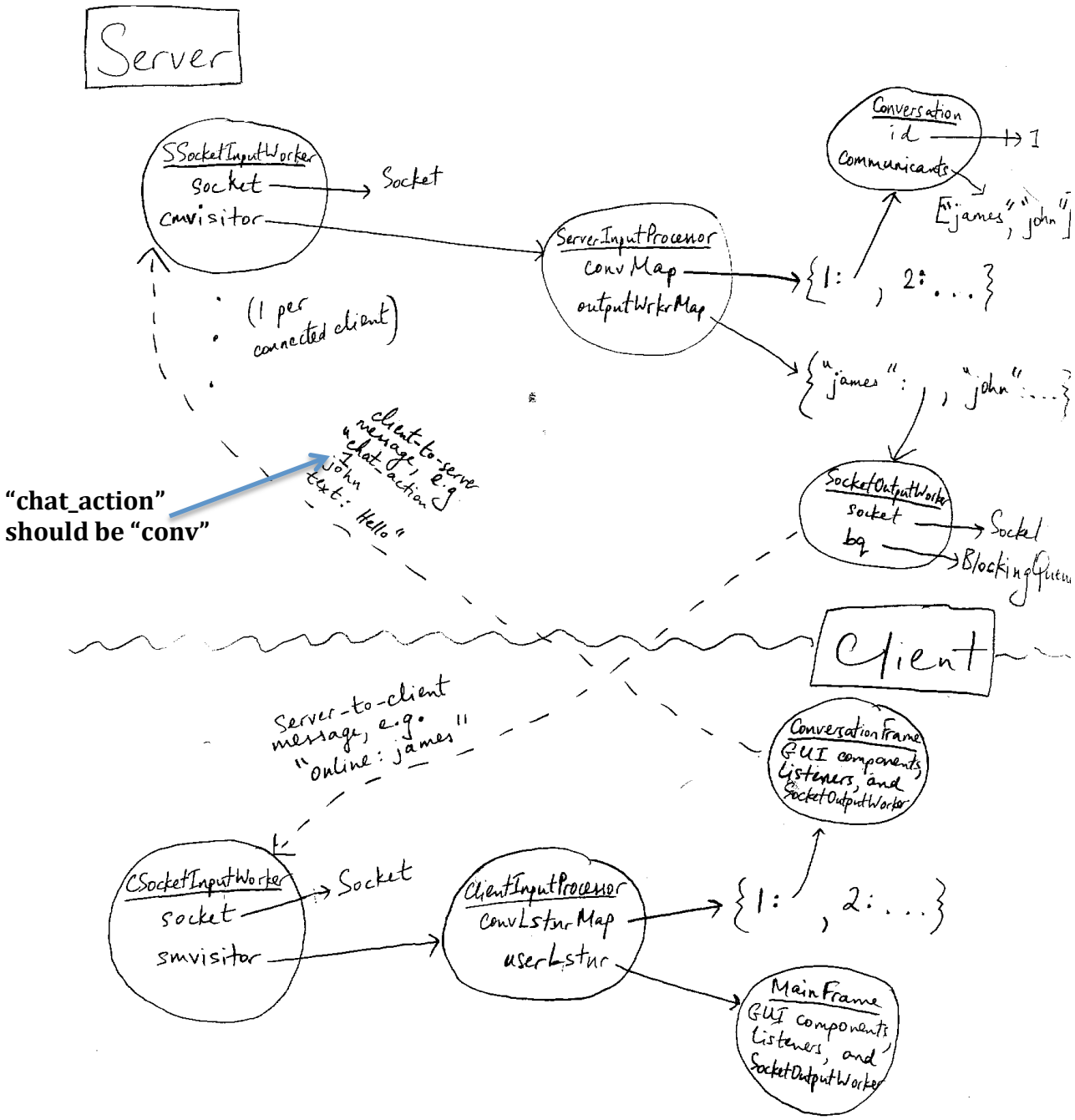
            a. ActionType at; ActionType is an enum nested in Action with three values: TEXT_MESSAGE, EXIT_CONV, and ADD_USER
            b. List<String> handles (may be null if not ADD_USER action)
            c. String textMessage (may be null if not TEXT_MESSAGE action)
        iv. AvailabilityInfo
            1. String handle
            2. Status s – a nested enum with values OFFLINE and ONLINE (can easily be expanded to include other states, e.g. "busy")
        v. BadHandle
            1. String handle
        vi. ReturnId
            1. Long id
    c. SMessageImpls also contains a factory method to convert (deserialize) a String server-to-client message into the appropriate SMessage
2. Datatypes for client-to-server messages
    a. The datatypes representing client-to-server messages are structured very similarly to those for server-to-client messages
        i. CMessage interface with one method: accept(CMessageVisitor)
        ii. CMessageImpls class that contains as static inner classes all of the classes that implement CMessage (other than the ones that also implement SMessage, which are found in SMessageImpls), which together cover all of the possibilities for CS_MESSAGE in the client-to-server grammar below
        iii. CMessageImpls also includes a factory method to convert a String client-to-server message into the appropriate CMessage
        iv. The remaining details are omitted for brevity
3. Other datatypes used by both server and client
    a. SocketOutputWorker, extends Thread
        i. Constructor takes a socket whose output stream we should write to
        ii. Has a BlockingQueue in which messages to be written to the output stream are stored
        iii. run() method sits in a loop calling take() on the BlockingQueue and writes any data it pulls from the queue
        iv. Has add() method that takes a String to be written to the socket output stream, adds this String to the BlockingQueue
4. Server-specific datatypes
    a. Conversation – a container class with the following variables
        i. List<String> communicants – a list of the handles of the people in this conversation
        ii. Long id – the server-assigned ID for this conversation
    b. One SSocketInputWorker ('S' stands for 'Server') per connected client – reads input from the socket for the client

i. Extends abstract class SocketInputWorker, which itself extends Thread
    1. Constructor takes a socket
    2. run() method reads input stream for socket and calls the abstract method process(String) with the read data
ii. SSocketInputWorker constructor takes both a socket and an instance of CMessageVisitor (in this case a ServerInputProcesser)
    1. process() is implemented to use the CMessageImpls factory method to produce a CMessage from the input String. It then calls accept on this CMessage with its CMessageVisitor as the argument
iii. ServerInputProcessor, implements CMessageVisitor
    1. It has the following variables
        a. Map from Long (conversation ID) to Conversation
        b. Map from String (user handle) to SocketOutputWorker (for the socket for that particular user)
    2. For each possible CMessage, it decides what (if any) SMessage to send to the clients that should be notified. It constructs this SMessage and calls toString() on it to generate the serialized message to pass to the SocketOutputWorkers for the recipient clients.

5. Client-specific datatypes
    a. Each client has one CSocketInputWorker, which extends the aforementioned abstract class SocketInputWorker
        i. Works much like to SSocketInputWorker, with CMessage* replaced by SMessage* see 4bii
    b. ClientInputProcessor implements SMessageVisitor, has the following variables (It can be thought of as a pseudo-model for the client, although its only duty is to notify the view of required updates to the data – the actual data storage is delegated to the view, since we deemed it pointless to store one copy of the data in a data structure in this class and another identical copy in the view itself; we can easily start storing data in this class if at any point we change the view to display only a subset of the total relevant data.)
        i. Map from Long (conversation ID) to ConversationListener (in this case the implementation is ConversationFrame, see d)
        ii. UserStatusListener ul (in this case the implementation is MainFrame, see c)
    c. MainFrame, extends JFrame, implements UserStatusListener (can be thought of as the view and the controller for the buddy list part of the client GUI)
        i. It implements the methods in UserStatusListener, which are
            1. addOnlineUser(String handle)
            2. removeOfflineUser(String handle)

    ii. When the user tries to close the MainFrame, it creates the datatype corresponding to an EXIT_CONV action (see grammar), serializes it, and passes it to this client's SocketOutputWorker
d. ConversationFrame, extends JFrame, implements ConversationListener, one per active conversation on the client (can be thought of as the view and the controller for an individual conversation in the GUI)
    i. It implements the methods in ConversationListener, which are
        1. addMessage(String senderHandle, String message)
        2. removeUser(String handle)
        3. addUser(String handle)
    ii. When the user enters a message for this conversation, adds a user to it, or tries to close the ConversationFrame, the ConversationFrame creates the datatype corresponding to the action, serializes it, and passes it to the client's SocketOutputWorker (the user's actions – with the exception of exiting the conversation – only show up in the view once they're passed back from the server)

*Snapshot Diagram:*



**Client/Server Protocol**

*Client-to-server grammar:*
CS_MESSAGE := GET_ID | INITIAL_CONV_MESSAGE |
NORMAL_CONV_ACTION | REGISTER_HANDLE | GET_USERS
GET_ID := "getid" /* to obtain a new ID from the server for a conversation */
INITIAL_CONV_MESSAGE := "initial" newline CONV_ID newline HANDLE /*
initiator */ newline USER_LIST /* the full list of users in the conversation, including the
initiator */ newline TEXT_MESSAGE /* the first message in the conversation */
NORMAL_CONV_ACTION := "conv" newline CONV_ID newline HANDLE /* sender
*/ newline ACTION
USER_LIST := HANDLE (“,” HANDLE)*
HANDLE := [a-z0-9]+
CONV_ID := [0-9]+
ACTION := TEXT_MESSAGE | EXIT_CONV | ADD_USER
TEXT_MESSAGE := "text: " TEXT
TEXT := [^\n]+
EXIT_CONV:= "exit"
ADD_USER := "add: " USER_LIST
REGISTER_HANDLE := "handle: " HANDLE
GET_USERS := "getusers" /* want list of all online users */

*Server-to-client grammar* (uses productions defined above):
SC_MESSAGE := RETURN_ID | INITIAL_CONV_MESSAGE |
NORMAL_CONV_ACTION | USER_ONLINE | USER_OFFLINE | BAD_HANDLE |
ONLINE_USER_LIST
RETURN_ID := "id: " NUM /* return a conversation ID to a user who requested it */
USER_ONLINE := "online: " HANDLE
USER_OFFLINE := "offline: " HANDLE
BAD_HANDLE := "unavailable: " HANDLE
ONLINE_USER_LIST := "users:" USER_LIST

*State stored by client and server:*
This is covered extensively in the conversation design part of this document. In summary, the server stores an ID for each conversation and the communicants in each conversation. It does not store the messages in the conversation. The client stores the ID for each conversation, and the client's view (but no outside data structures) contains the list of online users, the communicants in each conversation, and the messages in each conversation.