

COMP208 - Group Software Project

Ballmer Peak

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Part I

Requirements

Chapter 1

Mission Statement

"to shift societal norms to a state wherein privacy is respected without caveat or justification"

In light of dissidents utilizing social networking websites such as Facebook and Twitter to organize protests, we feel that there is a need for an easy to use, encrypted communications platform with support for real-time and asynchronous communication between users.

Chapter 2

Mission Objectives

The proposed project (Turtlenet) is a simple, privacy oriented social network, which demands zero security or technical knowledge on behalf of its users. In order to ensure security and privacy in the face of nation state adversaries the system must be unable spy on its users even if it wants to or server operators intend to.

We feel that obscuring the content of messages isn't enough, because suspicion may, and often does, fall upon people not for what they say, but to whom they are speaking[24]. Our system will therefore not merely hide the content of messages, but the recipient of messages too. Hiding the fact that an IP address sent a message is out of scope, but hiding which user/keypair did so is in scope, as is which IP/user/keypair received the message and the content of the message. It is important to hide the recipient of the message, because otherwise they may be unfairly targeted[11] if they use our services to communicate with the wrong people on a phone which is later identified, or they may merely be 'selected' for spying and harassment [20, p. 3].

We feel that current tools have significant usability problems, as was recently made starkly clear when Glenn Greenwald, a reporter of the guardian, was unable to work with Edward Snowden because he found GPG to be "too annoying" to use.

"It's really annoying and complicated, the [email] encryption software" - Glenn Greenwald [20]

While there exist many tools for hiding what you are saying, relatively few seek to hide who talks with whom, and those which do often implement it merely as a proxy, or seek to provide convenience over security.

The system is to have strict security measures implemented. It is able to encrypt messages with the use of RSA and AES. The only way for the other user to decrypt the data is if it was encrypted using their public key; which is given from the recipient to the sender via whichever medium he

prefers, e.g. email. We will also allow users to transmit public keys as QR codes, for ease of use.

The system will provide a platform for people to securely communicate, both one-to-one and in groups. Users will be able to post information to all of their friends, or a subset of them as well as sharing links and discussing matters of interest.

The following are our main design goals. Please note that the system is designed with axiom that the server operators are unjust, seeking to spy on potential users, and able to modify the source for the server.

- Strong cryptography protecting the content of messages
- Make it an impossible task to derive, from the information the server has or is able to collect, which users send a message to which users
- Make it an impossible task to derive, from the information the server has or is able to collect, which users receive a message at all
- Transmission of public key is easy, and doesn't require knowing what a public key is
- Be intuitive and easy to use, prompting the user when required
- Provide a rich social network experience, so as to draw regular members and drive up network diversity

The server operator will have access to the following information:

- Which IP uploaded which message (although they will be ignorant of its content, type, recipient, and sender)
- Which IPs are connecting to the server as clients (but not what they view, whom they talk with, or whether they receive a message at all)
- What times a specific IP connects ¹

A third party logging all traffic between all clients and a server will have access to what IPs connect to the server, and whether they upload or download information ²

The benefits we feel this system provides over current solutions are:

- Server operators can not know who talks with whom
- Server operators can not know the content of messages
- Server operators can not know which message is intended for which user

¹While this will aid in tying an IP address to a person, it is deemed acceptable because it is not useful information unless the persons private key is compromised.

²size correlation attacks could be used here if the message content is known

- Server operators can not know who is friends with whom

In order to ensure nobody can tell who is talking with whom, we will base our security model on the idea of shared mailboxes, as seen in practice at [alt.anonymous.messages](https://groups.google.com/forum/#!forum/alt.anonymous.messages)³. In this model one posts a message by encrypting it using the public key of the recipient, and posting it in a public location. In this model, one reads a message by downloading all messages from that location, and attempting to decrypt them all using ones private key. Our protocol will build atop this simple premise, and the the server will be a mere repository of messages, the real work occurring wholly in the client.

³<https://groups.google.com/forum/#!forum/alt.anonymous.messages>

Chapter 3

Project Target

A project of this scope has a rather specific target in sight. Due to its encrypted nature, Turtlenet can act as a form of anonymity between users who would otherwise be targeted by governments and/or institutions opposed to them. Countries such as China[32] and a majority of the middle east[19] have recently seen negative press due to their persecution of individuals whom disagree with the ruling regime, such software would allow said individuals safety from what the wider world views as acceptable.

Large multinational defence corporations (e.g. IBM, Thales, BAE) might also find Turtlenet useful, as it would allow for a secure communication tool between employees in an office. It could also potentially be used outside a company firewall to send messages securely between offices across much larger distances. Corporations such as defence contractors often hold security in the highest regard, and such a project would match their needs well.

A more likely recipient of this system however, is society itself, as we have decided to waive our copyright granted monopoly. Should another group decide to embark on a similar project, they will have access to this project, to act as a baseline for their own work. See Appendix C.

Chapter 4

Threat Model

When designing a system in which security is a significant aspect, it helps to define clearly exactly what adversaries are anticipated. In this section we will describe a hypothetical adversary (hereafter 'the adversary') against whom we will protect our users.

The adversary will be granted all powers available to all conceivable attackers, such that no collusion of attackers may overcome our security (should it work for any given considered attacker).

The following individual attackers are considered, those attackers excluded are excluded on the basis that their abilities are a subset of the union of the abilities of the already considered attackers.

- Nation state without regard for international law and convention (e.g.: USA)
 - Pressure those it claims governance over into doing as it demands
 - Pressure companies operating within it into colluding in an attack
 - Identify all people connecting to the server. (Formed from the union of powers of the ISP and the server owner and operators)
- ISP (e.g.: BSKYB)
 - View all traffic on their network, after the point at which a user comes under suspicion.
 - Manipulate all traffic on their network however they desire.
 - Identify an IP address (during a specific time) with a person.
- Server Owners and Operators (i.e.: Those who own and operate Turtlenet)
 - Alter the source of the server in any way they desire.
 - Log all traffic before and after a user comes under attack.
 - Manipulate all traffic in any way they desire.

- Collect the IP of all connecting users.

Some of these claims may seem extreme, but given that companies such as BT, Vodafone Cable, Verizon, Level 3, and others have provided unlimited access to their networks[16] to governmental spy agencies, we feel it is a reasonable threat model in light of recent revelations[31].

Given that our system is intended to both protect people from the governments which claim governance over them, and mere greedy companies looking to sell or collect user data for profit, we will assume the worst case: i.e. that all our users, their ISPs, and the owners and operators of the Turtlenet server they use are able to be pressured by the adversary.

We grant the adversary all the powers listed above, and assume that all ISPs, companies, and Turtlenet server operators are actively working against all of our users. In summary, we consider the adversary to be:

A nation state for which money is no object, claims governance over the user, and has the ability to pressure service providers into spying on their users.

4.1 Scope

We do not attempt to protect against an adversary who has access to and the ability to modify the users hardware, nor do we attempt to conceal that an IP uploads data to the network.

While we recognise that the ability to post messages anonymously is important, especially considering that countries normally considered benign are prosecuting people over whom they claim governance for saying 'offensive' things [1], it is unfortunately out of scope for this project.

Chapter 5

Anticipated Software

We anticipate the creation of the following software:

- Windows, Linux, and OSX executable: client
- Windows, Linux, and OSX executable: server
- Windows, Linux, and OSX executable: installer for client and server
- Full source for server, client, and any associated works

The client will create and use an SQLite database, local to each client, this database will be used to store all information that the specific client is aware of.

Chapter 6

Anticipated Documentation

We will provide the following documentation:

- Installation guide for a server
- User manual for a client
- Full protocol documentation for third parties wishing to implement their own clients
- Full description of system design and architecture, for future maintenance
- Full description of database design
- Interface documentation

Chapter 7

Anticipated Experiments and Their Evaluation

7.1 Performance Testing

Evaluating how well the system performs under a high work load.

- Test to see how many simultaneous clients the server can handle.
- Test to see if the data received from the server under a high work load is accurate.
- Test the impact of a large number of clients on the servers response time.

A high work load will be simulated by automated clients performing user actions at random. The server should be capable of allowing these clients to communicate with one another quickly. The maximum number of concurrent clients possible without noticeable lag (twice the frequency of updates) should be recorded.

7.2 Robustness Testing

System level black box testing.

- Devise a series of inputs and expected outputs.
- Run these inputs through the system and record the actual outputs.
- Compare the actual outputs with the expected outputs.

- Simulate a denial of service attack. The server should be able to recover from the attack quickly and with minimal impact on the clients. Blocking such an attack is beyond the scope of this project.

Inputs used should range from expected use patterns to silly as users tend to do things totally unexpected. Expected and actual outputs should be recorded. Any differences will indicate problems with the system which need to be fixed.

7.3 Recoverability Testing

Evaluating how well the application recovers from crashes and errors.

- Restart the computer while the application is running. Ensure the local database is not corrupted.
- While the application is running terminate the computers network connection. Ensure the application continues working after the connection is re-established.
- Send a badly formatted message to another client. Ensure the application is able to keep running after receiving unexpected data from another client.

Each test should be run several times. If any test fails once or more this indicates that the system is bad at recovering from crashes and/or failures. In the case of a failure changes to the system should be implemented to improve recoverability.

7.4 Learnability Testing

Trialling the user interface with non expert users. Users should be able to use the system with minimal frustration and, ideally, without consulting the manual.

- Ensure users understand how to add friends, send messages, create posts, comment on posts and like posts.
- Ensure users don't spend excessive time searching for functions within the interface.
- Ensure error messages can be understood by the user and offer understandable advice on how to proceed.

Each test should be run several times with different users. If more than one user fails a test then changes need to be made to the interface. A single user experiencing problems is not an indication of a problem with the interface but instead suggests user incompetence.

7.5 Security Testing

The main goal of the system is to be secure. To ensure this goal is met the security of the system should be tested.

- Send non standard messages to clients. These should be rejected. If there is a flaw in the system the client may reveal information unintended for the recipient, in this case the program sending non standard messages.
- Recruit experienced programmers from outside of the group to attempt to penetrate or otherwise break the system. All attempts should be unsuccessful.

If any test fails this indicates a vulnerability in the system which should to be corrected immediately. Security tests should be rerun after any changes during the testing phase to ensure new vulnerabilities are not introduced.

Chapter 8

User View

The user will be presented with a simple and easy to use interface, which assumes and requires no knowledge of security. The most complicated thing that the user will have to do is transmit to other users their public key. We plan to alleviate this process by encoding the public key as both a QR code and plaintext string (depending on user preference), both of which may be easily transmitted via email, SMS, meeting in person, or over any other channel.

Upon connecting to the system for the first time, the user will be prompted to enter a username, and any profile information they choose to share, and a passphrase. They will be urged to avoid using their real name as their username, and informed that profile information is shared on a case by case basis, and is not automatically visible to people whom they add. The entered passphrase will be used to deterministically derive an AES key which will be used to encrypt the users keypair and local DB. The user will be given the option of creating a second passphrase which, when entered, will overwrite the keypair and local DB with random data.

They will then be brought to the main page of the system, where they (and) people they authorize, may post message. There will be a prompt for them to add peoples public keys, and the option to add either a QR encoded or plaintext encoded public key.

Upon adding another's public key, they will first be informed of that persons username, and prompted to categorise the person. The user will be able to create a number of categories into which they can place that user. Already created categories will be displayed. One person may be added to multiple categories, and nobody but the user is aware that this occurs. Depending upon the categories the person is entered into, that person gains the ability to view certain content posted by the user.

When the user posts a message they are prompted to enter a recipient, this may be: a previously created category (such as friend, co-worker); a number of individuals; or any combination thereof.

Upon receiving a message a sound is played and the user is informed. They are then able to

click on the notification to open the message, and chat. When chatting with another user they have the ability to 'ignore' that user, in this case the user will see no more messages from that user.

8.1 System Boundary Diagram

Each client (of which there may be many) has his own client boundary consisting of his database and program client, whilst the server operators have their own boundary consisting of just the server. You can see in the diagram that at no point does the server operator or user functionality coincide with each other, leaving their privacy fully independent of one another. Each client (of which there may be many) has his own client boundary consisting of his database and program client, whilst the server operators have their own boundary consisting of just the server.

We can see the users interaction with the system below in the System Boundary Diagram:

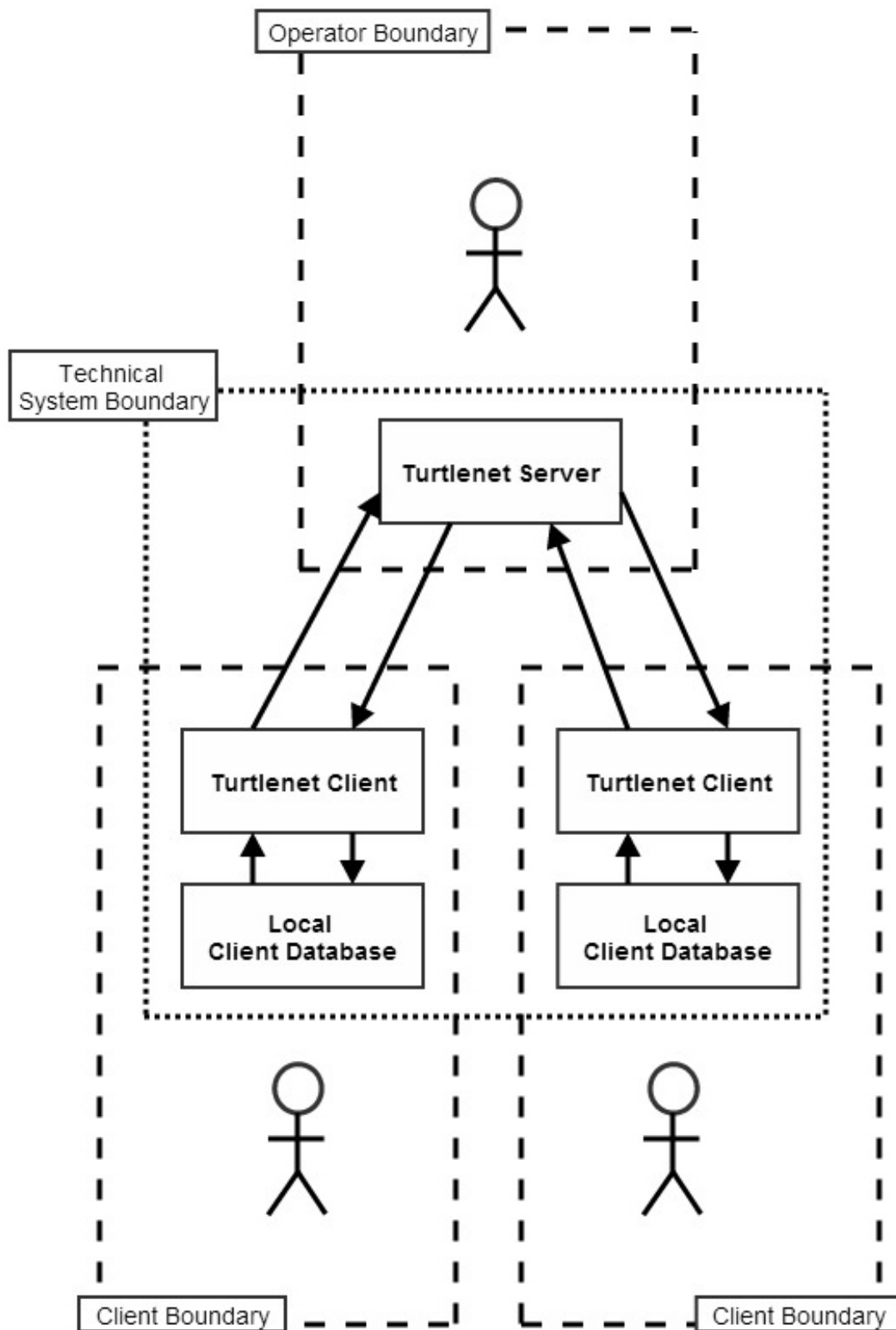


Figure 8.1: System Boundary Diagram

Chapter 9

User Requirements

9.1 Registration

Users may register by sending a CLAIM message to the server, this will claim a username for that user, and allow people they send messages to to see their username.

Before registering the user must generate an RSA keypair, they will be given the option of generating a new keypair, or using an existing keypair. The keypair provided will be encrypted using AES with the users password being used to derive the key. The user therefore must enter their password to log into the client. The database will be encrypted using the same AES key as the keys are encrypted with.

9.2 Interacting with other users

People are added by adding their public key, this is transmitted outside of our system, via whichever channel the users deem appropriate¹. We will provide a user with their public key as a QR code, or a plaintext string, depending on user preference.

Adding someone is asymmetric. Just because you add them doesn't mean they've added you. You do not require consent to add someone, just their public key.

The system allows the user to manage their list of known people into categories such as friends, family, and co-workers. The user defines these groups as lists of people whose public key they know. The user may create any group they desire, these groups are visible to only the user, and private.

¹This is required to prevent server operators from MitM'ing users

9.3 Profile Data

Profile data will be transmitted via PDATA messages. Different versions of profile information may be provided to different groups of people. Profile data may be updated by the user by future PDATA messages.

The supported fields in a PDATA message are:

- Name
- Username (unique, but this uniqueness is ensured by server and shouldn't be relied on)
- Birthday
- Sex
- E-Mail
- About
- Misc.

9.4 Account recovery

Account recovery is not possible without your keypair, due to this the GUI should urge the user to keep a copy on a flash drive, or external hard drive. The keys themselves will be encrypted with the users password.

9.5 Posts

9.5.1 Walls

Each user has their own wall. On their wall they may posts messages for themselves and others to see. All wall posts should be addressed to the user themselves so they can see their own posts, otherwise they will be unable to even view their own posts. When posting to their wall they choose who will be able to see the post, whether this is a group or people, a specific list of people, or just themselves is up to the user. They will not however be given the option to post publicly. Users may also post to another users wall.

Wall posts may contain links to other content, however this content is never thumb-nailed².

²client MUST NEVER thumbnail links or otherwise access external content without EXPLICIT user consent (see tor/js exploit on freedom hosting by the USA and tracking techniques recently thwarted by GMail now caching images. Specifically the fact that by delivering content over a secure channel that initiates communications outside of that channel, the recipients of content may be identified. A common variation of this is 'pixels' whereby a would be tracker embeds a 1x1 transparent PNG in a document, and watches who downloads that image from their servers.[28]

A user may edit their old posts, however older versions will still be available for viewing; similarly users may 'delete' posts, but they are still visible to malicious clients.

Due to bandwidth limitations on such networks as we are building, a user may only post plain-text, they may not post images, video, or audio.

9.5.2 Commenting and Liking

All wall posts may be commented on by any user who can see them. Comments are visible to all people who can see the original post; due to this, comments must be forwarded by the original posters client to all the same recipients, as the commenter may not know whom the original posters allowed to see the post.

Any wall post, comment, or other item on a wall may be liked.

9.5.3 Events

The client will alert the user to other users birthdays by automatically posting a wall post that only the user may read, which alerts the user of the event. These are otherwise normal wall posts. The user has the option of setting a category of people as a group for whom they desire to be alerted of events regarding.

Furthermore users may create their own events, for themselves and others to be alerted to. Recipients of events they did not create must accept the event before they are alerted of it.

9.6 Chat

Users may chat in real time, however messages can still be sent when one user logs off, to be received when they log in. Past conversations are saved, and a user may block users from messaging them; the client actually just ignores their messages, it's impossible to stop someone from messaging you.

Conversations may include two or more people.

Chapter 10

Case Study: Facebook

10.1 Overview

A user has a profile with information about them, they may add other users as 'friends', friends may view each others 'posts' and talk to each other. Posts are multimedia messages typically visible to all the friends of the person who made the post. Most posts can be commented upon, and both posts and comments may be 'liked'. Liking merely publicly marks the fact that you approve of something.

10.2 Registration

In order to be a user of facebook, one must register. In doing so you provide facebook with the following information, this may also be used to later reset the password of your account, should you forget it.

- First Name
- Last Name
- E-Mail
- Password
- Birthday
- Sex

In order to register one must read and agree to their terms [10], read their data use policy [9], and read their cookie policy [8]. Given profile information can be changed at a later date, within certain bounds. Facebook requires the use of your real name, and in fact forbids all false personal information, under their terms.[10, p. 4.1]

10.3 Account Management

The user is given the ability to set the security defaults for their posts and information. These options include who is able to see wall posts, whether comments are enabled by default, and who may see which aspects of your profile information. You can also manage the permissions granted to facebook apps.

Access may be gained to an account by knowing certain information, the intent is to allow people to recover their account if they forget their password.

A users profile may contain the following information:

- Work and education
- Place of Birth
- Relationship
- Basic Information
 - Birthday
 - Relationship
 - Status
 - Anniversary
 - Languages
 - Religious
 - Political
 - Family
 - Contact Information

10.4 Friend

In facebook, 'friending' someone is symmetric; that is, if you are friends with them, they are friends with you. The facebook servers store which user is friends with which other users. Adding another

Field	Description
Photo	All the photos the user's has tagged
Friend	What friends the user has
Note	What notes the users up/downloaded to facebook
Groups	What groups the user has join
Events	What events user may be attending
Likes	What page(s) (unknown type) the user liked
Apps	What apps the user has
Books	What book pages the user liked/followed
TV programmes	What TV pages the user liked/followed
Films	What films pages the user liked/followed
Music	What music(or stars) the user liked/followed
Sports	What sport pages the user liked
Place	Where's the user has been

Table 10.1: The user adds a new post

user as a friend is simply a matter of sending that user a friend request, and having it approved by the second user. A user may see a list of all who are their 'friend' on FB, in the friend list. After friending somebody that persons wall posts will appear on your news feed, and you will be able to chat with that user.

In order to add friends, facebook allows you to see your friends friend lists, and search by name, email, and location for other users. Facebook also suggests other users whom you may already know IRL, based on your friends friends. Non-users are also able to search facebook for people that they may know.

10.5 Post

10.5.1 Posts, and functions thereof

Facebook allows a user to post on their wall or friend's wall (if they are friens with the facebook user). Posts may contain: text, images, videos, or any combination thereof.

A user posting a post may do the following:

- Delete their own post
- Rewrite their own post
- Decide who may view a post, the options are as follows:
 - Public
 - Private

- Only-me
- Friends only
- Friends of friends

10.5.2 Interaction with another's posts

A post will typically be displayed on the news feeds of the people who are able to see it, due to this the name of the person who made a post is always displayed next to it. Posts themselves may be commented upon, liked, and reposted to the viewers wall ('shared') with an additional message; the number and names of people who have liked a post is displayed underneath it; likes may be cancelled at a later date. The comment function however, may be disabled by the user who makes the post.

A user may hide specific posts, or hide all posts by a specific user. They may also, instead of hiding another's posts all together, merely prevent them from being automatically displayed on their news feed. A user may report an image, video or comment to facebook team (e.g. the post is offensive). Comments may also be liked, hidden, and reported; following such a report FB is able to remove offensive or illegal posts.

Images which are posted may be tagged, this allows other users to mouse-over parts of the image and be informed who is pictured. This functionality is also used to add all posted images of someone to their profile.

10.6 Wall

A users wall stores all the posts of the user posted since the account was created and the information about the user, this information is presented in reverse chronological order, so that recent events are at the top of the page and easily visible. Other users may view the users wall by clicking the name of the user from anywhere in facebook. Other users may post on a friends wall along with it's owner (see section on posts for more information); in this case, both the poster and the owner of the wall can delete the post. Facebook also retains the power to erase any content on its service.

Posts mentioning a user are automatically reposted to that users wall, this can occur manually or when that person is tagged in an image.

10.7 Chat System

Facebook allows a user to chat with their friends, and will inform a user of whether their friends are online or not (though this can be faked), and whether the user you are chatting with has read

the last message that you sent them. You are also informed whether your friend is logged in on a mobile device or not.

Whole groups of users may chat together, in multi-user conversations. Facebook also supports video calling and file transfer during chats. If a user does not wish to be bothered by another using chatting with them, then they may 'mute' that users conversion. Users spamming via chat may be reported to facebook. Because multi-user conversations (and indeed long running one-to-one conversations) can get rather large, facebook allows you to hide the history of a conversation.

Facebook chat alerts the user to new messages in a conversation by playing a sound.

10.8 Architecture

From a users point of view facebook is ostensibly organised as a single central server; we are here concerned with the general architecture and not the specific implementation of it, and so we will consider all of facebook's servers to be a single server for the purposes of this section.

Users connect to facebook using a web browser, and proceed to download a client written in javascript. User data is uploaded to facebook over HTTP as cleartext. The data is stored on unencrypted on facebook's servers, and facebook maintains a database of all data.

This allows clients to download only the data they need, as they can simply ask for it. This in turn means that facebook's current architecture can, and does, support a huge user-base, measured in the millions.

10.9 Security

In order to use facebook after registration a user must 'log in'. This places an authentication cookie on the users computer which gives anyone in possession of it the ability to act as that user.

If the user logs in from an IP associated with a region geographically far from the last login, facebook will confirm that the user owns the account by asking them to identify a friend in a photograph, or by other means.

Facebook chat turns the users computer into a server, whereby facebook's central server sends messages to the client as it receives them, rather than the client requesting new messages. This has been used in the past to identify facebook users by correlating sent messages of specific size sent at a specific time.

Facebook has access to all its users data, and is able to erase, modify, and fabricate it. Facebook is aware of everything which happens on facebook. Censorship is a common occurrence on facebook.

Chapter 11

Case Study: Tor

11.1 Overview of Protocol

Tor is an implementation of onion routing, it routes traffic from your computer through a number of other nodes; the final 'exit' node the routes the traffic to the final destination[15]. Node IP's are listed publicly in directory servers. In this manner the IP of clients connecting to a server is obscured from that server.

RSA/AES is used to ensure that only you, the exit node, and the final destination see the plaintext traffic being routed. With the use of TLS, SSL, or other end-to-end encryption those who see the plaintext can be reduced to you and the final destination. However a malicious exit node can MitM SSL connections using ssl-strip or a similar tool. There are methods of avoiding this, but it is a serious issue because users believe that SSL is secure. This exploit is found in the wild[18], and so is most definitely a concern.

Tor also supports 'hidden services' which seek to conceal the IP of the client from the server, and the IP of the server from the client. These are significantly more secure as the traffic never exits the tor network, however provide no protection from the adversary as will be described later; after all, we're assuming the server operators are colluding, so they will provide data required for traffic confirmation.

11.2 Security

Given that Tor is a low-latency network, traffic can easily be correlated. This problem is ameliorated in high-latency networks such as mix nets, but not eliminated.

Tor does not seek to protect against size correlation, or time correlation of traffic. Rather the purview of tor is to conceal the IP address of a client from the servers which it connects to.

Should a global passive adversary have perfect visibility of the internet, they would be able to track tor traffic from source to host by correlating the size and time of transmissions.

The Tor design doesn't try to protect against an attacker who can see or measure both traffic going into the Tor network and also traffic coming out of the Tor network[7]. - Roger Dingledine

We can safely assume that the adversary has access to the clients traffic, since our threat model is that of a nation state seeking to spy on its citizens. Furthermore we may assume that the adversary has access to the content host, as our threat model assumes that service operators may be pressured legally or otherwise into spying on their users. Therefore we must conclude, at least for *the* adversary, that Tor is unsuitable for concealing activity in traditional social networks, due to traffic confirmation.

Does this then mean that Tor is insecure? No. So far as we know[30] the US does not currently have the ability to reliably and consistently track tor users; if the US is incapable of doing so, it is reasonable to assume that no other nation state has this ability. This is however not something which should be relied upon, as assumptions widely lead to mistakes. We shall therefore consider Tor as unsuitable for transmitting our data, at least if we were to do so as a traditional social network.

With manual analysis we can de-anonymize a very small fraction of Tor users, however, no success de-anonymizing a user in response to a TOPI request/on demand[30].

Chapter 12

Case Study: GPG and Email

GPG is an implementation of the PGP[2], providing both public/private key encryption and also a number of symmetric ciphers that can be used separately.

It is common practice to use GPG to encrypt email, and several popular addons for browsers exist to aid in this[12]. Unfortunately GPG itself is difficult to use[20], and a significant barrier to entry.

The encrypting of email with RSA¹ is a good solution if one wants to keep the content of messages secure, and unmodified. However it is out of scope for PGP to hide who is communicating, so while we find the underlying cryptography sound, our scope is simply too different for PGP to be of any use; with one exception.

Public key distribution is a significant challenge². PGP partially solves this problem by introducing the concept of a 'web of trust'. In such a system one marks public keys as trusted, presumably the keys of people you trust, and the people whom you have marked as trusted can then sign the keys of other people whom they trust. These keys may then be distributed, with the RSA signatures of everyone who signed them, to everyone. If I download a key and see that it has been verified by someone that I trust, then I can trust that key (albeit less than the original key). This in combination with the small word hypothesis³[29] allows a large number of public keys to become known to a user merely by adding one friends key, and having the client automatically sign all keys it comes across from a trusted source.

We will take the 'web of trust' into consideration during design, however it may present some significant security issues.

¹and a symmetric cipher

²Our system can't do it, or it would be trivial to MitM users who don't check they received the correct key via another channel

³The phenomenon that people in the earth's population seem to be separated by at most 6 intermediaries.

Chapter 13

Case Study: alt.anonymous.messages and Mix Networks

alt.anonymous.messages is a newsgroup¹ to which people publicly post encrypted messages. In order to retrieve messages a recipient downloads all new messages and attempts to decrypt them all, those which they are able to decrypt are read, and others ignored.

This type of system is known as a 'shared mailbox', and is often not used by hand, but by mix network servers, which provide high-latency email forwarding, and handle the encryption on behalf of the users. Mix-networks massively slow timing-based traffic confirmation because they cache a large number of messages before sending them all out at once in a random order[26].

This system provides the property we are seeking: concealing who talks with whom on our network, even from the server itself. This property is ensured by the fact that the server cannot tell who reads a specific message, even though it knows which IP uploaded it. It also introduces a huge amount of overhead, in the form of downloading everyone else's messages as well as ones own.

Mix networks however have some serious issues, and misconfiguration easily allows for traffic correlation[25], albeit not confirmation (without a large sample size). Furthermore mix networks only function if the operator is trusted, this is unacceptable against our threat model. For these reasons we will not use the idea of mix networks.

We have identified the method of operation of shared mailboxes as the basis for our communications protocol, and will build a social network on top of this concept.

¹It may be accessed, without an installed Usenet client, through several websites providing an interface to it, one such website is Google Groups, and may be accessed here: <https://groups.google.com/forum/#!forum/alt.anonymous.messages>

Chapter 14

Security and Usability

14.1 Security and Usability

There is room for improvement when it comes to increasing the level of usability and user-friendliness in the Turtlenet software.

Firstly, as developers, we need to pay attention to the target audience, especially when it alludes to the general public, which have different ranges of user experience and knowledge when using a social network program. Paying attention and understand to how the general public thinks and the level of their knowledge are, we as developers can shape the program into something that is user-friendly and avoid mistakes which can be easily made by the users if the program is confusing. We have to be aware that since Turtlenet is a social media which is more security oriented, there are some functionalities that the general public might not be knowledgeable about.

In order to help the users who uses Turtlenet for the first time in our future development, is the use of 'pop up manual'. These instructions will pop out in a subtly manner in specific areas on the website when the user uses Turtlenet for the first time. An example is under the public key field. The general public would have no idea what a public key is or what is to do with it. A pop up manual is useful for this case, it will pop out saying in a generic, non-jargon or technical sense saying "Public key is the key to share with your trusted friends! Hence its name, it behaves like a key which can be passed along to others so they can unlock and view your profile."

Lastly, in order to make future improvements of the program, one important and effective way to do so is to listen to the customers' feedback. There are several platforms to gather feedback from customers, one common way to do it nowadays is using social media websites, and Twitter will be the best option for this case. Users can easily mention us in tweets, could be anything from actual feedback, rants, questions regarding the use of the program, what they like about it, and positive feedback. This could become useful to us developers to see how the customer think, feel and behave

towards Turtlenet, and possibly the trends about their use of it. Using such information, developers can improve on certain areas of the program according to the users needs. Users are the one who uses the program regularly and know what is best when it comes to functionality.

Chapter 15

System Requirements

An estimate is hereafter given as to the size of all stored messages, and the amount of data which would need downloading by each client when it is started. The following assumptions are used throughout:

- A users average message posted to their wall is 200 characters
- A users average number of messages posted to their wall per day is 10
- A users average number of friends is 100 (each and every friend represents one key exchange)
- A users average private message (to single user) is 50 characters
- A users average number of private (to single user) messages per day is 300

With these generous estimates, each user would generate $(200*10*100)+(50*300*1)$ bytes of raw data per day. Assuming a 10% protocol overhead we would see 236,500 bytes of data per day per user.

The storage space required for a server is therefore 86MB per year per user. On a server with 50,000 users that has been running for 3 years, there would be just 1.3TB of data.

Every time a client connects, it must download all messages posted since it last connected to the server. To mitigate this we may run as a daemon on linux, or a background process in windows, that starts when the user logs in. If we can expect a computer to be turned on for just 4 hours a day then 20 hours of data must be downloaded. $((236,500*\text{no_of_users})/24)*\text{hours_off_per_day}$ bytes must be downloaded when the users computer is turned on.

The following table shows the delays between the computer turning on, and every message having been downloaded (assuming a download speed of 500KB/second, and a network of 1000 users).

Hours off per day	Minutes to sync
0	0
4	1.3
10	3.2
12	3.9
16	5.2
20	6.5

Table 15.1: Hours a computer is turned off per day vs minutes to sync

We feel that waiting 2-5 minutes is an acceptable delay for the degree of privacy provided. Once the user is synced after turning their computer on, no further delays will be incurred until the computer is shut down.

Due to the inherently limited network size (<1500 users of one server is practical) we recommend a number of smaller servers, each serving either a geographic location, or a specific interest group.

While this latency could be avoided, and huge networks (>1,000,000) used, it would come at the cost of the server operator being able to learn that somebody is sending or receiving messages, and also who those messages are sent to/from (although they couldn't know what the messages said).

The server therefore merely needs a fast internet connection to upload and download content from clients. The client is required to perform a significant amount of encryption and decryption, however the client will almost certainly be able to encrypt/decrypt faster than a connection to the internet so the network speed may be considered the limiting factor for users on the internet [5]. Large companies however may very well use the system over a LAN, however these can be reasonably expected to have fairly modern computers which can more than handle RSA decryption.

Chapter 16

Transaction Requirements

Due to the nature of Turtlenet there may exist no central database, rather each client maintains their own local database of everything they know. The data forming this is all stored centrally, however to build a complete database would require the private key of every user of the service, which clearly we do not have access to.

There are 3 categories of data transaction:

- 1. Data entry
- 2. Data update and deletion
- 3. Data queries

16.1 Profile creation of the user

All that is required to use a Turtlenet server is a valid RSA keypair. Users don't have accounts per se, but rather associate profile data with a public key if they so desire. Users have no login information, rather posts are authenticated via RSA signatures. Usernames are the sole public information in our system, and as such each client has a complete list of usernames.

When a client first connects it is advisable, albeit not required, to claim a username. This is done merely by posting that username, and a signed hash of it to the server. Therefore the DB must store all such CLAIM messages.

Optional profile data which the user may enter is stored as PDATA messages, and the database will be required to store these.

16.2 Adding of user relations

Communication between people on Turtlenet requires that one is in possession of the public key of the recipient, and should they wish to respond then they must be in possession of your public key. We define 'A being related to B' to mean that A is in possession of B's public key, and B is in possession of A's public key. This is given a special name as it is a very common situation.

A user may be uniquely identified by their public key, and it may be used to derive their username, if they claimed one. Being in a relation with someone doesn't mean that you can see any profile information of theirs, however the GUI will ask the user whether they wish to share their own profile information with someone when they add that persons key.

16.3 Assigning relations into categories

When a user adds a relation, he has a choice of adding him into a specific category (or categories). A user can create any category he wants by going to the options and click 'Add new category'. The database then records the new category into the category table. The user then can then assign the relation into the existing category.

Categories are useful because they allow the user to share their posts with a predetermined set of people automatically, withing having to list each individual as a recipient.

16.4 Adding of posts

Users may post on their, or - with permission - others, walls. A post has a list of people who can see it (the user may choose a previously defined category or a specific list of people) however this list isn't public so only the DB of the author of a post (and the owner of the wall) will contain information as to who is able to see it.

The post itself has a timestamp, a signature (authenticating it), and content. The database will store all of these.

NB: When a user posts something, they are automatically added to the list of recipients. A users own posts are downloaded from the server, just like everyone elses, and are in no way special.

16.5 Adding of events

The database will store events, these may be created by the user, or recieved from other users. At the appropriate time the GUI will notify the user of an event occuring. Example include birthdays, deadlines, and important dates. Events recieved from other users must be accepted by the user

before the GUI will alert the user of them, for this reason the DB must also store whether an event is accepted or not.

16.6 User creating a new message

A user can initiate a conversation with (an)other user(s) by creating a new message. Messages are merely a special case of wall posts, which are handled differently by the GUI.

16.7 Receiving Content

When the client connects it will download all messages posted since it last connected, it will then attempt to decrypt them all using the users private key. Those messages which are successfully decrypted are authenticated by verifying the signature and the content added to the database. It is in this manner that all content is passed from server to client.

Chapter 17

Task List

Task ID	Task Description (Desc.)	Due Date	Deliverable
1	Project Planning	14/02/2014	Planning segment
1.1	Mission Statement	07/02/2014	Same as Desc.
1.2	Mission Objectives	07/02/2014	Project Goals
1.3	Project Target	07/02/2014	Project Scope
1.4	Threat Model	07/02/2014	Project Scope
1.5	System Requirements	07/02/2014	Same as Desc.
1.6	User View and Requirements	07/02/2014	Same as Desc.
1.7	Transaction Requirements	07/02/2014	Same as Desc.
1.8	Case Studies (CS)	14/07/2014	Eval. of rival
1.8.1	CS: Facebook	14/07/2014	Eval. of rival
1.8.2	CS: GPG and E-Mail	14/02/2014	Eval. of rival
1.8.3	CS: Tor	14/02/2014	Eval. of rival
1.8.4	CS: 'aam' and mix networks	14/02/2014	Eval. of rival
1.10	Risk Assessment	14/02/2014	Same as Desc.
1.11	Anticipated Software	14/02/2014	Project Estimates
1.12	Anticipated Experiments and Evaluation	14/02/2014	Project Estimates
1.13	Anticipated Documentation	14/02/2014	Project Estimates
1.15	User View	14/02/2014	Same as Desc.
1.16	Gantt Chart	14/02/2014	Same as Desc.

Task ID	Task Description (Desc.)	Due Date	Deliverable
2	Project Design	14/03/2014	Design Segment
2.1	Research (Res.)	21/02/2014	Research Segment
2.1.1	Res: Database Languages	21/02/2014	Same as Desc.
2.1.2	Res: Programming Languages	21/02/2014	Same as Desc.
2.1.3	Res: Interfaces	21/02/2014	Same as Desc.
2.2	Designs (Des.)	07/03/2014	Design Segment
2.2.1	Des: Databases	28/02/2014	Same as Desc.
2.2.2	Des: Class Interfaces	28/02/2014	Same as Desc.
2.2.3	Des: Protocol	28/02/2014	Same as Desc.
2.2.4	Des: Architecture	28/02/2014	Same as Desc.
2.2.5	Des: Sequence Diagrams	28/02/2014	Same as Desc.
2.2.6	Des: Data Flow Diagrams	28/02/2014	Same as Desc.
2.2.7	Des: Class Diagrams	28/02/2014	Same as Desc.
2.2.8	Des: Server-side Interfaces	28/02/2014	Same as Desc.
2.2.9	Des: Client-side Interfaces	28/02/2014	Same as Desc.
2.2.10	Des: Server-side Protocols	28/02/2014	Same as Desc.
2.2.11	Des: Client-side Protocols	28/02/2014	Same as Desc.
2.2.12	Des: Server-side Pseudo-code	07/03/2014	Same as Desc.
2.2.13	Des: Client-side Pseudo-code	07/03/2014	Same as Desc.
2.3	Segment Review	10/03/2014	Design Segment
2.3.1	Evaluate Segment Quality	14/03/2014	N/A
2.3.2	Improve Segment	14/03/2014	Design Segment

Task ID	Task Description (Desc.)	Due Date	Deliverable
3	Implementation stage (Imp.)	28/04/2014	Imp. Segment
3.1.1	Imp: Architecture	21/03/2014	Work Environment
3.1.2	Imp: Architecture Docs	21/03/2014	Documentation
3.2.1	Imp: Target System (TS)	21/03/2014	Work Environment
3.2.2	Imp: TS Documentation	21/03/2014	Documentation
3.3.1	Imp: Databases	21/03/2014	Database
3.3.2	Imp: Database Documentation	21/03/2014	Documentation
3.4.1	Imp: Server-side Protocols	28/03/2014	Program function
3.4.2	Imp: Server Protocol Docs	28/03/2014	Documentation
3.5.1	Imp: Client-side Protocols	28/03/2014	Program function
3.5.2	Imp: Client Protocol Docs	28/03/2014	Documentation
3.6.1	Imp: Server-side Interface	04/04/2014	Interface
3.6.2	Imp: Server Interface Docs	04/04/2014	Documentation
3.7.1	Imp: Client-side Interface	04/04/2014	Interface
3.7.2	Imp: Client Interface Docs	04/04/2014	Documentation
3.8.1	Imp: Server-side Source Code	18/04/2014	Program
3.8.2	Imp: Client-side Source Code	18/04/2014	Program
3.9.1	Imp: Server Install Docs	18/04/2014	Documentation
3.9.2	Imp: Client Install Docs	18/04/2014	Documentation
3.10	Segment Review	28/04/2014	Imp. Segment
3.10.1	Evaluate Segment Quality	28/04/2014	N/A
3.10.2	Improve Segment	28/04/2014	Imp. Segment
Task ID	Task Description (Desc.)	Due Date	Deliverable
4	Project Portfolio	09/05/2014	Portfolio
4.1	Fabricate Reports	02/05/2014	Reports

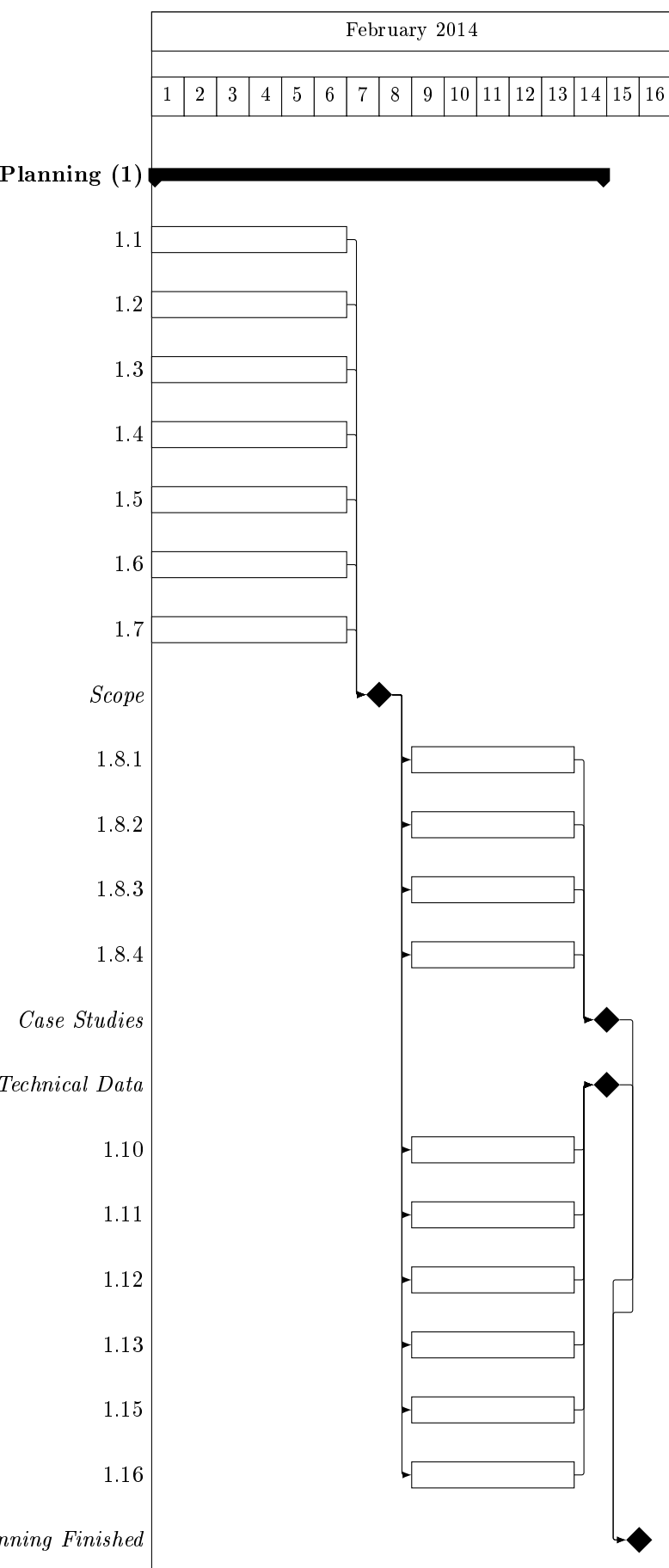
Chapter 18

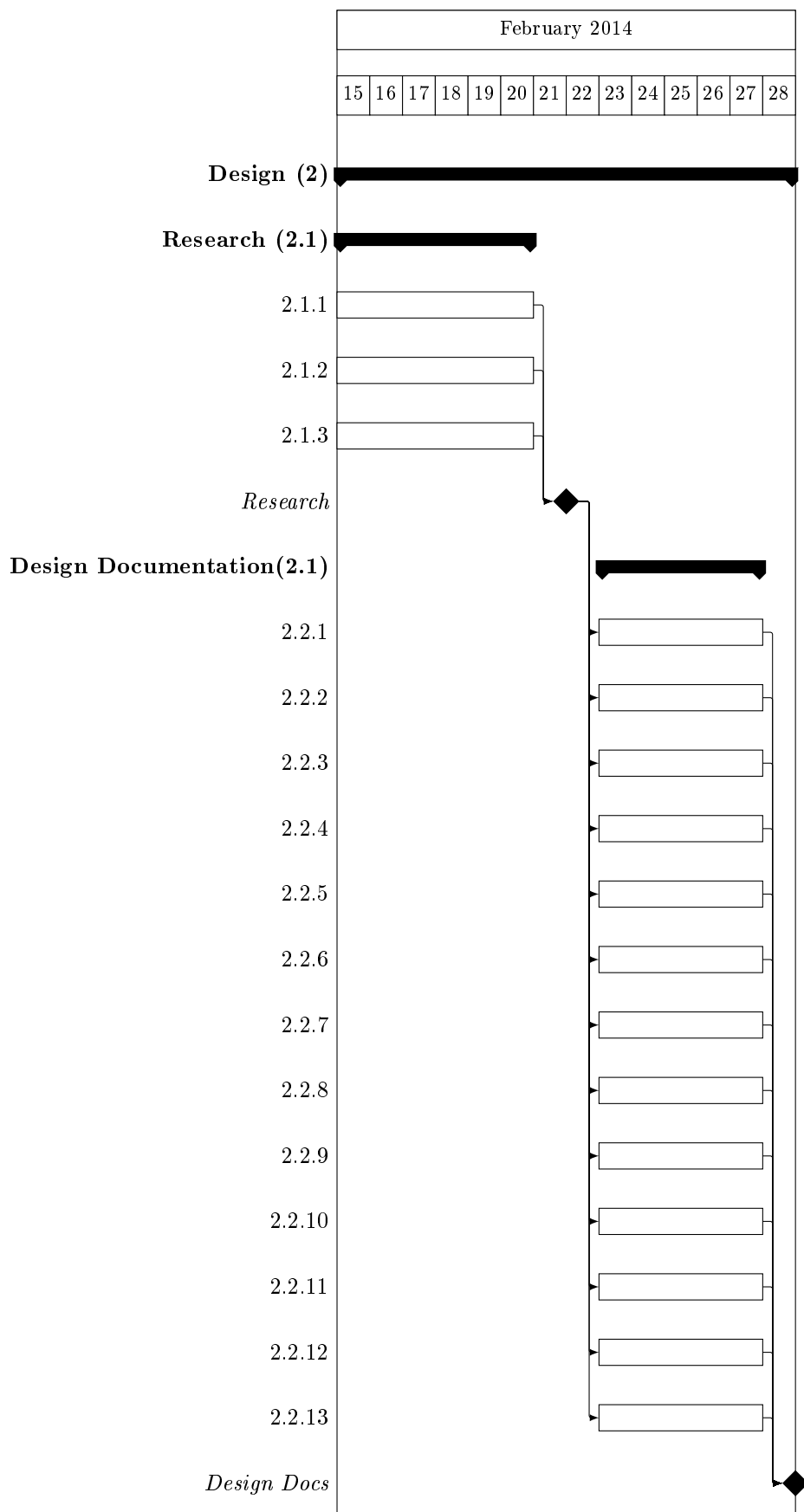
Gantt Chart

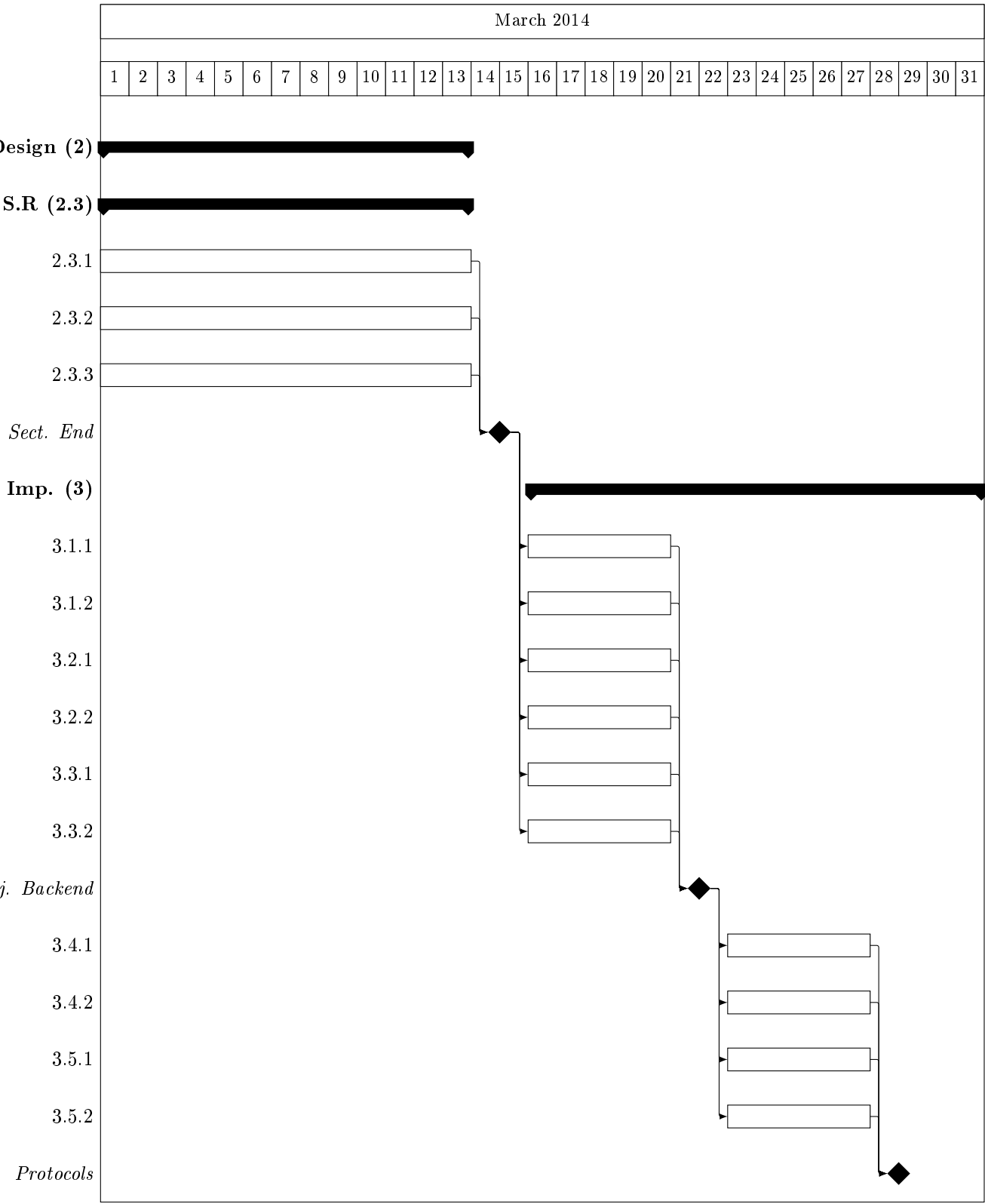
The following are Gantt Charts of the project. They are developed from looking at overall requirements for the project, and to act as a base for us to follow when developing the project.

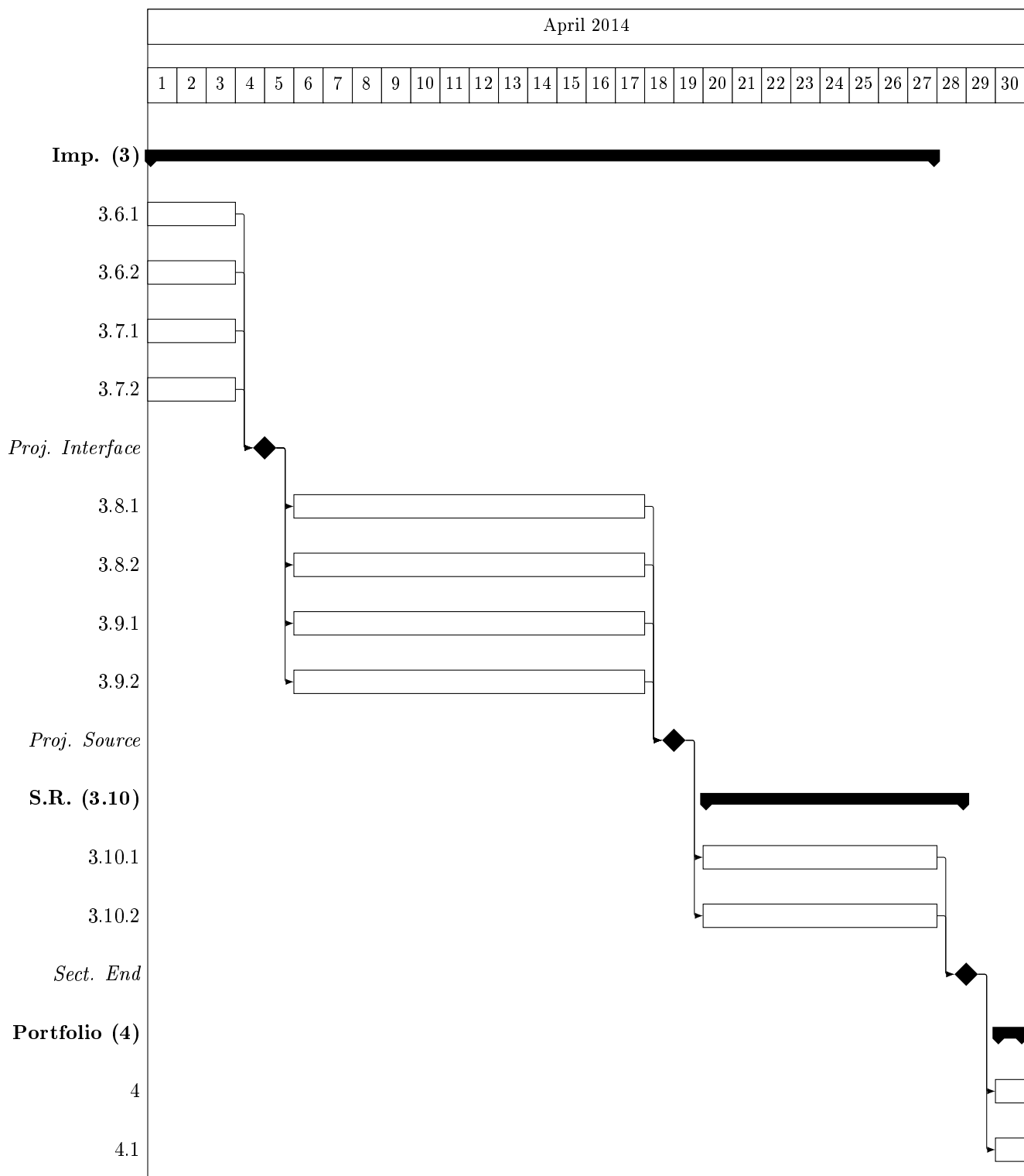
It is a graphical representation of the Task List documented prior to the charts. They have been split up either monthly or bi-monthly basis to allow acceptable formatting, due to differing workloads between months.

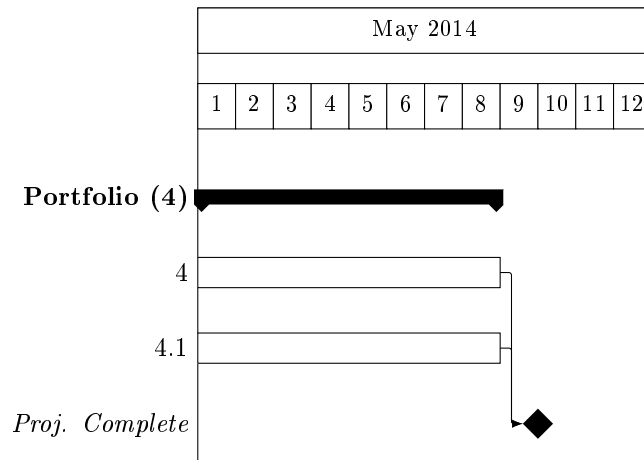
February is the most work intensive as it is providing the foundations of the project and is therefore detailed to reduce the risk of the project failing. April is the most lax of the working months (apart from May being project clean up) as the group members will be concentrating on the larger tasks as opposed to diverting attention between four or five tasks each, like in the Planning stage of the project.











Chapter 19

Risk Assessment

19.1 Parallel Tasks

A big concern for any project is the amount of tasks that will be performed simultaneously [3]. For every task that is carried out together, but potentially separate from each other, risk is increased - with more tasks making a more dramatic increase of potential failure for the project. For the planning section of this project we have performed a large amount of tasks simultaneously which may be detrimental to our quality of work later in the project.

In order to reduce or even eliminate the risk of too many parallel activities, the project should be planned using a Gantt chart to reduce the amount of tasks being performed simultaneously, and have more milestones within the project. This will help effectively split up the project into more manageable sections, which will not only make the project seem simpler to complete, but will improve the monitoring capabilities of the project as well.

19.2 Group Work

Working within a group can make deliverable dates difficult to achieve. This can be due to a lack of communication, unavailability of party members or an incapability to meet deadlines for some of the members. A meeting of minds also includes an assemblage of work ethics. Because of this, work may grind to a halt as members argue over personal yet trivial matters such as formatting documents or a varying opinion on what is classed as 'enough work' for a task.

Combating the disadvantages of working as a group can be difficult. As some problems are part of a group unable to function either properly or efficiently together, this can be the breaking factor of the project. This is a risk that cannot be eliminated but can be reduced. A way of minimising the amount of damage that the risk will do would be to have a centralised form of contacting members of

the group - examples being a website or using a revision control system such as 'Apache Subversion' or 'Git', will give a common area for the group to look for potential absences or reasons for reduce work output from members.

The best way to reduce the risk of differing qualities of work between the group would be to define a standard of work between the group - such as the layout of source files in programming languages, or a house style for formal documents as part of the group's external identity. Having this be available to the group in some form, such as in a text file within a shared area will allow the group to refresh their memories of parts of the set standard that they wouldn't follow otherwise.

19.3 Deadlines

Deadlines are the final day or dates that an object needs to be completed by. Sometimes within a project the deadline may be overstepped due to any of the risks mentioned within this document, which can lead to something small such as being berated by the project leader or something serious such as a breach in contract with the client. For these reasons, deadlines need to be adhered to so that the project can continue on schedule.

Reducing the risk of deadlines are important, especially for those that are not capable of monitoring their time effectively. By providing deadlines as a range of dates as opposed to a singular date, there is increased flexibility within the project and it gives some people more time to finish their work if it is required. By using a range of dates the group can finish on the beginning of the deadline range - a sort of pseudo-deadline - meet up and discuss whether alterations need to be made on the work, and then use the remainder of the time until near the end of the deadline range to perform them.

19.4 Scope

The scope is what the project will be encompassing and therefore is one of the most important sections as it defines what you'll be doing for the entirety of the project. That's not the only risk associated with the scope [21]. There is also scope creep, which is when the scope grows to cover more work than the project originally intended, often without an increase in resources matching the higher load on the project deliverables. Performing estimates on the scope, as well as anything else in the project, can be inaccurate as you are essentially guessing the near future, which is difficult at the best of times.

To minimise the risk placed upon the scope, it is best to define what exactly is required of the project before any work takes place on the deliverables. For example it is best to define an encryption method for a project at the beginning and sticking to it, rather than changing the method which may require a different implementation, creating more work. If at a later phase

ambiguities appear in the scope, a meeting to define or even redefine these points should occur before any more work is carried out on the offending article, reducing the amount of change to the project that shall occur.

19.5 Change Management

Change Management is the application of a structured process and set of tools for leading the people side of change to achieve a desired outcome [14]. Problems that are associated with Change Management include conflicts which occur between stakeholders, as they may be disagreeing in how the project should move forward. Assuming that an irreparable state has befallen the project due to a drastic amount of changes that have been placed upon the project, or even ambiguous or inaccurate changes being added onto the project [21]. All of these can amount into an increase in workload, or a decrease if the targets haven't been properly defined.

To reduce the amount of risk involved with Change Management, communication and clear definition on what the project needs to perform is required. Stakeholders should be as detailed as possible at every stage so that no ambiguity is caused, or cleared up if any does occur.

19.6 Stakeholders

Stakeholders are people that have an interest in the project, whether they are the members of the group, the group's monitor/superior or the target audience of the project. Some of the problems that Stakeholders cause for the project members include:

- Losing interest: if they become uninterested with the project then they may back out, which can be dangerous for the project if they were providing any form of input, such as experience in the target field or economic support.
- Stakeholders becoming disillusioned: They are unaware of what the deliverables will be or have a twisted view on what and how the final product will perform its intended purpose.
- Quality Risk: Stakeholders may give ambiguous input both accidentally or on purpose, depending whether the Stakeholder wants the project to fail or not [21].

The best way to reduce the amount of risk involved with Stakeholders would be to keep them informed of the project's current status through external communication such as e-mail, and through meetings so that the team can personally inform the Stakeholder with relevant information, which should ease their mind of any apprehensive thoughts about the project [6].

19.7 Platforms

The main risk in Platforms would be the difference between the chosen development platform and the target market's system. The change between executable files for different operating systems are usually great enough so that a separate executable is required for each distinct operating system. What may also cause problems, especially with low-level programming, would be differing architectures, hardware sets and how the system reads commands [23]. Another problem with platforms would be whether the required software for the project is installed, such as any required run-time environments or files which are needed to use Structured Query Language databases.

This risk can be eliminated if platform-independent code is used - such as the Java Programming Language [13]. This would mean that no changes in implementation would be needed, and database functionality could occur within the platform-independent environment if need be. Otherwise to reduce the amount of risk involved with the varying systems that the target audience may own, compiling the source on different virtual systems to create executables for the many various platforms available would suffice. Of course, this can be mitigated by choosing to not support other systems in favour of only allowing the development platform and its Operating System to be supported.

19.8 Integration

The integration of the project can be high risk due to a couple of factors:

- The intended environment is incompatible or unavailable
- Incomplete testing means the final product may be buggy
- Final product doesn't work (e.g. bad link to database)
- Product lowers efficiency due to learning curve [21]

In order to combat the risks involved in implementation, having a set testing day in an isolated environment can allow the completed builds of the project to be evaluated before being given to the target audience. This will allow the checking of compatibility with the system as well as in-house bug testing. A manual or help section could be implemented into the system so that the learning curve is not as steep compared to not having such resources.

19.9 Requirements

Requirements are not just a list of functional needs and wants but also the constraints on the project as well. However, there are similar risks involved in the requirements, such as generalisation,

ambiguity or even being incomplete. Another risk to do with requirements is whether they align with the design factor or not.

An example would be having both 'fast processing' and 'system independence' as requirements; C++ is faster but Java is independent of platform and although speed may not be an issue with smaller data, larger chunks of data will undoubtedly have an effect on interpreted code [17].

To minimise the risk with requirements, communication between group members and stakeholders is needed; making sure that the requirements and the scope are in line with each other, and that any suggested changes are properly handled with little to no ambiguity. Choosing a design structure and sticking to it is also beneficial to the project. Reducing the workload of the implementation can help towards minimising the risks of requirements and the program, such as removing old data that is no longer needed upon the program's start-up.

19.10 Authority

Without distinct authority within the project, risks can become apparent. If the members of the project do not have the correct privileges on the target system to perform what is required, work output slows or even stops until the matter is resolved. Another risk would be misguided authority; where the team is unclear who has been given the authority to perform a task and therefore there are multiple members allocating the same task to themselves, which will slow down the efficiency of the team due to duplicated work.

Lowering the negative impact of Authority is done through the use of clear definitions. Allocating work to project members and centralising a form of 'to-do' list so that project members can look up what has been assigned to them. Another way of reducing the amount of inefficiency caused by problems with authority would be to make sure the permissions are correctly set up on both the testing and target systems.

19.11 External

There are a couple of external factors which may impact the project in a negative manner. The first being any legal restrictions. This is important as there is a chance that the final product may be used in a location that differs to the geographical area that it was developed in. For example there is a law within the UK which requires that you must provide encryption keys under certain circumstances to the UK authorities [4][22]. In the USA however, it is something of a grey-area, as giving up encryption keys could violate the fifth amendment, as doing so could give incriminating evidence against yourself:

'unlike surrendering a key, disclosing a password reveals the contents of one's mind

and is therefore testimonial.’ [27]

Not only is the law a big risk in projects, but also nature. If you are situated where natural disasters can happen or otherwise things such as heavy weather occur, this can reduce the work flow by denying the team members access to their workspace. Another factor that is external is the changing of technology. Updates to programming languages can lead to deprecated functions or newer operating systems may not be capable of running the same software as their previous iterations, meaning an increased amount of work to keep the software compatible with the target system.

Reducing the amount of risk caused by external factors is difficult as the project team have little to no influence upon them. For example the team cannot bypass any laws that govern the area that the program will be used in, so they must be adhered to as part of the constraints of the project. Natural disaster cannot be stopped, but if you are able to, bringing some of the work back so you could work on it during bad weather may reduce the impact that said weather will have on the project. To reduce the damage caused by software deprecation it is ideal if the functionality coded in the project is not old, or otherwise buggy, so that maintaining or updating the software will require less work.

19.12 Project Management

Project Management, or rather a lack of, can also be a risk to the endeavours of the team. If the group has been asked to reduce or combine the amount of stages in the System Development Life Cycle (SDLC), this can increase the risk of the project failing because it leaves more room for error; combining the stages will often cause a decrease in quality, as less resources are being dedicated to a particular section of the project. A lack of Project Management will also be seen as a high risk because of how difficult it is to monitor a project and its success without these tools.

To reduce the risk that Project Management will apply upon the project, a formal methodology, such as the ‘waterfall’ method could be implemented. This would however reduce inefficiency as the output needs to be moderated and cleared before the start of the next stage in the SDLC can occur. On the other hand an informal methodology would increase the risks, but may potentially allow the project to be completed within a smaller time frame and to the same standard.

19.13 User Acceptance

Just because a project has been made for a target audience doesn’t mean that *that* audience will like it. During testing the target market may reject the initial builds of the project due to the way

it does or does not work, or the look of the project could mean that it is unwieldy to use, whether it is due to low quality or the interface being anti-intuitive.

The main method of reducing the risk pre-emptively is to perform research on any currently available software that achieve similar goals to the project's. By doing this you can find out what users are acquainted with and create a similar yet unique design, or use the competitors as a way of highlighting what is wrong with the current market and create something entirely different. Another method which does require more work is to take in user feedback during testing and implement their suggestions for the look of the project, or the inner mechanics if they have the knowledge to suggest improvements.

19.14 Conclusion

In order to reduce the risk of the project as a generalisation, it is suggested that you:

- Have a centralised communication system used by all members - this reduces all communicative related risks.
- Define team objectives and allocation clearly - this reduces the authority-based risks as well as any that are communicative.
- Define a target system for development - other types of platform can be supported at a later date should the need arise.
- Create and uphold a work ethic to be followed by everyone - this helps to maintain a standard of quality throughout the project.
- Testing should be first on each individual module/deliverable, then as a whole. This improves bug catching and helps monitor the quality of the project.
- Choose a methodology and follow it - this creates a standard of work ethics which will give a layout as well as structure to the project.

By following these pointers a moderate amount of risk can be mitigated with little need for concern. Do note that the legality of the project in differing countries should be researched and followed, should the project be in use within that country.

Part II

Design

Chapter 20

Proposal Summary

The project, a security based social media network, will have multiple components to be investigated and used in this design section. The key critical components to be looked at consist of:

- Database
- Client
- Client GUI
- Server
- Server GUI
- Mobile GUI (future work)

Of each of these components we should look at how they will impact their respective uses in order to best make use of their full functionality. We will look at multiple possible and practical solutions for the above criteria, making sure the best solution is chosen. We will also look at possible work in the future, or any areas to continue with into the coming stages.

The requirements section has helped so far through analysis of existing social media networks and how they have implemented their networks, along with how their interfaces react to the user.

Chapter 21

Architecture

21.1 Network Architecture

Turtlenet is a centralized service, whereby a large number of clients connect to a single server which provides storage, and facilitates communication between clients.

Due to the inherently limited network size (5-50K users per server depending on percentage of active participants vs consumers and local internet speeds) we recommend that servers serve a particular interest group or geographic locality.

Clients send messages to, and only to, these central servers. Due to the fact that all messages (except CLAIM messages, see client-server/client-client protocols for details) are encrypted the server does not maintain a database, it cannot; rather clients each maintain their own local database, populated with such information to which they have been granted access.

When a client wishes to send a message to a person, they encrypt the message with the public key of the recipient¹ and upload it to the server. It is important to note that all network connections are performed via Tor.

When a client wishes to view messages sent to them, they download all messages posted to the server since they last downloaded all messages from it, and attempt to decrypt them all with their private key; those messages the client successfully decrypts (message decryption/integrity is verified via SHA256 hash) were intended for it and parsed. During the parsing of a message the sender is determined by seeing which known public key can verify the RSA signature.

Due to the nature of data storage in client-local databases, all events and data within the system must be represented within these plaintext messages. This is achieved by having multiple types of messages (see client-client protocol).

¹using RSA/AES, see protocol for details

21.2 System Architecture

The system has a number of modules which interact with one another via strictly defined interfaces. Each module has one function, and interacts as little as possible with the rest of the system. The modules and their interactions are shown below. NB: $a \rightarrow b$ denotes that data passes from module a to module b, and $a \leftrightarrow b$ similarly denotes that data passes both from a to b and from b to a.

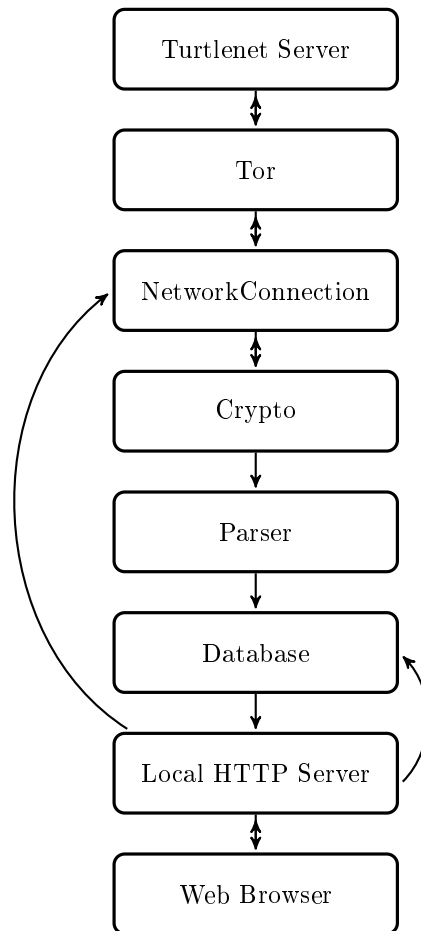


Figure 21.1: Module Interaction

21.3 Data Flow Diagram

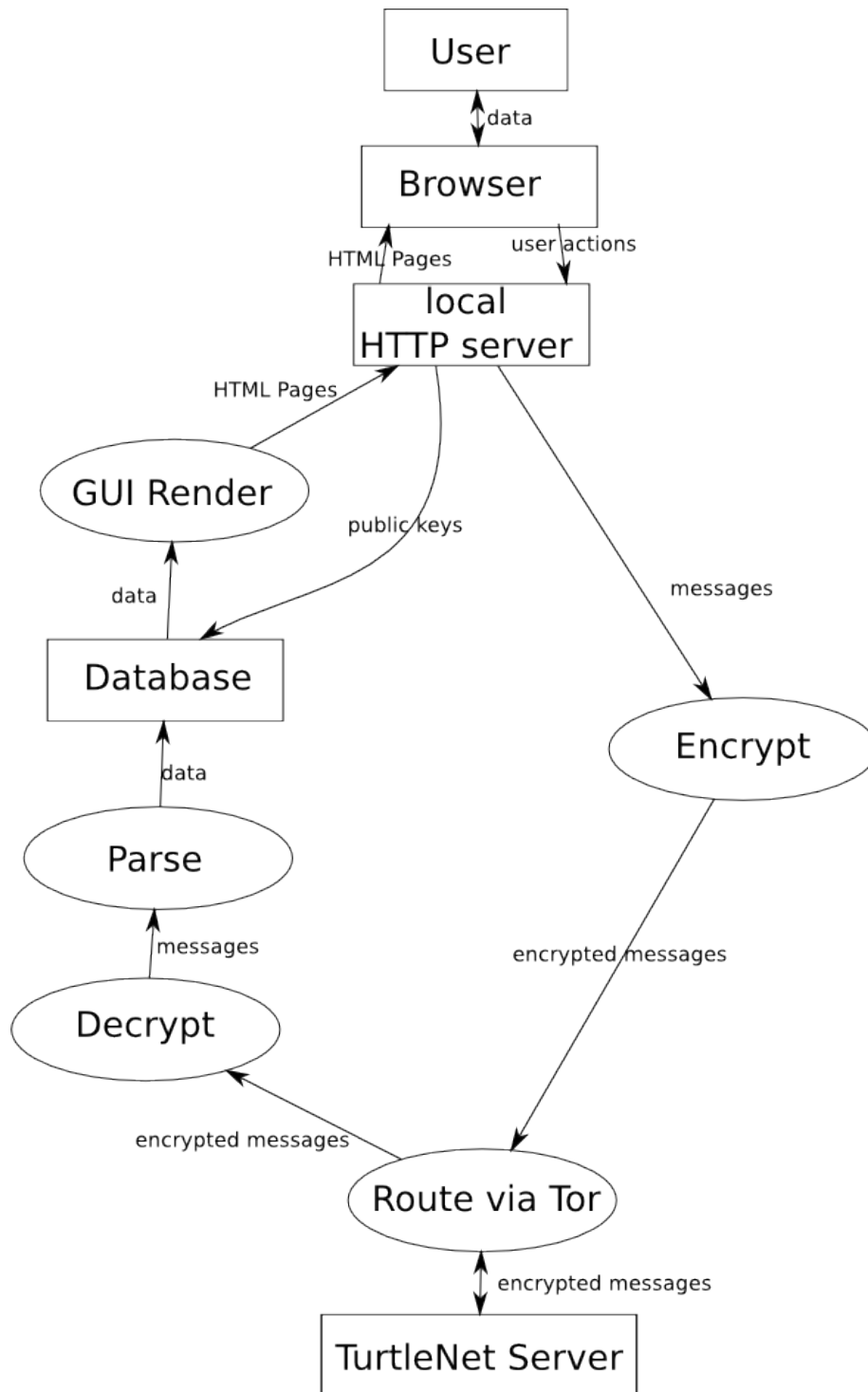
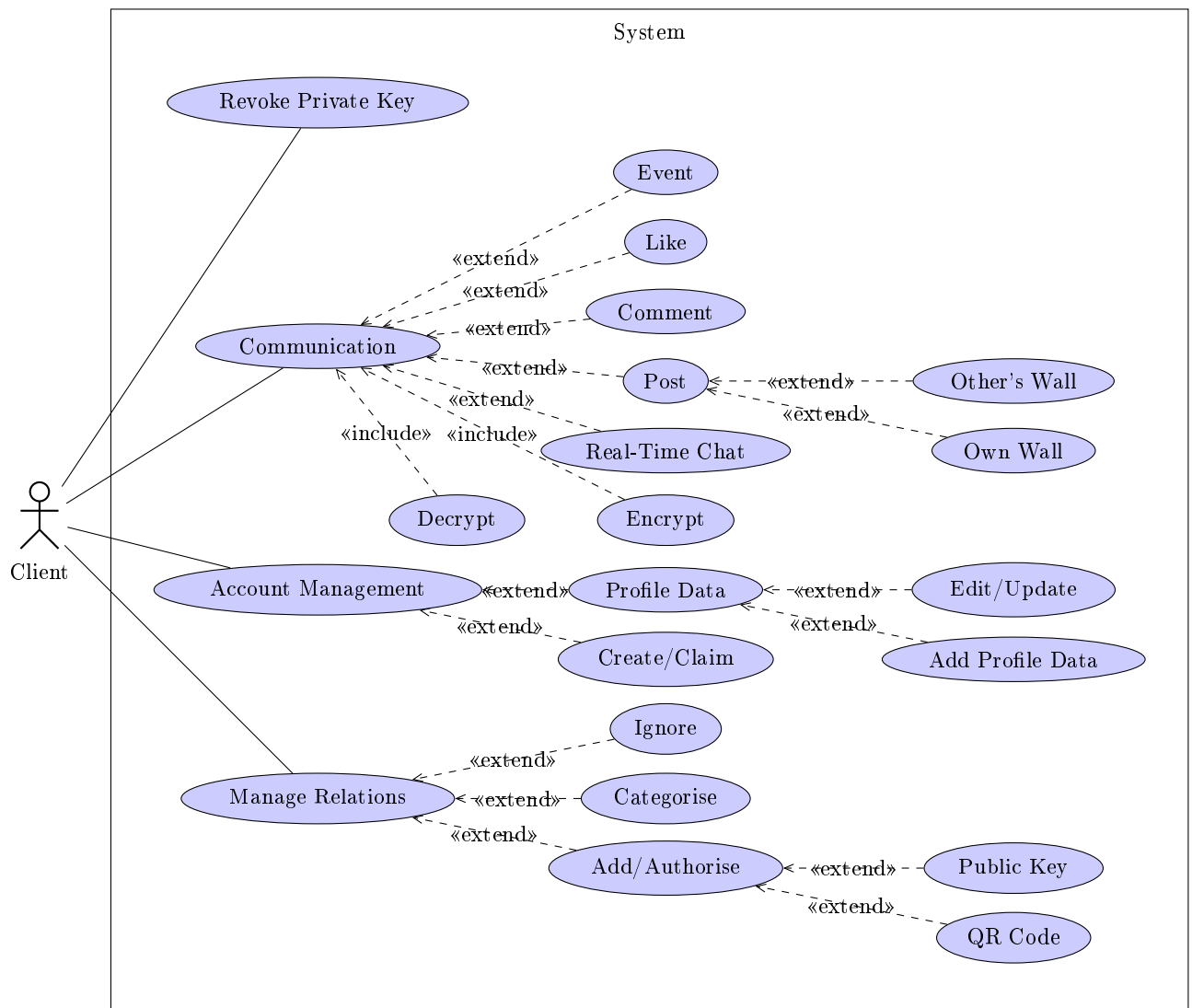


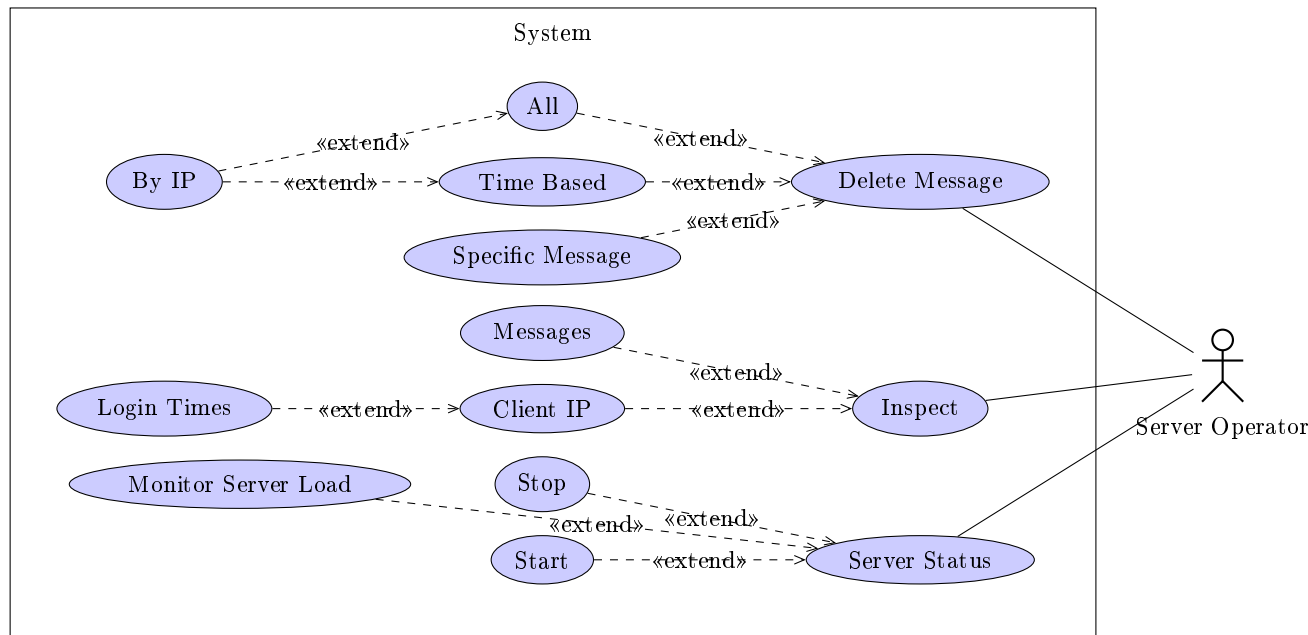
Figure 21.2: Data Flow Diagram

Chapter 22

Use Case Diagrams

Here we have a use case diagram displaying an actors interaction with our system. It shows the functionality available to both the client, and the operator. We also have a sequence diagram to augment the use case diagrams.





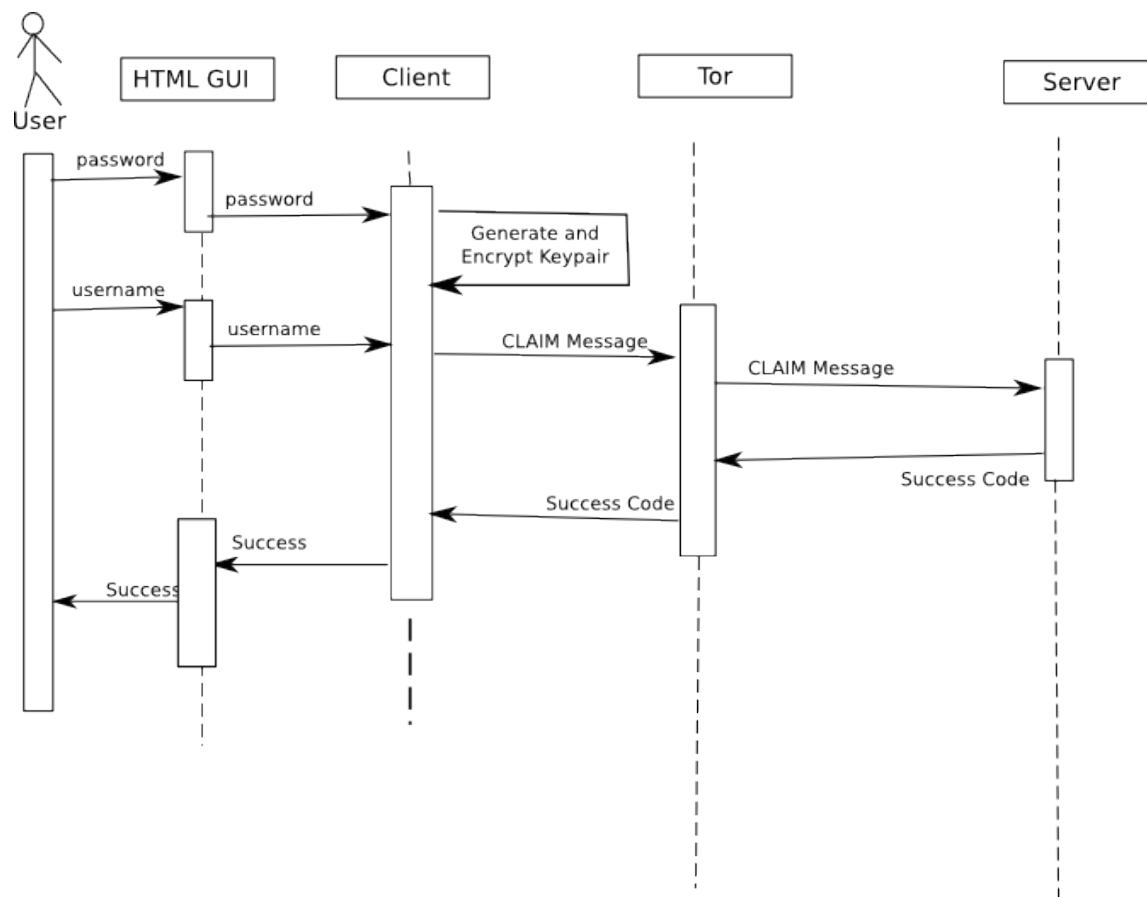


Figure 22.1: Sequence Diagram - Registering

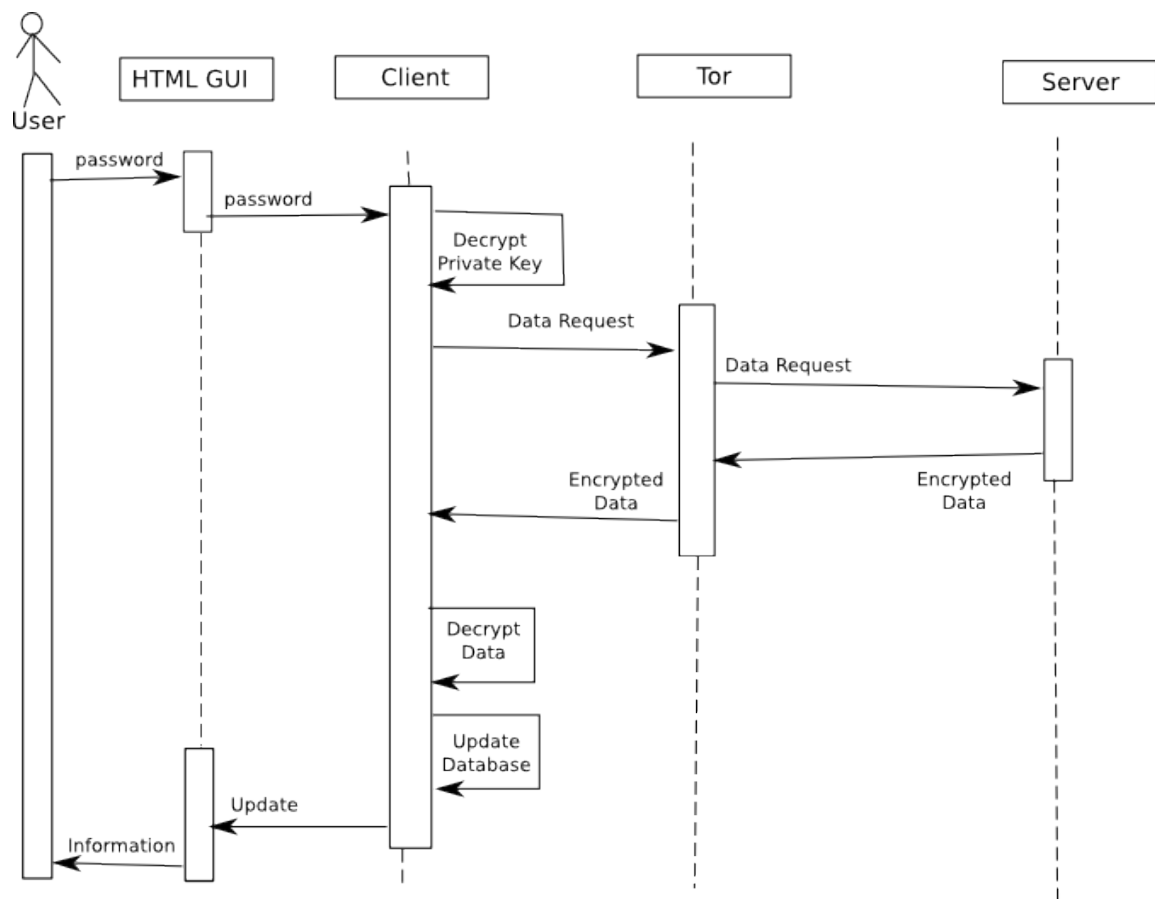


Figure 22.2: Sequence Diagram - Retrieving Data

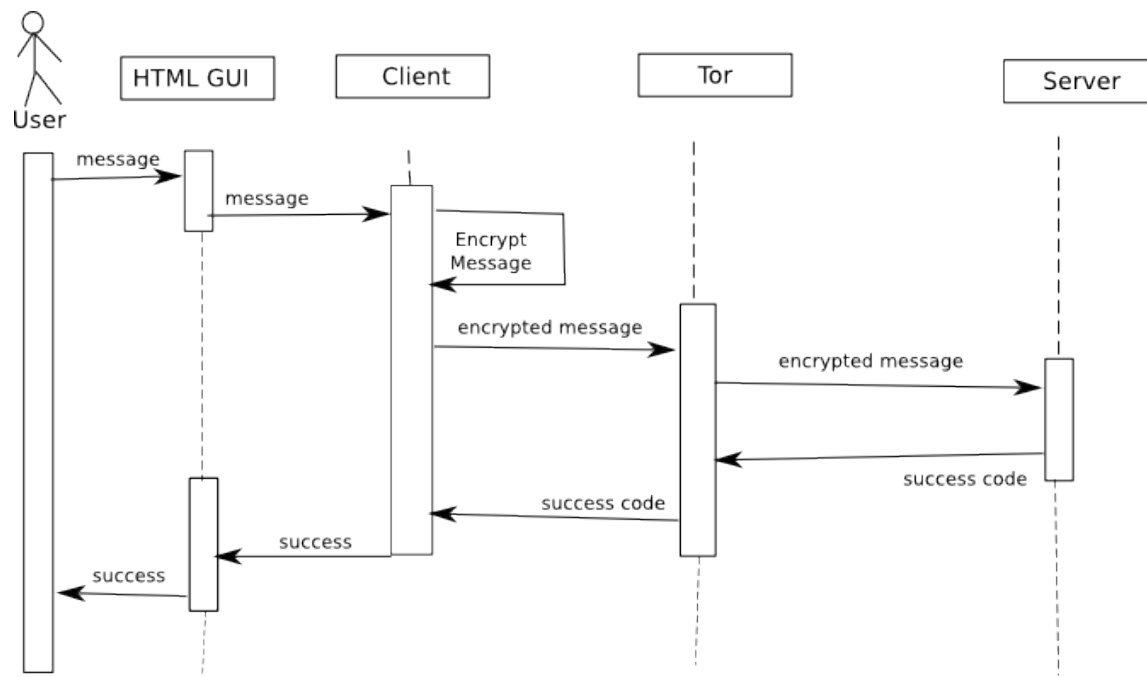


Figure 22.3: Sequence Diagram - Sending Data

Chapter 23

Protocol

23.1 High Level Summary of Protocol

Creating an account is done by generating an RSA keypair, and choosing a name. An unencrypted (but signed) message is then posted to the server associating that keypair with that name. In this way, by knowing the public key of someone, you may discover their name in the service, but not vice versa.

Connecting for the first time Every unencrypted message stored on the server is downloaded (signed nicknames and nothing more). At this time the local database contains only signed messages claiming usernames. The public keys are not provided, these are of use only when you learn the public key behind a name. The rationale for not providing public keys is provided in the section regarding adding a friend. Messages posted after your name was claimed will require downloading too, as once you claim a name people may send you messages. It's worth noting that messages from before you connected for the first time are now downloaded because they can not have been sent to you (with a compliment client) if someone retroactively grants you permission to view something they publish it as a new message with an old timestamp; the sole exception to this is when you connect using a new device, in which case all messages since you first claimed a name will be downloaded.

Connecting subsequently The client requests every message stored on the server since the last time they connected up to the present. Decryptable messages are used to update the local DB, others are discarded.

Continued connection During a session the client requests updates from the server every

0.5-5 seconds (configurable by the user).

Adding a friend is performed by having a friend email (or otherwise transfer) you their public key. This is input to the client, and it finds their username (via public posting that occurred when registering). You may now interact with that person. They may not interact with you until they receive your public key. Public key transferral will be performed via exchanging plaintext base64 encoded strings, or QR codes. The user will be prompted, after retrieving the username of the user, to categorise them.

Talking with a friend or posting on your wall is achieved by writing a message, signing it with your private key, and encrypting one copy of it with each of the recipients public keys before posting it to the server. The client prevents one from posting a message to someone's public key if they have not claimed a nickname.

Posting to a friends wall, commenting and liking may be requested by sending a EPOST/CM-NT/LIKE message to the friend (upon whose wall/post you are posting, commenting or liking), when that friend logs in they will receive your request, and may confirm or deny it. If they confirm then they take your (signed) message and transmit it to each of their friends as previously described. Given that authentication is entirely based on crypto signatures it doesn't matter that your friend relays the message. This is required because it is impossible for one to know who is able to see the persons wall, post, or comment upon which you seek to post, like, or comment.

23.2 Client-Server Protocol

The client-server architecture is necessarily simple.

The client connects to the server, sends a single command, receives the servers response and then disconnects. The following shows commands sent by the client, and the servers action in response.

command	purpose	servers action
t	get the server time	sends back the current time (unix time in milliseconds)
s <i>utf-8_text</i>	send messages	the text sent is stored on the server
get <i>ms_unix_time</i>	get new messages	every message stored since the given time is sent
c <i>utf-8_text</i>	claim a username	the text sent is stored on the server, with a special filename

Table 23.1: Client-Server Protocol

Every command is terminated with a linefeed. Every response from the server will be terminated with a linefeed. The last line sent by the server will always be "s" for success, or "e" for failure (this is omitted from the above table).

CLAIM messages (sent with `c`) will be parsed by the `Message` class and the username extracted for use in a filename. The filename of claim messages is as follows `<unix_time_in_ms>_<username>`; the filename of all other messages is as follows `<unix_time_in_ms>_<SHA256_hash>`.

23.3 Client-Client Protocol

23.4 Summary

All client-client communication is mediated by the server. When one client wishes to send a message to another it encrypts the message with the public key associated with the recipient and uploads it to the server. When one client wishes to receive a message it downloads all new messages from the server and parses those it can decrypt. This is performed in order to hide who receives a message. All messages except CLAIM messages are encrypted. Multiple recipients imply multiple messages being uploaded, this is taken for granted in the text which follows.

23.5 Message Formatting

23.5.1 Unencrypted Messages

Messages have a command (or type), which specifies the nature of the message; messages have content, which specifies the details of the message; messages have an RSA signature, which authenticates the message; messages have a timestamp, which dates the message down to the millisecond, the time format is unix time in milliseconds.

Messages are represented external to the system as utf-8 strings, and internally via the `Message` class. The string representation is as follows:

$$\langle command \rangle \backslash \langle signature \rangle \backslash \langle content \rangle \backslash \langle timestamp \rangle$$

Backslashes are literal, angle brackets denote placeholder values where data specific to a message is placed.

An example follows:

$$\text{POST} \backslash \langle signature \rangle \backslash \text{Hello, World!} \backslash 1393407435547$$

backslashes in message content are escaped with another backslash, signatures are base64 encoded SHA256/RSA signatures of the content of the message concatenated with a decimal string representation of the timestamp. All text is encoded in UTF-8.

23.5.2 Encrypted Messages

Encrypted messages contain the AES IV's; the RSA encrypted AES key; and the AES encrypted message.

Messages are encrypted by encoding the entire message to be sent with UTF-8; encrypting the message with a randomly generated AES key; encrypting the AES key with RSA; encoding the RSA encrypted AES key in base64; encoding the (random) AES initialization vectors in base64 and concatenating these three parts with a backslash between each. The format follows:

<AES IV>\<RSA encrypted random AES key>\<AES encrypted message>

Backslashes are literal, angle brackets denote placeholder values where data specific to a message is placed.

23.6 Claiming a Username

Each user (keypair) should claim one username. Uniqueness is enforced by the server, and so not relied upon at all. Usernames are useful because public keys are not human readable. In order to claim a username, one must send an unencrypted CLAIM message to the server. The format follows:

CLAIM\<signature>\<username>\<timestamp>

23.7 Revoking a Key

If a users private key should be leaked, then they must be able to revoke that key. This is done by sending a REVOKE message to the server. All content signed by the private key after the stated time will be flagged as untrusted. The format follows:

REVOKE\<signature>\<time>\<timestamp>

23.8 Profile Data

Users may wish to share personal details with certain people, they may share this information via profile data. Profile data is shared using PDATA messages. A PDATA message contains a list of fields, followed by a colon, followed by the value, followed by a semicolon. The format follows:

PDATA\<signature>\<values>\<timestamp>

The format for values follows:

$\langle field \rangle: \langle value \rangle; \dots$

An example follows:

PDATA\<signature>\name:Luke Thomas;dob:1994;\<timestamp>

23.9 Inter-User Realtime Chat

Users can chat in in real time, this by achieved by sending a CHAT message to all people you wish the include in the conversation. This message includes a full list of colon delimited public keys involved in the chat. The format follows:

CHAT\<signature>\<keys>\<timestamp>

The format for keys follows:

$\langle key \rangle: \langle another_key \rangle \dots$

An example follows:

CHAT\<signature>\<key1>:<key2>\<timestamp>

Following the establishment of a conversation, messages may be added to it with PCHAT messages, the format follows:

PCHAT\<signature>\<conversation>:<message>\<timestamp>

Whereby $\langle conversation \rangle$ denotes the signature present on the establishing message. An example follows:

PCHAT\<signature>\9f86d081884c7d659a2feaa0c55ad015a3bf4f1b2b0b822cd15d6c15b0f00a08:First!\<timestamp>

23.10 Posting to own wall

When a user posts to their own wall they upload a POST message to the server of the following format.

POST\<signature>\<message>\<timestamp>

The format of message is merely UTF-8 text, with backslashes escaped with backslashes.

An example follows which contains the text "Hello, World!", a newline, "foo \bar\baz":

POST\<signature>\Hello, World!
foo\\bar\\baz\<timestamp>

23.11 Posting on another users wall

A user may request to post on a friends wall by sending them an FPOST message, the poster may not decide who is able to view the message. The format is identical to that of a POST message, except for the command and singular recipient. An example follows:

```
FPOST\<signature>\Hello, World!\<timestamp>
```

Upon receipt of an FPOST message the friend is prompted by the client to choose whether or not to display it, and if so who may view it. Once this is done the friend reposts the message with the command changed to POST instead of FPOST as they would post anything to their own wall. This works because authentication is entirely based on RSA signatures so in copying the original signature the friend may post as the original author provided they don't alter the message (and thus its hash and required signature).

23.12 Commenting

Commenting works similarly to posting on another's wall, so an explanation of details of how it occurs is not provided (see prior section). The only difference is the format of a CMNT message from an FPOST message. The format of a CMNT message is as follows:

```
CMNT\<signature>\<hash>: <comment>\<timestamp>
```

Where *<hash>* denotes the hash of the post or comment being commented upon. An example comment follows:

```
CMNT\<signature>\v/sXfb3DG2qT2k2hXIH4csJy1yEG+TANRbbxQw1VkSE=: Yeah, well,  
that's just like, your opinion, man.\<timestamp>
```

23.13 Liking

Like messages are identical to comments except for the command and the the fact that no ":<comment>" follows the hash. An example like follows:

```
LIKE\<signature>\v/sXfb3DG2qT2k2hXIH4csJy1yEG+TANRbbxQw1VkSE=\<timestamp>
```

23.14 Events

A user may have the client remind him of an event by alerting him when it occurs. A user may inform others of events, and they may choose to be reminded about them. When a user creates

an event just for themselves they just create a normal event and only inform themselves of it. An event is created by posting an EVNT message to the server. The format follows:

EVNT*<signature>*\<event_start_time>: <event_end_time>: <event_name>\<timestamp>

An example follows of a reminder for bobs birthday which occurs on the 14th of January, the event was created on the second of January:

EVNT*<signature>*\1389657600000: 1389744000000: bobs birthday\1388676821000

Chapter 24

Class Interfaces

24.1 Class Interfaces

The following is a description of the public functions of all public classes. Many classes have inner private classes they use for convenience, however to simplify interaction between parts of our system ('modules') we have very few convenience classes.

return	function	description
void	main()	(static) starts the server

Table 24.1: Server

return	function	description
void	main()	(static) constructs and starts all necessary classes and threads, runs the main loop

Table 24.2: Client

return	function	description
N/A	NetworkConnection()	Constructs a NetworkConnection and connects to the given URL (through tor)
void	run()	periodically download new messages until asked to close, downloaded messages are stored in a FIFO buffer
void	close()	kills the thread started by run()
boolean	hasMessage()	return true if there is a message in the buffer, false otherwise
String	getMessage()	return the oldest message in the buffer
boolean	claimName()	claim a given username, returns true on success, false otherwise
void	revokeKeypair()	revokes your keypair
void	pdata()	adds or updates profile information
void	chat()	begins or continues a conversation
void	post()	post a message to your wall
void	fpost()	post a message to a friends wall
void	comment()	comment on a comment or post
void	like()	like a comment or post
void	event()	create an event

Table 24.3: NetworkConnection

return	function	description
boolean	keysExist()	(static) return true if the user has a keypair, false otherwise
void	keyGen()	(static) generate a keypair for the user
PublicKey	getPublicKey()	(static) returns the users public key
PrivateKey	getPrivateKey()	(static) returns the users private key
String	sign()	(static) returns an RSA signature of the passed string
boolean	verifySig()	(static) returns true if author signed msg, false otherwise
String	encrypt()	(static) returns an encrypted message constructed from the passed parameters
Message	decrypt()	(static) decrypts the passed string, returns the appropriate message, on failure a NULL message is returned
String	base64Encode()	(static) base64 encodes the passed data, returns the string
byte[]	base64Decode()	(static) base64 decodes the passed data, returns the byte[]
String	encodeKey()	(static) encodes a public key as a string, returns that string (X509)
PublicKey	decodeKey()	(static) decodes a public key encoded as a string, returns that public key(X509)
String	hash ()	(static) returns the SHA256 hash the the passed string as a hex string
int	rand ()	(static) returns a pseudorandom value <= max and >= min

Table 24.4: Crypto

return	function	description
void	parse()	(static) parses a sting message, records parsed data in the database

Table 24.5: Parser

return	function	description
void	addClaim()	adds a username CLAIM message
pair<string,string>[]	getClaims()	gets all CLAIMs to usernames
string[]	getUsernames()	gets all usernames
void	addRevocation()	adds a keypair revocation
pair<PublicKey, long>[]	getRevocations()	gets all revocations
boolean	isRevoked()	returns the time a key was revoked, if the given key has not been revoked then 0 is returned.
void	addPData()	adds (or amends existing) profile data
string	getPData()	gets the specified piece of profile data for a specified user
void	createChat()	creates new chat
pair<string,string>[]	getChat()	returns messages from a given chat
void	addToChat()	adds a post to a given chat
void	addPost()	creates new post, on your or another's wall
pair<string,string>[]	getPosts()	gets all posts either within timeframe, or from certain people within a timeframe
void	addComment()	adds a comment onto post or comment
pair<string,string>[]	getComments()	gets all comments for a post or comment
void	addLike()	likes a post or comment
String[]	getLikes()	gets all likes from certain person within a timeframe
int	countLikes()	gets the number of likes for a comment or post
void	addEvent()	adds new event
pair<string,long>[]	getEvent()	gets all events within timeframe
void	acceptEvent()	accepts notification of an event
void	declineEvent()	declines notification of an event
void	addKey()	adds a public key to the DB
PublicKey[]	getKey()	gets the public key for a username, or all which are stored
string	getName()	gets a username for the given public key
void	addCategory()	adds a new category to the DB
void	addToCategory()	adds a user to a category

Table 24.6: Database

return	function	description
N/A	GUI()	Constructs a GUI
void	run()	continually updates the GUI from the DB
void	close()	kills the GUIServer thread
boolean	isRunning()	returns true if the GUIServer is running, false otherwise

Table 24.7: GUI

return	function	description
N/A	Message()	Constructs a message with given data
Message	parse()	(static) parses the string representation of a message into a message
String	toString()	creates a string representation of the message
String	getCmd()	returns the type of message
String	getContent()	returns the content of the message
String	getSig()	returns the RSA signature on the message
long	getTimestamp()	returns the timestamp on the message

Table 24.8: Message

return	function	description
N/A	Pair()	Constructs a pair with given data
A	first()	returns the first value passed to the constructor
B	second()	returns the second value passed to the constructor

Table 24.9: Pair<A, B>

24.2 Class Diagram

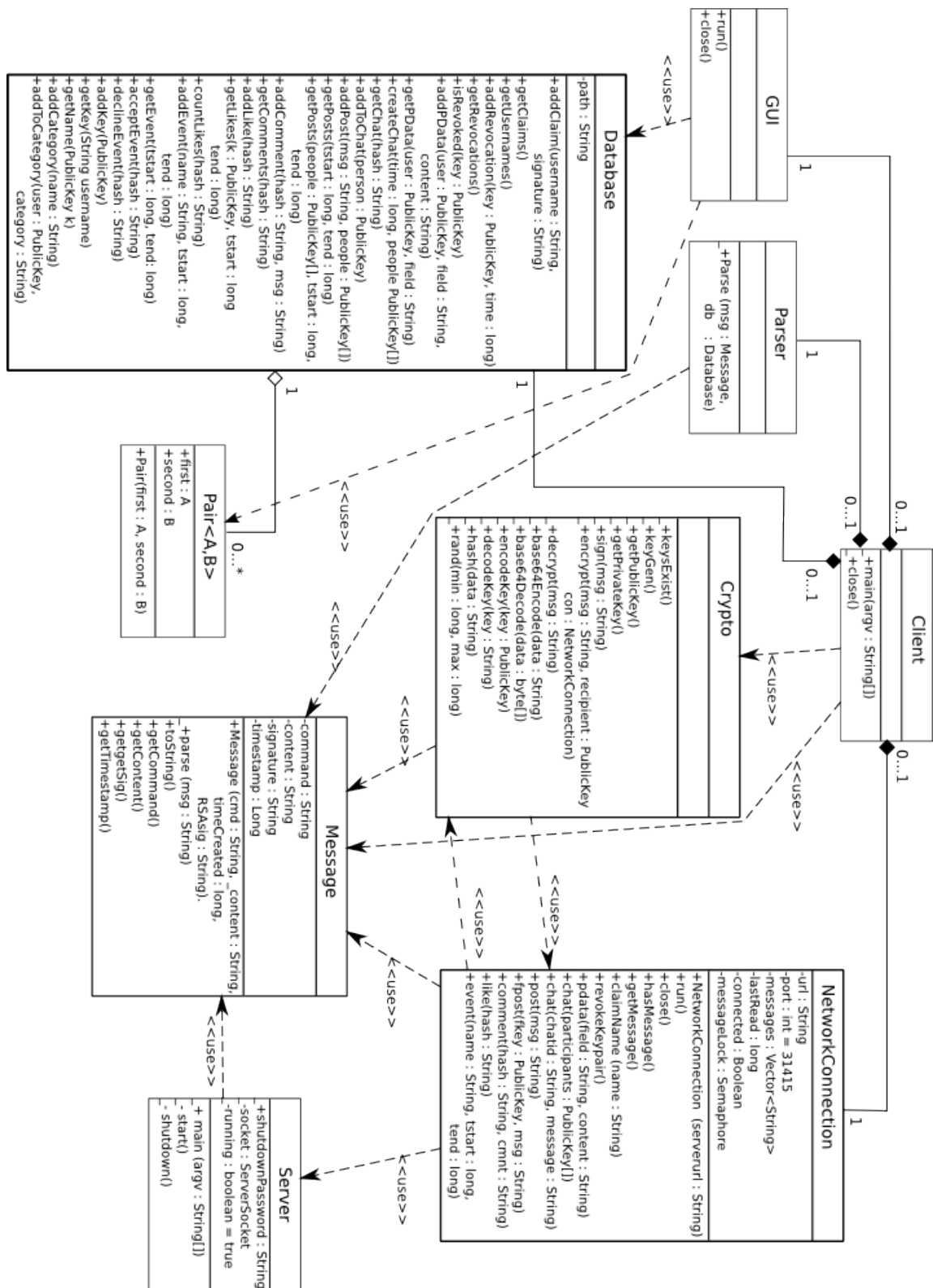


Figure 24.1: UML Class Diagram

Chapter 25

Pseudocode

25.1 Server

```
static void main () {
    startGUIthread()
    startServer()
}

static void start () {
    socket = new ServerSocket(port)
    while (running) {
        incoming = socket.accept()
        t = new Thread(new Session(incoming))
        t.start()
    }

    shutdown()
}
```

25.2 Client

```
static void main () {
    NetworkConnection connection = new NetworkConnection("server.tld")
    Thread networkThread = new Thread(connection)
    Database db = new Database("./db")
}
```

```

GUI                gui                = new GUI(db, connection)
Thread            guiThread           = new Thread(gui)

if (!Crypto.keysExist())
    Crypto.keyGen()

networkThread.start()
guiThread.start()

while (gui.isRunning())
    while (connection.hasMessage())
        Parser.parse(Crypto.decrypt(connection.getMessage()), db)
}

```

25.3 Crypto

```

keyGen () {
    keypair = generateRSAkeypair()
    pw      = GUI.getUserInputString()
    filesystem.write("keypair", Crypto.aes(pw, keypair))
}

static String sign (String msg) {
    byte[] sig = SHA1RSASign(msg.getBytes("UTF-8"), Crypto.getPrivateKey())
    return Crypto.Base64Encode(sig)
}

static String encrypt(String cmd, String text, PublicKey recipient,
                      NetworkConnection connection) {
    Message msg = new Message(cmd, text, connection.getTime()+Crypto.rand(0,50),
                              Crypto.sign(text))

    //encrypt with random AES key with random initialization vectors
    byte[] iv = new byte[16]
    byte[] aeskey = new byte[16]

    fillWithRandomData(iv);
    fillWithRandomData(aeskey);
}

```

```

byte[] aesCipherText = aes(aeskey, iv, msg.toString().getBytes("UTF-8"))

//encrypt AES key with RSA
byte[] encryptedAESKey = rsa(Crypto.getPrivateKey(), aeskey)

//iv\RSA encrypted AES key\cipher text"
return Base64Encode(iv) + "\\\" + Base64Encode(encryptedAESKey) +
    "\\\" + Base64Encode(aesCipherText)
}

static Message decrypt(String msg) {
    //handle claim messages (which are the only plaintext in the system)
    if (msg.substring(0,2).equals("c "))
        return Message.parse(Base64Decode(msg.substring(2)))

    //handle encrypted messages
    String[] tokens = new String[3]
    tokens = tokenize("msg", "\\")

    byte[] iv          = Base64Decode(tokens[0])
    byte[] cipheredKey = Base64Decode(tokens[1])
    byte[] cipherText  = Base64Decode(tokens[2])

    //decrypt AES key
    byte[] aesKey = rsaDecrypt(cipheredKey, getPrivateKey())

    //decrypt AES Ciphertext
    aes.init(Cipher.DECRYPT_MODE, aesKeySpec, IVSpec)
    byte[] messagePlaintext = aesDecrypt(cipherText, aesKey, iv)

    return Message.parse(messagePlaintext)
}

```

25.4 Database

Most database functions are just going to construct parameterized SQL queries to be sent to the database from passed parameter values. The exceptions which include significant computing are

listed here:

```
void addKey (PublicKey k) {
    for each row r in table message_claim
        if (Crypto.verifySig(r.signature, k))
            addFriend(new Friend(k, r.username))
}
```

```
PublicKey[] getKey (String username) {
    PublicKey[] keys
    for each row r in table user
        if (r.username == username)
            keys.add(r.public_key)
    return keys
}
```

```
void addToCategory (Friend f, String category) {
    for each row r in table wall_post
        if (r.permission_to includes category)
            sendMessage(r, f)
}
```

25.5 Network Connection

The vasy majority of messages here merely construct the appropriate message from the parameters and pass it to serverCmd()

```
void main (String _url) {
    url = _url
    messages = new Vector<String>()
    messageLock = new Semaphore(1)
    connected = true

    File lastReadFile = new File("./db/lastread")
    lastRead = Long.parseLong(lastReadFile.readLine())
}

void run () {
    while(running) {
```



```

        sleep(delay)
        downloadNewMessages()
    }
}

String[] serverCmd(String cmd) {
    Socket s;
    BufferedReader in;
    PrintWriter out;

    //connect
    s = new Socket(new Proxy(Proxy.Type.SOCKS, new InetSocketAddress("localhost", 9050)))
    s.connect(new InetSocketAddress(url, port))
    in = new BufferedReader(new InputStreamReader(s.getInputStream()))
    out = new PrintWriter(s.getOutputStream(), true)

    //send command
    out.println(cmd);
    out.flush();

    //recieve output of server
    Vector<String> output = new Vector<String>();
    String line = null;
    do {
        line = in.readLine();
        if (line != null)
            output.add(line);
    } while (line != null);
}

```

25.6 Parser

```

void parse (String msg, Database db) {
    Message m = Message.parse(msg)
    if (m.cmd == "PDATA") {
        String[] tokens = tokenize(msg.content, ":")
    }
}

```

```
        db.addPData(tokens[0], tokens[1])
    } else if (m.cmd == "REVOKE") {
        PublicKey key
        for row r in table users
            if Crypto.verifySig(r.public_key, m.signature)
                key = r.public_key
        db.addRevocation(key)
    } else if {
        etc...
    }
```

Chapter 26

Database

26.1 Database design description

Note the difference between 'main user' and 'user'. Main user refers to the user who owns the local database. 'User' or 'other user' refers to other users, usually the relations of the main user.

26.1.1 user table

This table stores user details, which includes the main user's own details and its relations. As the user makes a new relation with another user, its details will be stored in this table. Every user has their own public key which uniquely identifies their accounts which also be stored in this table.

26.1.2 user, is_in_category, category table

With the category table, the user can create new categories to group his relations. As it is possible for many users to belong in many categories, the *is_in_category* table is needed to identify which set of users belong in the categories.

26.1.3 user, is_invited, events table

These tables suggest that users can create events. One particular feature regarding these tables that on the *is_invited* table, where the user (the main one) can invite anyone individually from the relations list or as a group from the category list. However, there will be no tuples added under this table when another user posts the event. Reason being is that the main user is not allowed to see who the list of other users invited in the event which was not created by the main user.

When the main user creates an event, he invites other people, either from the user table or from the category table or both. Once the invitation is sent out to those users, the users can either accept or reject the invitation. Using the *decision* attribute from the *is_invited* table, if decision has not been made, it will be NULL. If user accepts the invitation, it will be 1 for true. If rejected, it will be 0 for false.

26.1.4 user, allowed_to, wall_post table

When users create post, its data will be inserted into the *wall_post* table. The attribute *from* refers to the user who has created the post, whilst the attribute *to* refers to the user who is referred or mentioned in this post. The main user can also choose to allow a set of his relations to view his post. Using the *allowed_to* table, similar as the *is_invited* table, the main user can select his relations either individually or through categories or both. If the post is created by another user, no tuples will be inserted into the *allowed_to* table.

26.1.5 user, has_like, wall_post table

Users can like any posts that appears in his main wall or personal wall. When a post is liked, a new tuple is created in the *has_like* table to identify who liked the post, which post is liked, and the time the post is liked. These likes are counted and displayed in the GUI showing how many users have liked this post.

26.1.6 user, has_like, has_comment table

Other than liking posts, users can like individual comments as well. Same feature as liking the post by this time, data is inserted into the attribute *comment_id* from the *has_like* table to show which particular comment has been liked by this user.

26.1.7 user, has_comment, wall_post table

Users can comment on posts. When post is commented on, a new tuple will be added into the *has_comment* table on information like the content of the comment, which post has been commented on, who commented on the post, and the time of comment.

26.1.8 user, has_comment table

Users can also comment on comments itself. This will create an indentation on the GUI to suggest that the parent comment has a child comment. When a comment is commented upon, the attribute *comment_comment_id* will insert the *parent_comment_id* which shows the relation of two comments, one parent and the other being the child.

26.1.9 user, is_in_message, private_message table

Another functionality found in Turtlenet is the user is able to send private messages to users. When a private message is created by the main user, a new tuple is added into the *private_message* table. The user then has the option to add other user(s) into the conversation. When done so, a tuple or tuples, depending on the number of users he has added onto the conversation, are added into the *is_in_message* table. This inserts the information such as the time of when the user has been added into the conversation, the user's ID and message ID. The *private_message* table on the other hand stores data such as the content of the message and the time for which this whole conversation was created.

26.1.10 message_claim table

This table stores all CLAIM messages which cannot be matched with a public key. When a new key is entered we search for the CLAIM message, erase it, and add a new entry to the user table.

26.1.11 key_revoke table

This stores key revocation messages. If a user suspects that their private key has been compromised then they can send a message informing their relations of this. Once a key revocation message is sent all content posted after the given time and signed with the corresponding private key is marked as untrusted.

26.1.12 login_logout_log table

This table simply tracks the login and logout activities of the main user. When a user logs in and out, a new tuple will be inserted into this table.

26.2 Table layout of the database

tCategory

catId	canSeePDATA
-------	-------------

tCategoryMembers

pk	catID	userKey
----	-------	---------

tClaim

sig	name	claimTime
-----	------	-----------

tRevocations

key	sig	timeOfLeak	creationTime
-----	-----	------------	--------------

tPostVisibleTo

pk	postSig	key
----	---------	-----

tConvoKeys

pk	convoID	key
----	---------	-----

tConvos

convoID	timeCreated
---------	-------------

tUser

key	username	knowName	email	name	gender	birthday
-----	----------	----------	-------	------	--------	----------

tComment

sig	msgText	senderKey	parent	creationTime
-----	---------	-----------	--------	--------------

tPost

sig	msgText	time	recieverKey	sendersKey
-----	---------	------	-------------	------------

tConvoMessages

pk	convoID	sendersKey	msgText	time
----	---------	------------	---------	------

tEvent

sig	startTime	endTime	creatorKey	accepted	name	creationTime
-----	-----------	---------	------------	----------	------	--------------

tLike

pk	likerKey	parent
----	----------	--------

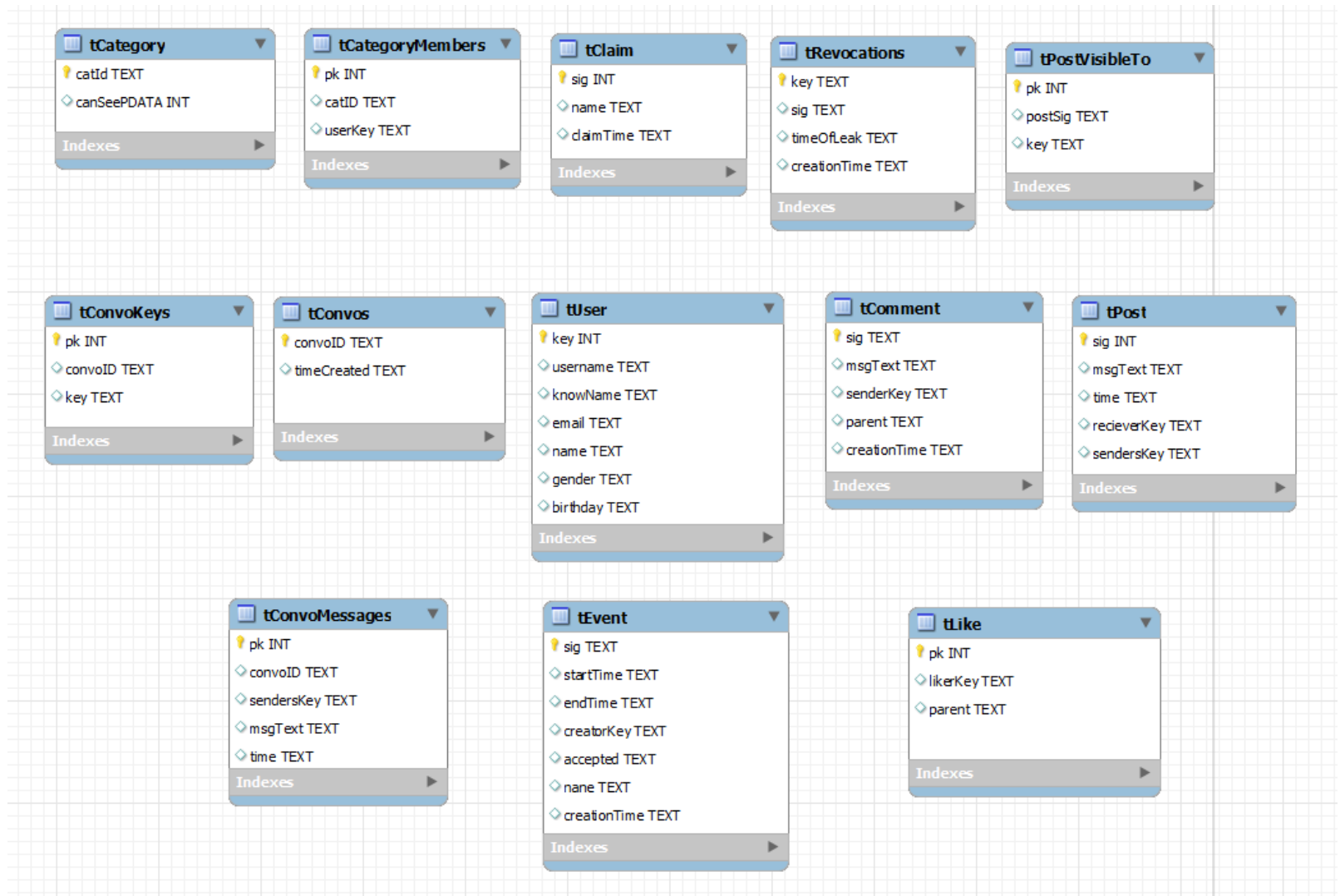


Figure 26.1: Database Entity Relationship diagram

Chapter 27

Transaction details

The table below shows the transaction details of each function which will be found in the program. There are four types of transactions for databases which are insert, read, update and delete.

Insertion is done when new data is added into a NULL attribute. Read on the other hand, is to view information from selected table(s) and its attribute(s). Similar as insertion but update is conducted when data already exists in the particular attribute. This basically removes previous data and add a new one. Lastly, delete, as it is self explanatory, deletes the whole tuple from the database. However this is usually avoided in database norms.

Function	Table(s) involved	Transaction(s)
addClaim()	message_claim	Insert
getClaims	message_claim	Read
getUsernames	user	Read
addRevocation	key_revoke	Insert
getRevocations	key_revoke	Read
isRevoked()	key_revoke	Read
addPData()	user	Update
getPData()	user	Read
createChat()	private_message	Insert
getChat()	private_message, is_in_message	Read
addToChat()	is_in_message	Insert
addPost()	wall_post	Insert
getPosts()	wall_post	Read

Function	Table(s) involved	Transaction(s)
addComment()	has_comment, wall_post	Insert, Read
getComments()	has_comment, wall_post	Read
addLike()	has_like, wall_post, has_comment	Insert, Read
getLikes()	has_like, wall_post, has_comment, user	Read
countLikes()	has_like, wall_post, has_comment	Read
addEvent()	events	Insert
getEvent()	events	Read
acceptEvent()	events	Update
declineEvent()	events	Update
addKey()	message_claim, user	Read, Delete, Insert
getKey()	user	Read
getName()	user	Read
addCategory()	category	Insert
addToCategory()	category, is_in_category	Read, Insert

Chapter 28

User Interfaces

28.1 Interface Research

As a social network, the user interface design is of high importance, as a lot of users of the program will have little core system knowledge, and rely entirely on the user interface. As a result we have looked at a variety of options into designing which will be the best for the project.

28.1.1 Swing

Swing is the primary Java GUI toolkit, providing a basic standpoint for entry level interface designing. Introduced back in 1996, Swing was designed to be an interface style that required minimal changes to the applications code, providing the user with a pluggable look and feel mechanism. It has been apart of the standard java library for over a decade, which, as I will now explain, may not be to our benefit.

Swing, whilst an excellent language to begin with, and write simple applications in, is quite dated. As our group advisor put it when inquiring about what we would be coding the user interface in:

"You should avoid Swing to prevent it looking like it was done in the nineties." - Sebastian Coope

Sebastian is not wrong either, as Swing does a very plain feel to it. This figure shows an old instant messaging system written with Swing by one of our team members. As you can see it is unlikely to appeal to the mass market with such visually plain appearance. This makes Swing, unlikely to be our GUI toolkit of choice, despite some of our members experience with it.

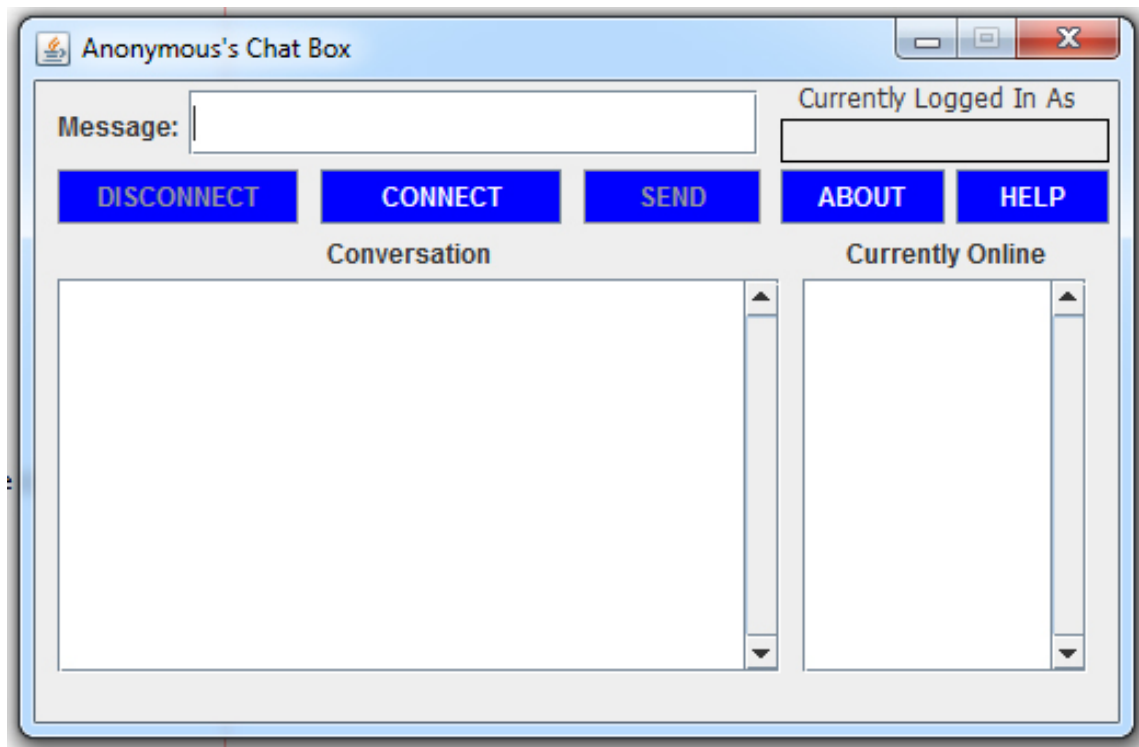


Figure 28.1: Swing Instant Messaging Application

28.1.2 Abstract Window Toolkit

Abstract Window Toolkit (otherwise known as AWT), was another choice given that we are programming in Java, and synchronicity between the two would be an advantage. Whilst AWT retained some advantages such as its style blending in with each operating system it runs on, it is even older than Swing being Java's original toolkit, making any GUI displayed via it look rather dated. None of the the current team has any proficiency with AWT however, and whilst it is possible to learn, there are still other options to consider that may provide the use with a more professional GUI build.

28.1.3 Standard Widget Toolkit

Standard Widget Toolkit (otherwise known as SWT), is one of the more promising candidates so far given its look and up-to-date support packages. The latest stable release of SWT was only last year, and is capable of producing programs with a modern and professionally built appearance, as shown in the figure.

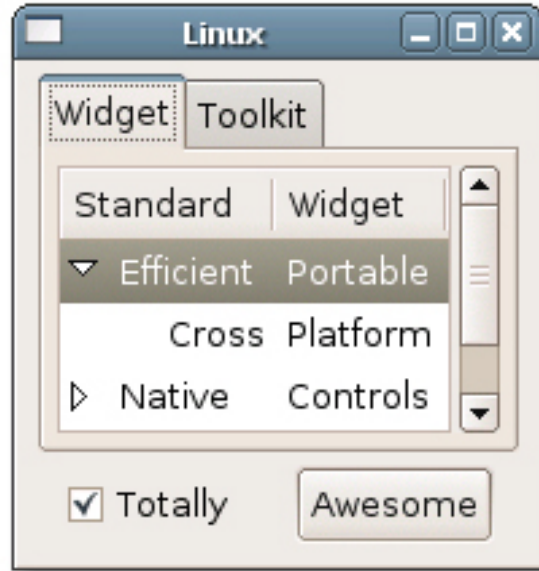


Figure 28.2: SWT Appearance Style

Unlike both Swing and AWT, SWT is not provided by Sun Microsystems as a part of the Java platform. It is now provided and maintained by the Eclipse Foundation, and provided as a part of their widely used Eclipse IDE, something a lot of the team is familiar with.

28.1.4 GWT

GWT allows you to create HTML/Javascript based user interfaces for Java applications running locally. The interface is programmed in Java and then GWT creates valid HTML/Javascript automatically. A web server is required in order for Javascript events to be sent to the Java application.

The user can then interact with the system by pointing their web browser at localhost. This has the benefit of being familiar to novice users as most modern computer interaction is done within a web browser.

Another advantage of using GWT is the ability to alter the appearance of web pages using CSS. This facilitates the creation of a modern, attractive user interface that integrates nicely with current operating systems and software.

28.1.5 Javascript

It is possible to create the entire client application in Javascript and use a HTML/Javascript GUI. This approach removes the need for a local web server meaning the only software the user is required

to run is a modern web browser.

Another advantage would be tight integration between the logic and interface elements of the client application and no risk of errors caused by using multiple programming languages.

One disadvantage of this approach is the difficulty in implementing the required security measures and encryption in Javascript. This can be remedied by using a Javascript library such as the Forge project which implements many cryptography methods.

The main disadvantage is that in this approach the server operator has complete control of the client the user uses. This is unacceptable because we're assuming that the server operator is seeking to spy on the user.

28.2 GUI Design

28.2.1 Client Design

Arguably the most important GUI in the project is the client GUI, as this is what the standard user will be interacting with, a person whom we are assuming has no knowledge of any inner workings. All tests we perform on our system at a later stage will be through this client, as per such its design takes a high level of importance. Its for this reason we have chosen something common users will be more accustomed to: web pages.

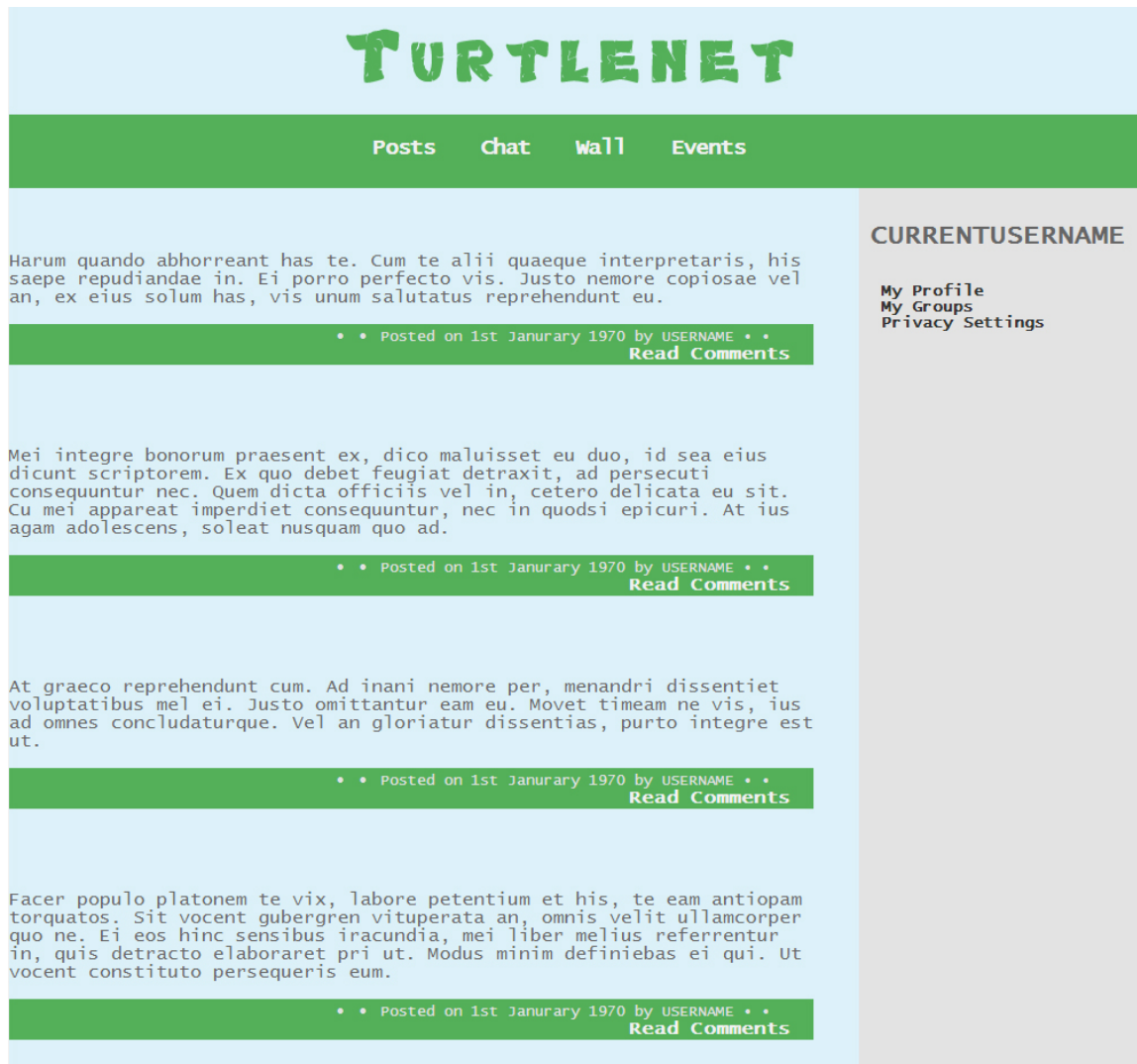


Figure 28.3: Client Design Image

Most users will be familiar with HTML and CSS page layouts, even if they do not know what HTML or CSS is. This will provide a certain level of comfort when it comes to using new applications and how to navigate between pages or tabs. Javascript would be used to pipe the data to the client program, but this is something the user would not interact with or see. It also provides the advantage of knowing nearly every operating system nowadays comes with a web browser natively meaning a HTML/CSS based GUI would likely be supported on nearly all platforms. For these reasons we have chosen to use GWT. A local web server has been decided as the best way forward, as it will

provide the best form of security from the server operators.

28.2.2 Server Design

Whilst not critically important, as it would only be operated by those with technical knowledge, is still an important aspect to consider. It needs to hold the system level settings and control mechanisms a server client would need, whilst not making them immediately and 'accidentally' accessible via the form of large obvious buttons. The easiest way of doing this is via a command input box beneath a chat log window to provide commands that way. It is also may be an idea to show server data such as memory usage on the operators end, as this data is completely accessible and non-intrusive to the client. The figure labelled 'Server Design Image' shows an example of how the server client may be completed. Pending on the features allowed in GWT, our method of choice, we will aim for it to retain a similar appearance.

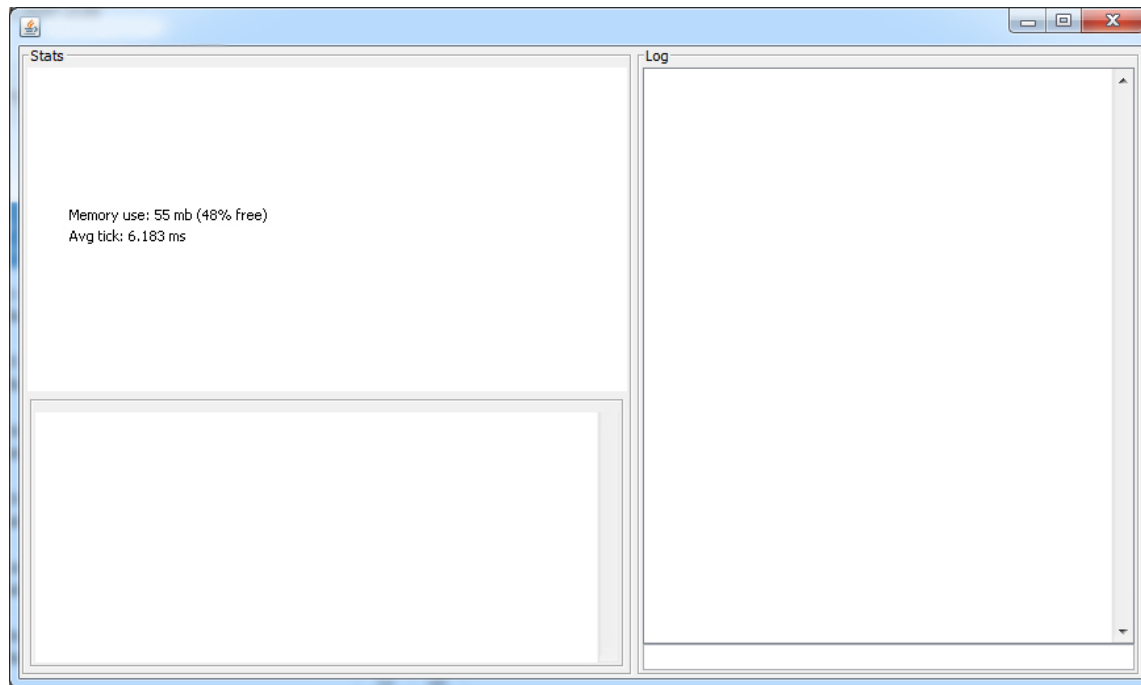


Figure 28.4: Server Design Image

28.3 Future Work

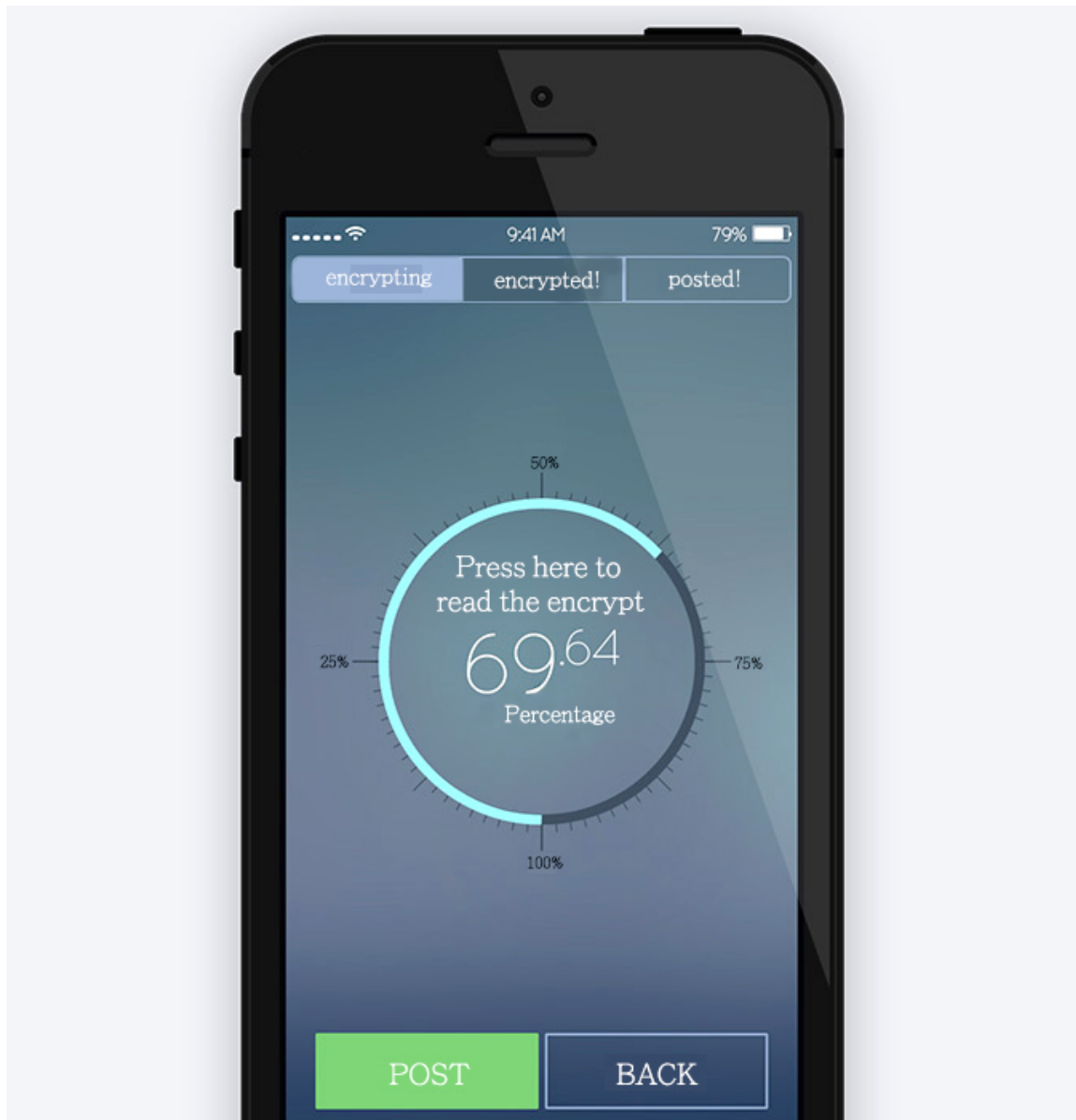


Figure 28.5: Mobile Sending Stage GUI

With some of the spare resources available during this phase, we were able to look into some future design work on the mobile front. One of our designers had some experience in this field of work

and offered to put some images together of what a mobile application version of our product could potentially look like.

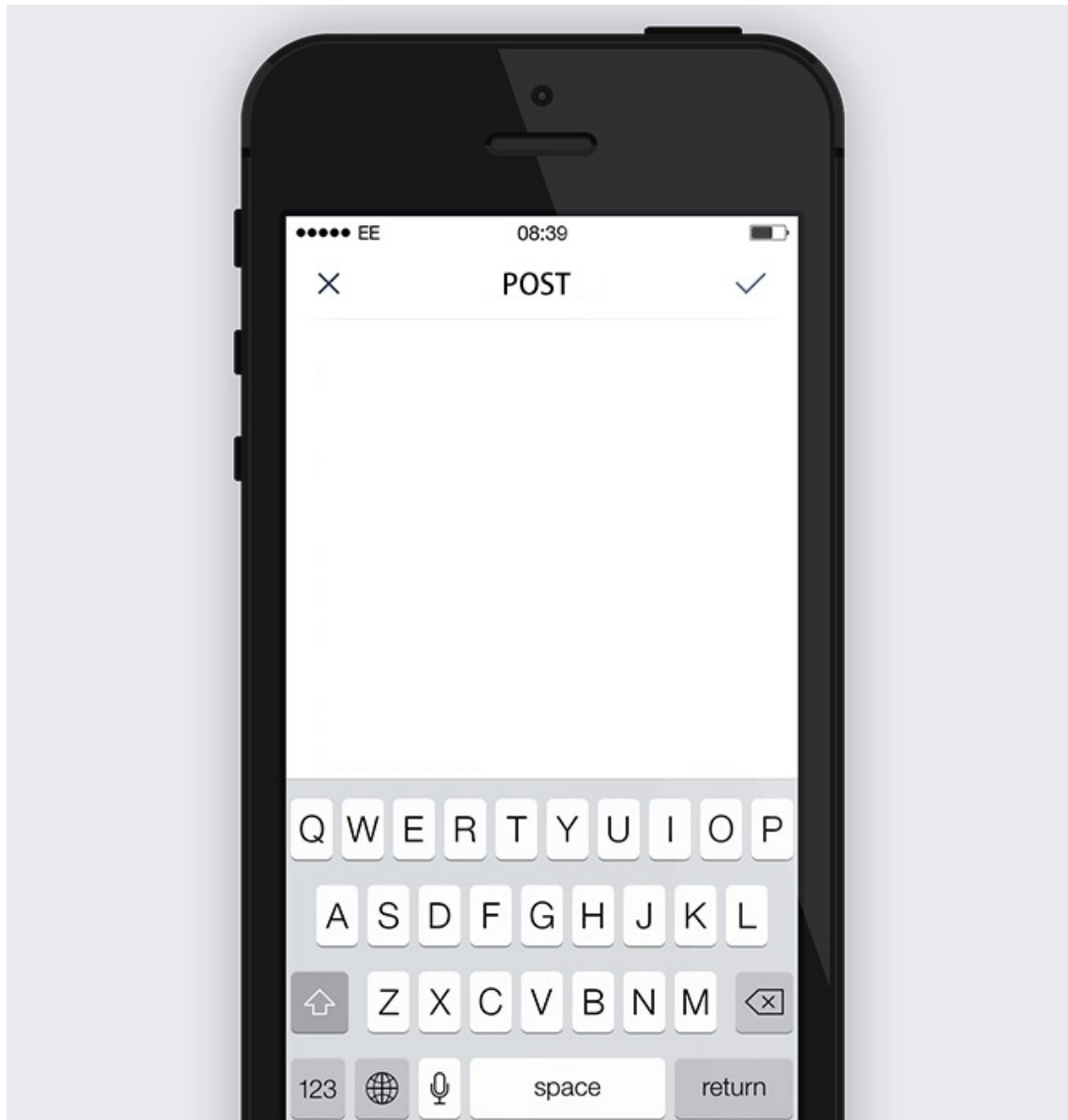


Figure 28.6: Mobile Post Stage GUI

The mobile interface data flow diagram shows how the application would flow between screens, giving an idea to the level of depth an application of this size might have.

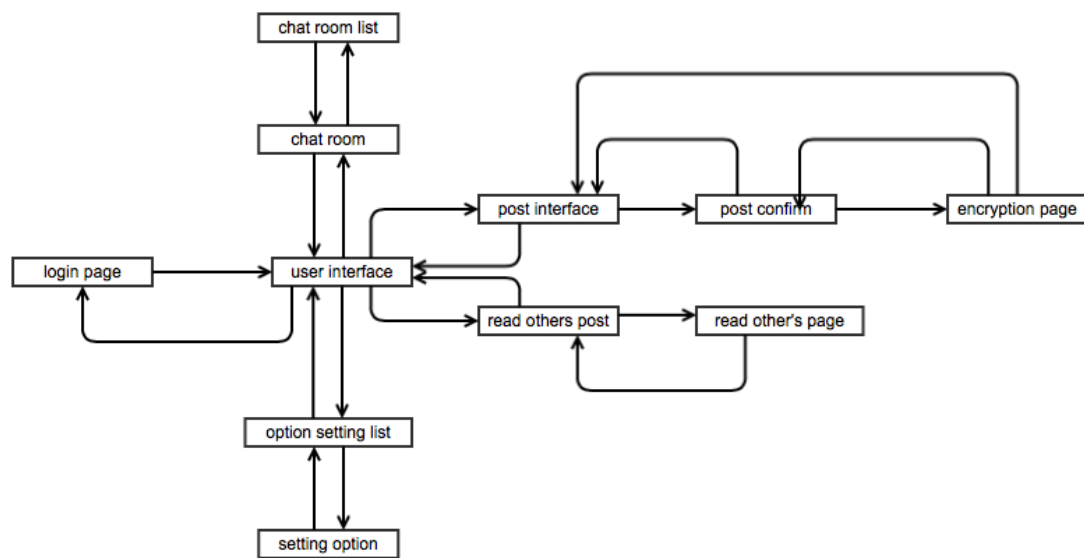


Figure 28.7: Mobile Data Flow Diagram

Chapter 29

Business Rules

In standard projects the business model can commonly outline certain validation practices for the program or project in the form of business rules or policies. Our project, and its fundamental idea, works a little different than most projects in terms of business, as per such we have only one business rule.

- To ensure the client never sends identifying data to the server or its operators.

This is to ensure that the privacy of communication is always within the hands of the client and user, as opposed to any who run the network. To violate this single rule would be going against both the company ideals, and the projects goals.

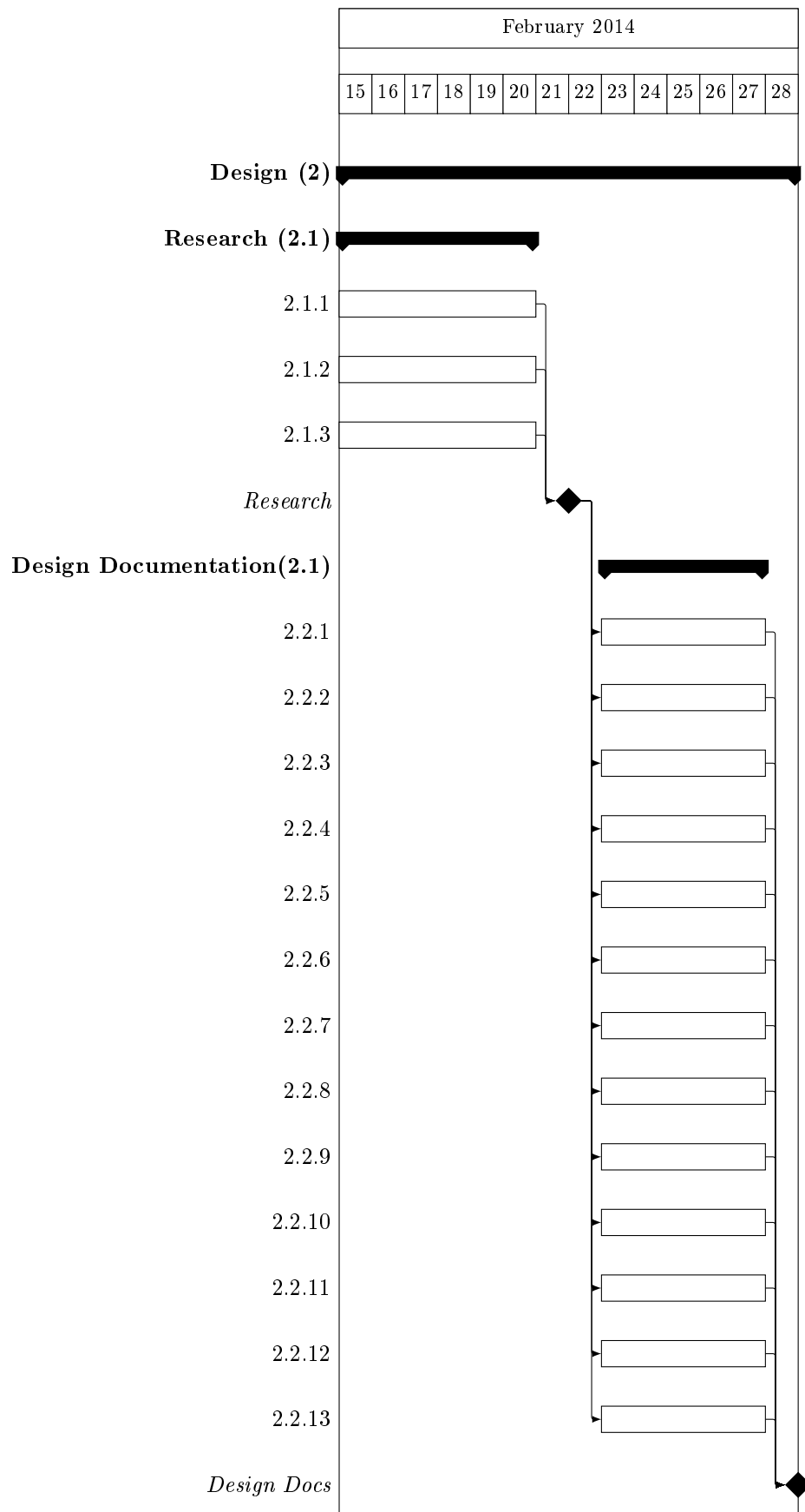
Chapter 30

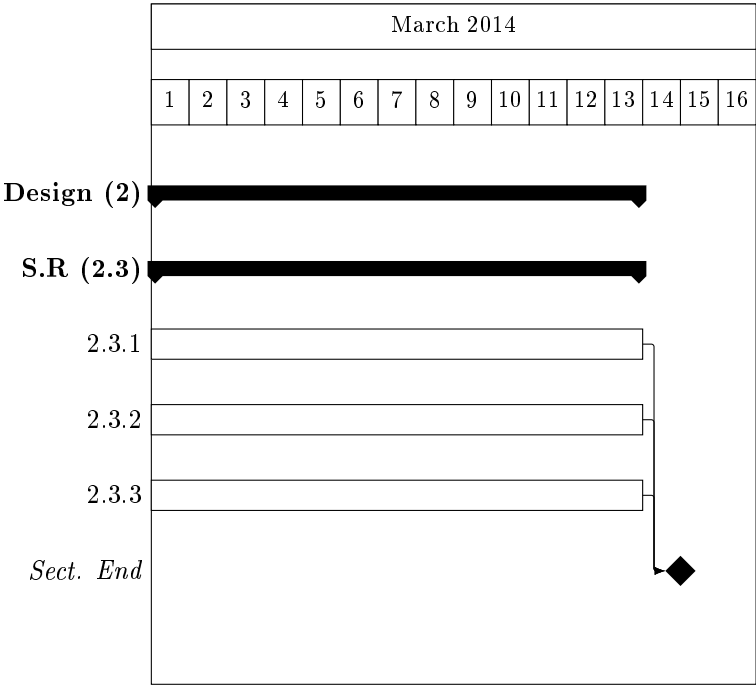
Gantt Chart

These are excerpts from the Gantt charts made during the requirements stage of the project. They have been used as a guide throughout the completed sections of the project. As the design section was foreseen as the most work-intensive part that is encompassed within the project, particular care and attention was made to make sure that official deadlines were met, through the use of un-official end dates for each task.

By doing so, therefore finishing tasks earlier than required, it has provided a buffer used for quality controlling the project's deliverables. A partial reproduction of the task list is also provided:

Task ID	Task Description (Desc.)	Due Date	Deliverable
2	Project Design	14/03/2014	Design Segment
2.1	Research (Res.)	21/02/2014	Research Segment
2.1.1	Res: Database Languages	21/02/2014	Same as Desc.
2.1.2	Res: Programming Languages	21/02/2014	Same as Desc.
2.1.3	Res: Interfaces	21/02/2014	Same as Desc.
2.2	Designs (Des.)	07/03/2014	Design Segment
2.2.1	Des: Databases	28/02/2014	Same as Desc.
2.2.2	Des: Class Interfaces	28/02/2014	Same as Desc.
2.2.3	Des: Protocol	28/02/2014	Same as Desc.
2.2.4	Des: Architecture	28/02/2014	Same as Desc.
2.2.5	Des: Sequence Diagrams	28/02/2014	Same as Desc.
2.2.6	Des: Data Flow Diagrams	28/02/2014	Same as Desc.
2.2.7	Des: Class Diagrams	28/02/2014	Same as Desc.
2.2.8	Des: Server-side Interfaces	28/02/2014	Same as Desc.
2.2.9	Des: Client-side Interfaces	28/02/2014	Same as Desc.
2.2.10	Des: Server-side Protocols	28/02/2014	Same as Desc.
2.2.11	Des: Client-side Protocols	28/02/2014	Same as Desc.
2.2.12	Des: Server-side Pseudo-code	07/03/2014	Same as Desc.
2.2.13	Des: Client-side Pseudo-code	07/03/2014	Same as Desc.
2.3	Segment Review	10/03/2014	Design Segment
2.3.1	Evaluate Segment Quality	14/03/2014	N/A
2.3.2	Improve Segment	14/03/2014	Design Segment





Chapter 31

Glossary

AES - Symmetric encryption standard.

Category - We allow our users to create ‘Categories’, and place one or more users into one or more categories. These sets of users are used to speed up repetitive actions such as allowing all of your friends permission to view something, by instead allowing the user to allow the category ‘friends’ to view it.

Client - The program that will be used by users which connects to a turtlenet server.

FaceBook - A social networking website designed to make the world more open and to connect people together in a simple format.

Onion Routing - A manner of routing traffic in a network with the goal of obscuring from the recipient who the sender was. This is achieved by routing it through a number of intermediaries, none of which have access to both who sent the traffic, and the plaintext traffic. ¹

Privacy - Personal information being known to only those whom you choose to inform of it.

Parameterized Query - A precompiled query lacking important information for the values of parts of it. These are used to protect against SQL injection and to provide a greater degree of abstraction from the database for the rest of the system.

QRCode - QR stands for Quick Response. Used to store data it is a form of 2D bar code, It was designed to be easy to read from low quality photographs.

Relation - Two users must know each others public keys in order to communicate. We say that two users who possess each others keys are in a ‘relation’. This is done because it is a situation we talk about often, and it helps to have a word for it.

RSA - An asymmetric encryption algorithm.

SocialNetwork - A website build around facillitating social interaction.

Server - A computer running the turtlenet server which allows clients to connect to it.

¹See http://en.wikipedia.org/wiki/Onion_routing for more information.

ServerOperator - The owners and engineers responsible for running Turtlenet servers.

Tor - An implementation of onion routing.

Part III

User Manual

User Manual - Turtlenet Ballmer Peak

M. Chadwick, P. Duff, A. Senin, L. Thomas

May 8, 2014

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Chapter 1

General

1.1 System Overview

Turtlenet is a purpose-built, privacy oriented social network, which demands zero security or technical knowledge on behalf of its users. It allows communication between users securely, which can either be in the form of instant messaging, or creating posts on users walls.

What makes Turtlenet significant is even the service operators are unaware of who communicates with whom. It is designed from the ground up that they can never know this, even if they wanted to. This resolves a more common security issue that plagues modern social media networks, an issue Turtlenet has been created to not have.

1.2 Contact

Team contact information:

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- l.prince@turtlenet.com
- m.chadwick@turtlenet.com
- l.choi@turtlenet.com

Chapter 2

Getting Started

2.1 Getting started

Welcome to using Turtlenet! Through the use of Turtlenet, you will experience the ease of use and the practicality of communicating and socialising with your friends, family, business associates or anyone else that you know through a medium where your data is ensured to be protected. This user manual has been designed and written specifically to assist the users by providing detailed description of all the various uses of the program. Let's get started!

2.2 System Requirements

These are the minimum system requirements for Turtlenet:

- An internet connection
- Any OS with a JRE (version 1.6.x or higher)
- Any up-to-date browser

2.3 Installing Turtlenet

In order to install Turtlenet, you simply download ONE of the files from our website:

www.turtlenet.co.uk/downloads.html

Most users will want to get the version that is without 'TOR' as unless you know what that acronym stands for, you won't have it installed. It is an external piece of networking software which

adds another layer of security, hiding your IP address so people don't know where you currently are.

As the file is a Java Archive (JAR), you can put it in whatever folder you choose - Turtlenet doesn't mind. It will create the required files and folders when it is running so just pick a pleasant home for the download.

2.4 Running Turtlenet

Now you have the client on your computer, you will need to run it. People who are familiar in using Java may be able to work it out but this section is here for those who want to make sure that they are going to run it first time correctly and without frustration. Here is what you do:

1. Open Command Prompt (Windows) or your Terminal (*nix and OS X)
2. use 'cd' to get to where your Turtlenet client .jar file is. Windows users changing drive letters will need the '/D' parameter. e.g. 'cd /D D:
TurtlenetFolder
,
3. You will want to run the java command:
'java -jar turtlenet.jar'

If you managed to get to the downloaded client JAR file and ran that command, you should have the back end of the Turtlenet client running. All you need to do now is open your preferred browser, or one of the suggested browsers if you have more than one, and type *'localhost:3141'* into your URL bar.

If the browser did not complain about anything and just worked, you should see a Turtlenet banner. If so, you have your client running successfully!

2.5 The Turtlenet Interface

Turtlenet comes with a simple interface that has the main menu, which has the following sections:

- My Wall
- My Details
- Messages
- Friends
- Logout

2.6 Account Creation

The user is expected to create a new account when using Turtlenet for the first time. In order to create an account, enter a user name and a password, as well as repeating your password into the confirmation box. Once the user has created an account they will be logged into Turtlenet. From here onwards, the user can then add further profile details should they wish to. How to do so will be explained under the 'Using the System' section.

Chapter 3

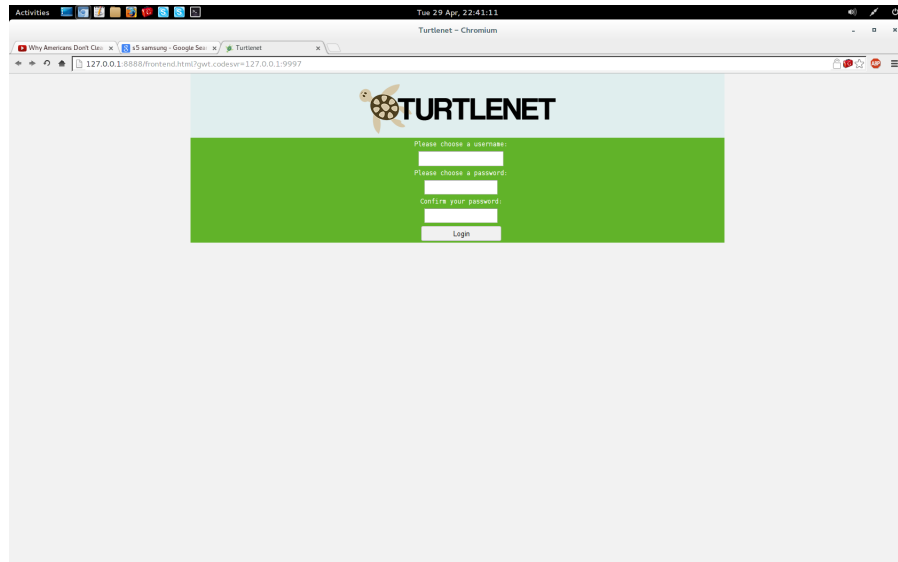
Using the System

This section extends upon the fundamentals mentioned in the Turtlenet (TN) general section.

3.1 Creating an Account

The 'General' chapter only briefly mentions creating an account so to make this section complete as a 'go-to' resource for users it will also be mentioned here too.

This is where your private communications begin.



This image shows the account creation page, which you should see when you run the client for the first time on your computer. From the top there are three text boxes:

- a Username box
- a Password box
- a Confirmation box

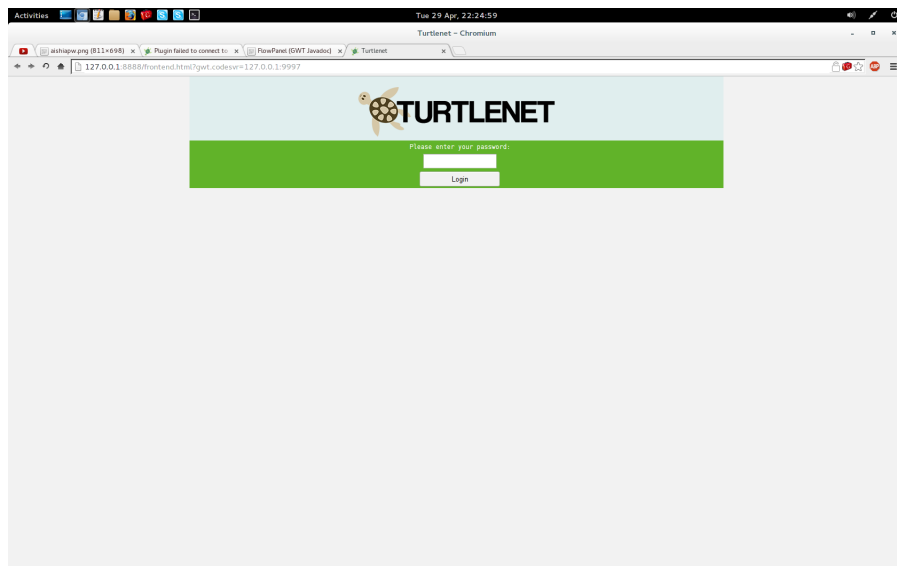
You fill in each of the fields with the required information which will be the following:

- The Username box should be filled in with your user name. This is what other users would call you when posting messages. This should be something that represents you, but should not link to you outside of Turtlenet. Simply, your Turtlenet user name should not be the same as any other user name you use on the internet. If the name can be linked to you then people are able to easily determine that you have a turtlenet account.
- Your password should be easy to remember but difficult for anyone else to guess. A good method for coming up with new passwords is to use four or five words, in a phrase. An example would be 'ThisIsTurtlenetzPassword'. This is better and easier to remember than what is usually suggested which is a shorter password with numbers in them: 'P@ssw0rd'. Of course, it depends on who is remembering the password so choose your own method if either option mentioned feels uncomfortable for you.
- The Confirmation box is where you type the password you defined in the previous box. Because of this, they should match, and must if the account creation is to be successful. The easiest way of thinking about this box is that it is giving you the practice of inputting your password while it is still fresh in your mind, to help you remember for later on.

By filling in these text boxes with the kind of information mentioned in this section, you can then click the button underneath these boxes to create your account. If successful you will be automatically logged in.

3.2 Logging into Turtlenet

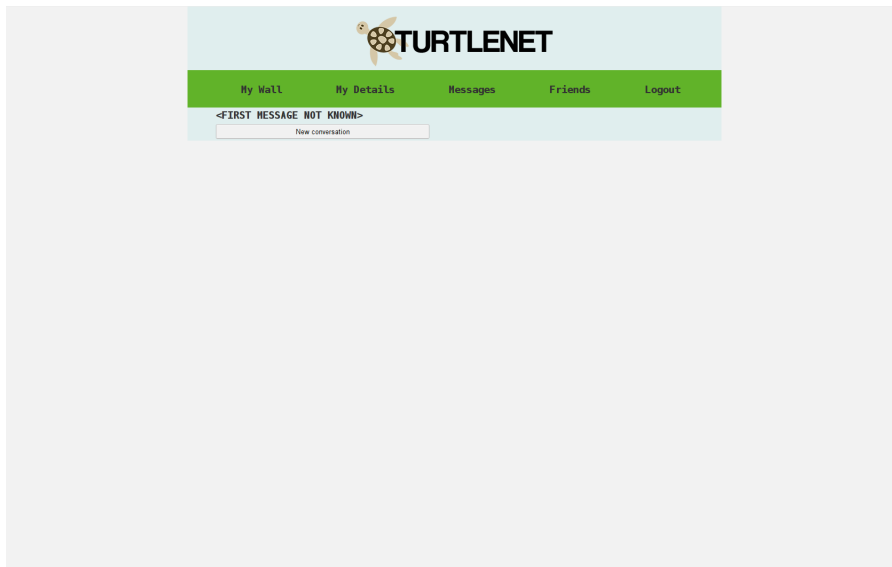
Logging into the Turtlenet client is as simple as using the password that you had used to create your account.



The screen shot shows the initial page you might see once you have created an account. Enter your password into the white text box above the 'Login' button and if the password is correct, you would have logged in.

3.3 Navigating around the Turtlenet client

Getting around the client's various areas is important in order to make the most of the functionality provided by Turtlenet. This is why all of the main segments are provided as buttons at the top of the interface:



The image shows that there are several main sections to the client - The wall, the user's details, messages between the user and other people, friends that the user has linked with and finally the function to logout. Click the corresponding button to get to the area you wish to view. The following sections will go through each section from right to left.

3.4 Logging out

For when you decide that you want to leave the safety of Turtlenet and work on other things, or you simply need to be away for a while and want to be sure that no one is using your account, you will want to log off. It is as painless as clicking the 'log off' button found at the top right of every page. Doing so will take you to the login screen (the one with just the password box and login button). Of course, we wish you good fortune until you come and join us again at Turtlenet.

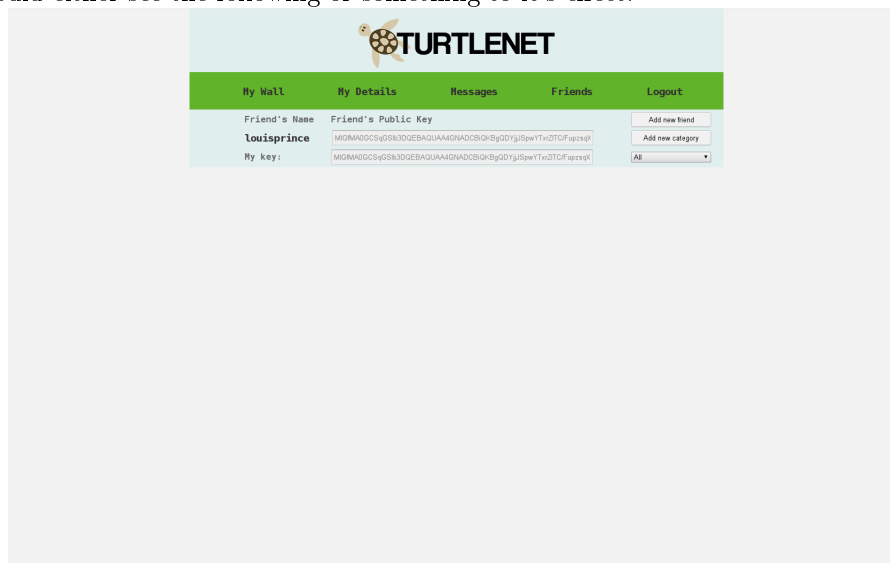
3.5 Friends on Turtlenet

Part of the philosophy of Turtlenet is to encrypt the messages that you send so that only the intended recipients can read them with any understanding. These people are known as your 'friends' on Turtlenet. In order to make any use of Turtlenet you need to add friends. You do this by exchanging 'public keys' with another user. Turtlenet uses Asymmetric relationships - this means that you may have some people as friends but they might not have you as a friend. Therefore you might understand what people have typed but they might not be reciprocated. If this doesn't make sense at the moment, the following sections will help.

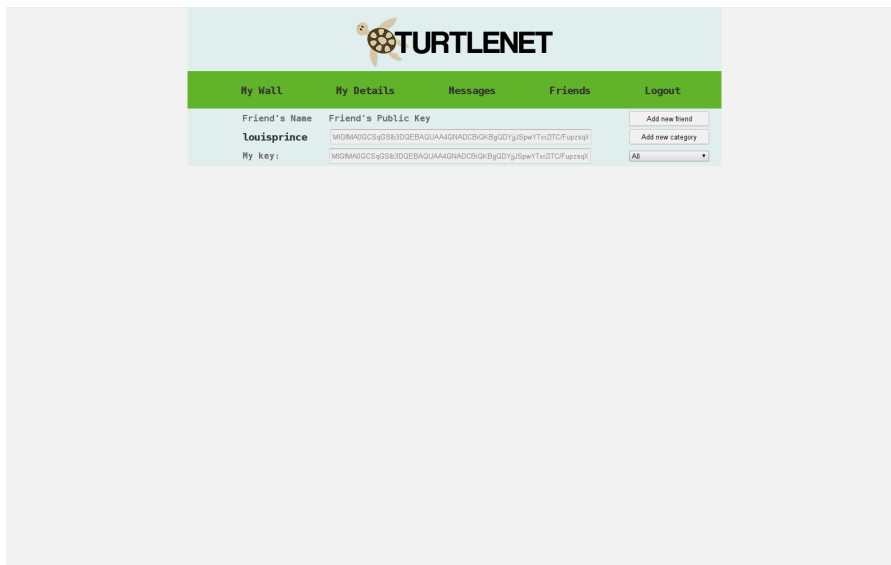
3.5.1 The 'Getting'

In order to get public keys from other users, they need to pass the information to you. The keys can be transferred in any manner, they are not remotely private and painting your public key on the side of your house would not diminish security.

Once you have the public key off of your friend, you will want to proceed to the 'friends' section of the Turtlenet client, by clicking the button near the top which has 'Friends' written upon it. You should either see the following or something to it's effect:



As you can see, there is 'My Key' which will be used by you to allow others to send you messages but that will be explained in the next section. For now, you want to click the 'Add new friend' button located to the right of the screen. This will bring you to a screen with a long input box which asks for the key of who will become your friend. You enter the long line of letters and numbers that you were given by your friend into the input box. Once you have the other person added, you should see something similar to this:



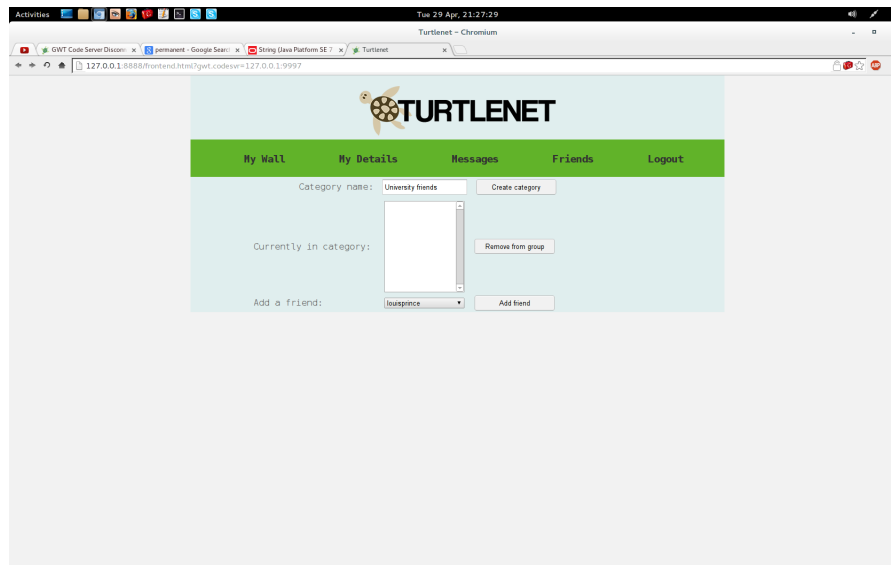
In the image above, the current user has added themselves to their friends list. Simply repeat the process as it takes you back to the main section for the friends tab.

3.5.2 The 'Making'

By getting other people's keys you can send messages to them but for people to send anything back that you can read, they would need to have your key as well. All you do in order to help others add you is to send the letters and numbers in the text box next to 'My key' and get the other user to follow the steps in the above section 'The 'Getting'.'

3.5.3 Banding Together

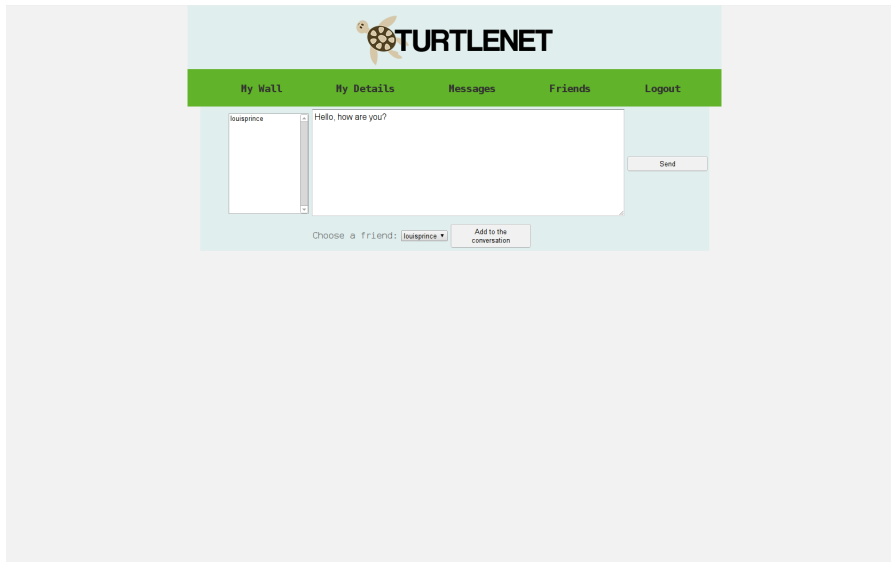
In Turtlenet you can associate other users with categories, custom made by you. This is useful if you want to send the same message to a number of people. To do this, whilst you are in the friends section of the client, click the 'Create category' button on the right. It should take you to this screen:



You will give your category a name so it hints to the kind of users you have in them together by typing the group name in the top text box. Click 'Create category' once you have finished the naming procedure. You are then able to add any members you wish whose keys you have attached to your account. This is done in the drop-down menu at the bottom of the interface and then clicking the 'Add friend' button next to said menu. If you no longer want a particular user in the group any more, select their user name in the large box in the middle and click the button to the side which says 'Remove from group'.

3.6 Messages in Turtlenet

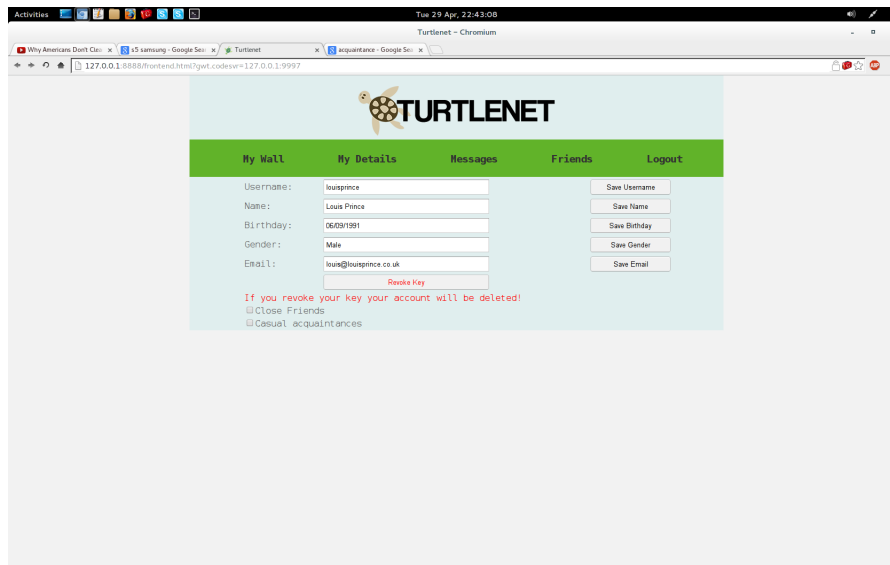
Messages can be sent to singular users or they can be sent to categories of users created by the current user of the client. Below is an example of what you may find in the messages section:



- the box at the left hand side is for your available recipients - our example user only has himself at the moment. This will fill up over time when you add public keys from other users.
- The larger of the two boxes is where you type the content of your message. There is no size limit.
- The Send button on the right finalises the message and sends it to the recipient to read. You cannot edit your message once you have sent it so be sure to re-read what has been typed to avoid any unfortunate errors!

3.7 What's mine is mine - Personal Data

When using Turtlenet, personal data is just that - personal. Similar to all of the messages and posts you make, your personal data is also encrypted and made secure so that the server moderators have no access to them. Here is a view at what you could see when entering the 'My Details' section of the client:



The image shows the only personal information that you may store using the Turtlenet client. Note that the only piece of information here that is important is the user name - all other fields are optional and at the user's discretion to fill in or not. Each button to the right saves what is currently in the associated field at the time of clicking, so you will need to save again if you edit after a save.

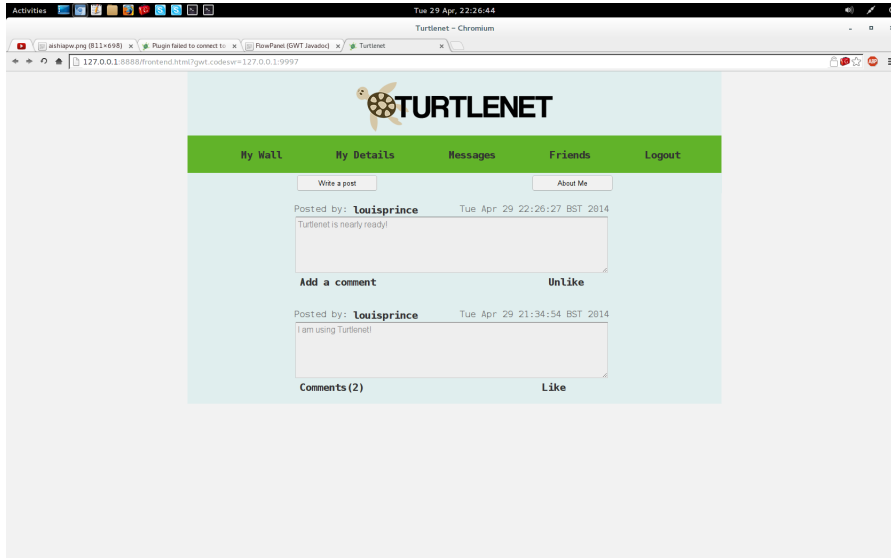
Below these fields is a list of categories you have created, check the box next to a category and members of it will be able to see your personal data. Unchecking the box hides any futures changes in it from them.

A note about revoking your key: This means that you mark your key as never again to be trusted, and so messages from it are ignored. **Do not click unless you wish to erase your Turtlenet presence.** After a revocation, another key is made for you to use, which means that any other users that had your key will need to be informed that you have changed and you will need to give them your new key if you wish to continue getting messages and posts from them.

3.8 Personal Graffiti - your Turtlenet wall

Your wall is a central social hub for many users of Turtlenet. It is a collection of messages aimed at the user, who may be off-line at the time. This section is for the functionality of the wall.

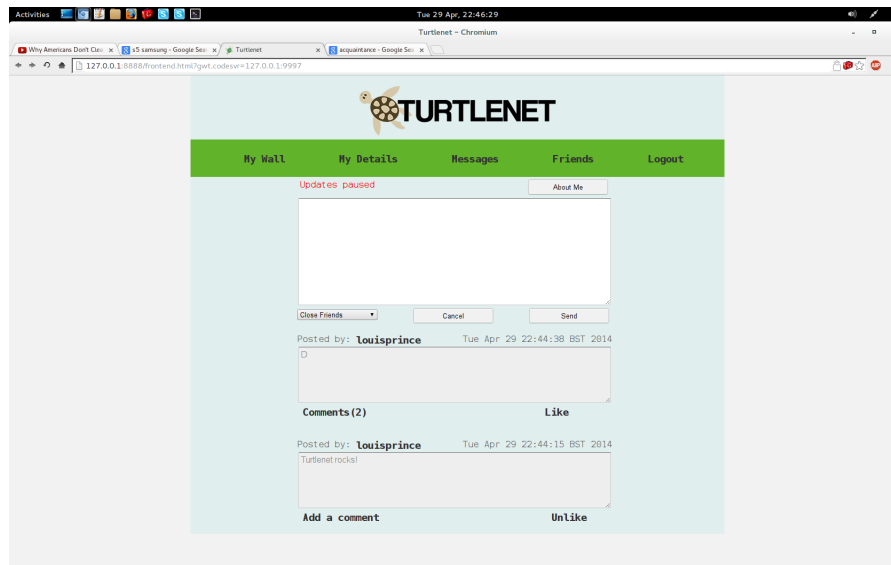
In Turtlenet a post is the generic way of talking about a message being left for another user - think of it similar to a sticky note on a cork board. An example of a wall is below:



The image outlines a couple of posts being made by the example user. Before posting is explained, this manual will explain the other elements in view:

- The 'About me' button allows a user to see an overview of their personal data. This allows a user quick access to their key, which could be sent to another user.
- You can 'like' posts to show enjoyment, appreciation or agreement with what another user has posted. This is done by simply clicking the 'like' that is found underneath the target post. Should your political views change for example, you can unlike any currently liked post in the same manner - clicking the 'unlike' that will be found in the same place under the target post.
- Commenting on a post is also possible with the Turtlenet client. Simply click the 'Add a comment' phrase underneath the target post and a large input box will appear beneath. Simply type your 'two cents' then click the 'Post comment' button under the input box. If you decide not to insert an interjection then you may click the Cancel button to remove the box and not attach your comment to the post.

Posting is as simple as clicking the 'Write a post' button near the top, which will bring a couple of new elements into the client:



As the above image shows, there are a couple of new buttons and a large text box that appears onto the Turtlenet client. First it is easiest to define a target for the post, which is done by clicking the drop down menu below the input box on the left side. The user is able to choose from categories that have been created, sending the post to multiple users. Once decided, type the content of the post into the large input box. Once finished, click the 'Send' button below the input box on the right side. If you wish to stop making a post, click the 'Cancel' button in the middle, underneath the input box.

Chapter 4

Troubleshooting

4.1 Frequently Asked Questions

This is the section which should hopefully answer most of the questions that most users might have about the system. Sending emails to one of the addresses in the contact section in the beginning of the user manual may help you get your answer but it is best if you continue looking for an answer whilst you wait for an official reply.

4.1.1 What does Turtlenet do?

Think of Turtlenet in a similar manner to any other social network commonly in use. It allows users to communicate with each other and allowing other people to voice their opinions on what others have written. At the moment it is text based, meaning you can't attach images and video to it when you post or comment. You can however send links to such content to each other. That is a convenient enough work around for the time being as it means that no one is having to download an encrypted video but are never able to view it as they do not have the key to unlock the data. I think everyone will appreciate not having to download hundreds of copies of current top 40 each week.

4.1.2 How many accounts can I have on Turtlenet?

You should only need one, but we don't preclude you from having more. If you merely wish to separate the content people can see then categories are a better solution, and future versions of Turtlenet will allow the sharing of different personal information with different groups. If you simply must have multiple accounts though, there's nothing stopping you. Just launch the client in a different directory.

4.1.3 I forgot my password. Can someone reset it for me?

The short answer is no. Turtlenet was designed so that no one but the user had any access to their account. As a result, if you lose your password we are unable to recover anything in the account. The only thing you can do is simply to create another. Feel safe in the knowledge that everything is encrypted on your old account so at least no one can access what was lost except those people you already shared it with.

4.1.4 Where is everything stored?

Information is stored on your computer, laptop or whatever else it is that uses the Turtlenet client. Each client downloads all of the data and reads what it can, using keys you have collected over time off of other users. Keeping it local means that no readable is stored on the server, so evil moderators cannot have their way with your data. Encrypted data is stored on the server, but nobody can read it who you didn't send it to.

4.1.5 How big does this database get?

As the only things being stored are text, not images or video, this means that each message is only small and will likely be less than a few megabytes over one year's very active use.

4.1.6 Why would someone want to build from source?

Given that compatability of jars isn't an issue the only reason to do so is to ensure that your binaries derive from the public source code and not an evil secret version.

4.1.7 The Client does stuff I don't think it should do...

You may have found a bug for us accidentally. email to one of the addresses at the beginning of the user manual and the developers will have a look at it. As the source is being released, maybe the community will have a look and suggest a fix themselves.

4.1.8 What do Server Moderators of Turtlenet do?

We don't have any, we can't moderate content we can't see.

4.1.9 I want to mod Turtlenet. Can I have the source?

It's nice to know that others wish to take up the helm, pioneering a secure method of communication. You can have the source, it is available to the public to browse and modify.

4.1.10 Why choose 'X' over the clearly superior 'Y'?

As developers ourselves, we understand that other people have differing opinions. That's the joy of releasing code. Other people can pick up what we have done, or use our ideals as a starting point for their own thing. What this project stood for is ease of use for the end user and security from any unwanted external influences and this, we believe, is achieved.

Chapter 5

Side Notes

5.1 Java Database Connector

Our project uses the 'Java Database Connector' (JDBC) SQLite driver developed by 'Taro L. Saito' - also known as xerial. Xerial's website is here: <http://xerial.org/> if you wish to obtain the driver or otherwise contact and give support, then there is your person.

Part IV

Portfolio

Chapter 32

Deviations in Requirements and Design

1. We have decided that the event function isn't very valuable and so dropped it from the requirements early in development.
2. We decided that having a website and active servers was important and so added it early in development.
3. Our data flow has changed in that the client now updates the local database without waiting for updates from the server to arrive. This was done so that network latency didn't interfere with the user experience. All actions are still sent to oneself via the server, else multiple clients with the same key wouldn't function.
4. The client-client protocol has been significantly expanded so that all actions can be represented within it. This is so that if all one has is a keypair to an account, that account may be fully recovered. An example of new functionality in the protocol is that category creation and modification is recorded on the server (via encrypted messages sent, and viewable, solely to oneself). NB: The client-server protocol is wholly unaltered.
5. The datatypes in the database have changes due to the limitations of SQLite.
6. The primary key in many database tables has changed from an arbitrary value to a globally identifying cryptographic signature (from the message establishing the relevant datum.)
7. The database doesn't make use of foreign keys because the combination of network latency being potentially different for every message (due to Tor) and asymmetric relationships and communication means that foreign keys will often reference something that either doesn't exist

yet or will never exist. Furthermore in SQLite a foreign key can only reference one thing, and two of our potential foreign keys don't always reference the same field. Therefore there is only one possible foreign key in our entire database: `tCategoryMembers.catID` references `tCategory.catID`, and even that is tenuous at best as it relies upon undefined behaviour of the frontend. For these reasons we removed foreign keys from the schema.

8. A number of accessors were added to the `Message` class for extracting information from different types of messages.
9. The `DBStrings` class was added so as to keep SQL query strings separate from java code, and to localize them within one namespace. This class merely contains a large number of static strings.
10. The `Logger`, `Tokenizer`, `MessageFactory`, and `F(ile)IO` class were added as helper classes. `Tokenizer` was created instead of using java's existing `Tokenizer` class because we needed a tokenizer automatically convertible to javascript. A factory class was required because the `Message` class cannot contain constructors not automatically convertible to javascript.
11. The following data bearing classes were created to return structured data to the HTML/JS frontend. They allow the more powerful java backend to extract (and format) data from the database before returning a simple class containing it.
 - (a) `Friend`
 - (b) `CommentDetails`
 - (c) `Conversation`
 - (d) `PostDetails`
12. The `Turtlenet`, `TurtlenetImpl`, and `TurtlenetAsync` classes exist to provide an asynchronous interface between the HTML/JS frontend and the Java backend.

Chapter 33

Turtlenet Website

The website (www.turtlenet.co.uk), allows users to download the client and view details on the project. For example, who has been working on it, and the fine print regarding the licensing. These things can not only be useful, but also necessary to inform the user what the program is, and why they need it, along with providing a suitable means of distribution for the project. Below is a short description of the website and its content.

- Home Page: This is a quick general description about what Turtlenet is, providing you with a link to both get the sourcecode for Turtlenet, and the client itself.
- Downloads: Holds the Turtlenet.jar file link, allowing the user to retrieve the client, as it does other pertinent information regarding any dependencies the client will need to run.
- About Us: This page is a small area dedicated to the team behind Turtlenet, Ballmer Peak, and our views on the project.
- Content: This area of the website contains all the contact information for our staff, should you need to contact them.
- FAQs: Frequently Asked Questions about the project come here.
- License: Finally, here is the legal rambling regarding the license for the project.

Chapter 34

Hosting

We chose Amazon Web Services(AWS) to host the remote server component of Turtlenet and the project website. The primary reason for this is that AWS offers a free package for the first 12 months of membership. The price after this is also fairly competitive although we would probably consider other providers if the offer didn't exist.

Another advantage of AWS is, due to their size, Amazon have many servers available which lends itself to high performance and increased redundancy. Performance isn't a major issue as the Turtlenet remote server acts as little more than a middleman. Still, the lower the latency the better.

It is uncertain if Amazon has provided any of it's customers personal data to the NSA or any other government sponsored agency. This isn't of concern though as very little data is stored by the Turtlenet remote server. Due to the distributed nature of Turtlenet all sensitive information is stored in a local database on the users device.

Chapter 35

Source Code and Github.com

35.1 Source Code

We chose to store our source code in a Git repository hosted by Github at: <https://github.com/thomal/COMP208/>.

The repository records all changes to files which allows group members know who has modified files, what has been added and what has been deleted.

If more than one person edits the same file it is possible to merge together the work of each person, often automatically. When more than one person edits the same line manual intervention is required to see who's edit should be kept.

We can also look back at previous revisions of files to figure out where bugs were introduced or to resurrect old code that has since been removed but may still be useful.

Chapter 36

Testing

36.1 Automated Testing

We have included a series of automated tests with Turtlenet. Each of these tests runs a different part of the system with predetermined data and compares the results with what we expect to receive from the part of the system currently being tested.

For example we can test the part of the system responsible for returning the contents of wall posts by sending it: "11 POSTgetText". We should expect to receive "I'm posting on your wall". If we do not receive that exact message we know that there is something wrong with the system and the developers are alerted to this.

More examples of the automated testing we used can be found at: <https://github.com/thomal/COMP208/blob/master/src/ballmerpeak/turtlenet/testing/Test.java>.

36.2 Black-box Testing

Black-box testing comprised mainly of:

- Clicking on buttons even if they didn't fit into the logical work flow.
- Attempting to 'cheat' the system by making it do things that aren't intended by the design.
- Entering silly values into various parts of the system in an attempt to see if this would break anything.

Given more time we would test more extensively and have people not familiar with the system perform Black-box testing on our behalf.

Chapter 37

Future Development

37.1 Interface Framework

Currently the interface framework is the Google Web Toolkit (GWT). This currently allows the Turtlenet client's interface to run in a web browser of the user's choosing. This choice helped the group and the project initially by allowing the developers to not consciously worry about any particular problems in the running of the project in terms of the front end - our mentality was that everyone had a browser on their computers so it was one less requirement to add to the minimum requirements section of the user manual. In hindsight however, what this decision has done is open the project to a flood of potential bug reports; some from inexperienced users hoping for a fix on Internet Explorer whilst others filling in reports about how their personally compiled browser is not rendering a button, for example. With Java, the code is run by a Java Virtual Machine (JVM) so there is only one platform to worry about whereas through the use of a browser being a container for the user interface, each with different layout engines and capabilities, the project can expect to receive bug reports from at least four different front ends.

With the potential workload heavily increased just by a decision made by the user, which we assume holds little to no knowledge and just wishes the project work on their computer, this may be a problem for the future developers of Turtlenet. As a possible solution, a different framework could be used which provides an executable that is tailored to the operating system, as opposed to a web browser. Running in a native window as opposed to a browser means that there is only a couple of different ways the front end can appear, variations mainly appearing due to a change of operating system - although a different desktop environment (DE) would also affect the final look of Turtlenet. This improves the usability of the project as the final outcome would be an executable file, which runs in the same or similar manner to other programs on their computer, improves consistency as GWT creates JavaScript as a core component in the running of the front-end, which may be blocked

by the browser as well as creating specific statements which are interpreted or ignored dependent on the browser currently in use. Finally there is debugging, which is improved because there are fewer main variables for the testers to cater to, such as versions of browsers and their plug-in files which may hamper use of the front end. Through consolidation into a native window, testing and bug catching can become more efficient as there are less programs to load, and less time required.

37.2 Interface and House Style

The current interface for the client has been made in such a way that it provides all of the functionality of the project in fairly easily identifiable sections. What it does not do though is look polished enough to be on an average user's computer yet. This is most likely due to time constraints stressing for functionality as opposed to aesthetics. Another potential problem is the house style of the front-end. Green has symbolic meaning and was not chosen simply due to the name of the project - Turtles more often than not have darker colours such as brown or grey and not green. Green is often used in healthcare as a sign that something is either safe or good for you (the green health 'plus' being an example), which is what Turtlenet aims to be for your communicative efforts. On a per-user basis however, colour is simply a way of making the front end become more pleasant.

This leads to the problem of personal taste - some people don't like green. Therefore to increase usability of the project as well as the total amount of users, themes could be a future development. Allowing the user to change the look of the front end can make a difference to the amount of people using the project. More users may appear if the project synchronises well with the rest of their system.

37.3 Languages Used

The project used Java for the back end of the system, SQLite for the Database and Java converted to JavaScript for the front end. Java was chosen for the interoperability of the language - being able to run on whatever has a Java Virtual Machine (JVM), which are available for most operating systems. Most users have the Java Runtime Environment (JRE) installed, which includes JVM so Java was a good choice for the project.

SQLite is a notably lightweight Database Management System (DBMS) at the expense of some features that are used in a more complete SQL solution, none of which were needed for the project. SQL notably requires you to define data type as well as the length of the variable as well - while SQLite is more lenient in this regard, removing this constraint completely would make a system more usable. An example of a more user friendly database would be one that uses MongoDB but that is not as popular as an SQL derived DBMS, so this is the reason SQLite was chosen.

Google Web Toolkit (GWT) allowed one of our developers the capability of writing code in a similar manner to Java which when compiled creates the required JavaScript and Ajax code. On a technical level we believed this to be quite clever, and was one of the reasons we chose GWT for the interface framework. In hindsight it would have been better to choose a different framework which would allow us to get a native executable after compilation. This would mean that the user does not need to open a terminal and enter any Java commands, improving usability by not forcing the user to enter an environment that they are not comfortable with.

Chapter 38

Ballmer Peak

Ballmer Peak is the team behind Turtlenet, both its designers and creators. We have worked together over the past 6 months to create a new, innovative product the entire team is proud of. Pooling our resources and individual technical skills we feel we came together as a team and produced a quality product. We all had our roles to fill in this project:

38.1 Peter Duff - Team Lead

- In charge of project management and organisation, as well as assigning roles and responsibilities, amongst other generic managerial admin.
- Was the designer and creator of the Turtlenet website.
- Proofreader of the entire requirements, design and portfolio documents.

38.2 Luke Thomas - Lead Programmer

- Created and designed the initial basic program and idea for the project.
- Handled the encryption side of the program.
- Designed the latex document structure.

38.3 Louis Prince - Programmer

- Programmed and designed the GUI for the client version.

- Redesigned parts of the Turtlenet website.
- Produced the projects testing techniques for the client.

38.4 Aishah Senin - Database Developer

- Documented all aspects of the database.
- Designed and created the SQLite database from scratch.
- Was effectively a one woman database machine.

38.5 Michael Chadwick - Software Engineer

- Wrote the majority of the client user manual for the program.
- Provided heavy documentation regarding some of the finer, non-technical points of the project (Gantt, Risk Asses. etc.).
- Also provided some measure of coding when required.

38.6 Leon Choi - Researcher

- Main researcher into existing similar systems and potential future work.
- Designed a mock GUI for future android work.
- Created the server application.

Chapter 39

Achievement of Objectives

- Achievement of objectives

Chapter 40

Evaluation

40.1 Interface Framework

Currently the interface framework is the Google Web Toolkit (GWT). This currently allows the Turtlenet client's interface to run in a web browser of the user's choosing. This choice helped the group and the project initially by allowing the developers to not consciously worry about any particular problems in the running of the project in terms of the front end - our mentality was that everyone had a browser on their computers so it was one less requirement to add to the minimum requirements section of the user manual. In hindsight however, what this decision has done is open the project to a flood of potential bug reports; some from inexperienced users hoping for a fix on Internet Explorer whilst others filling in reports about how their personally compiled browser is not rendering a button, for example. With Java, the code is run by a Java Virtual Machine (JVM) so there is only one platform to worry about whereas through the use of a browser being a container for the user interface, each with different layout engines and capabilities, the project can expect to receive bug reports from at least four different front ends.

With the potential workload heavily increased just by a decision made by the user, which we assume holds little to no knowledge and just wishes the project work on their computer, this may be a problem for the future developers of Turtlenet. As a possible solution, a different framework could be used which provides an executable that is tailored to the operating system, as opposed to a web browser. Running in a native window as opposed to a browser means that there is only a couple of different ways the front end can appear, variations mainly appearing due to a change of operating system - although a different desktop environment (DE) would also affect the final look of Turtlenet. This improves the usability of the project as the final outcome would be an executable file, which runs in the same or similar manner to other programs on their computer, improves consistency as GWT creates JavaScript as a core component in the running of the front-end, which may be blocked

by the browser as well as creating specific statements which are interpreted or ignored dependent on the browser currently in use. Finally there is debugging, which is improved because there are fewer main variables for the testers to cater to, such as versions of browsers and their plug-in files which may hamper use of the front end. Through consolidation into a native window, testing and bug catching can become more efficient as there are less programs to load, and less time required.

40.2 Interface and House Style

The current interface for the client has been made in such a way that it provides all of the functionality of the project in fairly easily identifiable sections. What it does not do though is look polished enough to be on an average user's computer yet. This is most likely due to time constraints stressing for functionality as opposed to aesthetics. Another potential problem is the house style of the front-end. Green has symbolic meaning and was not chosen simply due to the name of the project - Turtles more often than not have darker colours such as brown or grey and not green. Green is often used in healthcare as a sign that something is either safe or good for you (the green health 'plus' being an example), which is what Turtlenet aims to be for your communicative efforts. On a per-user basis however, colour is simply a way of making the front end become more pleasant.

This leads to the problem of personal taste - some people don't like green. Therefore to increase usability of the project as well as the total amount of users, themes could be a future development. Allowing the user to change the look of the front end can make a difference to the amount of people using the project. More users may appear if the project synchronises well with the rest of their system.

40.3 Languages Used

The project used Java for the back end of the system, SQLite for the Database and Java converted to JavaScript for the front end. Java was chosen for the interoperability of the language - being able to run on whatever has a Java Virtual Machine (JVM), which are available for most operating systems. Most users have the Java Runtime Environment (JRE) installed, which includes JVM so Java was a good choice for the project.

SQLite is a notably lightweight Database Management System (DBMS) at the expense of some features that are used in a more complete SQL solution, none of which were needed for the project. SQL notably requires you to define data type as well as the length of the variable as well - while SQLite is more lenient in this regard, removing this constraint completely would make a system more usable. An example of a more user friendly database would be one that uses MongoDB but that is not as popular as an SQL derived DBMS, so this is the reason SQLite was chosen.

Google Web Toolkit (GWT) allowed one of our developers the capability of writing code in a similar manner to Java which when compiled creates the required JavaScript and Ajax code. On a technical level we believed this to be quite clever, and was one of the reasons we chose GWT for the interface framework. In hindsight it would have been better to choose a different framework which would allow us to get a native executable after compilation. This would mean that the user does not need to open a terminal and enter any Java commands, improving usability by not forcing the user to enter an environment that they are not comfortable with.

Appendices

Appendix A

Source Listing

```
1  package ballmerpeak.turtlenet.server;
2
3  import java.util.Date;
4  import java.util.Scanner;
5
6  public class TNClient implements Runnable {
7      public NetworkConnection connection;
8      public Thread networkThread;
9      public Database db = null;
10     public String password = "NOT SET";
11     public boolean running = true;
12     public boolean dbReady = false;
13
14     public TNClient (String pw) {
15         password = pw;
16     }
17
18     public void run () {
19         if (!Crypto.keysExist())
20             Crypto.keyGen();
21
22         connection = new NetworkConnection("turtle.turtlenet.co.uk");
23         networkThread = new Thread(connection);
24         db = new Database(password);
25
26         networkThread.start();
27         dbReady = true;
28
29         while (running)
30             while (connection.hasMessage())
31                 Parser.parse(Crypto.decrypt(connection.getMessage()), db);
32
33         connection.close();
34         db.dbDisconnect();
35         Logger.close();
36     }
37 }
```

```

1  package ballmerpeak.turtlenet.remoteserver;
2
3  import ballmerpeak.turtlenet.shared.Message;
4  import java.io.*;
5  import java.net.*;
6  import java.util.Date;
7  import java.util.StringTokenizer;
8  import javax.xml.bind.DataConverterFactory;
9
10 public class Server
11 {
12     public static String shutdownPassword = "SHUTDOWN 83eea84d472df09f5e64468996fdff0e";
13     private static ServerSocket socket;
14     private static boolean running = true;
15
16     public static void start (int port) {
17         Socket incoming;
18         Thread t;
19
20         try {
21             socket = new ServerSocket(port);
22
23             while (running) {
24                 incoming = socket.accept();
25                 t = new Thread(new Session(incoming));
26                 t.start();
27             }
28         } catch (Exception e) {
29             if (running)
30                 System.out.println("ERROR: " + e.getMessage());
31         } finally {
32             shutdown();
33         }
34     }
35
36     public static void shutdown() {
37         running = false;
38
39         try {
40             socket.close();
41         } catch (Exception e) {
42             System.out.println("ERROR: " + e.getMessage());
43             System.exit(1);
44         }
45     }
46
47     public static void main (String[] argv) {
48         System.out.println("Server running...");
49         start(31415);
50     }
51 }
52
53 class Session implements Runnable
54 {
55     private Socket client;
56
57     Session (Socket s) {
58         client = s;
59     }
60
61     // execute()s the clients command and then closes the connection.
62     public void run() {
63         System.out.println("Connection from " + client.getInetAddress().getHostAddress());
64         BufferedReader in = null;
65         PrintWriter out = null;
66
67         try {
68             in = new BufferedReader
69                 (new InputStreamReader(client.getInputStream()));
70             out = new PrintWriter
71                 (new OutputStreamWriter(client.getOutputStream()));
72
73             execute(in.readLine(), in, out);
74         } catch (IOException e) {
75             System.out.println("ERROR: " + e.getMessage());
76         }
77         out.flush();
78         //close everything related to this session
79         try {
80             in.close();
81         } catch (Exception e) {}
82
83         try {
84             out.close();
85         } catch (Exception e) {}
86
87         try {
88             client.close();
89         } catch (Exception e) {}
90     }
91
92     //Protocol:
93     //NB: The universe came into existence at midnight on january 1st 1970

```

```

94 //A typical session is the following:
95 // Connect -> Send command to server -> disconnect
96 //Valid commands are the following:
97 // t - request the number of milliseconds since midnight 1970-01-01
98 // s <string> - request that a string be stored on the server
99 // get <long> - get every message posted since <long> number of milliseconds past midnight 1970-01-01
100 // c <claim message> - claim a username UNENCRYPTED PUBLICALLY KNOWN
101 //Responses are the following:
102 //s - success
103 //e - error
104 //<long> - number of milliseconds since midnight on 1970-01-01
105 //<string*> - (0 or more strings) messages requested using get
106 public void execute(String cmd, BufferedReader in, PrintWriter out) {
107     System.out.println("Recieved \" + cmd + "\"");
108
109     if (cmd.equals(Server.shutdownPassword)) {
110         System.out.println("WARNING: shutdown password should be loaded from config file");
111         System.out.println("Shutting down");
112         Server.shutdown();
113     }
114
115     else if (cmd.equals("t")) {
116         out.println(String.valueOf(new Date().getTime()));
117         out.println("s");
118     }
119
120     else if (cmd.length() > 2 && cmd.substring(0,1).equals("s")) {
121         try {
122             String message = cmd.substring(2);
123             System.out.println("Storing: " + message);
124             BufferedWriter writer = new BufferedWriter(
125                 new FileWriter(
126                     new File("./data/" + (new Date()).getTime() +
127                         "_" + Hasher.hash(message))));
128             writer.write(message);
129             writer.close();
130             out.println("s");
131         } catch (Exception e) {
132             System.out.println("ERROR: Unable to save: " + e);
133         }
134     }
135
136     else if (cmd.length() > 4 && cmd.substring(0,3).equals("get")) {
137         System.out.println(cmd);
138         try {
139             String timestamp = cmd.substring(4);
140             long lastRead = Long.parseLong(timestamp);
141
142             File dataDir = new File("./data");
143             File[] files = dataDir.listFiles();
144             for (int i = 0; i < files.length; i++) {
145                 if (lastRead <= getTimestamp(files[i])) {
146                     BufferedReader reader = new BufferedReader(
147                         new FileReader(files[i]));
148                     String msg = reader.readLine();
149                     out.println(msg);
150                 }
151             }
152             out.println("s");
153         } catch (Exception e) {
154             System.out.println("ERROR: Cannot execute \" + cmd + "\"");
155             out.println("e");
156         }
157     }
158
159     else if (cmd.length() > 2 && cmd.substring(0,2).equals("c ")) {
160         Message claim = Message.parse(
161             new String(
162                 DatatypeConverter.parseBase64Binary(
163                     cmd.substring(2))));
164
165         String content = claim.getContent();
166         File data = new File("./data/" + (new Date()).getTime() + "_" + content);
167         if (userExists(content)) {
168             out.println("e");
169         } else {
170             try {
171                 BufferedWriter writer = new BufferedWriter(new FileWriter(data));
172                 writer.write(cmd);
173                 writer.close();
174                 out.println("s");
175             } catch (Exception e) {
176                 System.out.println("ERROR: Could not write claim to disk");
177                 out.println("e");
178             }
179         }
180     }
181
182     else {
183         System.out.println("Recieved \" + cmd + "\", ignoring it");
184         out.println("e");
185     }
186 }

```

```
187         out.flush();
188     }
189
190     //44634633434_HASH -> 44634633434
191     private long getTimestamp (File f) {
192         try {
193             String fn = f.getName();
194             if (fn.indexOf("_") != -1) {
195                 String ts = fn.substring(0, fn.indexOf("_"));
196                 return Long.parseLong(ts);
197             }
198         } catch (Exception e) {
199             System.out.println("ERROR: Could not parse file timestamp: " + e);
200         }
201         return 1;
202     }
203
204     private Boolean userExists (String name) {
205         File dir = new File("./data");
206         File[] files = dir.listFiles();
207         for (int i = 0; i < files.length; i++) {
208             if (files[i].getName().indexOf("_") != -1) {
209                 String fname = files[i].getName();
210                 String[] tokens = new String[2];
211                 StringTokenizer tokenizer = new StringTokenizer(fname, "_", false);
212                 tokens[0] = tokenizer.nextToken();
213                 tokens[1] = "";
214                 while (tokenizer.hasMoreTokens())
215                     tokens[1] += tokenizer.nextToken();
216                 if (tokens[1].equals(name))
217                     return true;
218             }
219         }
220         return false;
221     }
222 }
```

```
1  body {
2      margin: 0;
3      background: #F2F2F2;
4      color: #666666;
5      font-family: "Lucida Console", monospace;
6  }
7
8  h1 {
9      font-size: 5em;
10     margin: 0;
11     letter-spacing: 10px;
12     font-weight: lighter;
13     padding: 10px 0 0 0;
14     text-align: center;
15 }
16
17 #header {
18     width: 1000px;
19     height: 120px;
20     margin: 0 auto;
21     background: #E0EEEE;
22     font-family: Sans-Serif;
23     color: #61B329;
24 }
25
26 #loading {
27     width: 1000px;
28     margin: 0 auto;
29     text-align: center;
30     font-size: 1.25em;
31 }
32
33 .gwt-login {
34     width: 1000px;
35     margin: 0 auto;
36     background: #61B329;
37     text-align: center;
38     font-size: 0.75em;
39     color: #000000;
40 }
41
42 .gwt-navigation {
43     width: 1000px;
44     height: 70px;
45     margin: 0 auto;
46     background: #61B329;
47     text-align: center;
48     padding: 25px 75px 0 0;
49 }
50
51 .gwt-friends-list {
52     width: 1000px;
53     margin: 0 auto;
54     background: #E0EEEE;
55     color: #666666;
56 }
57
58 .gwt-post-panel {
59     width: 700px;
60     margin: 0 auto;
61     background: #E0EEEE;
62     color: #666666;
63     padding: 20px 100px 20px 200px;
64 }
65
66 .gwt-comments-contents {
67     width: 675px;
68     margin: 0 auto;
69     background: #E0EEEE;
70     color: #666666;
71     padding: 20px 0 20px 60px;
72 }
73
74 .gwt-comments {
75     width: 700px;
76     margin: 0 auto;
77     background: #E0EEEE;
78     color: #666666;
79 }
80
81 .gwt-wall {
82     width: 1000px;
83     margin: 0 auto;
84     background: #E0EEEE;
85     color: #666666;
86 }
87
88 .gwt-wall-control {
89     width: 1000px;
90     margin: 0 auto;
91     background: #E0EEEE;
92     color: #666666;
93     padding: 0 150px 0 200px;
```

```
94 }
95
96 .gwt-create-post {
97     width: 800px;
98     margin: 0 auto;
99     background: #E0EEEE;
100     color: #666666;
101     padding: 0 0 0 200px;
102 }
103
104 .gwt-post-contents-footer {
105     width: 700px;
106     margin: 0 auto;
107     background: #E0EEEE;
108     color: #666666;
109     padding: 0 100px 0 10px;
110 }
111
112 .gwt-edit-group {
113     width: 1000px;
114     margin: 0 auto;
115     background: #E0EEEE;
116     color: #666666;
117     padding: 0 300px 0 115px;
118 }
119
120 .gwt-new-group {
121     width: 1000px;
122     margin: 0 auto;
123     background: #E0EEEE;
124     color: #666666;
125     padding: 0 300px 0 200px;
126 }
127
128 .gwt-friend {
129     width: 1000px;
130     margin: 0 auto;
131     background: #E0EEEE;
132     color: #666666;
133     padding: 0 0 0 200px;
134 }
135
136 .gwt-conversation-list {
137     width: 1000px;
138     margin: 0 auto;
139     background: #E0EEEE;
140     color: #666666;
141     padding: 0 200px 0 50px;
142 }
143
144 .gwt-conversation {
145     width: 950px;
146     margin: 0 auto;
147     background: #E0EEEE;
148     color: #666666;
149     padding: 0 0 0 50px;
150 }
151
152 .gwt-my-details {
153     width: 1000px;
154     margin: 0 auto;
155     background: #E0EEEE;
156     color: #666666;
157     padding: 0 0 0 200px;
158 }
159
160 .gwt-my-details-permissions {
161     width: 1000px;
162     margin: 0 auto;
163     background: #E0EEEE;
164     color: #666666;
165     padding: 0 200px 0 200px;
166 }
167
168 .gwt-friends-details {
169     width: 1000px;
170     margin: 0 auto;
171     background: #E0EEEE;
172     color: #666666;
173     padding: 0 0 10px 200px;
174 }
175
176 .gwt-Anchor {
177     font-size: 1.2em;
178     font-weight: bold;
179     color: #333333;
180 }
181
182 .gwt-Anchor:visited {
183     color: #666666;
184 }
185
186 .gwt-Anchor:hover {
```



```
187         color: #666666;
188     }
189
190     .gwt-Button {
191         width: 150px;
192     }
193
194     .gwt-TextArea-readonly {
195         background-color: #EEEEEE;
196         color: #555555;
197     }
198
199     .gwt-TextBox-readonly {
200         background-color: #EEEEEE;
201         color: #555555;
202     }
```

```
1  <!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
2  <html xmlns="http://www.w3.org/1999/xhtml">
3      <head>
4          <meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
5          <title>Turtlenet</title>
6          <link href="frontend.css" rel="stylesheet" type="text/css" />
7          <link href="favicon.ico" rel="shortcut icon" type="image/x-icon" />
8          <link rel="icon" type="image/png" href="favicon.png" />
9          <script type="text/javascript" language="javascript" src="frontend/frontend.nocache.js"></script>
10     </head>
11
12     <body>
13         <iframe src="javascript:''" id="__gwt_historyFrame" tabIndex='-1'
14         style="position:absolute;width:0;height:0;border:0"></iframe>
15
16         <div id="header">
17             <h1></h1>
18         </div>
19
20         <div id = "loading">
21             <style type="text/css">
22                 #loading {
23                     padding: 20px 0 0 0;
24                 }
25             </style>
26             Loading Turtlenet...
27         </div>
28     </body>
29 </html>
```

```

1  package ballmerpeak.turtlenet.client;
2
3  import ballmerpeak.turtlenet.shared.CommentDetails;
4  import ballmerpeak.turtlenet.shared.PostDetails;
5  import ballmerpeak.turtlenet.shared.Message;
6  import ballmerpeak.turtlenet.shared.Conversation;
7
8  import com.google.gwt.core.client.*;
9  import com.google.gwt.event.dom.client.*;
10 import com.google.gwt.user.client.ui.*;
11 import com.google.gwt.event.logical.shared.*;
12 import com.google.gwt.user.client.Window;
13 import com.google.gwt.user.client.rpc.AsyncCallback;
14 import com.google.gwt.dom.client.Style.FontWeight;
15 import com.google.gwt.dom.client.DivElement;
16 import com.google.gwt.dom.client.Document;
17 import com.google.gwt.user.client.Timer;
18 import com.google.gwt.user.client.Window;
19 import java.util.Date;
20
21 public class frontend implements EntryPoint, ClickListener {
22
23     // Create remote service proxy to talk to the server-side Turtlenet service
24     private final TurtlenetAsync turtlenet = GWT.create(Turtlenet.class);
25     //private final TurtlenetAsync msgsfactory = GWT.create(MessageFactory.class);
26     public void onModuleLoad() {
27         // Remove loading indicator from frontend.html
28         DivElement loadingIndicator = DivElement.as(Document.get().getElementById("loading"));
29         loadingIndicator.setInnerHTML("");
30
31         /* Add handler for window closing */
32         Window.addCloseHandler(new CloseHandler<Window>() {
33             public void onClose(CloseEvent<Window> event) {
34                 turtlenet.stopTN(new AsyncCallback<String>() {
35                     public void onFailure(Throwable caught) {
36                         //pretend nothing happened
37                     }
38                     public void onSuccess(String result) {
39                         //bask in success
40                     }
41                 });
42             }
43         });
44
45         // Call method to load the initial login page
46         login();
47     }
48
49     private String location = new String("");
50     private String refreshID = new String("");
51
52     // LOUISTODO May need to remove ' = new FlexTable()'
53     private FlexTable loginPanel = new FlexTable();
54     private void login() {
55         location = "login";
56         refreshID = "";
57         RootPanel.get().clear();
58         loginPanel = new FlexTable();
59         loginPanel.clear();
60         RootPanel.get().add(loginPanel);
61
62         // Create login panel widgets
63         final Button loginButton = new Button("Login");
64         loginButton.addClickListener(this);
65         final PasswordTextBox passwordInput = new PasswordTextBox();
66         final Label passwordLabel = new Label();
67
68         turtlenet.isFirstTime(new AsyncCallback<String>() {
69             public void onFailure(Throwable caught) {
70                 System.out.println("turtlenet.isFirstTime failed: " + caught);
71             }
72             public void onSuccess(String result) {
73                 if(result.equals("true")) { //GWT can only return objects
74                     passwordLabel.setText("Please choose a password:");
75                     final PasswordTextBox passwordConfirmInput = new PasswordTextBox();
76                     final Label passwordConfirmLabel = new Label("");
77                     passwordConfirmLabel.setText("Confirm your password:");
78                     final TextBox usernameInput = new TextBox();
79                     final Label usernameLabel = new Label("");
80                     usernameLabel.setText("Please choose a username:");
81
82                     // Add widgets to login panel
83                     loginPanel.setWidget(1, 1, usernameLabel);
84                     loginPanel.setWidget(2, 1, usernameInput);
85                     loginPanel.setWidget(3, 1, passwordLabel);
86                     loginPanel.setWidget(4, 1, passwordInput);
87                     loginPanel.setWidget(5, 1, passwordConfirmLabel);
88                     loginPanel.setWidget(6, 1, passwordConfirmInput);
89                     loginPanel.setWidget(7, 1, loginButton);
90
91                     // Add click handler for button
92                     loginButton.addClickHandler(new ClickHandler() {
93                         public void onClick(ClickEvent event) {

```

```

94         passwordLabel.setText("Please choose a password:");
95         passwordLabel.getElement().getStyle().setProperty("color", "#000000");
96         passwordConfirmLabel.setText("Confirm your password");
97         passwordConfirmLabel.getElement().getStyle().setProperty("color", "#000000");
98         usernameLabel.setText("Please choose a username:");
99         usernameLabel.getElement().getStyle().setProperty("color", "#000000");
100
101         if(usernameInput.getText().equals("")) {
102             usernameLabel.setText("Must enter a username");
103             usernameLabel.getElement().getStyle().setProperty("color", "#FFFFFF");
104         } else if(passwordInput.getText().equals("")) {
105             passwordLabel.setText("Must enter a password");
106             passwordLabel.getElement().getStyle().setProperty("color", "#FFFFFF");
107         } else if(passwordConfirmInput.getText().equals("")) {
108             passwordConfirmLabel.setText("Must confirm password");
109             passwordConfirmLabel.getElement().getStyle().setProperty("color", "#FFFFFF");
110         } else if(passwordInput.getText().equals(passwordConfirmInput.getText())) {
111             turtlenet.register(usernameInput.getText(), passwordInput.getText(), new
112 AsyncCallback<String>() {
113
114             public void onFailure(Throwable caught) {
115                 System.out.println("turtlenet.register failed: " + caught);
116             }
117             public void onSuccess(String result) {
118                 if (result.equals("success")) {
119                     turtlenet.getMyKey(new AsyncCallback<String>() {
120                         public void onFailure(Throwable caught) {
121                             System.out.println("turtlenet.getMyKey failed: " + caught);
122                         }
123                         public void onSuccess(String result) {
124                             wall(result, false);
125                         }
126                     });
127                 } else if (result.equals("taken")) {
128                     usernameLabel.setText("Username already taken. Try again:");
129                     usernameLabel.getElement().getStyle().setProperty("color", "#FFFFFF");
130                 } else {
131                     System.out.println("turtlenet.register onSuccess String result did not equal
132 success or taken");
133                 }
134             }
135         });
136     } else {
137         passwordLabel.setText("Passwords do not match. Try again:");
138         passwordLabel.getElement().getStyle().setProperty("color", "#FFFFFF");
139         passwordConfirmInput.setText("");
140         passwordInput.setText("");
141     }
142 }
143 }
144 }
145 }
146 }
147 }
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173 }
174 }
175 }
176 }
177 }
178 }
179 }
180 }
181 }
182 }
183 }

```

// Add style name for CSS

```

184     loginPanel.addStyleName("gwt-login");
185 }
186
187 // Used to track the most recent wall post to be displayed
188 Long wallLastTimeStamp = 0L;
189 Long conversationLastTimeStamp = 0L;
190 Long commentsLastTimeStamp = 0L;
191
192 // When the login button is clicked we start a repeating timer that refreshes
193 // the page every 5 seconds.
194 public void onClick(Widget sender) {
195     Timer refresh = new Timer() {
196         public void run() {
197             if(location.equals("wall")) {
198                 turtlenet.timeMostRecentWallPost(refreshID, new AsyncCallback<Long>() {
199                     public void onFailure(Throwable caught) {
200                         System.out.println("turtlenet.timeMostRecentWallPost failed: " + caught);
201                     }
202                     public void onSuccess(Long result) {
203                         if(result > wallLastTimeStamp) {
204                             System.out.println("Refreshing wall. refreshID: " + refreshID);
205                             wall(refreshID, true);
206                         }
207                     }
208                 });
209             } else if(location.equals("conversationList")) {
210                 System.out.println("Refreshing conversationList");
211                 conversationList();
212             } else if(location.equals("conversation")) {
213                 turtlenet.getConvoLastUpdated(refreshID, new AsyncCallback<Long>() {
214                     public void onFailure(Throwable caught) {
215                         //TODO Error
216                     }
217                     public void onSuccess(Long result) {
218                         if(result > conversationLastTimeStamp) {
219                             System.out.println("Refreshing conversation. refreshID: " + refreshID);
220                             conversation(refreshID, true);
221                         }
222                     }
223                 });
224             } else {
225                 //Do nothing
226             }
227         }
228     };
229     refresh.scheduleRepeating(5*1000);
230 }
231
232 private void navigation() {
233     HorizontalPanel navigationPanel = new HorizontalPanel();
234     RootPanel.get().add(navigationPanel);
235
236     // Create navigation links
237     Anchor linkMyWall = new Anchor("My Wall");
238     linkMyWall.getElement().getStyle().setProperty("paddingLeft", "100px");
239     Anchor linkMyDetails = new Anchor("My Details");
240     linkMyDetails.getElement().getStyle().setProperty("paddingLeft", "100px");
241     Anchor linkConversations = new Anchor("Messages");
242     linkConversations.getElement().getStyle().setProperty("paddingLeft", "100px");
243     Anchor linkFriends = new Anchor("Friends");
244     linkFriends.getElement().getStyle().setProperty("paddingLeft", "100px");
245     Anchor linkLogout = new Anchor("Logout");
246     linkLogout.getElement().getStyle().setProperty("paddingLeft", "100px");
247
248     // Add links to navigation panel
249     navigationPanel.add(linkMyWall);
250     navigationPanel.add(linkMyDetails);
251     navigationPanel.add(linkConversations);
252     navigationPanel.add(linkFriends);
253     navigationPanel.add(linkLogout);
254
255     // Add style name for CSS
256     navigationPanel.addStyleName("gwt-navigation");
257
258     // Add click handlers for anchors
259     linkMyWall.addClickHandler(new ClickHandler() {
260         public void onClick(ClickEvent event) {
261             turtlenet.getMyKey(new AsyncCallback<String>() {
262                 public void onFailure(Throwable caught) {
263                     System.out.println("turtlenet.getMyKey failed: " + caught);
264                 }
265                 public void onSuccess(String result) {
266                     wall(result, false);
267                 }
268             });
269         }
270     });
271
272     // Add click handlers for anchors
273     linkMyDetails.addClickHandler(new ClickHandler() {
274         public void onClick(ClickEvent event) {
275             myDetails();
276         }
277     });

```

```

277         });
278
279         linkConversations.addClickHandler(new ClickHandler() {
280             public void onClick(ClickEvent event) {
281                 conversationList();
282             }
283         });
284
285         linkFriends.addClickHandler(new ClickHandler() {
286             public void onClick(ClickEvent event) {
287                 friendsList("All");
288             }
289         });
290
291         linkLogout.addClickHandler(new ClickHandler() {
292             public void onClick(ClickEvent event) {
293                 turtlenet.stopTN(new AsyncCallback<String>() {
294                     public void onFailure(Throwable caught) {
295                         System.out.println("turtlenet.stopTN failed: " + caught);
296                     }
297                     public void onSuccess(String result) {
298                         login();
299                     }
300                 });
301             }
302         });
303     });
304 }
305
306 String[][] friendsListCategoryMembers = new String[0][0];
307 String[][] friendsListCategoryList = new String[0][0];
308 private TextBox friendsListPanel_myKeyTextBox;
309 private void friendsList(final String currentGroupID) {
310     location = "friendsList";
311     refreshID = "";
312
313     RootPanel.get().clear();
314     navigation();
315     final FlexTable friendsListPanel = new FlexTable();
316     RootPanel.get().add(friendsListPanel);
317
318     // Column title for anchors linking to messages
319     Label friendsNameLabel = new Label("Friend's Name");
320     friendsNameLabel.getElement().getStyle().setFontWeight(FontWeight.BOLD);
321     friendsNameLabel.getElement().getStyle().setProperty("paddingLeft", "100px");
322     friendsListPanel.setWidget(1, 0, friendsNameLabel);
323
324     // Column title for labels outputting the date a message was recieved
325     Label friendsKeyLabel = new Label("Friend's Public Key");
326     friendsKeyLabel.getElement().getStyle().setFontWeight(FontWeight.BOLD);
327     friendsListPanel.setWidget(1, 1, friendsKeyLabel);
328
329     turtlenet.getCategoryMembers(currentGroupID, new AsyncCallback<String[][]>() {
330         int i;
331         public void onFailure(Throwable caught) {
332             System.out.println("turtlenet.getCategoryMembers failed: " + caught);
333         }
334         public void onSuccess(String[][] _result) {
335             friendsListCategoryMembers = _result;
336             for (i = 0; i < friendsListCategoryMembers.length; i++) {
337                 //list names/keys
338                 Anchor linkFriendsWall = new Anchor(friendsListCategoryMembers[i][0]);
339                 linkFriendsWall.getElement().getStyle().setProperty("paddingLeft", "100px");
340                 friendsListPanel.setWidget((i + 2), 0, linkFriendsWall);
341                 final String resultString = friendsListCategoryMembers[i][1];
342                 TextBox friendKeyBox = new TextBox();
343                 friendKeyBox.setText(resultString);
344                 friendKeyBox.setVisibleLength(75);
345                 friendKeyBox.setReadOnly(true);
346                 friendsListPanel.setWidget((i + 2), 1, friendKeyBox);
347                 //link names to walls
348                 System.out.println("adding link to " + friendsListCategoryMembers[i][0] + "'s wall");
349                 final String fkey = friendsListCategoryMembers[i][1];
350                 linkFriendsWall.addClickHandler(new ClickHandler() {
351                     public void onClick(ClickEvent event) {
352                         wall(fkey, false);
353                     }
354                 });
355             }
356         }
357     });
358
359     int row = friendsListPanel.getRowCount() + 2;
360
361     if(!currentGroupID.equals("All")) {
362         Label currentGroupLabel = new Label(currentGroupID);
363         friendsListPanel.setWidget((row - 1), 3, currentGroupLabel);
364     }
365
366     final ListBox currentGroups = new ListBox();
367     currentGroups.setVisibleItemCount(1);
368     currentGroups.setWidth("150px");

```

```

369     currentGroups.addItem("All");
370     friendsListPanel.setWidget(3, 3, currentGroups);
371
372     turtlenet.getCategories(new AsyncCallback<String[][]>() {
373         int i;
374         public void onFailure(Throwable caught) {
375             System.out.println("turtlenet.getCategories failed: " + caught);
376         }
377         int selected;
378         public void onSuccess(String[][] _result) {
379             friendsListCategoryList = _result;
380             for (i = 0; i < friendsListCategoryList.length; i++) {
381                 currentGroups.addItem(friendsListCategoryList[i][0]);
382                 // Check if the group we've just added is the current group
383                 // If it is not the index using selected. We need to add
384                 // 1 to selected as "All" always appears first in the list.
385                 if(friendsListCategoryList[i][0].equals(currentGroupID)) {
386                     selected = (i + 1);
387                 }
388             }
389             // Use selected to set the selected item in the listbox to the
390             // current group
391             currentGroups.setSelectedIndex(selected);
392
393             currentGroups.addChangeHandler(new ChangeHandler() {
394                 public void onChange(ChangeEvent event) {
395                     friendsList(currentGroups.getItemText(currentGroups.getSelectedIndex()));
396                 }
397             });
398         }
399     });
400
401     Button newGroup = new Button("Add new category");
402     friendsListPanel.setWidget(2, 3, newGroup);
403     newGroup.addClickHandler(new ClickHandler() {
404         public void onClick(ClickEvent event) {
405             newGroup();
406         }
407     });
408
409     friendsListPanel_myKeyTextBox = new TextBox();
410     friendsListPanel_myKeyTextBox.setWidth("480px");
411     friendsListPanel_myKeyTextBox.setReadOnly(true);
412
413     turtlenet.getMyKey(new AsyncCallback<String>() {
414         public void onFailure(Throwable caught) {
415             System.out.println("turtlenet.getMyKey failed: " + caught);
416         }
417         public void onSuccess(String result) {
418             friendsListPanel_myKeyTextBox.setText(result);
419         }
420     });
421
422     Label myKeyLabel = new Label("My key: ");
423     myKeyLabel.getElement().getStyle().setFontWeight(FontWeight.BOLD);
424     myKeyLabel.getElement().getStyle().setProperty("paddingLeft", "100px");
425     friendsListPanel.setWidget((row - 1), 0, myKeyLabel);
426     friendsListPanel.setWidget((row - 1), 1, friendsListPanel_myKeyTextBox);
427
428     if(currentGroupID.equals("All")) {
429         Button addFriend = new Button("Add new friend");
430         friendsListPanel.setWidget(1, 3, addFriend);
431         addFriend.addClickHandler(new ClickHandler() {
432             public void onClick(ClickEvent event) {
433                 addFriend();
434             }
435         });
436     } else {
437         Button editGroup = new Button("Edit category");
438         friendsListPanel.setWidget(1, 3, editGroup);
439         editGroup.addClickHandler(new ClickHandler() {
440             public void onClick(ClickEvent event) {
441                 editGroup(currentGroupID);
442             }
443         });
444     }
445
446     // Add style name for CSS
447     friendsListPanel.addStyleName("gwt-friends-list");
448 }
449
450 FlexTable conversationListPanel;
451 private void conversationList() {
452     location = "conversationList";
453     refreshID = "";
454
455     //Setup basic page
456     RootPanel.get().clear();
457     navigation();
458
459     //Create panel to contain widgets
460     conversationListPanel = new FlexTable();
461     RootPanel.get().add(conversationListPanel);

```

```

462
463     turtlenet.getConversations(new AsyncCallback<Conversation[]>() {
464         Conversation[] result;
465         public void onFailure(Throwable caught) {
466             System.out.println("turtlenet.getConversations failed: " + caught);
467         }
468         public void onSuccess(Conversation[] _result) {
469             result = _result;
470             for(int j = 0; j < result.length; j++) {
471                 System.out.println(result[j]);
472             }
473             System.out.println("result.length = " + result.length);
474             for (int i = 0; i < result.length; i++) {
475                 final String conversationID = result[i].signature;
476                 // Substrings dont work if we set the end point so its
477                 // bigger than our string. If the length is less than 40
478                 // we output the full string. If the string is 40 or
479                 // about we take the first 40 characters and add ...
480                 String linkText = new String("");
481                 if ((result[i].firstMessage).length() < 40) {
482                     linkText = (result[i].firstMessage);
483                 } else {
484                     linkText = (result[i].firstMessage).substring(1, 40) + "...";
485                 }
486                 Anchor linkConversation = new Anchor(linkText);
487                 conversationListPanel.setWidget(i, 0, linkConversation);
488
489                 // Add click handlers for anchors
490                 linkConversation.addClickHandler(new ClickHandler() {
491                     public void onClick(ClickEvent event) {
492                         conversation(conversationID, false);
493                     }
494                 });
495                 Label conversationParticipants = new Label(result[i].concatNames());
496                 conversationListPanel.setWidget(i, 1, conversationParticipants);
497             }
498             Button newConversation = new Button("New conversation");
499             newConversation.setWidth("400px");
500             newConversation.addClickHandler(new ClickHandler() {
501                 public void onClick(ClickEvent event) {
502                     newConversation();
503                 }
504             });
505
506             conversationListPanel.setWidget((result.length + 1), 0, newConversation);
507         }
508     });
509
510     // Add style name for CSS
511     conversationListPanel.addStyleName("gwt-conversation-list");
512 }
513
514 private void myDetails() {
515     location = "myDetails";
516     refreshID = "";
517
518     RootPanel.get().clear();
519     navigation();
520     FlexTable myDetailsPanel = new FlexTable();
521     RootPanel.get().add(myDetailsPanel);
522
523     // Create widgets relating to username
524     Label usernameLabel = new Label("Username:");
525     myDetailsPanel.setWidget(0, 0, usernameLabel);
526
527     final TextBox editUsername = new TextBox();
528     editUsername.setWidth("300px");
529     turtlenet.getMyUsername(new AsyncCallback<String>() {
530         public void onFailure(Throwable caught) {
531             System.out.println("turtlenet.getMyUsername failed: " + caught);
532         }
533         public void onSuccess(String result) {
534             editUsername.setText(result);
535         }
536     });
537
538     myDetailsPanel.setWidget(0, 1, editUsername);
539
540     Button saveUsername = new Button("Save Username");
541     myDetailsPanel.setWidget(0, 2, saveUsername);
542
543     final Label editUsernameLabel = new Label();
544     editUsernameLabel.setWidth("200px");
545     myDetailsPanel.setWidget(0, 3, editUsernameLabel);
546
547     saveUsername.addClickHandler(new ClickHandler() {
548         public void onClick(ClickEvent event) {
549             turtlenet.claimUsername(editUsername.getText(), new AsyncCallback<String>() {
550                 public void onFailure(Throwable caught) {
551                     System.out.println("turtlenet.claimUsername failed: " + caught);
552                 }
553                 public void onSuccess(String result) {
554                     if (result.equals("success")) {

```



```

555         editUsernameLabel.setText("Username saved");
556     } else if (result.equals("failure")) {
557         editUsernameLabel.setText("Username taken");
558     }
559     });
560 });
561 }
562 });
563
564 // Create widgets relating to name
565 Label nameLabel = new Label("Name:");
566 myDetailsPanel.setWidget(1, 0, nameLabel);
567
568 final TextBox editName = new TextBox();
569 editName.setWidth("300px");
570 turtlenet.getMyPDATA("name", new AsyncCallback<String>() {
571     public void onFailure(Throwable caught) {
572         System.out.println("turtlenet.getMyPDATA name failed: " + caught);
573     }
574     public void onSuccess(String result) {
575         editName.setText(result);
576     }
577 });
578 myDetailsPanel.setWidget(1, 1, editName);
579
580 Button saveName = new Button("Save Name");
581 myDetailsPanel.setWidget(1, 2, saveName);
582
583 final Label editNameLabel = new Label();
584 myDetailsPanel.setWidget(1, 3, editNameLabel);
585
586 saveName.addClickHandler(new ClickHandler() {
587     public void onClick(ClickEvent event) {
588         turtlenet.updatePDATA("name", editName.getText(), new AsyncCallback<String>() {
589             public void onFailure(Throwable caught) {
590                 System.out.println("turtlenet.updatePDATA name failed: " + caught);
591             }
592             public void onSuccess(String result) {
593                 if (result.equals("success")) {
594                     editNameLabel.setText("Name saved");
595                 } else if (result.equals("failure")) {
596                     // HORRIBLE FIX
597                     //editNameLabel.setText("Failed to save name");
598                     editNameLabel.setText("Name saved");
599                 }
600             }
601         });
602     }
603 });
604
605 // Create widgets relating to birthday
606 Label birthdayLabel = new Label("Birthday:");
607 myDetailsPanel.setWidget(2, 0, birthdayLabel);
608
609 final TextBox editBirthday = new TextBox();
610 editBirthday.setWidth("300px");
611 turtlenet.getMyPDATA("birthday", new AsyncCallback<String>() {
612     public void onFailure(Throwable caught) {
613         System.out.println("turtlenet.getMyPDATA birthday failed: " + caught);
614     }
615     public void onSuccess(String result) {
616         editBirthday.setText(result);
617     }
618 });
619 myDetailsPanel.setWidget(2, 1, editBirthday);
620
621 Button saveBirthday = new Button("Save Birthday");
622 myDetailsPanel.setWidget(2, 2, saveBirthday);
623
624 final Label editBirthdayLabel = new Label();
625 myDetailsPanel.setWidget(2, 3, editBirthdayLabel);
626
627 saveBirthday.addClickHandler(new ClickHandler() {
628     public void onClick(ClickEvent event) {
629         turtlenet.updatePDATA("birthday", editBirthday.getText(), new AsyncCallback<String>() {
630             public void onFailure(Throwable caught) {
631                 System.out.println("turtlenet.updatePDATA birthday failed: " + caught);
632             }
633             public void onSuccess(String result) {
634                 if (result.equals("success")) {
635                     editBirthdayLabel.setText("Birthday saved");
636                 } else if (result.equals("failure")) {
637                     // HORRIBLE FIX
638                     //editBirthdayLabel.setText("Failed to save birthday");
639                     editBirthdayLabel.setText("Birthday saved");
640                 }
641             }
642         });
643     }
644 });
645
646 // Create widgets relating to gender
647 Label genderLabel = new Label("Gender:");

```

```

648     myDetailsPanel.setWidget(3, 0, genderLabel);
649
650     final TextBox editGender = new TextBox();
651     editGender.setWidth("300px");
652     turtlenet.getMyPDATA("gender", new AsyncCallback<String>() {
653         public void onFailure(Throwable caught) {
654             System.out.println("turtlenet.getMyPDATA gender failed: " + caught);
655         }
656         public void onSuccess(String result) {
657             editGender.setText(result);
658         }
659     });
660     myDetailsPanel.setWidget(3, 1, editGender);
661
662     Button saveGender = new Button("Save Gender");
663     myDetailsPanel.setWidget(3, 2, saveGender);
664
665     final Label editGenderLabel = new Label();
666     myDetailsPanel.setWidget(3, 3, editGenderLabel);
667
668     saveGender.addClickHandler(new ClickHandler() {
669         public void onClick(ClickEvent event) {
670             turtlenet.updatePDATA("gender", editGender.getText(), new AsyncCallback<String>() {
671                 public void onFailure(Throwable caught) {
672                     System.out.println("turtlenet.updatePDATA gender failed: " + caught);
673                 }
674                 public void onSuccess(String result) {
675                     if (result.equals("success")) {
676                         editGenderLabel.setText("Gender saved");
677                     } else if (result.equals("failure")) {
678                         // HORRIBLE FIX
679                         //editGenderLabel.setText("Failed to save gender");
680                         editGenderLabel.setText("Gender saved");
681                     }
682                 }
683             });
684         }
685     });
686
687     // Create widgets relating to email
688     final Label emailLabel = new Label("Email:");
689     myDetailsPanel.setWidget(4, 0, emailLabel);
690
691     final TextBox editEmail = new TextBox();
692     editEmail.setWidth("300px");
693     turtlenet.getMyPDATA("email", new AsyncCallback<String>() {
694         public void onFailure(Throwable caught) {
695             System.out.println("turtlenet.getMyPDATA email failed: " + caught);
696         }
697         public void onSuccess(String result) {
698             editEmail.setText(result);
699         }
700     });
701     myDetailsPanel.setWidget(4, 1, editEmail);
702
703     Button saveEmail = new Button("Save Email");
704     myDetailsPanel.setWidget(4, 2, saveEmail);
705
706     final Label editEmailLabel = new Label();
707     myDetailsPanel.setWidget(4, 3, editEmailLabel);
708
709     saveEmail.addClickHandler(new ClickHandler() {
710         public void onClick(ClickEvent event) {
711             turtlenet.updatePDATA("email", editEmail.getText(), new AsyncCallback<String>() {
712                 public void onFailure(Throwable caught) {
713                     System.out.println("turtlenet.updatePDATA email failed: " + caught);
714                 }
715                 public void onSuccess(String result) {
716                     if (result.equals("success")) {
717                         editEmailLabel.setText("Email saved");
718                     } else if (result.equals("failure")) {
719                         // HORRIBLE FIX
720                         //editEmailLabel.setText("Failed to save email");
721                         editEmailLabel.setText("Email saved");
722                     }
723                 }
724             });
725         }
726     });
727
728     Button revoke = new Button("Revoke Key");
729     myDetailsPanel.setWidget(5, 1, revoke);
730     revoke.getElement().getStyle().setProperty("color", "#FF0000");
731     revoke.setWidth("310px");
732
733     final Label editkeyRevokeLabel = new Label();
734     myDetailsPanel.setWidget(5, 3, editkeyRevokeLabel);
735
736     revoke.addClickHandler(new ClickHandler() {
737         public void onClick(ClickEvent event) {
738             turtlenet.revokeMyKey(new AsyncCallback<String>() {
739                 public void onFailure(Throwable caught) {
740                     System.out.println("turtlenet.revokeMyKey failed: " + caught);

```

```

741         }
742         public void onSuccess(String result) {
743             //if (result.equals("success")) {
744                 editEmailLabel.setText("Key revoked");
745                 login();
746             //} else if (result.equals("failure")) {
747                 //editEmailLabel.setText("Failed to revoke key");
748             //}
749         }
750     });
751 }
752 });
753
754 myDetailsPermissions();
755
756 // Add style name for CSS
757 myDetailsPanel.addStyleName("gwt-my-details");
758 }
759
760 private void myDetailsPermissions() {
761     location = "myDetailsPermissions";
762     refreshID = "";
763
764     // Add panel to contain widgets
765     final FlexTable myDetailsPermissionsPanel = new FlexTable();
766     RootPanel.get().add(myDetailsPermissionsPanel);
767
768     Label keyRevokeLabel = new Label("If you revoke your key your account will be deleted!");
769     keyRevokeLabel.getElement().getStyle().setProperty("color", "#FF0000");
770     myDetailsPermissionsPanel.setWidget(0, 0, keyRevokeLabel);
771
772     Label myDetailsPermissionsLabel = new Label("Select which groups can view your details:");
773     myDetailsPermissionsLabel.getElement().getStyle().setFontWeight(FontWeight.BOLD);
774     myDetailsPermissionsPanel.setWidget(1, 0, myDetailsPermissionsLabel);
775
776     turtlenet.getCategories(new AsyncCallback<String[][]>() {
777         String[][] result;
778         int i;
779         public void onFailure(Throwable caught) {
780             System.out.println("turtlenet.getCategories failed: " + caught);
781         }
782         public void onSuccess(String[][] _result) {
783             result = _result;
784             for (i = 0; i < result.length; i++) {
785                 final CheckBox groupCheckBox = new CheckBox(result[i][0]);
786                 groupCheckBox.setValue(result[i][1].equals("true"));
787                 myDetailsPermissionsPanel.setWidget((i + 1), 0, groupCheckBox);
788
789                 groupCheckBox.addClickHandler(new ClickHandler() {
790                     public void onClick(ClickEvent event) {
791                         turtlenet.updatePDATAPermission(groupCheckBox.getText(), groupCheckBox.getValue(), new
792 AsyncCallback<String>() {
793                             public void onFailure(Throwable caught) {
794                                 System.out.println("updatePDATAPermission failed: " + caught);
795                             }
796                             public void onSuccess(String result) {
797                                 //success
798                             }
799                         });
800                     }
801                 });
802             }
803         });
804     myDetailsPermissionsPanel.addStyleName("gwt-my-details-permissions");
805 }
806
807 private void friendsDetails(final String friendsDetailsKey, FlowPanel wallPanel, Button userDetails) {
808     userDetails.addClickHandler(new ClickHandler() {
809         public void onClick(ClickEvent event) {
810             wall(friendsDetailsKey, false);
811         }
812     });
813
814     userDetails.setText("Reload page");
815     userDetails.getElement().getStyle().setProperty("color", "#61B329");
816
817     location = "friendsDetails";
818     refreshID = "";
819
820     // Create main panel
821     final FlexTable friendsDetailsPanel = new FlexTable();
822     wallPanel.insert(friendsDetailsPanel, 1);
823     friendsDetailsPanel.clear();
824
825     // Create widgets
826     Label friendsDetailsUsernameTitle = new Label("Username:");
827     friendsDetailsPanel.setWidget(0, 0, friendsDetailsUsernameTitle);
828
829     Label friendsDetailsNameTitle = new Label("Name:");
830     friendsDetailsPanel.setWidget(1, 0, friendsDetailsNameTitle);
831
832     Label friendsDetailsBirthDayTitle = new Label("Birthday:");

```

```

833         friendsDetailsPanel.setWidget(2, 0, friendsDetailsBirthdayTitle);
834
835         Label friendsDetailsGenderTitle = new Label("Gender:");
836         friendsDetailsPanel.setWidget(3, 0, friendsDetailsGenderTitle);
837
838         Label friendsDetailsEmailTitle = new Label("Email:");
839         friendsDetailsPanel.setWidget(4, 0, friendsDetailsEmailTitle);
840
841         Label friendsDetailsKeyTitle = new Label("Public Key:");
842         friendsDetailsPanel.setWidget(5, 0, friendsDetailsKeyTitle);
843
844         turtlenet.getUsername(friendsDetailsKey, new AsyncCallback<String>() {
845             public void onFailure(Throwable caught) {
846                 System.out.println("turtlenet.getUsername failed: " + caught);
847             }
848             public void onSuccess(String result) {
849                 Label friendsDetailsUsernameLabel = new Label(result);
850                 friendsDetailsPanel.setWidget(0, 1, friendsDetailsUsernameLabel);
851             }
852         });
853
854         turtlenet.getPDATA("name", friendsDetailsKey, new AsyncCallback<String>() {
855             public void onFailure(Throwable caught) {
856                 System.out.println("turtlenet.getPDATA name failed: " + caught);
857             }
858             public void onSuccess(String result) {
859                 Label friendsDetailsNameLabel = new Label(result);
860                 friendsDetailsPanel.setWidget(1, 1, friendsDetailsNameLabel);
861             }
862         });
863
864         turtlenet.getPDATA("birthday", friendsDetailsKey, new AsyncCallback<String>() {
865             public void onFailure(Throwable caught) {
866                 System.out.println("turtlenet.getPDATA birthday failed: " + caught);
867             }
868             public void onSuccess(String result) {
869                 Label friendsDetailsBirthdayLabel = new Label(result);
870                 friendsDetailsPanel.setWidget(2, 1, friendsDetailsBirthdayLabel);
871             }
872         });
873
874         turtlenet.getPDATA("gender", friendsDetailsKey, new AsyncCallback<String>() {
875             public void onFailure(Throwable caught) {
876                 System.out.println("turtlenet.getPDATA gender failed: " + caught);
877             }
878             public void onSuccess(String result) {
879                 Label friendsDetailsGenderLabel = new Label(result);
880                 friendsDetailsPanel.setWidget(3, 1, friendsDetailsGenderLabel);
881             }
882         });
883
884         turtlenet.getPDATA("email", friendsDetailsKey, new AsyncCallback<String>() {
885             public void onFailure(Throwable caught) {
886                 System.out.println("turtlenet.getPDATA email failed: " + caught);
887             }
888             public void onSuccess(String result) {
889                 Label friendsDetailsEmailLabel = new Label(result);
890                 friendsDetailsPanel.setWidget(4, 1, friendsDetailsEmailLabel);
891             }
892         });
893
894         TextBox friendsDetailsKeyBox = new TextBox();
895         friendsDetailsKeyBox.setReadOnly(true);
896         friendsDetailsKeyBox.setWidth("400px");
897         friendsDetailsKeyBox.setText(friendsDetailsKey);
898         friendsDetailsPanel.setWidget(5, 1, friendsDetailsKeyBox);
899
900         turtlenet.getMyKey(new AsyncCallback<String>() {
901             public void onFailure(Throwable caught) {
902                 System.out.println("turtlenet.getMyKey failed: " + caught);
903             }
904             public void onSuccess(String myKey) {
905                 if(friendsDetailsKey.equals(myKey)) {
906                     Button edit = new Button("Edit my details");
907                     edit.setWidth("410px");
908                     friendsDetailsPanel.setWidget(6, 1, edit);
909                     edit.addClickHandler(new ClickHandler () {
910                         public void onClick(ClickEvent event) {
911                             myDetails();
912                         }
913                     });
914                 }
915             }
916         });
917
918         // Add style name for CSS
919         friendsDetailsPanel.addStyleName("gwt-friends-details");
920     }
921
922     // Global stuff for wall
923     private HorizontalPanel wallControlPanel = new HorizontalPanel();
924     private TextArea postText;
925     PostDetails[] wallPostDetails;

```

```

926 int wallCurrentPost;
927 private FlowPanel wallPanel = new FlowPanel();
928 private Button wallControlPanelUserDetailsButton;
929 private Anchor linkToComments;
930
931 private void wall(final String key, final boolean refresh) {
932     location = "wall";
933     refreshID = key;
934
935     wallPanel = new FlowPanel();
936     wallPanel.clear();
937
938     if(!refresh) {
939         // Setup basic page
940         RootPanel.get().clear();
941         navigation();
942         RootPanel.get().add(wallPanel);
943         // Create a container for controls
944         wallControlPanel = new HorizontalPanel();
945         wallControlPanel.clear();
946         wallControlPanel.addStyleName("gwt-wall-control");
947         wallControlPanel.setSpacing(5);
948         wallPanel.insert(wallControlPanel, 0);
949
950         wallControlPanelUserDetailsButton = new Button("About");
951         wallControlPanelUserDetailsButton.getElement().getStyle().setProperty("color", "#000000");
952         wallControlPanel.add(wallControlPanelUserDetailsButton);
953         wallControlPanelUserDetailsButton.getElement().getStyle().setProperty("marginRight", "150px");
954         wallControlPanelUserDetailsButton.addClickHandler(new ClickHandler() {
955             public void onClick(ClickEvent event) {
956                 friendsDetails(key, wallPanel, wallControlPanelUserDetailsButton);
957             }
958         });
959
960         turtlesnet.getMyKey(new AsyncCallback<String>() {
961             public void onFailure(Throwable caught) {
962                 System.out.println("turtlesnet.getMyKey failed: " + caught);
963             }
964             public void onSuccess(String result) {
965                 if(key.equals(result)) {
966                     wallControlPanelUserDetailsButton.setText("About Me");
967                 } else {
968                     turtlesnet.getUsername(key, new AsyncCallback<String>() {
969                         public void onFailure(Throwable caught) {
970                             System.out.println("turtlesnet.getUsername failed: " + caught);
971                         }
972                         public void onSuccess(String result) {
973                             wallControlPanelUserDetailsButton.setText("About " + result);
974                         }
975                     });
976                 }
977             }
978         });
979
980         final Button createPost = new Button("Write a post");
981         createPost.getElement().getStyle().setProperty("color", "#000000");
982         wallControlPanel.add(createPost);
983
984         final FlowPanel createPostPanel = new FlowPanel();
985         createPostPanel.addStyleName("gwt-create-post");
986         postText = new TextArea();
987         postText.setCharacterWidth(80);
988         postText.setVisibleLines(10);
989         createPostPanel.add(postText);
990
991         HorizontalPanel createPostControlPanel = new HorizontalPanel();
992         createPostPanel.add(createPostControlPanel);
993
994         final ListBox chooseGroup = new ListBox();
995         chooseGroup.setVisibleItemCount(1);
996         chooseGroup.setWidth("150px");
997         chooseGroup.addItem("All");
998         createPostControlPanel.add(chooseGroup);
999         createPostControlPanel.setCellWidth(chooseGroup, "217px");
1000
1001
1002         turtlesnet.getCategories(new AsyncCallback<String[][]>() {
1003             public void onFailure(Throwable caught) {
1004                 System.out.println("turtlesnet.getCategories failed: " + caught);
1005             }
1006             public void onSuccess(String result[][]) {
1007                 for (int i = 0; i < result.length; i++)
1008                     chooseGroup.addItem(result[i][0]);
1009             }
1010         });
1011
1012         Button cancel = new Button("Cancel");
1013         createPostControlPanel.add(cancel);
1014         createPostControlPanel.setCellWidth(cancel, "217px");
1015         cancel.addClickHandler(new ClickHandler() {
1016             public void onClick(ClickEvent event) {
1017                 wallPanel.remove(wallControlPanel);
1018                 wallPanel.remove(createPostPanel);

```

```

1019         wall(key, false);
1020     }
1021     });
1022
1023     Button send = new Button("Send");
1024     send.setWidth("150px");
1025     createPostControlPanel.add(send);
1026     send.addClickHandler(new ClickHandler() {
1027         public void onClick(ClickEvent event) {
1028             AsyncCallback<String>() {
1029                 public void onFailure(Throwable caught) {
1030                     System.out.println("turtlenet.addPost failed: " + caught);
1031                 }
1032                 public void onSuccess(String result) {
1033                     //if (result.equals("success")) {
1034                         wallPanel.remove(wallControlPanel);
1035                         wallPanel.remove(createPostPanel);
1036                         wall(key, false);
1037                     //} else {
1038                         //System.out.println("turtlenet.addPost onSuccess String result did not equal success");
1039                     //}
1040                 }
1041             });
1042         }
1043     });
1044
1045     createPost.addClickHandler(new ClickHandler() {
1046         public void onClick(ClickEvent event) {
1047             location = "createPost";
1048             refreshID = "";
1049             createPost.setText("Updates paused");
1050             createPost.getElement().getStyle().setProperty("color", "#FF0000");
1051             wallPanel.insert(createPostPanel, 1);
1052         }
1053     });
1054 }
1055
1056 turtlenet.getWallPosts(key, new AsyncCallback<PostDetails[]>() {
1057     public void onFailure(Throwable caught) {
1058         System.out.println("turtlenet.getWallPosts failed: " + caught);
1059     }
1060     public void onSuccess(PostDetails[] result) {
1061         wallPostDetails = result;
1062         for (wallCurrentPost = 0; wallCurrentPost < wallPostDetails.length; wallCurrentPost++) {
1063             final PostDetails details = wallPostDetails[wallCurrentPost];
1064
1065             if(!refresh || wallPostDetails[wallCurrentPost].timestamp > wallLastTimeStamp) {
1066                 final FlowPanel postPanel = new FlowPanel();
1067                 postPanel.clear();
1068                 wallPanel.insert(postPanel, 1);
1069                 postPanel.addStyleName("gwt-post-panel");
1070
1071                 HorizontalPanel postControlPanel = new HorizontalPanel();
1072                 postPanel.add(postControlPanel);
1073
1074                 //Name
1075                 Label postedByLabel = new Label("Posted by: ");
1076                 postControlPanel.add(postedByLabel);
1077                 postControlPanel.setCellWidth(postedByLabel, "110");
1078
1079                 Anchor linkToUser = new Anchor(wallPostDetails[wallCurrentPost].posterUsername);
1080                 postControlPanel.add(linkToUser);
1081                 postControlPanel.setCellWidth(linkToUser, "200");
1082                 linkToUser.addClickHandler(new ClickHandler() {
1083                     public void onClick(ClickEvent event) {
1084                         wall(wallPostDetails[wallCurrentPost].posterKey, false);
1085                     }
1086                 });
1087
1088                 //Date
1089                 wallLastTimeStamp = wallPostDetails[wallCurrentPost].timestamp;
1090                 Label dateLabel = new Label(new Date(wallPostDetails[wallCurrentPost].timestamp).toString());
1091                 postControlPanel.add(dateLabel);
1092
1093                 FlowPanel postContentsPanel = new FlowPanel();
1094                 postPanel.clear();
1095                 postPanel.add(postContentsPanel);
1096
1097                 TextArea postContents = new TextArea();
1098                 postContents.setCharacterWidth(80);
1099                 postContents.setVisibleLines(5);
1100                 postContents.setReadOnly(true);
1101
1102                 //Text
1103                 postContents.setText(wallPostDetails[wallCurrentPost].text);
1104                 postContentsPanel.add(postContents);
1105
1106                 final HorizontalPanel postContentsFooterPanel = new HorizontalPanel();
1107                 postContentsFooterPanel.addStyleName("gwt-post-contents-footer");
1108                 postContentsPanel.add(postContentsFooterPanel);
1109
1110                 //Like

```

```

1111         Anchor likePost;
1112
1113         if (wallPostDetails[wallCurrentPost].liked) {
1114             likePost = new Anchor("Unlike");
1115             likePost.addClickListener(new ClickHandler() {
1116                 public void onClick(ClickEvent event) {
1117                     turtlenet.unlike(details.sig, new AsyncCallback<String>() {
1118                         public void onFailure(Throwable caught) {
1119                             System.out.println("turtlenet.unlike (post) failed: " + caught);
1120                         }
1121                         public void onSuccess(String _result) {
1122                             //if (_result.equals("success")) {
1123                                 wall(key, false);
1124                             //} else {
1125                                 //System.out.println("turtlenet.unlike (post) onSuccess String _result did
not equal success");
1126                             //}
1127                         }
1128                     });
1129                 }
1130             });
1131         } else {
1132             likePost = new Anchor("Like");
1133             likePost.addClickListener(new ClickHandler() {
1134                 public void onClick(ClickEvent event) {
1135                     turtlenet.like(details.sig, new AsyncCallback<String>() {
1136                         public void onFailure(Throwable caught) {
1137                             System.out.println("turtlenet.like (post) failed: " + caught);
1138                         }
1139                         public void onSuccess(String _result) {
1140                             //if (_result.equals("success")) {
1141                                 wall(key, false);
1142                             //} else {
1143                                 //System.out.println("turtlenet.like (post) onSuccess String _result did not
equal success");
1144                             //}
1145                         }
1146                     });
1147                 }
1148             });
1149         }
1150         postContentsFooterPanel.add(likePost);
1151         final Label stop = new Label("");
1152
1153         //Comments
1154         int commentCount = wallPostDetails[wallCurrentPost].commentCount;
1155         if (commentCount == 0) {
1156             linkToComments = new Anchor("Add a comment");
1157         } else {
1158             linkToComments = new Anchor("Comments(" + Integer.toString(commentCount) + ")");
1159         }
1160
1161         linkToComments.getElement().getStyle().setProperty("paddingRight", "100px");
1162         postContentsFooterPanel.add(linkToComments);
1163         linkToComments.addClickListener(new ClickHandler() {
1164             public void onClick(ClickEvent event) {
1165                 postContentsFooterPanel.remove(linkToComments);
1166                 stop.setText("Page auto update paused");
1167                 stop.getElement().getStyle().setProperty("color", "#FF0000");
1168                 comments(details.sig, key, false, postPanel);
1169             }
1170         });
1171         postContentsFooterPanel.add(stop);
1172         postContentsFooterPanel.add(likePost);
1173         likePost.getElement().getStyle().setProperty("paddingLeft", "270px");
1174     }
1175
1176     if (refresh) {
1177         // TODO LOUISTODO use this
1178         //Window.scrollTo(0, (Window.getScrollTop() + 200));
1179     }
1180 }
1181
1182 });
1183
1184 // Add style name for CSS
1185 wallPanel.addStyleName("gwt-wall");
1186
1187 }
1188
1189 // Global stuff for comments
1190 private int commentCount;
1191 private TextArea threadReplyContents;
1192 private String keyOfWallCommentsAreOn = new String("");
1193
1194 private void comments(final String postID, final String wallKey, final boolean refresh, FlowPanel postPanel) {
1195     final FlowPanel commentsPanel = new FlowPanel();
1196     location = "comments";
1197     refreshID = postID;
1198     keyOfWallCommentsAreOn = wallKey;
1199
1200     if (!refresh) {
1201         commentsPanel.clear();

```



```

1202
1203 // Disables the comment anchor for the current post to prevent duplicate
1204 // comment panels being created.
1205 linkToComments.addClickHandler(new ClickHandler() {
1206     public void onClick(ClickEvent event) {
1207         commentsPanel.clear();
1208     }
1209 });
1210
1211 // Add main panel to page
1212 postPanel.add(commentsPanel);
1213 FlexTable commentsReplyThreadPanel = new FlexTable();
1214 commentsReplyThreadPanel.getElement().getStyle().setProperty("paddingLeft", "60px");
1215 commentsPanel.add(commentsReplyThreadPanel);
1216
1217 threadReplyContents = new TextArea();
1218 threadReplyContents.setCharacterWidth(60);
1219 threadReplyContents.setVisibleLines(6);
1220 commentsReplyThreadPanel.setWidget(0, 0, threadReplyContents);
1221
1222 Button cancel = new Button("Cancel");
1223 cancel.setWidth("450px");
1224 commentsReplyThreadPanel.setWidget(1, 0, cancel);
1225 cancel.addClickHandler(new ClickHandler() {
1226     public void onClick(ClickEvent event) {
1227         wall(wallKey, false);
1228     }
1229 });
1230
1231 Button replyToThread;
1232 if(commentCount == 0) {
1233     replyToThread = new Button("Post comment");
1234 } else {
1235     replyToThread = new Button("Reply to thread");
1236 }
1237 replyToThread.setWidth("450px");
1238 commentsReplyThreadPanel.setWidget(2, 0, replyToThread);
1239
1240 replyToThread.addClickHandler(new ClickHandler() {
1241     public void onClick(ClickEvent event) {
1242         turtlenet.addComment(postID, threadReplyContents.getText(), new AsyncCallback<String>() {
1243             public void onFailure(Throwable caught) {
1244                 System.out.println("turtlenet.addComment failed: " + caught);
1245             }
1246             public void onSuccess(String result) {
1247                 //if (result.equals("success")) {
1248                     wall(wallKey, false);
1249                 //} else {
1250                     //System.out.println("turtlenet.addComment onSuccess String result did not equal success");
1251                 //}
1252             }
1253         });
1254     }
1255 });
1256 }
1257
1258 turtlenet.getComments(postID, new AsyncCallback<CommentDetails[]>() {
1259     public void onFailure(Throwable caught) {
1260         System.out.println("turtlenet.getComments failed: " + caught);
1261     }
1262     public void onSuccess(CommentDetails[] result) {
1263         commentCount = result.length;
1264         for (int i = 0; i < result.length; i++) {
1265             if(!refresh || result[i].timestamp > commentsLastTimeStamp) {
1266                 final CommentDetails details = result[i];
1267                 // Create panel to contain the main contents of each comment
1268                 FlowPanel commentsContentsPanel = new FlowPanel();
1269                 commentsContentsPanel.addStyleName("gwt-comments-contents");
1270                 commentsPanel.insert(commentsContentsPanel, commentsPanel.getWidgetCount() - 1);
1271
1272                 final String commentID = result[i].sig;
1273                 // Create widgets
1274                 TextArea commentContents = new TextArea();
1275                 commentContents.setCharacterWidth(60);
1276                 commentContents.setVisibleLines(3);
1277                 commentContents.setReadOnly(true);
1278
1279                 //Text
1280                 commentContents.setText(result[i].text);
1281                 commentsContentsPanel.add(commentContents);
1282
1283                 //Create panel to contain controls for each comment
1284                 HorizontalPanel commentsControlPanel = new HorizontalPanel();
1285                 commentsContentsPanel.add(commentsControlPanel);
1286
1287                 final String postedByKey = result[i].posterKey;
1288
1289                 Label commentPostedByLabel = new Label("Posted by: ");
1290                 commentPostedByLabel.getElement().getStyle().setProperty("paddingLeft", "10px");
1291                 commentsControlPanel.add(commentPostedByLabel);
1292
1293                 Anchor postedBy = new Anchor(result[i].posterName);
1294                 postedBy.getElement().getStyle().setProperty("paddingLeft", "10px");

```



```

1295         commentsControlPanel.add(postedBy);
1296
1297         postedBy.addClickHandler(new ClickHandler() {
1298             public void onClick(ClickEvent event) {
1299                 wall(details.posterKey, false);
1300             }
1301         });
1302
1303         Anchor likeComment;
1304
1305         if (result[i].liked) {
1306             likeComment = new Anchor("Unlike");
1307             likeComment.addClickHandler(new ClickHandler() {
1308                 public void onClick(ClickEvent event) {
1309                     turtlenet.unlike(details.sig, new AsyncCallback<String>() {
1310                         public void onFailure(Throwable caught) {
1311                             System.out.println("turtlenet.unlike (comment) failed: " + caught);
1312                         }
1313                         public void onSuccess(String _result) {
1314                             //if (_result.equals("success")) {
1315                                 wall(wallKey, false);
1316                             //} else {
1317                                 //System.out.println("turtlenet.unlike (comment) onSuccess String _result
1318                                     did not equal success");
1319                             //}
1320                         }
1321                     });
1322                 }
1323             } else {
1324                 likeComment = new Anchor("Like");
1325                 likeComment.addClickHandler(new ClickHandler() {
1326                     public void onClick(ClickEvent event) {
1327                         turtlenet.like(details.sig, new AsyncCallback<String>() {
1328                             public void onFailure(Throwable caught) {
1329                                 System.out.println("turtlenet.like (comment) failed: " + caught);
1330                             }
1331                             public void onSuccess(String _result) {
1332                                 //if (_result.equals("success")) {
1333                                     wall(wallKey, false);
1334                                 //} else {
1335                                     //System.out.println("turtlenet.like (comment) onSuccess String _result did
1336                                         not equal success");
1337                                 //}
1338                             }
1339                         });
1340                     }
1341                 });
1342             }
1343             likeComment.getElement().getStyle().setProperty("paddingLeft", "200px");
1344             commentsControlPanel.add(likeComment);
1345         }
1346     }
1347 }
1348 });
1349 commentsPanel.addStyleName("gwt-comments");
1350 }
1351
1352 //must be global because it must be referenced from callback
1353 private TextArea newConvoInput = new TextArea();
1354 private void newConversation() {
1355     location = "newConversation";
1356     refreshID = "";
1357
1358     // Setup basic page
1359     RootPanel.get().clear();
1360     navigation();
1361
1362     // Create panel to contain widgets
1363     final FlexTable newConversationPanel = new FlexTable();
1364     RootPanel.get().add(newConversationPanel);
1365
1366     final ListBox currentFriends = new ListBox();
1367     currentFriends.setVisibleItemCount(11);
1368     currentFriends.setWidth("150px");
1369     newConversationPanel.setWidget(0, 0, currentFriends);
1370
1371     newConvoInput.setCharacterWidth(80);
1372     newConvoInput.setVisibleLines(10);
1373     newConversationPanel.setWidget(0, 1, newConvoInput);
1374
1375     final ListBox chooseFriend = new ListBox();
1376     chooseFriend.setWidth("150px");
1377
1378     turtlenet.getPeople(new AsyncCallback<String[][]>() {
1379         String[][] result;
1380         String[] memberKeys;
1381         int i;
1382         public void onFailure(Throwable caught) {
1383             System.out.println("turtlenet.getPeople failed: " + caught);
1384         }
1385         public void onSuccess(String[][] _result) {

```

```

1386         result = _result;
1387         for (i = 0; i < result.length; i++) {
1388             //fill combo box
1389             chooseFriend.addItem(result[i][0]);
1390             String friendKey = (result[i][1]);
1391             chooseFriend.setValue(i, friendKey);
1392         }
1393         chooseFriend.setVisibleItemCount(1);
1394
1395         FlexTable subPanel = new FlexTable();
1396         newConversationPanel.setWidget(1, 1, subPanel);
1397         subPanel.setWidget(1, 0, new Label("Choose a friend: "));
1398         subPanel.setWidget(1, 1, chooseFriend);
1399
1400         Button addFriend = new Button("Add to the conversation");
1401         subPanel.setWidget(1, 2, addFriend);
1402         addFriend.addClickHandler(new ClickHandler() {
1403             public void onClick(ClickEvent event) {
1404                 currentFriends.addItem(chooseFriend.getItemText(chooseFriend.getSelectedIndex()));
1405                 currentFriends.setValue((currentFriends.getItemCount() - 1), chooseFriend.getValue
1406 (chooseFriend.getSelectedIndex()));
1407             }
1408         });
1409
1410         Button send = new Button("Send");
1411         newConversationPanel.setWidget(0, 2, send);
1412
1413         send.addClickHandler(new ClickHandler() {
1414             String[] createChatReturn;
1415             public void onClick(ClickEvent event) {
1416                 memberKeys = new String[currentFriends.getItemCount()+1];
1417                 for (int i = 0; i < currentFriends.getItemCount(); i++) {
1418                     memberKeys[i] = currentFriends.getValue(i);
1419                 }
1420
1421                 turtlenet.getMyKey(new AsyncCallback<String>() {
1422                     public void onFailure(Throwable caught) {
1423                         System.out.println("turtlenet.getMyKey failed: " + caught);
1424                     }
1425                     public void onSuccess(String userkey) {
1426                         memberKeys[memberKeys.length-1] = userkey;
1427                         turtlenet.createCHAT(memberKeys, new AsyncCallback<String[]>() {
1428                             int i;
1429                             public void onFailure(Throwable caught) {
1430                                 System.out.println("createCHAT failed: " + caught);
1431                             }
1432                             public void onSuccess(String[] _ret) {
1433                                 createChatReturn = _ret;
1434                                 if (createChatReturn[0].equals("success")) {
1435                                     turtlenet.addMessageToCHAT(newConvoInput.getText(), createChatReturn[1], new
1436 AsyncCallback<String>() {
1437                                         public void onFailure(Throwable caught) {
1438                                             System.out.println("turtlenet.addMessageToCHAT failed: " + caught);
1439                                         }
1440                                         public void onSuccess(String success) {
1441                                             //if (success.equals("success")) {
1442                                                 conversation(createChatReturn[1], false);
1443                                             //} else {
1444                                                 //System.out.println("turtlenet.addMessageToCHAT onSuccess String
1445 success did not equal success");
1446                                             //}
1447                                         }
1448                                     });
1449                                 } else {
1450                                     // THIS IS TEMPORARY!
1451                                     conversation(createChatReturn[1], false);
1452                                     //System.out.println("turtlenet.createCHAT onSuccess String createChatReturn[0]
1453 did not equal success");
1454                                 }
1455                             }
1456                         });
1457                     }
1458                 });
1459             }
1460         });
1461
1462         // Add style name for CSS
1463         newConversationPanel.addStyleName("gwt-conversation");
1464     }
1465
1466     // Global stuff for conversation
1467     private String convoPanelSetup_convoSig; //needed in inner class
1468     private TextArea convoPanelSetup_input = new TextArea();
1469     private FlowPanel conversationPanel;
1470
1471     private void conversation(final String conversationID, final boolean refresh) {
1472         location = "conversation";
1473         refreshID = conversationID;
1474
1475         conversationPanel = new FlowPanel();

```

```

1475         final List<String> currentFriends = new ArrayList<>();
1476
1477         if(!refresh) {
1478             conversationPanel.clear();
1479             // Set up basic page
1480             RootPanel.get().clear();
1481             navigation();
1482             RootPanel.get().add(conversationPanel);
1483             HorizontalPanel conversationParticipantsPanel = new HorizontalPanel();
1484             conversationParticipantsPanel.setSpacing(5);
1485             conversationPanel.add(conversationParticipantsPanel);
1486             convoPanelSetup_convoSig = conversationID;
1487             Label participantsLabel = new Label("Participants: ");
1488             participantsLabel.getElement().getStyle().setProperty("marginRight", "20px");
1489             conversationParticipantsPanel.add(participantsLabel);
1490
1491             currentFriends.setVisibleItemCount(1);
1492             currentFriends.setWidth("150px");
1493             conversationParticipantsPanel.add(currentFriends);
1494         }
1495
1496         turtlenet.getConversation(convoPanelSetup_convoSig, new AsyncCallback<Conversation>() {
1497             Conversation result;
1498             int i;
1499             public void onFailure(Throwable caught) {
1500                 System.out.println("turtlenet.getConversation failed: " + caught);
1501             }
1502             public void onSuccess(Conversation _result) {
1503                 result = _result;
1504
1505                 if (!refresh) {
1506                     for (i = 0; i < result.users.length; i++) {
1507                         currentFriends.addItem(result.users[i]);
1508                     }
1509                 }
1510
1511                 turtlenet.getConversationMessages(convoPanelSetup_convoSig, new AsyncCallback<String[][]>() {
1512                     String[][] messages;
1513                     int i;
1514                     public void onFailure(Throwable caught) {
1515                         System.out.println("turtlenet.getConversationMessages failed: " + caught);
1516                     }
1517                     public void onSuccess(String[][] msgs) {
1518                         messages = msgs;
1519
1520                         Button replyToConversation = new Button("Reply");
1521                         replyToConversation.setWidth("590px");
1522
1523                         for (int i = 0; i < messages.length; i++) {
1524                             if(!refresh || Long.parseLong(msgs[i][1]) > conversationLastTimeStamp) {
1525                                 HorizontalPanel conversationContentsPanel = new HorizontalPanel();
1526                                 conversationContentsPanel.setSpacing(5);
1527                                 conversationPanel.add(conversationContentsPanel);
1528                                 Label postedBy = new Label(messages[i][0]);
1529                                 postedBy.getElement().getStyle().setProperty("marginRight", "110px");
1530                                 postedBy.getElement().getStyle().setFontWeight(FontWeight.BOLD);
1531
1532                                 // LOUISTODO This might not work
1533                                 conversationContentsPanel.add(postedBy);
1534                                 //conversationContentsPanel.insert(postedBy, conversationPanel.getWidgetIndex
1535
1536                                 Label messageContents = new Label(messages[i][2]);
1537                                 conversationContentsPanel.add(messageContents);
1538
1539                                 conversationLastTimeStamp = Long.parseLong(msgs[i][1]);
1540                             }
1541                         }
1542
1543                         if(!refresh) {
1544                             conversationPanel.add(replyToConversation);
1545                             final FlowPanel conversationReplyPanel = new FlowPanel();
1546                             convoPanelSetup_input.setCharacterWidth(80);
1547                             convoPanelSetup_input.setVisibleLines(10);
1548                             conversationReplyPanel.add(convoPanelSetup_input);
1549
1550                             HorizontalPanel conversationReplyControlsPanel = new HorizontalPanel();
1551                             conversationReplyPanel.add(conversationReplyControlsPanel);
1552
1553                             Label stop = new Label("Page auto update paused");
1554                             stop.getElement().getStyle().setProperty("color", "#FF0000");
1555                             stop.getElement().getStyle().setProperty("paddingRight", "55px");
1556                             conversationReplyControlsPanel.add(stop);
1557                             stop.addClickHandler(new ClickHandler() {
1558                                 public void onClick(ClickEvent event) {
1559                                     conversation(conversationID, false);
1560                                 }
1561                             });
1562
1563                             Button cancel = new Button("Cancel");
1564                             conversationReplyControlsPanel.add(cancel);
1565
1566                             cancel.addClickHandler(new ClickHandler() {
1567                                 public void onClick(ClickEvent event) {

```

```

1567         conversation(conversationID, false);
1568     }
1569 });
1570
1571 Button send = new Button("Send");
1572 conversationReplyControlsPanel.add(send);
1573 send.addClickHandler(new ClickHandler() {
1574     public void onClick(ClickEvent event) {
1575         turtlenet.addMessageToCHAT(convoPanelSetup_input.getText(), convoPanelSetup_convosig, new
1576 AsyncCallback<String>() {
1577         public void onFailure(Throwable caught) {
1578             System.out.println("turtlenet.addMessageToCHAT failed: " + caught);
1579         }
1580         public void onSuccess(String postingSuccess) {
1581             //Reload the conversation after the new message has been added
1582             conversation(convoPanelSetup_convosig, false);
1583         }
1584     });
1585 }
1586 });
1587
1588 replyToConversation.addClickHandler(new ClickHandler() {
1589     public void onClick(ClickEvent event) {
1590         location = "replyToConversation";
1591         refreshID = "";
1592     }
1593 });
1594 conversationPanel.add(conversationReplyPanel);
1595 }
1596 });
1597 }
1598 });
1599 });
1600
1601 // Add style name for CSS
1602 conversationPanel.addStyleName("gwt-conversation");
1603 }
1604
1605 TextBox newGroup_nameInput = new TextBox();
1606 private void newGroup() {
1607     location = "newGroup";
1608     refreshID = "";
1609
1610     RootPanel.get().clear();
1611     navigation();
1612     FlexTable newGroupPanel = new FlexTable();
1613     RootPanel.get().add(newGroupPanel);
1614
1615     newGroupPanel.setWidget(0, 0, new Label("Category name: "));
1616     newGroupPanel.setWidget(0, 1, newGroup_nameInput);
1617
1618     Button createGroup = new Button("Create category");
1619     newGroupPanel.setWidget(0, 2, createGroup);
1620
1621     createGroup.addClickHandler(new ClickHandler() {
1622         public void onClick(ClickEvent event) {
1623             turtlenet.addCategory(newGroup_nameInput.getText(), new AsyncCallback<String>() {
1624                 public void onFailure(Throwable caught) {
1625                     System.out.println("turtlenet.addCategory failed: " + caught);
1626                 }
1627                 public void onSuccess(String result) {
1628                     //if (result.equals("success")) {
1629                         editGroup(newGroup_nameInput.getText());
1630                     //} else {
1631                         //System.out.println("turtlenet.addCategory onSuccess String result did not equal success");
1632                     //}
1633                 }
1634             });
1635         }
1636     });
1637
1638     newGroupPanel.addStyleName("gwt-new-group");
1639 }
1640
1641 private void editGroup(final String groupID) {
1642     location = "editGroup";
1643     refreshID = "";
1644
1645     FlexTable editGroupPanel = new FlexTable();
1646     editGroupPanel.clear();
1647     RootPanel.get().add(editGroupPanel);
1648
1649     editGroupPanel.setWidget(1, 0, new Label("Currently in category: "));
1650     final ListBox currentMembers = new ListBox();
1651     currentMembers.setVisibleItemCount(10);
1652     currentMembers.setWidth("150px");
1653     editGroupPanel.setWidget(1, 1, currentMembers);
1654
1655     turtlenet.getCategoryMembers(groupID, new AsyncCallback<String[][]>() {
1656         String[][] result;
1657         int i;
1658         public void onFailure(Throwable caught) {

```

```

1659         System.out.println("turtlenet.getCategoryMembers failed: " + caught);
1660     }
1661     public void onSuccess(String[][] _result) {
1662         result = _result;
1663         for (i = 0; i < result.length; i++) {
1664             currentMembers.addItem(result[i][0]);
1665             currentMembers.setValue(i, result[i][1]); //their key
1666         }
1667     }
1668 });
1669
1670 Button removeFromGroup = new Button("Remove from group");
1671 editGroupPanel.setWidget(1, 2, removeFromGroup);
1672 removeFromGroup.addClickHandler(new ClickHandler() {
1673     public void onClick(ClickEvent event) {
1674         AsyncCallback<String>() {
1675             public void onFailure(Throwable caught) {
1676                 System.out.println("turtlenet.removeFromCategory failed: " + caught);
1677             }
1678             public void onSuccess(String result) {
1679                 friendsList(groupID);
1680             }
1681         }
1682     });
1683 });
1684
1685 editGroupPanel.setWidget(2, 0, new Label("Add a friend: "));
1686 final ListBox allFriends = new ListBox();
1687 allFriends.setVisibleItemCount(1);
1688 allFriends.setWidth("150px");
1689 editGroupPanel.setWidget(2, 1, allFriends);
1690
1691 turtlenet.getPeople(new AsyncCallback<String[][]>() {
1692     String[][] result;
1693     int i;
1694     public void onFailure(Throwable caught) {
1695         System.out.println("turtlenet.getPeople failed: " + caught);
1696     }
1697     public void onSuccess(String[][] _result) {
1698         result = _result;
1699         for (i = 0; i < result.length; i++) {
1700             String friendKey = new String(result[i][1]);
1701             allFriends.addItem(result[i][0]);
1702             allFriends.setValue(i, friendKey);
1703         }
1704     }
1705 });
1706
1707 Button addFriend = new Button("Add friend");
1708 editGroupPanel.setWidget(2, 2, addFriend);
1709 addFriend.addClickHandler(new ClickHandler() {
1710     public void onClick(ClickEvent event) {
1711         AsyncCallback<String>() {
1712             public void onFailure(Throwable caught) {
1713                 System.out.println("turtlenet.addToCategory failed: " + caught);
1714             }
1715             public void onSuccess(String result) {
1716                 //if (result.equals("success")) {
1717                     friendsList(groupID);
1718                 //} else {
1719                     //System.out.println("turtlenet.addToCategory onSuccess String result did not equal success");
1720                 //}
1721             }
1722         }
1723     });
1724 });
1725
1726 editGroupPanel.addStyleName("gwt-edit-group");
1727 }
1728
1729 TextBox addFriend_keyInput = new TextBox();
1730 private void addFriend() {
1731     location = "addFriend";
1732     refreshID = "";
1733
1734     RootPanel.get().clear();
1735     navigation();
1736     FlexTable addFriendPanel = new FlexTable();
1737     RootPanel.get().add(addFriendPanel);
1738
1739     addFriendPanel.setWidget(0, 0, new Label("Enter the key of the person you wish to add:"));
1740     addFriend_keyInput.setVisibleLength(100);
1741     addFriendPanel.setWidget(1, 0, addFriend_keyInput);
1742
1743     Button submit = new Button("Add key");
1744     submit.setWidth("640px");
1745     addFriendPanel.setWidget(2, 0, submit);
1746     final Label success = new Label("");
1747     addFriendPanel.setWidget(3, 0, success);
1748
1749     submit.addClickHandler(new ClickHandler() {

```

```
1750         public void onClick(ClickEvent event) {
1751             turtlenet.addKey(addFriend_keyInput.getText(), new AsyncCallback<String>() {
1752                 public void onFailure(Throwable caught) {
1753                     success.setText("Key could not be added");
1754                     System.out.println("turtlenet.addKey failed: " + caught);
1755                 }
1756                 public void onSuccess(String result) {
1757                     if (result.equals("success")) {
1758                         success.setText("Key has been added");
1759                     } else {
1760                         success.setText("Key could not be added");
1761                         System.out.println("turtlenet.addKey onSuccess String result did not equal success");
1762                     }
1763                 }
1764             });
1765         }
1766     });
1767     addFriendPanel.addStyleName("gwt-friend");
1768 }
1769 }
```

```

1  package ballmerpeak.turtlenet.client;
2
3  import ballmerpeak.turtlenet.shared.CommentDetails;
4  import ballmerpeak.turtlenet.shared.PostDetails;
5  import ballmerpeak.turtlenet.shared.Conversation;
6  import ballmerpeak.turtlenet.shared.Message;
7  import com.google.gwt.user.client.rpc.RemoteService;
8  import com.google.gwt.user.client.rpc.RemoteServiceRelativePath;
9
10 @RemoteServiceRelativePath("turtlenet")
11 public interface Turtlenet extends RemoteService {
12     String      startTN      (String password);
13     String      stopTN       ();
14     String      isFirstTime  (); //GWT requires an object
15     String      register     (String username, String password);
16
17     String      getUsername   (String key);
18     String      getMyUsername ();
19     String      getPDATA      (String field, String key);
20     String      getMyPDATA    (String field);
21     String      getKey        (String username);
22     String      getMyKey      ();
23     String[][]  getPeople     (); //{{"name1","key1"}, {"name2","key2"}}
24     String[][]  getCategories (); //{{"friends", "false"}, {"family", "true"}}
25     String[][]  getCategoryMembers (String category); //{{"name1","key1"}, {"name2","key2"}}
26     Conversation getConversation (String sig);
27     Conversation[] getConversations ();
28     String[][]  getConversationMessages (String sig);
29     PostDetails[] getWallPosts (String key);
30     CommentDetails[] getComments (String parent);
31     Long        timeMostRecentWallPost (String key);
32     Long        getConvoLastUpdated (String sig);
33     Long        getPostLastCommented (String sig);
34
35     String      claimUsername (String uname);
36     String      updatePDATA   (String field, String newValue);
37     String      updatePDATApermission (String category, boolean value);
38     String[]    createCHAT    (String[] keys); //{"success", "<convo signature>"}
39     String      addMessageToCHAT (String text, String sig);
40     String      like          (String sig);
41     String      unlike        (String sig);
42     String      addCategory    (String name);
43     String      addToCategory  (String category, String key);
44     String      addKey        (String key);
45     String      addPost       (String wallKey, String categoryVisibleTo, String msg);
46     String      addComment    (String parent, String text);
47     String      removeFromCategory (String group, String key);
48     String      revokeMyKey   ();
49 }

```

```

1  package ballmerpeak.turtlenet.client;
2
3  import ballmerpeak.turtlenet.shared.CommentDetails;
4  import ballmerpeak.turtlenet.shared.PostDetails;
5  import ballmerpeak.turtlenet.shared.Conversation;
6  import ballmerpeak.turtlenet.shared.Message;
7  import com.google.gwt.user.client.rpc.AsyncCallback;
8
9  public interface TurtlenetAsync {
10     void startTN      (String password,                AsyncCallback<String> callback);
11     void stopTN       (                                AsyncCallback<String> callback);
12     void isFirstTime  (                                AsyncCallback<String> callback);
13     void register     (String username, String password, AsyncCallback<String> callback);
14
15     void getUsername  (String key,                    AsyncCallback<String> callback);
16     void getMyUsername(                                AsyncCallback<String> callback);
17     void getPDATA     (String field, String pk,        AsyncCallback<String> callback);
18     void getMyPDATA   (String pk,                    AsyncCallback<String> callback);
19     void getKey       (String username,               AsyncCallback<String> callback);
20     void getMyKey     (                                AsyncCallback<String> callback);
21     void getPeople    (                                AsyncCallback<String[][]> callback);
22     void getCategories(                                AsyncCallback<String[][]> callback);
23     void getCategoryMembers (String category,        AsyncCallback<String[][]> callback);
24     void getConversation (String sig,                AsyncCallback<Conversation> callback);
25     void getConversations (String sig,                AsyncCallback<Conversation[]> callback);
26     void getConversationMessages (String sig,        AsyncCallback<String[][]> callback);
27     void getWallPosts (String key,                    AsyncCallback<PostDetails[]> callback);
28     void getComments  (String parent,                AsyncCallback<CommentDetails[]> callback);
29     void timeMostRecentWallPost (String key,         AsyncCallback<Long> callback);
30     void getConvoLastUpdated (String sig,            AsyncCallback<Long> callback);
31     void getPostLastCommented (String sig,           AsyncCallback<Long> callback);
32
33     void claimUsername (String uname,                 AsyncCallback<String> callback);
34     void updatePDATA   (String field, String value,   AsyncCallback<String> callback);
35     void updatePDATAPermission (String category, boolean value, AsyncCallback<String> callback);
36     void createCHAT    (String[] keys,               AsyncCallback<String[]> callback);
37     void addMessageToCHAT (String text, String sig,   AsyncCallback<String> callback);
38     void like          (String sig,                   AsyncCallback<String> callback);
39     void unlike        (String sig,                   AsyncCallback<String> callback);
40     void addCategory   (String name,                  AsyncCallback<String> callback);
41     void addToCategory (String name, String key,      AsyncCallback<String> callback);
42     void addKey        (String key,                   AsyncCallback<String> callback);
43     void addPost       (String key, String categoryVisibleTo, String msg, AsyncCallback<String> callback);
44     void addComment    (String parent, String text,   AsyncCallback<String> callback);
45     void removeFromCategory (String group, String key, AsyncCallback<String> callback);
46     void revokeMyKey   (                                AsyncCallback<String> callback);
47 }

```



```

1  package ballmerpeak.turtlenet.server;
2
3  import ballmerpeak.turtlenet.client.Turtlenet;
4  import com.google.gwt.user.server.rpc.RemoteServiceServlet;
5  import java.io.*;
6  import java.security.*;
7  import ballmerpeak.turtlenet.server.TNClient;
8  import ballmerpeak.turtlenet.server.MessageFactory;
9  import ballmerpeak.turtlenet.shared.Message;
10 import ballmerpeak.turtlenet.shared.Conversation;
11 import ballmerpeak.turtlenet.shared.PostDetails;
12 import ballmerpeak.turtlenet.shared.CommentDetails;
13
14 @SuppressWarnings("serial")
15 public class TurtlenetImpl extends RemoteServiceServlet implements Turtlenet {
16     TNClient c = null;
17
18     public String startTN(String password) {
19         Logger.init("LOG_turtlenet");
20         Logger.write("INFO", "TnImpl", "startTN(" + password + ")");
21         c = new TNClient(password);
22         if (c != null) {
23             Thread t = new Thread(c);
24             t.start();
25             return "success";
26         } else {
27             return "failure";
28         }
29     }
30
31     public String stopTN() {
32         Logger.write("INFO", "TnImpl", "stopTN()");
33         c.running = false;
34         return "success";
35     }
36
37     public String isFirstTime() {
38         return !Database.DBExists() ? "true" : "false"; //GWT can only return objects
39     }
40
41     public String register(String username, String password) {
42         Logger.init("LOG_turtlenet");
43         Logger.write("INFO", "TnImpl", "Registering \"" + username + "\" with PW \"" + password + "\"");
44
45         if (startTN(password).equals("success")) {
46             while(!c.dbReady) {
47                 try{
48                     Logger.write("CRAP", "TnImpl", "WAITING FOR DB");
49                     Thread.sleep(1000); //TODO THIS IS AWFUL PRACTICE
50                 }catch(Exception e){}
51             }
52
53             Logger.write("INFO", "TnImpl", "Started TN...continuing registration");
54             if (claimUsername(username).equals("success")) {
55                 addKey(Crypto.encodeKey(Crypto.getPublicKey()));
56                 return "success";
57             } else {
58                 Logger.write("INFO", "TnImpl", "Username taken");
59                 Logger.write("INFO", "TnImpl", "---REGISTRATION FAIL#tUN---");
60                 return "taken";
61             }
62         } else {
63             Logger.write("ERROR", "TnImpl", "Could not start Turtlenet");
64             Logger.write("ERROR", "TnImpl", "---REGISTRATION FAIL#noTN---");
65             return "failure";
66         }
67     }
68
69     //Profile Data
70     public String getMyUsername() {
71         Logger.write("VERBOSE", "TnImpl", "getMyUsername()");
72         return c.db.getName(Crypto.getPublicKey());
73     }
74
75     public String getUsername(String key) {
76         Logger.write("VERBOSE", "TnImpl", "getUsername(" + key + ")");
77         String name = c.db.getName(Crypto.decodeKey(key));
78         Logger.write("VERBOSE", "TnImpl", "getUsername returning \"" + name + "\"");
79         return name;
80     }
81
82     public String getMyPDATA(String field) {
83         Logger.write("VERBOSE", "TnImpl", "getMyPDATA(" + field + ")");
84         return getPDATA(field, Crypto.encodeKey(Crypto.getPublicKey()));
85     }
86
87     public String getPDATA(String field, String key) {
88         Logger.write("VERBOSE", "TnImpl", "getPDATA(" + field + ", ...)");
89         return c.db.getPDATA(field, Crypto.decodeKey(key));
90     }
91
92     public String getMyKey() {
93         Logger.write("VERBOSE", "TnImpl", "getMyKey()");

```

```

94         return Crypto.encodeKey(Crypto.getPublicKey());
95     }
96
97     public String getKey(String username) {
98         Logger.write("VERBOSE", "TnImpl", "getKey(" + username + ")");
99         return Crypto.encodeKey(c.db.getKey(username));
100     }
101
102     public String[][] getCategories () {
103         Logger.write("VERBOSE", "TnImpl", "getCategories()");
104         return c.db.getCategories();
105     }
106
107     public String[][] getPeople () {
108         Logger.write("VERBOSE", "TnImpl", "getPeople()");
109         return getCategoryMembers("all");
110     }
111
112     public Conversation[] getConversations () {
113         Logger.write("VERBOSE", "TnImpl", "START-----getConversations()");
114         Conversation[] conversations = c.db.getConversations();
115         for (int i = 0; i < conversations.length; i++) {
116             Logger.write("VERBOSE", "TnImpl", "\tSig: " + conversations[i].signature);
117             Logger.write("VERBOSE", "TnImpl", "\tTime: " + conversations[i].timestamp);
118             Logger.write("VERBOSE", "TnImpl", "\tFirst Message: " + conversations[i].firstMessage);
119             Logger.write("VERBOSE", "TnImpl", "\tUsers: " + conversations[i].users.length);
120             Logger.write("VERBOSE", "TnImpl", "\tKeys: " + conversations[i].keys.length);
121         }
122         Logger.write("VERBOSE", "TnImpl", "END -----getConversations()");
123         return conversations;
124     }
125
126     public Conversation getConversation (String sig) {
127         Logger.write("VERBOSE", "TnImpl", "getConversation(...)");
128         return c.db.getConversation(sig);
129     }
130
131     public String[][] getConversationMessages (String sig) {
132         Logger.write("VERBOSE", "TnImpl", "getConversationMessages(...)");
133         return c.db.getConversationMessages(sig);
134     }
135
136     public String[][] getCategoryMembers (String category) {
137         Logger.write("VERBOSE", "TnImpl", "getCategoryMembers(" + category + ")");
138         PublicKey[] keys = c.db.getCategoryMembers(category);
139         String[][] pairs = new String[keys.length][2];
140
141         for (int i = 0; i < keys.length; i++) {
142             pairs[i][0] = c.db.getName(keys[i]);
143             pairs[i][1] = Crypto.encodeKey(keys[i]);
144         }
145
146         return pairs;
147     }
148
149     public PostDetails[] getWallPosts (String key) {
150         Logger.write("VERBOSE", "TnImpl", "getWallPosts(...) ENTERING");
151         Message[] msgs = c.db.getWallPost(Crypto.decodeKey(key));
152         PostDetails[] posts = new PostDetails[msgs.length];
153         for (int i = 0; i < msgs.length; i++) {
154             String sig = msgs[i].getSig();
155             boolean liked = c.db.isLiked(sig);
156             int commentCount = c.db.getComments(sig).length;
157             Long time = msgs[i].getTimestamp();
158             String username = c.db.getName(Crypto.decodeKey(c.db.getWallPostSender(msgs[i].getSig())));
159             String text = msgs[i].POSTgetText();
160
161             posts[i] = new PostDetails(sig, liked, commentCount, time, username, text, Crypto.encodeKey(c.db.getSignatory(msgs
162 [i])));
163         }
164         Logger.write("VERBOSE", "TnImpl", "getWallPosts(...) RETURNING");
165         return posts;
166     }
167
168     public CommentDetails[] getComments (String parent) {
169         Logger.write("VERBOSE", "TnImpl", "START-----getComments(...)");
170         Message[] commentMsgs = c.db.getComments(parent);
171         CommentDetails[] details = new CommentDetails[commentMsgs.length];
172
173         for (int i = 0; i < commentMsgs.length; i++) {
174             CommentDetails thisCmnt = new CommentDetails();
175             thisCmnt.posterKey = Crypto.encodeKey(c.db.getSignatory(commentMsgs[i]));
176             thisCmnt.posterName = c.db.getName(Crypto.decodeKey(thisCmnt.posterKey));
177             thisCmnt.sig = commentMsgs[i].getSig();
178             thisCmnt.text = commentMsgs[i].CMNTgetText();
179             thisCmnt.liked = c.db.isLiked(thisCmnt.sig);
180             details[i] = thisCmnt;
181         }
182         for (int i = 0; i < details.length; i++) {
183             Logger.write("VERBOSE", "TnImpl", "comment sig: " + details[i].sig);
184             Logger.write("VERBOSE", "TnImpl", "comment text: " + details[i].text);
185             Logger.write("VERBOSE", "TnImpl", "comment liked: " + details[i].liked);
186         }
187     }

```

```

186
187     Logger.write("VERBOSE", "TnImpl", "END -----getComments(...)");
188     return details;
189 }
190
191 public Long timeMostRecentWallPost (String key) {
192     return c.db.timeMostRecentWallPost(Crypto.decodeKey(key));
193 }
194
195 public Long getConvoLastUpdated (String sig) {
196     String[][] details = c.db.getConversationMessages(sig);
197     if (details.length > 0)
198         return Long.parseLong(details[details.length-1][1]);
199     else
200         return 0L;
201 }
202
203 public Long getPostLastCommented (String sig) {
204     Message[] comments = c.db.getComments(sig);
205     return comments[comments.length-1].getTimestamp();
206 }
207
208 //Profile Data
209 public String claimUsername (String uname) {
210     Logger.write("VERBOSE", "TnImpl", "claimUsername(" + uname + ")");
211     c.db.addClaim(new MessageFactory().newCLAIM(uname));
212     if(c.connection.claimName(uname))
213         return "success";
214     else
215         return "failure";
216 }
217
218 public String updatePDATA (String field, String value) {
219     String ret = "success";
220     Logger.write("VERBOSE", "TnImpl", "updatePDATA(" + field + ", " + value + ")");
221     PublicKey[] keys = c.db.keysCanSeePDATA();
222     Message message = new MessageFactory().newPDATA(field, value);
223     for (int i = 0; i < keys.length; i++)
224         if (!c.connection.postMessage(message, keys[i]))
225             ret = "failure";
226     if (!c.connection.postMessage(message, Crypto.getPublicKey()))
227         ret = "failure";
228     Parser.parse(message, c.db);
229     return ret;
230 }
231
232 public String updatePDATapermission (String category, boolean value) {
233     Logger.write("VERBOSE", "TnImpl", "updatePDATapermission(" + category + ", " + value + ")");
234     String ret = "success";
235
236     Message msg = new MessageFactory().newUPDATECAT(category, value);
237     ret = c.connection.postMessage(msg, Crypto.getPublicKey())?"success":"failure";
238     if (!c.db.updatePDATapermission(category, value))
239         ret = "failure";
240     if (value) {
241         PublicKey[] keys = c.db.getCategoryMembers(category);
242         for (int i = 0; i < keys.length; i++) {
243             if(!sendPDATA(Crypto.encodeKey(keys[i])).equals("success"))
244                 ret = "failure";
245         }
246     }
247     Parser.parse(msg, c.db);
248
249     return ret;
250 }
251
252 //Posting
253 public String[] createCHAT (String[] keys) {
254     Logger.write("INFO", "TnImpl", "createCHAT(< + keys.length + " keys>)");
255     String[] ret = new String[2];
256     ret[0] = "success";
257
258     String myStrKey = Crypto.encodeKey(Crypto.getPublicKey());
259     int count = 0;
260     int index = 0;
261     for (int i=0; i < keys.length; i++) {
262         if (keys[i].equals(myStrKey)) {
263             count++;
264             index = i;
265         }
266     }
267
268     //add self, or remove double self, from convo participants list
269     String[] newKeys = null;
270     if (count == 0) {
271         newKeys = new String[keys.length+1];
272         for (int i=0; i < keys.length; i++)
273             newKeys[i] = keys[i];
274         newKeys[keys.length] = myStrKey;
275         keys = newKeys;
276     } else if (count == 2) {
277         newKeys = new String[keys.length-1];
278         int j = 0; //javac complains about 'for (int i=0, int j=1;...' for some reason

```

```

279         for (int i=0; i < keys.length; i++)
280             if (i != index)
281                 newKeys[j++] = keys[i];
282         keys = newKeys;
283     }
284
285     Message msg = new MessageFactory().newCHAT(keys);
286     for (int i = 0; i < keys.length; i++)
287         c.connection.postMessage(msg, Crypto.decodeKey(keys[i]));
288     Parser.parse(msg, c.db);
289
290     Logger.write("VERBOSE", "TnImpl", "createCHAT returning " + msg.getSig());
291     ret[1] = msg.getSig();
292     return ret;
293 }
294
295 public String addMessageToCHAT (String text, String sig) {
296     Logger.write("INFO", "TnImpl", "addMessageToCHAT(" + text + ",...)");
297     PublicKey[] keys = c.db.getPeopleInConvo(sig);
298     String ret = "success";
299
300     if (keys.length == 0) {
301         Logger.write("INFO", "TnImpl", "addMessageToCHAT(...) convo has " + Integer.toString(keys.length) + "
participants");
302         return "failure"; //Convo doesn't exist, or we don't know about it yet
303     }
304
305     Logger.write("INFO", "TnImpl", "addMessageToCHAT(...) convo has " + Integer.toString(keys.length) + " participants");
306     Message msg = new MessageFactory().newPCHAT(sig, text);
307     for (int i = 0; i < keys.length; i++)
308         if (!c.connection.postMessage(msg, keys[i]))
309             ret = "failure";
310     Parser.parse(msg, c.db);
311     return ret;
312 }
313
314 public String like (String sig) {
315     Logger.write("VERBOSE", "TnImpl", "like(...)");
316     PublicKey[] visibleTo = c.db.getVisibilityOfParent(sig);
317     Message message = new MessageFactory().newLIKE(sig);
318     String ret = "success";
319
320     for (int i = 0; i < visibleTo.length; i++)
321         if (!c.connection.postMessage(message, visibleTo[i]))
322             ret = "failure";
323     if (!c.connection.postMessage(message, Crypto.getPublicKey()))
324         ret = "failure";
325     Parser.parse(message, c.db);
326
327     return ret;
328 }
329
330 public String unlike (String sig) {
331     Logger.write("VERBOSE", "TnImpl", "unlike(...)");
332     PublicKey[] visibleTo = c.db.getVisibilityOfParent(sig);
333     Message message = new MessageFactory().newUNLIKE(sig);
334     String ret = "success";
335
336     for (int i = 0; i < visibleTo.length; i++)
337         if (!c.connection.postMessage(message, visibleTo[i]))
338             ret = "failure";
339     if (!c.connection.postMessage(message, Crypto.getPublicKey()))
340         ret = "failure";
341     Parser.parse(message, c.db);
342
343     return ret;
344 }
345
346 //Friends
347 public String addCategory (String name) {
348     Logger.write("VERBOSE", "TnImpl", "addCategory(" + name + ")");
349     Message msg = new MessageFactory().newADDCAT(name, false);
350
351     return (c.db.addCategory(name, false) &&
352            c.connection.postMessage(msg, Crypto.getPublicKey()))
353            ? "success" : "failure";
354 }
355
356 public String addToCategory (String group, String key) {
357     Logger.write("VERBOSE", "TnImpl", "addToCategory(" + group + ",...)");
358
359     boolean alreadyMember = false;
360     PublicKey[] members = c.db.getCategoryMembers(group);
361     for (int i = 0; i < members.length; i++)
362         if (members[i].equals(Crypto.decodeKey(key)))
363             alreadyMember = true;
364
365     if (!alreadyMember) {
366         if (c.db.addToCategory(group, Crypto.decodeKey(key))) {
367             Message msg = new MessageFactory().newADDCAT(group, key);
368             c.connection.postMessage(msg, Crypto.getPublicKey());
369             if (c.db.canSeePDATA(group)) {
370                 return sendPDATA(key).equals("success") ? "success" : "failure";

```

```

371         } else {
372             return "success";
373         }
374
375         //We do not retroactively send people posts/comments/likes because
376         // people will forget what they've posted in the past and accidentally
377         // share it with new contacts.
378     } else {
379         return "failure";
380     }
381 } else {
382     Logger.write("WARNING", "TnImpl", "Duplicate entry to tCategoryMembers prevented");
383     return "failure";
384 }
385 }
386
387 public String sendPDATA (String key) {
388     String[] values = {"email", "name", "gender", "birthday"};
389     String[] fields = {getMyPDATA("email"), getMyPDATA("name"), getMyPDATA("gender"), getMyPDATA("birthday")};
390     return c.connection.postMessage(new MessageFactory().newPDATA(fields, values),
391                                   Crypto.decodeKey(key))
392         ? "success" : "failure";
393 }
394
395 public String removeFromCategory (String group, String key) {
396     Logger.write("VERBOSE", "TnImpl", "removeFromCategory(" + group + ",...)");
397     Message msg = new MessageFactory().newREMFROMCAT(group, key);
398     c.connection.postMessage(msg, Crypto.getPublicKey());
399     return c.db.removeFromCategory(group, Crypto.decodeKey(key))?"success":"failure";
400 }
401
402 public String addKey (String key) {
403     Logger.write("VERBOSE", "TnImpl", "addKey(...)");
404     Message msg = new MessageFactory().newADDKEY(key);
405     return (c.db.addKey(Crypto.decodeKey(key)) &&
406            c.connection.postMessage(msg, Crypto.getPublicKey())) ? "success":"failure";
407 }
408
409 public String addPost (String wallKey, String categoryVisibleTo, String msg) {
410     Logger.write("VERBOSE", "TnImpl", "addPost(..., " + msg + ")");
411     PublicKey[] visibleTo = c.db.getCategoryMembers(categoryVisibleTo);
412     String[] visibleToStr = new String[visibleTo.length];
413     String ret = "success";
414
415     for (int i = 0; i < visibleTo.length; i++)
416         visibleToStr[i] = Crypto.encodeKey(visibleTo[i]);
417     Message message = new MessageFactory().newPOST(msg, wallKey, visibleToStr);
418
419     for (int i = 0; i < visibleTo.length; i++)
420         if (!c.connection.postMessage(message, visibleTo[i]))
421             ret = "failure";
422     if (!c.connection.postMessage(message, Crypto.getPublicKey()))
423         ret = "failure";
424     Parser.parse(message, c.db);
425
426     return ret;
427 }
428
429 public String addComment (String parent, String text) {
430     Logger.write("VERBOSE", "TnImpl", "addComment(..., " + text + ")");
431     PublicKey[] visibleTo = c.db.getVisibilityOfParent(parent);
432     Message message = new MessageFactory().newCMNT(parent, text);
433     String ret = "success";
434
435     Logger.write("VERBOSE", "TnImpl", "=====POSTING COMMENT TO " + visibleTo.length + " people");
436
437     for (int i = 0; i < visibleTo.length; i++)
438         if (!c.connection.postMessage(message, visibleTo[i]))
439             ret = "failure";
440     if (!c.connection.postMessage(message, Crypto.getPublicKey()))
441         ret = "failure";
442     Parser.parse(message, c.db);
443
444     return ret;
445 }
446
447 //Bad stuff
448 public String revokeMyKey () {
449     Logger.write("VERBOSE", "TnImpl", "-----revokeMyKey()-----");
450     PublicKey[] keys = c.db.getCategoryMembers("all");
451     String ret = "success";
452
453     for (int i = 0; i < keys.length; i++)
454         if (!c.connection.postMessage(new MessageFactory().newREVOKE(0), keys[i])) //Can't be sent in cleartext,
serverops could suppress it
455             ret = "failure";
456
457     //erase db and keypair
458     new File(Database.path + "/lastread").delete();
459     new File(Database.path + "/public.key").delete();
460     new File(Database.path + "/private.key").delete();
461     new File(Database.path + "/turtlenet.db").delete();
462     new File(Database.path).delete();

```

```
463
464         return ret;
465     }
466 }
```

```

1  //All methods ought to be static
2  package ballmerpeak.turtlenet.server;
3
4  import ballmerpeak.turtlenet.server.FIO;
5  import ballmerpeak.turtlenet.shared.Message;
6  import java.io.*;
7  import java.security.*;
8  import javax.crypto.Cipher;
9  import javax.crypto.KeyGenerator;
10 import javax.crypto.SecretKey;
11 import java.security.spec.X509EncodedKeySpec;
12 import javax.crypto.spec.SecretKeySpec;
13 import javax.crypto.spec.IvParameterSpec;
14 import javax.xml.bind.DatatypeConverter;
15 import java.util.StringTokenizer;
16 import java.security.SecureRandom;
17
18 public class Crypto {
19     public static SecureRandom srand = new SecureRandom(
20         Long.toString(
21             System.currentTimeMillis())
22         .getBytes());
23
24     public static Boolean keysExist() {
25         File publicKey = new File(Database.path + "/public.key");
26         File privateKey = new File(Database.path + "/private.key");
27         return publicKey.exists() && privateKey.exists();
28     }
29
30     public static void keyGen() {
31         try {
32             Logger.write("INFO", "Crypto", "Generating keys");
33
34             //generate the key
35             KeyPairGenerator gen = KeyPairGenerator.getInstance("RSA");
36             gen.initialize(1024, srand);
37             KeyPair keys = gen.generateKeyPair();
38
39             //create the DB directory if needed
40             if (!Database.DBDirExists())
41                 Database.createDBDir();
42
43             //and save the keys into it
44             ObjectOutputStream publicKeyFile = new ObjectOutputStream(
45                 new FileOutputStream(
46                     new File("./db/public.key")));
47             publicKeyFile.writeObject(keys.getPublic());
48             publicKeyFile.close();
49
50             ObjectOutputStream privateKeyFile = new ObjectOutputStream(
51                 new FileOutputStream(
52                     new File("./db/private.key")));
53             privateKeyFile.writeObject(keys.getPrivate());
54             privateKeyFile.close();
55         } catch (Exception e) {
56             Logger.write("ERROR", "Crypto", "Could not generate keypair");
57         }
58     }
59
60     //encrypt all files in db folder, rename to <filename>.aes
61     public static boolean encryptDB(String password) {
62         Logger.write("VERBOSE", "Crypto", "encryptDB(" + password + ")");
63         try {
64             String salt = Long.toString(System.currentTimeMillis());
65             password += salt;
66             FIO.writeFileBytes(salt.getBytes("UTF-8"), Database.path + "/salt");
67             FIO.writeFileBytes(encryptBytes(FIO.readFileBytes(Database.path + "/turtlenet.db"), password+"db"), Database.path
68 + "/turtlenet.db.aes");
69             FIO.writeFileBytes(encryptBytes(FIO.readFileBytes(Database.path + "/public.key"), password+"pu"), Database.path +
70 + "/public.key.aes");
71             FIO.writeFileBytes(encryptBytes(FIO.readFileBytes(Database.path + "/private.key"), password+"pr"), Database.path
72 + "/private.key.aes");
73             FIO.writeFileBytes(encryptBytes(FIO.readFileBytes(Database.path + "/lastread"), password+"lr"), Database.path + "/"
74 + "lastread.aes");
75             new File(Database.path + "/turtlenet.db").delete();
76             new File(Database.path + "/public.key").delete();
77             new File(Database.path + "/private.key").delete();
78             new File(Database.path + "/lastread").delete();
79         } catch (Exception e) {
80             Logger.write("FATAL", "Crypto", "Unable to encrypt files: " + e);
81             return false;
82         }
83         return true;
84     }
85
86     //decrypt all files <filename>.aes in db folder, rename to <filename>
87     public static boolean decryptDB(String password) {
88         Logger.write("VERBOSE", "Crypto", "decryptDB(" + password + ")");
89         try {
90             password += new String(FIO.readFileBytes(Database.path + "/salt"));
91             FIO.writeFileBytes(decryptBytes(FIO.readFileBytes(Database.path + "/turtlenet.db.aes"), password+"db"),
92 Database.path + "/turtlenet.db");
93             FIO.writeFileBytes(decryptBytes(FIO.readFileBytes(Database.path + "/public.key.aes"), password+"pu"),

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```

    Database.path + "/public.key");
89     FIO.writeFileBytes(decryptBytes(FIO.readFileBytes(Database.path + "/private.key.aes"), password+"pr"),
    Database.path + "/private.key");
90     FIO.writeFileBytes(decryptBytes(FIO.readFileBytes(Database.path + "/lastread.aes"), password+"lr"), Database.path
+ "/lastread");
91     new File(Database.path + "/turtlenet.db.aes").delete();
92     new File(Database.path + "/public.key.aes").delete();
93     new File(Database.path + "/private.key.aes").delete();
94     new File(Database.path + "/lastread.aes").delete();
95     new File(Database.path + "/salt").delete();
96 } catch (Exception e) {
97     Logger.write("FATAL", "Crypto", "Unable to decrypt files: " + e);
98     return false;
99 }
100 return false;
101 }
102
103 public static KeyPair getTestKey() {
104     Logger.write("INFO", "Crypto", "Generating test keypair");
105     try {
106         KeyPairGenerator gen = KeyPairGenerator.getInstance("RSA");
107         gen.initialize(1024, srnd);
108         return gen.generateKeyPair();
109     } catch (Exception e) {
110         Logger.write("ERROR", "Crypto", "Couldn't generate test keypair: " + e);
111         return null;
112     }
113 }
114
115 public static PublicKey getPublicKey() {
116     try {
117         ObjectInputStream file = new ObjectInputStream(
118             new FileInputStream(
119                 new File("./db/public.key")));
120         return (PublicKey) file.readObject();
121     } catch (Exception e) {
122         Logger.write("WARNING", "Crypto", "Could not read public key");
123     }
124     return null;
125 }
126
127 public static PrivateKey getPrivateKey() {
128     try {
129         ObjectInputStream file = new ObjectInputStream(
130             new FileInputStream(
131                 new File("./db/private.key")));
132         return (PrivateKey) file.readObject();
133     } catch (Exception e) {
134         Logger.write("WARNING", "Crypto", "Could not read private key");
135     }
136     return null;
137 }
138
139 public static String sign (Message msg) {
140     Logger.write("INFO", "Crypto", "sign()");
141     return sign(msg, Crypto.getPrivateKey());
142 }
143
144 public static String sign (Message msg, PrivateKey k) {
145     Logger.write("INFO", "Crypto", "sign()");
146     try {
147         Signature signer = Signature.getInstance("SHA1withRSA");
148         signer.initSign(k);
149         signer.update((Long.toString(msg.timestamp) + msg.content).getBytes("UTF-8"));
150         byte[] sig = signer.sign();
151         return Crypto.Base64Encode(sig);
152     } catch (Exception e) {
153         Logger.write("ERROR", "Crypto", "Could not sign message");
154     }
155     return "";
156 }
157
158 public static String hash (String data) {
159     try {
160         MessageDigest hasher = MessageDigest.getInstance("SHA-256");
161         return DatatypeConverter.printHexBinary(hasher.digest(data.getBytes("UTF-8")));
162     } catch (Exception e) {
163         Logger.write("FATAL", "DB", "SHA-256 not supported by your JRE");
164     }
165     return "not_a_hash";
166 }
167
168 public static boolean verifySig (Message msg, PublicKey author) {
169     Logger.write("INFO", "Crypto", "verifySig()");
170     try {
171         Signature sigChecker = Signature.getInstance("SHA1withRSA");
172         sigChecker.initVerify(author);
173         sigChecker.update((Long.toString(msg.getTimestamp())+msg.getContent()).getBytes("UTF-8"));
174         boolean valid = sigChecker.verify(Crypto.Base64Decode(msg.getSig()));
175         if (valid) {
176             Logger.write("INFO", "Crypto", "verifySig() - TRUE");
177         } else {
178             Logger.write("INFO", "Crypto", "verifySig() - FALSE");

```



```

179         }
180         return valid;
181     } catch (Exception e) {
182         Logger.write("ERROR", "Crypto", "Could not verify signature");
183     }
184     return false;
185 }
186
187 //Time differentials can, and have, been used to corrolate otherwise
188 // anonymous messages; therefore server time is used. This is not to
189 // protect against malicious server operators, but operators ordered after
190 // the fact to provide the data they've collected.
191 //The NetworkConnection is used to get the servers time.
192 public static String encrypt(Message msg, PublicKey recipient, NetworkConnection connection) {
193     try {
194         Logger.write("INFO", "Crypto", "encrypt()");
195         //encrypt with random AES key
196         byte[] iv = new byte[16];
197         byte[] aeskey = new byte[16];
198         srand.nextBytes(iv); //fills the array with random data
199         srand.nextBytes(aeskey);
200
201         SecretKeySpec aesKeySpec = new SecretKeySpec(aeskey, "AES");
202         IvParameterSpec IVSpec = new IvParameterSpec(iv);
203
204         Cipher aes = Cipher.getInstance("AES/CBC/PKCS5Padding");
205         aes.init(Cipher.ENCRYPT_MODE, aesKeySpec, IVSpec);
206         byte[] aesCipherText = aes.doFinal(msg.toString().getBytes("UTF-8"));
207
208         //encrypt AES key with RSA
209         Cipher rsa = Cipher.getInstance("RSA");
210         rsa.init(Cipher.ENCRYPT_MODE, recipient);
211         byte[] encryptedAESKey = rsa.doFinal(aeskey);
212
213         //iv\RSA encrypted AES key\cipher text"
214         return Crypto.Base64Encode(iv) + "\\\" + Crypto.Base64Encode(encryptedAESKey) + "\\\" +
215             Crypto.Base64Encode(aesCipherText);
216     } catch (Exception e) {
217         Logger.write("WARNING", "Crypto", "Unable to encrypt message: " + e);
218     }
219     return "";
220 }
221
222 public static Message decrypt(String msg) {
223     Logger.write("INFO", "Crypto", "decrypt()");
224     try {
225         //claim messages are the only plaintext in the system, still need decoding
226         if (msg.substring(0,2).equals("c ")) {
227             String decoding = new String(Crypto.Base64Decode(msg.substring(2)));
228             return Message.parse(decoding);
229         }
230
231         String[] tokens = new String[3];
232         StringTokenizer tokenizer = new StringTokenizer(msg, "\\\"", false);
233         tokens[0] = tokenizer.nextToken();
234         tokens[1] = tokenizer.nextToken();
235         tokens[2] = tokenizer.nextToken();
236
237         byte[] iv = Crypto.Base64Decode(tokens[0]);
238         byte[] cipheredKey = Crypto.Base64Decode(tokens[1]);
239         byte[] cipherText = Crypto.Base64Decode(tokens[2]);
240
241         //decrypt AES key
242         Cipher rsa = Cipher.getInstance("RSA");
243         rsa.init(Cipher.DECRYPT_MODE, getPrivateKey());
244         byte[] aesKey = rsa.doFinal(cipheredKey);
245
246         //decrypt AES Ciphertext
247         SecretKeySpec aesKeySpec = new SecretKeySpec(aesKey, "AES");
248         IvParameterSpec IVSpec = new IvParameterSpec(iv);
249         Cipher aes = Cipher.getInstance("AES/CBC/PKCS5Padding");
250         aes.init(Cipher.DECRYPT_MODE, aesKeySpec, IVSpec);
251         byte[] messagePlaintext = aes.doFinal(cipherText);
252
253         return Message.parse(new String(messagePlaintext));
254     } catch (Exception e) {
255         //This is to be expected for messages not addressed to you
256         //Logger.write("WARNING", "Crypto", "Unable to decrypt message: " + e);
257     }
258     return new Message("NULL", "", 0, "");
259 }
260
261 public static String encodeKey (PublicKey key) {
262     if (key != null) {
263         return Base64Encode(key.getEncoded());
264     } else {
265         Logger.write("ERROR", "Crypto", "encodeKey passed null key");
266         return "--INVALID KEYSTRING--";
267     }
268 }
269
270 public static PublicKey decodeKey (String codedKey) {
271     if (codedKey != null) {

```

```
272         try {
273             return KeyFactory.getInstance("RSA").generatePublic(
274                 new X509EncodedKeySpec(Base64Decode(codedKey)));
275         } catch (Exception e) {
276             Logger.write("ERROR", "Crypto", "decodeKey(" + codedKey + ") passed invalid keystore");
277             return null;
278         }
279     }
280     Logger.write("WARNING", "Crypto", "decodeKey(...) returning null - passed invalid keystore");
281     return null;
282 }
283
284 public static String Base64Encode (byte[] data) {
285     return DatatypeConverter.printBase64Binary(data);
286 }
287
288 public static byte[] Base64Decode (String data) {
289     return DatatypeConverter.parseBase64Binary(data);
290 }
291
292 public static int rand (int min, int max) {
293     int range = max - min;
294     return (int)(Math.random() * (range + 1)) + min;
295 }
296
297 public static byte[] encryptBytes (byte[] data, String key) {
298     try {
299         SecretKeySpec spec = new SecretKeySpec(getAESKey(key), "AES");
300         Cipher cipher = Cipher.getInstance("AES");
301         cipher.init(Cipher.ENCRYPT_MODE, spec);
302         return cipher.doFinal(data);
303     } catch (Exception e) {
304         Logger.write("FATAL", "Crypto", "Could not encrypt bytes: " + e);
305         return null;
306     }
307 }
308
309 public static byte[] decryptBytes (byte[] data, String key) {
310     try {
311         SecretKeySpec spec = new SecretKeySpec(getAESKey(key), "AES");
312         Cipher cipher = Cipher.getInstance("AES");
313         cipher.init(Cipher.DECRYPT_MODE, spec);
314         return cipher.doFinal(data);
315     } catch (Exception e) {
316         Logger.write("FATAL", "Crypto", "Could not decrypt bytes: " + e);
317         return null;
318     }
319 }
320
321 private static byte[] getAESKey(String password) {
322     try {
323         byte[] pwBytes = password.getBytes("UTF-8");
324         KeyGenerator gen = KeyGenerator.getInstance("AES");
325         SecureRandom srandAES = SecureRandom.getInstance("SHA1PRNG");
326         srandAES.setSeed(pwBytes);
327         gen.init(128, srandAES);
328         SecretKey key = gen.generateKey();
329         return key.getEncoded();
330     } catch (Exception e) {
331         Logger.write("FATAL", "Crypto", "Could not get AES key: " + e);
332         return null;
333     }
334 }
335 }
```

```

1  package ballmerpeak.turtlenet.server;
2
3  import ballmerpeak.turtlenet.shared.Message;
4  import ballmerpeak.turtlenet.shared.Conversation;
5  import java.security.*;
6  import java.sql.*;
7  import java.security.*;
8  import java.util.List;
9  import java.io.File;
10 import java.util.Vector;
11 import java.util.Arrays;
12
13 public class Database {
14     public static String path = "./db"; //path to database directory
15     private Connection dbConnection;
16     private String password = "UNSET";
17
18     public Database (String pw) {
19         password = pw;
20         dbConnection = null;
21         if (DBExists()) dbConnect(true); else dbCreate();
22     }
23
24     public static boolean DBDirExists() {
25         File dir = new File(path);
26         return dir.exists();
27     }
28
29     public static boolean DBExists() {
30         File edb = new File(path + "/turtlenet.db.aes");
31         File db = new File(path + "/turtlenet.db");
32         return db.exists() || edb.exists();
33     }
34
35     public static boolean createDBDir() {
36         return (new File(path)).mkdirs();
37     }
38
39     //Creates a database from scratch
40     public void dbCreate() {
41         Logger.write("INFO", "DB", "Creating database");
42         try {
43             if (!Database.DBDirExists())
44                 Database.createDBDir();
45             dbConnect(false);
46             for (int i = 0; i < DBStrings.createDB.length; i++)
47                 execute(DBStrings.createDB[i]);
48         } catch (Exception e) {
49             Logger.write("FATAL", "DB", "Failed to create databse: " + e);
50         }
51     }
52
53     //Connects to a pre-defined database
54     public boolean dbConnect(boolean dbexists) {
55         if (dbexists)
56             if (!Crypto.decryptDB(password))
57                 Logger.write("FATAL", "DB", "failed to decrypt database");
58
59         Logger.write("INFO", "DB", "Connecting to database");
60         try {
61             Class.forName("org.sqlite.JDBC");
62             dbConnection = DriverManager.getConnection("jdbc:sqlite:db/turtlenet.db");
63             return true;
64         } catch (Exception e) { //Exception logged to disk, program allowed to crash naturally
65             Logger.write("FATAL", "DB", "Could not connect: " + e.getClass().getName() + ": " + e.getMessage() );
66             return false;
67         }
68     }
69
70     //Disconnects the pre-defined database
71     public void dbDisconnect() {
72         Logger.write("INFO", "DB", "Disconnecting from database");
73         try {
74             dbConnection.close();
75         } catch (Exception e) { //Exception logged to disk, program allowed to continue
76             Logger.write("FATAL", "DB", "Could not disconnect: " + e.getClass().getName() + ": " + e.getMessage() );
77         }
78
79         if (!Crypto.encryptDB(password))
80             Logger.write("FATAL", "DB", "failed to encrypt database");
81     }
82
83     public void execute (String query) throws java.sql.SQLException {
84         try {
85             /*
86             if (query.indexOf('(') != -1)
87                 Logger.write("VERBOSE", "DB", "execute(\"" + query.substring(0,query.indexOf('(') + "...\"");
88             else
89                 Logger.write("VERBOSE", "DB", "execute(\"" + query.substring(0,20) + "...\"");
90             */
91             Logger.write("VERBOSE", "DB", "execute(\"" + query + "\"");
92
93             Statement statement = dbConnection.createStatement();

```

```

94         statement.setQueryTimeout(30);
95         dbConnection.setAutoCommit(false);
96         statement.executeUpdate(query);
97         dbConnection.commit();
98         dbConnection.setAutoCommit(true);
99     } catch (java.sql.SQLException e) {
100         Logger.write("ERROR", "DB", "SQLException: " + e);
101         throw e;
102     }
103 }
104
105 public ResultSet query (String query) throws java.sql.SQLException {
106     /*
107     if (query.indexOf('(') != -1)
108         Logger.write("VERBOSE", "DB", "query(\"" + query.substring(0,query.indexOf('(')) + "...\"");
109     else
110         Logger.write("VERBOSE", "DB", "query(\"" + query.substring(0,20) + "...\"");
111     */
112     Logger.write("VERBOSE", "DB", "query(\"" + query + "\")");
113
114     try {
115         Statement statement = dbConnection.createStatement();
116         statement.setQueryTimeout(30);
117         ResultSet r = statement.executeQuery(query);
118         return r;
119     } catch (java.sql.SQLException e) {
120         Logger.write("RED", "DB", "Failed to query database: " + e);
121         throw e;
122     }
123 }
124
125 //Get from DB
126 public String getPDATA(String field, PublicKey key) {
127     Logger.write("VERBOSE", "DB", "getPDATA(" + field + ",...)");
128     String value = "";
129     try {
130         String strKey = Crypto.encodeKey(key);
131         String sqlStatement = DBStrings.getPDATA.replace("__FIELD__", field);
132         sqlStatement = sqlStatement.replace("__KEY__", strKey); //mods SQL template
133
134         ResultSet results = query(sqlStatement);
135         if(results.next())
136             value = results.getString(field); //gets current value in 'field'
137         else
138             value = "<No Value>";
139     } catch (java.sql.SQLException e) {
140         Logger.write("ERROR", "DB", "SQLException: " + e);
141     }
142
143     if (value != null)
144         return value;
145     else
146         return "<no value>";
147 }
148
149 //Set the CMD to POST in the Message constructor
150 public Message[] getWallPost (PublicKey key) {
151     Logger.write("VERBOSE", "DB", "getWallPost(...)");
152     Vector<Message> posts = new Vector<Message>();
153     try {
154         String sqlStatement = DBStrings.getWallPostSigs.replace("__KEY__", Crypto.encodeKey(key) );
155         ResultSet results = query(sqlStatement);
156
157         while (results.next()) {
158             Vector<String> visibleTo = new Vector<String>();
159             ResultSet currentPost = query(DBStrings.getPost.replace("__SIG__", results.getString("sig")));
160             ResultSet currentPostVisibleTo = query(DBStrings.getVisibleTo.replace("__SIG__", results.getString("sig")));
161             while(currentPostVisibleTo.next())
162                 visibleTo.add(currentPostVisibleTo.getString("key") );
163
164             if(currentPost.next()) {
165                 Message m = new MessageFactory().newPOST(currentPost.getString("msgText"), currentPost.getString
166 ("recieverKey"), (visibleTo.toArray(new String[0])) );
167                 m.timestamp = Long.parseLong(currentPost.getString("time"));
168                 m.signature = currentPost.getString("sig");
169                 m.command = "POST";
170                 posts.add(m);
171             }
172         } catch (java.sql.SQLException e) {
173             Logger.write("ERROR", "DB", "SQLException: " + e);
174         }
175
176         return posts.toArray(new Message[0]);
177     }
178
179 public String getWallPostSender (String sig) {
180     Logger.write("VERBOSE", "DB", "getWallPostSender(...)");
181     try {
182         ResultSet sendersKey = query(DBStrings.getPostSender.replace("__SIG__", sig));
183         if (sendersKey.next())
184             return sendersKey.getString("sendersKey");
185         else

```

```

186         return "<POST DOESN'T EXIST>";
187     } catch (java.sql.SQLException e) {
188         Logger.write("ERROR", "DB", "SQLException: " + e);
189         return "ERROR";
190     }
191 }
192
193 public Message[] getComments (String sig) {
194     Vector<Message> comments = new Vector<Message>();
195     Logger.write("VERBOSE", "DB", "getComments(...)");
196
197     try {
198         ResultSet commentSet = query(DBStrings.getComments.replace("__PARENT__", sig));
199         while (commentSet.next()) {
200             Message cmnt = new MessageFactory().newCMNT(sig, commentSet.getString("msgText"));
201             cmnt.timestamp = Long.parseLong(commentSet.getString("creationTime"));
202             cmnt.signature = commentSet.getString("sig");
203             comments.add(cmnt);
204         }
205     } catch (java.sql.SQLException e) {
206         Logger.write("ERROR", "DB", "SQLException: " + e);
207     }
208
209     return comments.toArray(new Message[0]);
210 }
211
212 public Long timeMostRecentWallPost (PublicKey key) {
213     Logger.write("VERBOSE", "DB", "timeMostRecentWallPost(...)");
214     try {
215         ResultSet mostRecent = query(DBStrings.mostRecentWallPost.replace("__KEY__", Crypto.encodeKey(key)));
216         if (mostRecent.next())
217             return Long.parseLong(mostRecent.getString("maxtime"));
218     } catch (java.sql.SQLException e) {
219         Logger.write("ERROR", "DB", "SQLException: " + e);
220     }
221     return 0L;
222 }
223
224 public boolean isLiked (String sig) {
225     Logger.write("VERBOSE", "DB", "isLiked(...)");
226     int ret = 0;
227
228     try {
229         ResultSet row = query(DBStrings.getLike.replace("__SIG__", sig));
230         return row.next();
231     } catch (java.sql.SQLException e) {
232         Logger.write("ERROR", "DB", "SQLException: " + e);
233     }
234
235     return false;
236 }
237
238 //Return all conversations
239 public Conversation[] getConversations () {
240     Vector<Conversation> convoList = new Vector<Conversation>();
241     Logger.write("VERBOSE", "DB", "getConversations()");
242
243     try {
244         ResultSet convoSet = query(DBStrings.getConversations);
245         while (convoSet.next())
246             convoList.add(getConversation(convoSet.getString("convoID")));
247     } catch (java.sql.SQLException e) {
248         Logger.write("ERROR", "DB", "SQLException: " + e);
249     }
250
251     return convoList.toArray(new Conversation[0]);
252 }
253
254 //Get keys of all people in the given conversation
255 public PublicKey[] getPeopleInConvo (String sig) {
256     Logger.write("VERBOSE", "DB", "getPeopleInConvo(...)");
257     Vector<PublicKey> keys = new Vector<PublicKey>();
258
259     try {
260         ResultSet keySet = query(DBStrings.getConversationMembers.replace("__SIG__", sig));
261         while (keySet.next())
262             keys.add(Crypto.decodeKey(keySet.getString("key")));
263     } catch (java.sql.SQLException e) {
264         Logger.write("ERROR", "DB", "SQLException: " + e);
265     }
266
267     return keys.toArray(new PublicKey[0]);
268 }
269
270 //Return a conversation object
271 public Conversation getConversation (String sig) {
272     Logger.write("VERBOSE", "DB", "getConversation(...)");
273     try {
274         ResultSet convoSet = query(DBStrings.getConversation.replace("__SIG__", sig));
275         if (convoSet.next()) {
276             String timestamp = convoSet.getString("time");
277             ResultSet messages = query(DBStrings.getConversationMessages.replace("__SIG__", sig));
278             String firstMsg;

```

```

279         if (messages.next())
280             firstMsg = messages.getString("msgText");
281         else
282             firstMsg = "<no messages yet>";
283         PublicKey[] keys = getPeopleInConvo(sig);
284         String[] keystings = new String[keys.length];
285         String[] users = new String[keys.length];
286         for (int i = 0; i < keys.length; i++) {
287             keystings[i] = Crypto.encodeKey(keys[i]);
288             users[i] = getName(keys[i]);
289         }
290         return new Conversation(sig, timestamp, firstMsg, users, keystings);
291     } else {
292         Logger.write("WARNING", "DB", "getConversation(...) empty conversation: " + sig);
293     }
294 } catch (java.sql.SQLException e) {
295     Logger.write("ERROR", "DB", "SQLException: " + e);
296 }
297 return new Conversation();
298 }
299
300 //Return all messages in a conversation
301 //{{username, time, msg}, {username, time, msg}, etc.}
302 //Please order it so that element 0 is the oldest message
303 public String[][] getConversationMessages (String sig) {
304     Logger.write("VERBOSE", "DB", "getConversationMessages(...)");
305     Vector<String[]> messagesList = new Vector<String[]>();
306
307     try {
308         ResultSet messageSet = query(DBStrings.getConversationMessages.replace("__SIG__", sig));
309         while(messageSet.next() ) {
310             String[] message = new String[3];
311             message[0] = getName(Crypto.decodeKey(messageSet.getString("sendersKey")));
312             message[1] = messageSet.getString("time");
313             message[2] = messageSet.getString("msgText");
314
315             messagesList.add(message);
316         }
317     } catch (java.sql.SQLException e) {
318         Logger.write("ERROR", "DB", "SQLException: " + e);
319     }
320
321     return messagesList.toArray(new String[0][0]);
322 }
323
324 //If multiple people have the same username then:
325 //Logger.write("FATAL", "DB", "Duplicate usernames");
326 //System.exit(1);
327 public PublicKey getKey (String userName) {
328     Logger.write("VERBOSE", "DB", "getKey(" + userName + ")");
329     int nameCount = 0;
330     String key = "<No Key>";
331
332     try {
333         ResultSet results = query(DBStrings.getKey.replace("__USERNAME__", userName) );
334         while(results.next()) {
335             nameCount++;
336             key = results.getString("key");
337         }
338     } catch (java.sql.SQLException e) {
339         Logger.write("ERROR", "DB", "SQLException: " + e);
340     }
341
342     if(nameCount == 0)
343         Logger.write("ERROR", "DB", "getKey(" + userName + ") - No keys found for userName");
344     else if (nameCount > 1)
345         Logger.write("ERROR", "DB", "getKey(" + userName + ") - Multple userNames found for key; Server OPs are evil!");
346
347     return Crypto.decodeKey(key);
348 }
349
350 public boolean canSeePDATA (String category) {
351     Logger.write("VERBOSE", "DB", "canSeePDATA()");
352
353     try {
354         ResultSet categorySet = query(DBStrings.canSeePDATA.replace("__CATID__", category));
355         if (categorySet.next()) {
356             return categorySet.getInt("canSeePDATA") == 1 ? true : false;
357         }
358     } catch (java.sql.SQLException e) {
359         Logger.write("ERROR", "DB", "SQLException: " + e);
360     }
361
362     return false;
363 }
364
365 //Return the name of each member and if it can see your profile info
366 //In this format: {"friends", "false"}, {"family", "true"}, etc.}
367 public String[][] getCategories () {
368     Logger.write("VERBOSE", "DB", "getCategories()");
369     Vector<String[]> catList = new Vector<String[]>();
370     String catName;
371     String canSeePDATA;

```

```

372
373     try {
374         ResultSet categorySet = query(DBStrings.getCategories());
375         while(categorySet.next() ) {
376             String[] category = new String[2];
377             category[0] = categorySet.getString("catID");
378             category[1] = categorySet.getInt("canSeePDATA") == 1 ? "true" : "false";
379             catList.add(category);
380         }
381     } catch (java.sql.SQLException e) {
382         Logger.write("ERROR", "DB", "SQLException: " + e);
383     }
384
385     Logger.write("VERBOSE", "DB", "getCategories() returning " + catList.toArray().length + " categories");
386     return catList.toArray(new String[0][0]);
387 }
388
389 //Return the keys of each member of the category
390 //if(category.equals("all")) //remember NEVER to compare strings with ==
391 //    return every key you know about
392 public PublicKey[] getCategoryMembers (String catID) {
393     Logger.write("VERBOSE", "DB", "getCategoryMembers(" + catID + ")");
394     String queryStr = "";
395
396     if(catID.toLowerCase().equals("all"))
397         queryStr = DBStrings.getAllKeys;
398     else
399         queryStr = DBStrings.getMemberKeys.replace("__CATNAME__", catID);
400
401     Vector<PublicKey> keyList = new Vector<PublicKey>();
402
403     try {
404         ResultSet keySet = query(queryStr);
405         while(keySet.next()) {
406             if(catID.toLowerCase().equals("all"))
407                 keyList.add(Crypto.decodeKey(keySet.getString("key")));
408             else
409                 keyList.add(Crypto.decodeKey(keySet.getString("userKey")));
410         }
411     } catch (java.sql.SQLException e) {
412         Logger.write("ERROR", "DB", "SQLException: " + e);
413     }
414
415     Logger.write("VERBOSE", "DB", "getCategoryMembers(" + catID + ") returning " + keyList.toArray().length + " members");
416     return keyList.toArray(new PublicKey[0]);
417 }
418
419 //Given the sig of a post or comment return the keys which can see it
420 public PublicKey[] getVisibilityOfParent(String sig) {
421     Logger.write("VERBOSE", "DB", "getVisibilityOfParent(" + sig + ")");
422
423     try {
424         ResultSet postWithSig = query(DBStrings.getPost.replace("__SIG__", sig));
425         if (postWithSig.next()) { //sig is a post
426             Logger.write("VERBOSE", "DB", "parent is a wall post: " + sig);
427             return getPostVisibleTo(sig);
428         } else { //sig is a comment
429             ResultSet commentWithSig = query(DBStrings.getComment.replace("__SIG__", sig));
430             if (commentWithSig.next())
431                 return getVisibilityOfParent(commentWithSig.getString("parent"));
432             else
433                 Logger.write("ERROR", "DB", "getVisibilityOfParent has no root");
434         }
435     } catch (java.sql.SQLException e) {
436         Logger.write("ERROR", "DB", "SQLException: " + e);
437     }
438
439     return null;
440 }
441
442 public PublicKey[] getPostVisibleTo (String sig) {
443     Logger.write("VERBOSE", "DB", "getPostVisibleTo(...)");
444     Vector<PublicKey> keyList = new Vector<PublicKey>();
445
446     try {
447         ResultSet keyRows = query(DBStrings.getVisibleTo.replace("__SIG__", sig));
448         while(keyRows.next())
449             keyList.add(Crypto.decodeKey(keyRows.getString("key")));
450     } catch (java.sql.SQLException e) {
451         Logger.write("ERROR", "DB", "SQLException: " + e);
452     }
453
454     return keyList.toArray(new PublicKey[0]);
455 }
456
457 //In the case of no username for the key: "return Crypto.encode(k);"
458 public String getName (PublicKey key) {
459     Logger.write("VERBOSE", "DB", "getName(...)");
460     String name = "";
461
462     try {
463         ResultSet nameRow = query(DBStrings.getName.replace("__KEY__", Crypto.encodeKey(key)));
464         if (nameRow.next())

```



```

465         name = nameRow.getString("username");
466     } catch (java.sql.SQLException e) {
467         Logger.write("ERROR", "DB", "SQLException: " + e);
468     }
469
470     if (name != null)
471         return name;
472     else
473         return "<no username>";
474 }
475
476 //What key signed this message
477 public PublicKey getSignatory (Message m) {
478     Logger.write("VERBOSE", "DB", "getSignatory(...)");
479     try {
480         ResultSet keys = query(DBStrings.getAllKeys);
481         while (keys.next())
482             if (Crypto.verifySig(m, Crypto.decodeKey(keys.getString("key"))))
483                 return Crypto.decodeKey(keys.getString("key"));
484     } catch (java.sql.SQLException e) {
485         Logger.write("ERROR", "DB", "SQLException: " + e);
486     }
487     Logger.write("WARNING", "DB", "getSignatory() could not find signatory");
488     return null;
489 }
490
491 //Add to DB
492 public boolean addPost (Message post) {
493     Logger.write("VERBOSE", "DB", "addPost(...)");
494
495     try {
496         execute(DBStrings.addPost.replace("__SIG__", post.getSig())
497             .replace("__msgText__", post.POSTgetText())
498             .replace("__time__", Long.toString(post.getTimestamp()))
499             .replace("__recieverKey__", post.POSTgetWall())
500             .replace("__sendersKey__", Crypto.encodeKey(getSignatory(post))));
501         String[] visibleTo = post.POSTgetVisibleTo();
502         for (int i = 0; i < visibleTo.length; i++)
503             execute(DBStrings.addPostVisibility.replace("__postSig__", post.getSig()).replace("__key__", visibleTo[i]));
504         return true;
505     } catch (java.sql.SQLException e) {
506         Logger.write("ERROR", "DB", "SQLException: " + e);
507         return false;
508     }
509 }
510
511 public boolean addKey (Message msg) {
512     return addKey(Crypto.decodeKey(msg.ADDKEYgetKey()));
513 }
514
515 public boolean addKey (PublicKey k) {
516     Logger.write("VERBOSE", "DB", "addKey(...)");
517
518     try {
519         execute(DBStrings.addKey.replace("__key__", Crypto.encodeKey(k)));
520         boolean ret = validateClaims(k);
521         if (!calcRevocationKeys(k))
522             ret = false;
523         return ret;
524     } catch (java.sql.SQLException e) {
525         Logger.write("ERROR", "DB", "SQLException: " + e);
526     }
527
528     return false;
529 }
530
531 //Update k's username by validating claims
532 public boolean validateClaims(PublicKey k) {
533     if (k == null) {
534         Logger.write("ERROR", "DB", "validateClaims(...) called with null key");
535         return false;
536     }
537
538     Logger.write("VERBOSE", "DB", "validateClaims(...)");
539
540     try {
541         ResultSet claimSet = query(DBStrings.getClaims);
542         while (claimSet.next()) {
543             Message msg = new Message("CLAIM",
544                 claimSet.getString("name"),
545                 Long.parseLong(claimSet.getString("claimTime")),
546                 claimSet.getString("sig"));
547
548             Logger.write("VERBOSE", "DB", "Considering Claim for name: \" + claimSet.getString("name") + "\"");
549             Logger.write("VERBOSE", "DB", "time: \" + Long.toString(Long.parseLong
550 (claimSet.getString("claimTime"))) + "\"");
551             Logger.write("VERBOSE", "DB", "sig: \" + claimSet.getString("sig") + "\"");
552
553             PublicKey signatory = getSignatory(msg);
554             if (signatory != null && signatory.equals(k)) {
555                 execute(DBStrings.newUsername.replace("__name__", msg.CLAIMgetName()).replace("__key__", Crypto.encodeKey
556 (k)));
557                 execute(DBStrings.removeClaim.replace("__sig__", msg.getSig()));

```



```

556         Logger.write("INFO", "DB", "Claim for " + msg.CLAIMgetName() + " verified");
557     }
558 }
559 } catch (java.sql.SQLException e) {
560     Logger.write("ERROR", "DB", "SQLException: " + e);
561     return false;
562 }
563 return true;
564 }
565
566 //update keys column in revocations
567 public boolean calcRevocationKeys (PublicKey k) {
568     if (k == null) {
569         Logger.write("ERROR", "DB", "calcRevocationKeys(...) called with null key");
570         return false;
571     }
572
573     Logger.write("VERBOSE", "DB", "calcRevocationKeys(...)");
574
575     try {
576         ResultSet revocationSet = query(DBStrings.getRevocations());
577         while (revocationSet.next()) {
578             Message msg = new Message("REVOKE",
579                                     revocationSet.getString("timeOfLeak"),
580                                     Long.parseLong(revocationSet.getString("creationTime")),
581                                     revocationSet.getString("sig"));
582             PublicKey signer = getSignatory(msg);
583             if (signer != null && signer.equals(k)) {
584                 execute(DBStrings.updateRevocationKey.replace("__KEY__", Crypto.encodeKey(k))
585                     .replace("__SIG__", revocationSet.getString("sig")));
586             }
587         }
588     } catch (java.sql.SQLException e) {
589         Logger.write("ERROR", "DB", "SQLException: " + e);
590         return false;
591     }
592     return true;
593 }
594
595 //if this key has already claimed a name, forget the old one
596 public boolean addClaim (Message claim) {
597     Logger.write("VERBOSE", "DB", "addClaim("+ claim.CLAIMgetName() +")");
598
599     try {
600         execute(DBStrings.addClaim.replace("__sig__", claim.getSig())
601             .replace("__name__", claim.CLAIMgetName())
602             .replace("__time__", Long.toString(claim.getTimestamp())));
603
604         ResultSet everyone = query(DBStrings.getAllKeys());
605         while (everyone.next())
606             validateClaims(Crypto.decodeKey(everyone.getString("key")));
607     } catch (java.sql.SQLException e) {
608         Logger.write("ERROR", "DB", "SQLException: " + e);
609         return false;
610     }
611     return true;
612 }
613
614 public boolean addRevocation (Message revocation) {
615     Logger.write("VERBOSE", "DB", "-----addRevocation(...)-----");
616
617     try {
618         execute(DBStrings.addRevocation.replace("__key__", Crypto.encodeKey(getSignatory(revocation)))
619             .replace("__sig__", revocation.getSig())
620             .replace("__time__", Long.toString(revocation.REVOKEgetTime()))
621             .replace("__creationTime__", Long.toString(revocation.getTimestamp())));
622         return eraseContentFrom(getSignatory(revocation));
623     } catch (java.sql.SQLException e) {
624         Logger.write("ERROR", "DB", "SQLException: " + e);
625         return false;
626     }
627 }
628
629 public boolean isRevoked (PublicKey key) {
630     Logger.write("VERBOSE", "DB", "isRevoked(...)");
631
632     try {
633         return query(DBStrings.isRevoked.replace("__KEY__", Crypto.encodeKey(key))).next();
634     } catch (java.sql.SQLException e) {
635         Logger.write("ERROR", "DB", "SQLException: " + e);
636         return false;
637     }
638 }
639
640 public boolean eraseContentFrom (PublicKey key) {
641     Logger.write("VERBOSE", "DB", "-----eraseContentFrom(...)-----");
642     String keyStr = Crypto.encodeKey(key);
643
644     try {
645         execute(DBStrings.removeMessageAccess.replace("__KEY__", keyStr));
646         execute(DBStrings.removeMessages.replace("__KEY__", keyStr));
647         execute(DBStrings.removePosts.replace("__KEY__", keyStr));
648         execute(DBStrings.removePostVisibility.replace("__KEY__", keyStr));

```

```

649         execute(DBStrings.removeUser.replace("__KEY__", keyStr));
650         execute(DBStrings.removeFromCategories.replace("__KEY__", keyStr));
651         execute(DBStrings.removeLikes.replace("__KEY__", keyStr));
652         execute(DBStrings.removeComments.replace("__KEY__", keyStr));
653         execute(DBStrings.removeEvents.replace("__KEY__", keyStr));
654     } catch (java.sql.SQLException e) {
655         Logger.write("ERROR", "DB", "SQLException: " + e);
656         return false;
657     }
658
659     return true;
660 }
661
662 public boolean addPDATA (Message update) {
663     Logger.write("VERBOSE", "DB", "addPDATA(...)");
664     boolean ret = true;
665
666     String[][] updates = update.PDATAgetValues();
667     for (int i = 0; i < updates.length; i++)
668         if (!updatePDATA(updates[i][0], updates[i][1], getSignatory(update)))
669             ret = false;
670
671     return ret;
672 }
673
674 public boolean updatePDATA (String field, String value, PublicKey k) {
675     Logger.write("VERBOSE", "DB", "updatePDATA(" + field + ", " + value + ", ...)");
676
677     try {
678         execute(DBStrings.addPDATA.replace("__field__", field)
679             .replace("__value__", value)
680             .replace("__key__", Crypto.encodeKey(k)));
681     } catch (java.sql.SQLException e) {
682         Logger.write("ERROR", "DB", "SQLException: " + e);
683         return false;
684     }
685
686     return true;
687 }
688
689 public boolean addConvo (Message convo) {
690     Logger.write("VERBOSE", "DB", "addConvo(...)");
691
692     try {
693         execute(DBStrings.addConvo.replace("__sig__", convo.getSig())
694             .replace("__time__", Long.toString(convo.getTimestamp())));
695         String[] keys = convo.CHATgetKeys();
696         for (int i = 0; i < keys.length; i++) {
697             execute(DBStrings.addConvoParticipant.replace("__sig__", convo.getSig())
698                 .replace("__key__", keys[i]));
699         }
700     } catch (java.sql.SQLException e) {
701         Logger.write("ERROR", "DB", "SQLException: " + e);
702         return false;
703     }
704
705     return true;
706 }
707
708 public boolean addMessageToChat (Message msg) {
709     Logger.write("VERBOSE", "DB", "addMessageToChat(...)");
710
711     try {
712         boolean duplicate = false;
713
714         String[][] messagesInConvo = getConversationMessages(msg.PCHATgetConversationID());
715         for (int i = 0; i < messagesInConvo.length; i++)
716             if (messagesInConvo[i][1].equals(Long.toString(msg.getTimestamp())) && messagesInConvo[i][2].equals
717                 (msg.PCHATgetText()))
718                 duplicate = true;
719
720         if (!duplicate) {
721             execute(DBStrings.addMessageToConvo.replace("__convoID__", msg.PCHATgetConversationID())
722                 .replace("__sendersKey__", Crypto.encodeKey(getSignatory(msg)))
723                 .replace("__msgText__", msg.PCHATgetText())
724                 .replace("__time__", Long.toString(msg.getTimestamp())));
725         }
726     } catch (java.sql.SQLException e) {
727         Logger.write("ERROR", "DB", "SQLException: " + e);
728         return false;
729     }
730
731     return true;
732 }
733
734 public boolean addComment (Message comment) {
735     Logger.write("VERBOSE", "DB", "addComment(...)");
736
737     try {
738         execute(DBStrings.addComment.replace("__sig__", comment.getSig())
739             .replace("__msgText__", comment.CMNTgetText())
740             .replace("__parent__", comment.CMNTgetItemID())
741             .replace("__commenterKey__", Crypto.encodeKey(getSignatory(comment))))

```

```

741         .replace("__senderKey__", Crypto.encodeKey(getSignatory(comment)))
742         .replace("__creationTime__", Long.toString(comment.getTimestamp())));
743     } catch (java.sql.SQLException e) {
744         Logger.write("ERROR", "DB", "SQLException: " + e);
745         return false;
746     }
747
748     return true;
749 }
750
751 public boolean addLike (Message like) {
752     Logger.write("VERBOSE", "DB", "addLike(...)");
753
754     try {
755         execute(DBStrings.addLike.replace("__likerKey__", Crypto.encodeKey(getSignatory(like)))
756         .replace("__parent__", like.LIKEgetItemID()));
757     } catch (java.sql.SQLException e) {
758         Logger.write("ERROR", "DB", "SQLException: " + e);
759         return false;
760     }
761
762     return true;
763 }
764
765 public boolean addEvent (Message event) {
766     Logger.write("VERBOSE", "DB", "addEvent(...)");
767     try {
768         execute(DBStrings.addEvent.replace("__sig__", event.getSig())
769         .replace("__startTime__", Long.toString(event.EVNTgetStart()))
770         .replace("__endTime__", Long.toString(event.EVNTgetEnd()))
771         .replace("__creatorKey__", Crypto.encodeKey(getSignatory(event)))
772         .replace("__accepted__", "0")
773         .replace("__name__", event.EVNTgetName())
774         .replace("__creationTime__", Long.toString(event.getTimestamp())));
775     } catch (java.sql.SQLException e) {
776         Logger.write("ERROR", "DB", "SQLException: " + e);
777         return false;
778     }
779
780     return true;
781 }
782
783 public boolean acceptEvent (String sig) {
784     Logger.write("VERBOSE", "DB", "acceptEvent(...)");
785     try {
786         execute(DBStrings.acceptEvent.replace("__sig__", sig));
787     } catch (java.sql.SQLException e) {
788         Logger.write("ERROR", "DB", "SQLException: " + e);
789         return false;
790     }
791
792     return true;
793 }
794
795 public boolean declineEvent (String sig) {
796     Logger.write("VERBOSE", "DB", "declineEvent(...)");
797     try {
798         execute(DBStrings.declineEvent.replace("__sig__", sig));
799     } catch (java.sql.SQLException e) {
800         Logger.write("ERROR", "DB", "SQLException: " + e);
801         return false;
802     }
803
804     return true;
805 }
806
807 public boolean updatePDATaPermission (Message msg) {
808     return updatePDATaPermission(msg.UPDATECATgetName(), msg.UPDATECATgetValue());
809 }
810
811 public boolean updatePDATaPermission (String category, boolean value) {
812     Logger.write("VERBOSE", "DB", "updatePDATaPermission(...)");
813     try {
814         execute(DBStrings.updatePDATaPermission.replace("__catID__", category)
815         .replace("__bool__", value?"1":"0"));
816     } catch (java.sql.SQLException e) {
817         Logger.write("ERROR", "DB", "SQLException: " + e);
818         return false;
819     }
820
821     return true;
822 }
823
824 public PublicKey[] keysCanSeePDATA () {
825     Logger.write("VERBOSE", "DB", "keysCanSeePDATA()");
826     Vector<PublicKey> keys = new Vector<PublicKey>();
827
828     try {
829         ResultSet categories = query(DBStrings.categoriesCanSeePDATA);
830         while (categories.next()) {
831             String catname = categories.getString("catID");
832             PublicKey[] memberKeys = getCategoryMembers(catname);
833             for (int i = 0; i < memberKeys.length; i++)

```

```

834         if (!keys.contains(memberKeys[i]))
835             keys.add(memberKeys[i]);
836     }
837 } catch (java.sql.SQLException e) {
838     Logger.write("ERROR", "DB", "SQLException: " + e);
839 }
840
841 return keys.toArray(new PublicKey[0]);
842 }
843
844 //no duplicate names
845 public boolean addCategory (Message msg) {
846     return addCategory(msg.ADDCATgetName(), msg.ADDCATgetValue());
847 }
848
849 public boolean addCategory (String name, boolean can_see_private_details) {
850     Logger.write("VERBOSE", "DB", "addCategory(...)");
851     try {
852         execute(DBStrings.addCategory.replace("__catID__", name)
853             .replace("__canSeePDATA__", can_see_private_details?"1":"0"));
854     } catch (java.sql.SQLException e) {
855         Logger.write("ERROR", "DB", "SQLException: " + e);
856         return false;
857     }
858
859     return true;
860 }
861
862 public boolean addToCategory (Message msg) {
863     return addToCategory(msg.ADDTOCATgetName(), Crypto.decodeKey(msg.ADDTOCATgetKey()));
864 }
865
866 public boolean addToCategory (String category, PublicKey key) {
867     Logger.write("VERBOSE", "DB", "addToCategory(" + category + ", ...)");
868
869     PublicKey[] members = getCategoryMembers(category);
870     if (Arrays.asList(members).contains(key)) {
871         return false;
872     }
873
874     try {
875         execute(DBStrings.addToCategory.replace("__catID__", category)
876             .replace("__key__", Crypto.encodeKey(key)));
877     } catch (java.sql.SQLException e) {
878         Logger.write("ERROR", "DB", "SQLException: " + e);
879         return false;
880     }
881
882     return true;
883 }
884
885 public boolean removeFromCategory (Message msg) {
886     return removeFromCategory(msg.REMFROMCATgetCategory(), Crypto.decodeKey(msg.REMFROMCATgetKey()));
887 }
888
889 public boolean removeFromCategory (String category, PublicKey key) {
890     Logger.write("VERBOSE", "DB", "removeFromCategory(" + category + ", ...)");
891     try {
892         execute(DBStrings.removeFromCategory.replace("__catID__", category)
893             .replace("__key__", Crypto.encodeKey(key)));
894     } catch (java.sql.SQLException e) {
895         Logger.write("ERROR", "DB", "SQLException: " + e);
896         return false;
897     }
898
899     return true;
900 }
901
902 public boolean like (String sig) {
903     Logger.write("VERBOSE", "DB", "like(...)");
904     try {
905         execute(DBStrings.addLike.replace("__parent__", sig)
906             .replace("__likerKey__", Crypto.encodeKey(Crypto.getPublicKey())));
907     } catch (java.sql.SQLException e) {
908         Logger.write("ERROR", "DB", "SQLException: " + e);
909         return false;
910     }
911
912     return true;
913 }
914
915 public boolean unlike (String sig) {
916     Logger.write("VERBOSE", "DB", "like(...)");
917     try {
918         execute(DBStrings.removeLike.replace("__parent__", sig)
919             .replace("__likerKey__", Crypto.encodeKey(Crypto.getPublicKey())));
920     } catch (java.sql.SQLException e) {
921         Logger.write("ERROR", "DB", "SQLException: " + e);
922         return false;
923     }
924
925     return true;
926 }

```

927 }

```

1  package ballmerpeak.turtlenet.server;
2
3  class DBStrings {
4      public static final String[] createdB = {
5          "CREATE TABLE tConvos ("
6              "convoID TEXT,"
7              "timeCreated TEXT,"
8              "PRIMARY KEY (convoID)"
9          ");",
10
11         "CREATE TABLE tConvoKeys ("
12             "pk INTEGER PRIMARY KEY AUTOINCREMENT,"
13             "convoID TEXT,"
14             "key TEXT"
15         ");",
16
17         "CREATE TABLE tConvoMessages ("
18             "pk INTEGER PRIMARY KEY AUTOINCREMENT,"
19             "convoID TEXT,"
20             "sendersKey TEXT,"
21             "msgText TEXT,"
22             "time TEXT"
23         ");",
24
25         "CREATE TABLE tPost ("
26             "sig TEXT,"
27             "msgText TEXT,"
28             "time TEXT,"
29             "recieverKey TEXT,"
30             "sendersKey TEXT,"
31             "PRIMARY KEY (sig);"
32         ");",
33
34         "CREATE TABLE tPostVisibleTo ("
35             "pk INTEGER PRIMARY KEY AUTOINCREMENT,"
36             "postSig TEXT,"
37             "key TEXT"
38         ");",
39
40         "CREATE TABLE tUser ("
41             "key TEXT,"
42             "username TEXT,"
43             "knowName INT,"
44             "email TEXT,"
45             "name TEXT,"
46             "gender TEXT,"
47             "birthday TEXT,"
48             "PRIMARY KEY (key);"
49         ");",
50
51         "CREATE TABLE tCategory ("
52             "catID TEXT,"
53             "canSeePDATA INT,"
54             "PRIMARY KEY (catID);"
55         ");",
56
57         "CREATE TABLE tCategoryMembers ("
58             "pk INTEGER PRIMARY KEY AUTOINCREMENT,"
59             "catID TEXT,"
60             "userKey TEXT"
61         ");",
62
63         "CREATE TABLE tEvent ("
64             "sig TEXT,"
65             "startTime TEXT,"
66             "endTime TEXT,"
67             "creatorKey TEXT,"
68             "accepted INT,"
69             "name TEXT,"
70             "creationTime TEXT,"
71             "PRIMARY KEY (sig);"
72         ");",
73
74         "CREATE TABLE tClaim ("
75             "sig TEXT,"
76             "name TEXT,"
77             "claimTime TEXT,"
78             "PRIMARY KEY (sig);"
79         ");",
80
81         "CREATE TABLE tLike ("
82             "pk INTEGER PRIMARY KEY AUTOINCREMENT,"
83             "likerKey TEXT,"
84             "parent TEXT,"
85             "PRIMARY KEY (pk, parent)"
86         ");",
87
88         "CREATE TABLE tComment ("
89             "sig TEXT,"
90             "msgText TEXT,"
91             "senderKey TEXT,"
92             "parent TEXT,"
93             "creationTime TEXT,"
94             "PRIMARY KEY (sig);"
95         ");",
96
97         "CREATE TABLE tRevocations ("
98             "key TEXT,"
99             "sig TEXT,"
100            "timeOfLeak TEXT,"

```

```

94         "creationTime TEXT, "+
95         "PRIMARY KEY (sig));",
96     };
97
98     public static final String getPDATA = "SELECT __FIELD__ FROM tUser WHERE key = '__KEY__';";
99     public static final String getWallPostSigs = "SELECT sig FROM tPost WHERE recieverKey = '__KEY__';";
100    public static final String getPost = "SELECT time, sig, msgText, recieverKey, sendersKey FROM tPost WHERE sig = '__SIG__';";
101    public static final String getPostSender = "SELECT sendersKey FROM tPost WHERE sig = '__SIG__';";
102    public static final String getVisibleTo = "SELECT key FROM tPostVisibleTo WHERE postSig = '__SIG__';";
103    public static final String getConversation = "SELECT sendersKey, msgText, time FROM tConvoMessages WHERE convoID = '__SIG__';";
104    public static final String getConversations = "SELECT * FROM tConvos;";
105    public static final String getConversationMembers = "SELECT key FROM tConvoKeys WHERE convoID = '__SIG__';";
106    public static final String getConversationMessages = "SELECT sendersKey, time, msgText FROM tConvoMessages WHERE convoID = '__SIG__';";
107    public static final String getKey = "SELECT key FROM tUser WHERE username = '__USERNAME__';";
108    public static final String getCategories = "SELECT * FROM tCategory;";
109    public static final String getCategory = "SELECT * FROM tCategory WHERE catID = '__CATNAME__';";
110    public static final String canSeePDATA = "SELECT canSeePDATA FROM tCategory WHERE catID = '__CATID__';";
111    public static final String categoriesCanSeePDATA = "SELECT catID FROM tCategory WHERE canSeePDATA = 1;";
112    public static final String getAllKeys = "SELECT key FROM tUser;";
113    public static final String getMemberKeys = "SELECT userKey FROM tCategoryMembers WHERE catID = '__CATNAME__';";
114    public static final String getName = "SELECT username FROM tUser WHERE key = '__KEY__';";
115    public static final String getClaims = "SELECT * FROM tClaim;";
116    public static final String getLike = "SELECT * FROM tLike WHERE parent = '__SIG__';";
117    public static final String getComments = "SELECT * FROM tComment WHERE parent = '__PARENT__';";
118    public static final String getComment = "SELECT * FROM tComment WHERE sig = '__SIG__';";
119    public static final String getRevocations = "SELECT * FROM tRevocations;";
120    public static final String isRevoked = "SELECT key FROM tRevocations WHERE key = '__KEY__';";
121    public static final String mostRecentWallPost = "SELECT maxtime FROM tPost " +
122        "INNER JOIN " +
123        "(SELECT MAX(time) maxtime, recieverKey FROM tPost GROUP BY
124        recieverKey) AS temp "+
125        "ON tPost.recieverKey = temp.recieverKey AND tPost.time = temp.maxtime
126        "+
127        "WHERE tPost.recieverKey = '__KEY__';";
128    public static final String addPost = "INSERT INTO tPost (sig, msgText, time, recieverKey, sendersKey)" +
129        "VALUES ('__SIG__', '__msgText__', '__time__', '__recieverKey__',
130        '__sendersKey__');";
131    public static final String addPostVisibility = "INSERT INTO tPostVisibleTo (postSig, key)" +
132        "VALUES ('__postSig__', '__key__');";
133    public static final String addKey = "INSERT INTO tUser (key) VALUES ('__key__');";
134    public static final String setUsername = "UPDATE tUser SET username = '__name__' WHERE key = '__key__';";
135    public static final String removeClaim = "DELETE FROM tClaim WHERE sig = '__sig__';";
136    public static final String addClaim = "INSERT INTO tClaim (sig, name, claimTime) VALUES ('__sig__',
137        '__name__', '__time__');";
138    public static final String addRevocation = "INSERT INTO tRevocations (key, sig, timeOfLeak, creationTime) VALUES
139        ('__key__', '__sig__', '__time__', '__creationTime__');";
140    public static final String updateRevocationKey = "UPDATE tRevocations SET key = '__KEY__' WHERE sig = '__SIG__';";
141    public static final String addPDATA = "UPDATE tUser SET __field__ = '__value__' WHERE key = '__key__';";
142    public static final String addConvo = "INSERT INTO tConvos (convoID, timeCreated) VALUES ('__sig__',
143        '__time__');";
144    public static final String addConvoParticipant = "INSERT INTO tConvoKeys (convoID, key) VALUES ('__sig__', '__key__');";
145    public static final String addMessageToConvo = "INSERT INTO tConvoMessages (convoID, sendersKey, msgText, time)" +
146        "VALUES ('__convoID__', '__sendersKey__', '__msgText__',
147        '__time__');";
148    public static final String addComment = "INSERT INTO tComment (sig, msgText, senderKey, parent, creationTime)" +
149        "VALUES ('__sig__', '__msgText__', '__senderKey__', '__parent__',
150        '__creationTime__');";
151    public static final String addLike = "INSERT INTO tLike (likerKey, parent) VALUES ('__likerKey__',
152        '__parent__');";
153    public static final String removeLike = "DELETE FROM tLike WHERE likerKey = '__likerKey__' AND parent =
154        '__parent__';";
155    public static final String addEvent = "INSERT INTO tEvent (sig, startTime, endTime, creatorKey, accepted,
156        name, creationTime)" +
157        "VALUES ('__sig__', '__startTime__', '__endTime__',
158        '__creatorKey__', '__accepted__', '__name__', '__creationTime__');";
159    public static final String acceptEvent = "UPDATE tEvent SET accepted = 1 WHERE sig = '__sig__';";
160    public static final String declineEvent = "UPDATE tEvent SET accepted = -1 WHERE sig = '__sig__';";
161    public static final String updatePDATApermission = "UPDATE tCategory SET canSeePDATA = __bool__ WHERE catID =
162        '__catID__';";
163    public static final String addCategory = "INSERT INTO tCategory (catID, canSeePDATA) VALUES ('__catID__',
164        '__canSeePDATA__');";
165    public static final String addToCategory = "INSERT INTO tCategoryMembers (catID, userKey) VALUES ('__catID__',
166        '__key__');";
167    public static final String removeFromCategory = "DELETE FROM tCategoryMembers WHERE catID = '__catID__' AND userKey =
168        '__key__';";
169
170    //revocation stuff
171    public static final String removeMessageAccess = "DELETE FROM tConvoKeys WHERE key = '__KEY__';";
172    public static final String removeMessages = "DELETE FROM tConvoMessages WHERE sendersKey = '__KEY__';";
173    public static final String removePosts = "DELETE FROM tPost WHERE sendersKey = '__KEY__';";
174    public static final String removePostVisibility = "DELETE FROM tPostVisibleTo WHERE key = '__KEY__';";
175    public static final String removeUser = "DELETE FROM tUser WHERE key = '__KEY__';";
176    public static final String removeFromCategories = "DELETE FROM tCategoryMembers WHERE userKey = '__KEY__';";
177    public static final String removeLikes = "DELETE FROM tLike WHERE likerKey = '__KEY__';";
178    public static final String removeComments = "DELETE FROM tComment WHERE senderKey = '__KEY__';";
179    public static final String removeEvents = "DELETE FROM tEvent WHERE creatorKey = '__KEY__';";
180 }

```

```
1  //File IO
2
3  package ballmerpeak.turtlenet.server;
4  import java.io.*;
5  import ballmerpeak.turtlenet.server.Logger;
6
7  public class FIO {
8      public static byte[] readFileBytes (String filename) {
9          RandomAccessFile f = null;
10         byte[] bytes = null;
11
12         try {
13             f = new RandomAccessFile(filename, "r");
14             Long lsize = f.length();
15             int isize = (int)f.length();
16             if (lsize == isize) {
17                 bytes = new byte[isize];
18                 f.readFully(bytes);
19             } else {
20                 Logger.write("FATAL", "FIO", filename + " is too large, could not read file.");
21             }
22             f.close();
23         } catch (IOException e) {
24             Logger.write("FATAL", "FIO", "Could not read file: " + e);
25             return bytes = null;
26         }
27
28         return bytes;
29     }
30
31     public static boolean writeFileBytes (byte[] data, String filename) {
32         FileOutputStream out;
33         try {
34             out = new FileOutputStream(new File(filename));
35             out.write(data);
36             out.close();
37             return true;
38         } catch (IOException e) {
39             Logger.write("FATAL", "FIO", "Could not write file: " + e);
40             return false;
41         }
42     }
43 }
```



```
1  /* Message Levels:
2  * UNIMPL
3  * VERBOSE - Way to much detail
4  * INFO    - Normal running, useful to follow execution
5  * WARNING - Something wierd is going on, someone fucked up
6  * RED     - Recoverable error (one query failing, one timeout)
7  * ERROR   - Something went badly wrong
8  * FATAL   - Going to crash, far more worrying if it doesn't crash
9  * CRITICAL - Fuck everything, the moon is purple
10 */
11
12 package ballmerpeak.turtlenet.server;
13
14 import java.io.*;
15 import java.util.Date;
16
17 public class Logger {
18     static boolean started = false;
19     static String path;
20     static PrintWriter log;
21
22     public static void init (String logfile) {
23         if (!started) {
24             started = true;
25             path = logfile;
26
27             try {
28                 log = new PrintWriter(new BufferedWriter(new FileWriter(path)));
29                 log.println("==== Turtlenet started at " + new Date() + "====");
30                 log.flush();
31             } catch (Exception e) {
32                 throw new RuntimeException("ERROR: Unable to open log: " + e);
33             }
34         }
35     }
36
37     public static void close () {
38         if(started) {
39             log.println("==== Turtlenet closed at " + new Date() + "====");
40             log.flush();
41             log.close();
42         }
43     }
44
45     public static void write (String level, String place, String s) {
46         if (started) {
47             log.println((System.currentTimeMillis()/1000L) + " " + level + getTabs(level) + place + "\t" + s);
48             log.flush(); //In case of a crash we don't want to be digging up the wrong code
49         }
50     }
51
52     private static String getTabs (String s) {
53         s = (System.currentTimeMillis()/1000L) + " " + s;
54         if (s.length() < 16) return "\t\t"; else return "\t";
55     }
56 }
```

```

1  //Can not be Message constructors because of GWT
2  //These methods can't be static like they should be because of GWT
3
4  package ballmerpeak.turtlenet.server;
5  import ballmerpeak.turtlenet.shared.Message;
6  import ballmerpeak.turtlenet.server.Crypto;
7  import java.security.*;
8
9
10 public class MessageFactory {
11     public MessageFactory(){
12     }
13
14     public Message newMessage(String cmd, String content) {
15         long timestamp = System.currentTimeMillis();
16         Message msg = new Message(cmd, content, timestamp, "");
17         msg.signature = Crypto.sign(msg);
18         return msg;
19     }
20
21     public Message newCLAIM(String username) {
22         return newMessage("CLAIM", username);
23     }
24
25     public Message newREVOKE(long time) {
26         return newMessage("REVOKE", ""+time);
27     }
28
29     public Message newPDATA(String field, String value) {
30         return newMessage("PDATA", field + ":" + value + ";");
31     }
32
33     public Message newPDATA(String[] fields, String[] values) {
34         String content = "";
35         for (int i = 0; i < fields.length; i++)
36             content += (values[i] + ";" + fields[i] + ";");
37         Logger.write("VERBOSE", "MsgF", "constructed pdata message: " + content);
38         return newMessage("PDATA", content);
39     }
40
41     public Message newCHAT(PublicKey[] keys) {
42         String keyString = "";
43         String delim = "";
44         for (int i = 0; i < keys.length; i++) {
45             keyString += delim + Crypto.encodeKey(keys[i]);
46             delim = " "; /*intentional*/
47         }
48         return newMessage("CHAT", keyString);
49     }
50
51     public Message newCHAT(String[] keys) {
52         String keyString = "";
53         String delim = "";
54         for (int i = 0; i < keys.length; i++) {
55             keyString += delim + keys[i];
56             delim = " "; /*intentional*/
57         }
58         return newMessage("CHAT", keyString);
59     }
60
61     public Message newPCHAT(String convoSig, String msg) {
62         return newMessage("PCHAT", convoSig + ":" + msg);
63     }
64
65     public Message newPOST(String msg, String wall, String[] visibleTo) {
66         String content = wall;
67         for (int i = 0; i < visibleTo.length; i++)
68             content += (";" + visibleTo[i]);
69         content += (";" + msg);
70         return newMessage("POST", content);
71     }
72
73     public Message newCMNT(String itemSig, String comment) {
74         return newMessage("CMNT", itemSig + ":" + comment);
75     }
76
77     public Message newLIKE(String itemSig) {
78         return newMessage("LIKE", itemSig);
79     }
80
81     public Message newUNLIKE(String itemSig) {
82         return newMessage("UNLIKE", itemSig);
83     }
84
85     public Message newEVNT(long start, long end, String descrip) {
86         return newMessage("EVNT", start + ":" + end + ":" + descrip);
87     }
88
89     public Message newADDCAT(String name, boolean canSeePDATA) {
90         return newMessage("ADDCAT", (canSeePDATA?"true":"false") + ":" + name);
91     }
92
93     public Message newUPDATECAT(String category, boolean value) {

```

```
94         return newMessage("UPDATECAT", (value?"true":"false") + ":" + category);
95     }
96
97     public Message newADDTOCAT(String category, String key) {
98         return newMessage("ADDTOCAT", key + ":" + category);
99     }
100
101     public Message newREMFROMCAT(String category, String key) {
102         return newMessage("REMFROMCAT", key + ":" + category);
103     }
104
105     public Message newADDKEY(String key) {
106         return newMessage("ADDKEY", key);
107     }
108 }
```

```

1  package ballmerpeak.turtlenet.server;
2
3  import ballmerpeak.turtlenet.shared.Message;
4  import java.util.Vector;
5  import java.util.Date;
6  import java.security.*;
7  import java.io.*;
8  import java.net.*;
9  import java.util.concurrent.Semaphore;
10
11 public class NetworkConnection implements Runnable {
12     public NetworkConnection (String serverurl) {
13         url = serverurl;
14         messages = new Vector<String>();
15         lastRead = 0;
16         messageLock = new Semaphore(1);
17         connected = true;
18         tor = true;
19
20         //parse db/lastread
21         File lastReadFile = new File("./db/lastread");
22         if (lastReadFile.exists()) {
23             try {
24                 BufferedReader reader = new BufferedReader(
25                     new FileReader(lastReadFile));
26                 lastRead = Long.parseLong(reader.readLine());
27                 Logger.write("INFO", "NetCon", "Read lastRead from file");
28             } catch (Exception e) {
29                 Logger.write("ERROR", "NetCon", "Could not read lastread from file");
30             }
31         }
32     }
33
34     public void run () {
35         Logger.write("INFO", "NetCon", "NetworkConnection started");
36         while (connected) {
37             try {
38                 Thread.sleep(1000); //update every second
39             } catch (Exception e) {
40                 Logger.write("WARNING", "NetCon", "Sleep interrupted: " + e);
41             }
42             downloadNewMessages();
43         }
44     }
45
46     public void close () {
47         Logger.write("INFO", "NetCon", "close()");
48         connected = false;
49         try {
50             File lastReadFile = new File("./db/lastread");
51
52             if (lastReadFile.exists())
53                 lastReadFile.delete();
54
55             BufferedWriter writer = new BufferedWriter(
56                 new FileWriter(lastReadFile));
57             writer.write(Long.toString(lastRead));
58             writer.close();
59             Logger.write("INFO", "NetCon", "Saved lastRead to disk");
60         } catch (Exception e) {
61             Logger.write("ERROR", "NetCon", "Unable to save lastRead: " + e);
62         }
63     }
64
65     //returns true if a message is available
66     public Boolean hasMessage () {
67         try {
68             messageLock.acquire();
69             boolean haveMessage = messages.size() >= 1;
70             messageLock.release();
71             return haveMessage;
72         } catch (Exception e) {
73             Logger.write("WARNING", "NetCon", "Acquire interrupted");
74         }
75         return false;
76     }
77
78     //get the next message in the queue, and remove it from the queue
79     public String getMessage () {
80         try {
81             messageLock.acquire();
82             String m = messages.get(0);
83             messages.removeElementAt(0);
84             messageLock.release();
85             return m;
86         } catch (Exception e) {
87             Logger.write("WARNING", "NetCon", "Acquire interrupted");
88         }
89         return new Message("NULL", "", 0, "").toString();
90     }
91
92     public long getTime () {
93         Vector<String> time = serverCmd("t");

```

```

94
95     if (time.size() == 2)
96         return Long.parseLong(time.get(0));
97     else
98         Logger.write("ERROR", "NetCon", "Couldn't retrieve time from server");
99
100     return 0;
101 }
102
103 public boolean postMessage (Message msg, PublicKey recipient) {
104     String ciphertext = Crypto.encrypt(msg, recipient, this);
105     if (!serverCmd("s " + ciphertext).get(0).equals("s")) {
106         Logger.write("RED", "NetCon", "server reported failure uploading message");
107         return false;
108     } else {
109         Logger.write("INFO", "NetCon", "uploaded message: \"\" + msg + "\"");
110         return true;
111     }
112 }
113
114 //The only time unencrypted data is sent
115 public Boolean claimName (String name) {
116     try {
117         Message claim = new Message("CLAIM", name,
118             getTime()+Crypto.rand(0,50), "");
119         claim.signature = Crypto.sign(claim);
120         String cmd = "c " + Crypto.Base64Encode(claim.toString().getBytes("UTF-8"));
121         if (serverCmd(cmd).get(0).equals("s")) {
122             Logger.write("INFO", "NetCon", "Claimed name: " + name);
123             Logger.write("INFO", "NetCon", "\tname: " + claim.CLAIMgetName());
124             Logger.write("INFO", "NetCon", "\ttime: " + Long.toString(claim.getTimestamp()));
125             Logger.write("INFO", "NetCon", "\tsig: " + claim.getSig());
126             return true;
127         }
128     } catch (Exception e) {
129         Logger.write("ERROR", "NetCon", "Could not register name: " + e);
130     }
131
132     Logger.write("INFO", "NetCon", "Could not register name: " + name);
133     return false;
134 }
135
136 public void downloadNewMessages () {
137     Vector<String> msgs = serverCmd("get " + lastRead);
138     lastRead = getTime();
139
140     for (int i = 0; i < msgs.size(); i++) {
141         if (!(msgs.get(i) == null) && !msgs.get(i).equals("s") && !msgs.get(i).equals("e")) {
142             try {
143                 messageLock.acquire();
144                 messages.add(msgs.get(i));
145                 messageLock.release();
146             } catch (Exception e) {
147                 Logger.write("WARNING", "NetCon", "Acquire interrupted.");
148             }
149         }
150     }
151 }
152
153 //send text to the server, receive its response
154 private Vector<String> serverCmd(String cmd) {
155     Socket s;
156     BufferedReader in;
157     PrintWriter out;
158     //if (!cmd.equals("t") && !cmd.substring(0,4).equals("get "))
159     //    Logger.write("VERBOSE", "NetCon", "Sending command to server \"\" + cmd + "\"");
160
161     //connect
162     try {
163         if (tor) {
164             s = new Socket(new Proxy(Proxy.Type.SOCKS,
165                 new InetSocketAddress("localhost", 9050))); //connect to Tor SOCKS proxy
166             s.connect(new InetSocketAddress(url, port)); //connect to server through Tor
167         } else {
168             s = new Socket(url, port);
169         }
170
171         in = new BufferedReader(new InputStreamReader(s.getInputStream()));
172         out = new PrintWriter(s.getOutputStream(), true);
173     } catch (Exception e) {
174         Logger.write("ERROR", "NetCon", "Could not connect to network: " + e);
175         return null;
176     }
177
178     //send command
179     out.println(cmd);
180     out.flush();
181
182     //receive output of server
183     Vector<String> output = new Vector<String>();
184     try {
185         String line = null;
186         do {

```

```
187         line = in.readLine();
188         if (line != null)
189             output.add(line);
190     } while (line != null);
191 } catch (Exception e) {
192     Logger.write("ERROR", "NetCon", "Could not read from rserver: " + e.getMessage());
193 }
194
195 //disconnect
196 try {
197     out.close();
198 } catch (Exception e) {
199     Logger.write("ERROR", "NetCon", "Could not disconnect from rserver: " + e.getMessage());
200 }
201
202 try {
203     in.close();
204 } catch (Exception e) {
205     Logger.write("ERROR", "NetCon", "Could not disconnect from rserver: " + e.getMessage());
206 }
207
208 try {
209     s.close();
210 } catch (Exception e) {
211     Logger.write("ERROR", "NetCon", "Could not close socket: " + e.getMessage());
212 }
213
214 return output;
215 }
216
217 private String url;
218 private final int port = 31415;
219 private Vector<String> messages;
220
221 private long lastRead;
222 private boolean connected;
223 private boolean tor;
224 private Semaphore messageLock;
225 }
```

```

1  //All methods ought to be static
2  //Most real parsing occurs in the Message class, this just passes commands to DB
3  package ballmerpeak.turtlenet.server;
4
5  import ballmerpeak.turtlenet.shared.Message;
6
7  public class Parser {
8      /* Useful to ID the type of message on behalf of the DB so it can use type
9       * specific get methods (e.g.: Message.PCHATgetConversationID()). Most
10      * parsing actually occurs in the Message class itself. Maybe this should
11      * be changed so parsing occurs here, e.g.: Parser.LIKEgetItemID(msg), but
12      * msg.LIKEgetItemID() is more natural.
13      */
14      public static void parse (Message msg, Database db) {
15
16          Logger.write("VERBOSE", "PARSE", "parsing message");
17
18          escape(msg);
19
20          if (db.isRevoked(db.getSignatory(msg)))
21              Logger.write("WARNING", "PARSE", "Revoked key in use, message dropped");
22          else if (msg.getCmd().equals("POST")) //post to own wall
23              db.addPost(msg);
24          else if (msg.getCmd().equals("CLAIM")) //claim a username
25              db.addClaim(msg);
26          else if (msg.getCmd().equals("REVOKE")) //revoke private key
27              db.addRevocation(msg);
28          else if (msg.getCmd().equals("PDATA")) //create or update profile data
29              db.addPDATA(msg);
30          else if (msg.getCmd().equals("CHAT")) //establish chat
31              db.addConvo(msg);
32          else if (msg.getCmd().equals("PCHAT")) //add message to chat
33              db.addMessageToChat(msg);
34          else if (msg.getCmd().equals("CMNT")) //comment
35              db.addComment(msg);
36          else if (msg.getCmd().equals("LIKE")) //like
37              db.addLike(msg);
38          else if (msg.getCmd().equals("UNLIKE")) //like
39              db.unlike(msg.UNLIKEgetItemID());
40          else if (msg.getCmd().equals("EVNT")) //event
41              db.addEvent(msg);
42          else if (msg.getCmd().equals("ADDCAT")) //add category
43              db.addCategory(msg);
44          else if (msg.getCmd().equals("UPDATECAT")) //update categorys canSeePDATA
45              db.updatePDATApermission(msg);
46          else if (msg.getCmd().equals("ADDTOCAT")) //add key to category
47              db.addToCategory(msg);
48          else if (msg.getCmd().equals("REMFROMCAT")) //remove key from category
49              db.removeFromCategory(msg);
50          else if (msg.getCmd().equals("ADDKEY")) //add public key
51              db.addKey(msg);
52          else if (msg.getCmd().equals("NULL"))
53              Logger.write("VERBOSE", "PARSE", "undecryptable message"); //not for us
54          else if (!msg.getCmd().equals("FPOST"))
55              Logger.write("ERROR", "PARSE", "Unknown message type: \"\" + msg.getCmd() + "\"");
56
57          if (msg.getCmd().equals("FPOST"))
58              Logger.write("WARNING", "PARSE", "FPOST is depreciated");
59      }
60
61      private static void escape (Message m) {
62          m.content = m.content.replace("'", "");
63      }
64  }

```

```

1  package ballmerpeak.turtlenet.shared;
2
3  import ballmerpeak.turtlenet.shared.Tokenizer;
4  import java.security.*;
5  import java.io.Serializable;
6  import java.util.Arrays;
7
8  public class Message implements Serializable {
9      //You shouldn't use this, rather use MessageFactory.newMessage(command, data)
10     //GWT cannot use the factory, it shouldn't construct messages but pass their
11     // data as arguments to whatever needs it. Maybe have an async factory?
12     public Message (String cmd, String _content, long timeCreated, String RSAsig) {
13         command = cmd;
14         content = _content;
15         signature = RSAsig;
16         timestamp = timeCreated;
17     }
18
19     public Message () {
20         command = "NULL";
21         content = "";
22         signature = "";
23         timestamp = -1;
24     }
25
26     /* "POST\520adfc4\Hello, World!\123" -> new Message("POST", "Hello, World!", "520adfc4", 123) */
27     public static Message parse (String msg) {
28         String[] tokens = new String[4];
29         Tokenizer tokenizer = new Tokenizer(msg, '\\');
30         tokens[0] = tokenizer.nextToken(); //command
31         tokens[1] = tokenizer.nextToken(); //signature
32         tokens[2] = msg.substring(msg.indexOf("\\", msg.indexOf("\\",0)+1)+1, msg.lastIndexOf("\\")); //message content
33         tokens[3] = msg.substring(msg.lastIndexOf("\\")+1); //timestamp
34         long ts = Long.parseLong(tokens[3]);
35
36         return new Message(tokens[0], tokens[2], ts, tokens[1]);
37     }
38
39     public String toString () {
40         return command + "\\" + signature + "\\" + content + "\\" + timestamp;
41     }
42
43     /* universal */
44     public String getCmd () {
45         return command;
46     }
47
48     public String getSig () {
49         return signature;
50     }
51
52     public String getContent () {
53         return content;
54     }
55
56     public long getTimestamp () {
57         return timestamp;
58     }
59
60     /* type specific */
61     public String POSTgetText() {
62         Tokenizer tokenizer = new Tokenizer(content, ':');
63         String[] colonPairs = new String[tokenizer.countTokens()];
64         for (int i = 0; tokenizer.hasMoreTokens(); i++)
65             colonPairs[i] = tokenizer.nextToken();
66         return colonPairs[colonPairs.length-1];
67     }
68
69     public String POSTgetWall() {
70         Tokenizer tokenizer = new Tokenizer(content, ':');
71         String[] colonPairs = new String[tokenizer.countTokens()];
72         for (int i = 0; tokenizer.hasMoreTokens(); i++)
73             colonPairs[i] = tokenizer.nextToken();
74         return colonPairs[0];
75     }
76
77     public String[] POSTgetVisibleTo() {
78         Tokenizer tokenizer = new Tokenizer(content, ':');
79         String[] colonPairs = new String[tokenizer.countTokens()];
80         for (int i = 0; tokenizer.hasMoreTokens(); i++)
81             colonPairs[i] = tokenizer.nextToken();
82         return Arrays.copyOfRange(colonPairs, 1, colonPairs.length-1);
83     }
84
85     public String CLAIMgetName() {
86         return content;
87     }
88
89     //content in form "field1:value1;field2:value2;"
90     public String[][] PDATAGetValues() {
91         //Split into colon pairs, semicolon delimiter
92         Tokenizer tokenizer = new Tokenizer(content, ';');
93         String[] colonPairs = new String[tokenizer.countTokens()];

```



```

94         for (int i = 0; tokenizer.hasMoreTokens(); i++)
95             colonPairs[i] = tokenizer.nextToken();
96
97         //split into field/value pairs, colon delimiter
98         String[][] values = new String[colonPairs.length][2];
99         for (int i = 0; i < colonPairs.length; i++) {
100             values[i][0] = Message.beforeColon(colonPairs[i]);
101             values[i][1] = Message.afterColon(colonPairs[i]);
102         }
103
104         return values;
105     }
106
107     /* establish a chat and the people in it, without any messages */
108     // returns an array of strings and now of keys because of GWT,
109     // Crypto.decodeKey should be used to turn each string into a key
110     public String[] CHATgetKeys() {
111         Tokenizer st = new Tokenizer(content, ':');
112         String[] keys = new String[st.countTokens()];
113         for (int i = 0; i < keys.length; i++) {
114             keys[i] = st.nextToken();
115         }
116         return keys;
117     }
118
119     /* PCHAT adds messages to a conversation */
120     // returns <conversation ID, messageText> */
121     public String PCHATgetText() {
122         Tokenizer st = new Tokenizer(content, ':');
123         String convoID = st.nextToken();
124         String text = st.nextToken();
125         return text;
126     }
127
128     public String PCHATgetConversationID() {
129         Tokenizer st = new Tokenizer(content, ':');
130         String convoID = st.nextToken();
131         String text = st.nextToken();
132         return convoID;
133     }
134
135     public String CMNTgetText() {
136         Tokenizer st = new Tokenizer(content, ':');
137         String itemID = st.nextToken();
138         String text = st.nextToken();
139         return text;
140     }
141
142     public String CMNTgetItemID() {
143         Tokenizer st = new Tokenizer(content, ':');
144         String itemID = st.nextToken();
145         String text = st.nextToken();
146         return itemID;
147     }
148
149     public String LIKEgetItemID() {
150         return content;
151     }
152
153     public String UNLIKEgetItemID() {
154         return content;
155     }
156
157     public String EVNTgetName() {
158         Tokenizer st = new Tokenizer(content, ':');
159         long start = Long.parseLong(st.nextToken());
160         long end = Long.parseLong(st.nextToken());
161         String name = st.nextToken();
162         return name;
163     }
164
165     public long EVNTgetStart() {
166         Tokenizer st = new Tokenizer(content, ':');
167         long start = Long.parseLong(st.nextToken());
168         long end = Long.parseLong(st.nextToken());
169         String name = st.nextToken();
170         return start;
171     }
172
173     public long EVNTgetEnd() {
174         Tokenizer st = new Tokenizer(content, ':');
175         long start = Long.parseLong(st.nextToken());
176         long end = Long.parseLong(st.nextToken());
177         String name = st.nextToken();
178         return end;
179     }
180
181     /* time of revocation, not timestamp of message */
182     // there cannot be a REVOKEgetKey due to GWT */
183     public long REVOKEgetTime() {
184         try {
185             return Long.parseLong(content);
186         } catch (Exception e) {
187             //Invalid timestamp

```

```
187         return -1;
188     }
189 }
190
191 public String ADDCATgetName() {
192     return Message.afterColon(content);
193 }
194
195 public boolean ADDCATgetValue() {
196     return Message.beforeColon(content).equals("true");
197 }
198
199 public String UPDATECATgetName() {
200     return Message.afterColon(content);
201 }
202
203 public boolean UPDATECATgetValue() {
204     return Message.beforeColon(content).equals("true");
205 }
206
207 public String ADDTOCATgetName() {
208     return Message.afterColon(content);
209 }
210
211 public String ADDTOCATgetKey() {
212     return Message.beforeColon(content);
213 }
214
215 public String REMFROMCATgetCategory() {
216     return Message.afterColon(content);
217 }
218
219 public String REMFROMCATgetKey() {
220     return Message.beforeColon(content);
221 }
222
223 public String ADDKEYgetKey() {
224     return content;
225 }
226
227 public static String beforeColon(String s) {
228     return s.substring(0, s.indexOf(':'));
229 }
230
231 public static String afterColon(String s) {
232     return s.substring(s.indexOf(':')+1);
233 }
234
235 public String command;
236 public String content;
237 public String signature;
238 public long timestamp;
239 }
```

```
1  package ballmerpeak.turtlenet.server;
2
3  import java.security.PublicKey;
4
5  public class Friend {
6      public Friend (String _name, PublicKey _key) {
7          name = _name;
8          key = _key;
9      }
10
11     public String getName () {
12         return name;
13     }
14
15     public void setName (String nname) {
16         name = nname;
17     }
18
19     public PublicKey getKey () {
20         return key;
21     }
22
23     private String name;
24     private PublicKey key;
25 }
```

```
1  package ballmerpeak.turtlenet.server;
2
3  public class Pair<A,B> {
4      public Pair(A f, B s) {
5          first = f;
6          second = s;
7      }
8
9      public A first;
10     public B second;
11 }
```

```
1  //To reduce RPC calls
2
3  package ballmerpeak.turtlenet.shared;
4
5  import java.io.Serializable;
6
7  public class CommentDetails implements Serializable {
8      public CommentDetails () {
9      }
10
11     public CommentDetails (String _posterKey, String _posterName, String _sig, String _text, boolean _liked, Long _timestamp) {
12         posterKey = _posterKey;
13         posterName = _posterName;
14         sig = _sig;
15         text = _text;
16         liked = _liked;
17         timestamp = _timestamp;
18     }
19
20     public String posterKey;
21     public String posterName;
22     public String sig;
23     public String text;
24     public boolean liked;
25     public Long timestamp;
26 }
```

```
1  package ballmerpeak.turtlenet.shared;
2
3  import java.io.Serializable;
4
5  public class Conversation implements Serializable {
6      public Conversation () {
7          signature = "<SIGNATURE NOT KNOWN>";
8          timestamp = "0";
9          firstMessage = "<FIRST MESSAGE NOT KNOWN>";
10         users = new String[0];
11         keys = new String[0];
12     }
13
14     public Conversation (String sig, String time, String fmsg, String[] _users, String[] _keys) {
15         signature = sig;
16         timestamp = time;
17         firstMessage = fmsg;
18         users = _users;
19         keys = _keys;
20     }
21
22     public String concatNames() {
23         String names = "";
24         for (int i = 0; i < users.length; i++)
25             names += users[i] + " ";
26         return names;
27     }
28
29     public String signature;
30     public String timestamp;
31     public String firstMessage;
32     public String[] users; //usernames
33     public String[] keys; //keys[0] is the key of users[0], etc.
34 }
```

```
1  //To reduce RPC calls
2
3  package ballmerpeak.turtlenet.shared;
4
5  import java.io.Serializable;
6
7  public class PostDetails implements Serializable {
8      public PostDetails () {
9      }
10
11     public PostDetails (String _sig, boolean _liked, int _commentCount, Long _timestamp, String _posterUsername, String _text,
String _posterKey) {
12         sig = _sig;
13         liked = _liked;
14         commentCount = _commentCount;
15         timestamp = _timestamp;
16         posterKey = _posterKey;
17         posterUsername = _posterUsername;
18         text = _text;
19     }
20
21     public String sig;
22     public boolean liked;
23     public int commentCount;
24     public Long timestamp;
25     public String posterKey;
26     public String posterUsername;
27     public String text;
28 }
```

```
1 //Can't use java.util.StringTokenizer because of GWT
2 package ballmerpeak.turtlenet.shared;
3
4 public class Tokenizer {
5     String[] tokens;
6     int i = 0;
7
8     public Tokenizer (String s, char c) {
9         String regex = "" + c;
10         if (c == '\\')
11             regex = "\\\\";
12         tokens = s.split(regex);
13     }
14
15     public String nextToken () {
16         return tokens[i++];
17     }
18
19     public boolean hasMoreTokens () {
20         return i < tokens.length;
21     }
22
23     public int countTokens () {
24         return tokens.length;
25     }
26 }
```



```
1 package ballmerpeak.turtlenet.remoteserver;
2
3 import javax.xml.bind.DatatypeConverter;
4 import java.security.MessageDigest;
5
6 class Hasher {
7     public static String hash (String data) {
8         try {
9             MessageDigest hasher = MessageDigest.getInstance("SHA-256");
10             byte[] hash = hasher.digest(data.getBytes("UTF-8"));
11             return DatatypeConverter.printHexBinary(hash);
12         } catch (Exception e) {
13             System.out.println("SHA-256 isn't supported.");
14         }
15         return "not_a_hash";
16     }
17 }
```

Appendix B

Deadlines

- **2014-01-31** topic and team
- **2014-02-14** requirements
- **2014-03-14** design
- **2014-05-09** portfolio & individual submission

Appendix C

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Policy on Exploitation and Commercialisation of Intellectual Property

January 2012

The Policy

1. INTRODUCTION

- 1.1 Intellectual Property Rights (IPR) are the legal rights associated with creative and intellectual effort or commercial reputation and goodwill. Together, the different types of intellectual property rights (patents, copyright, know-how, registered trademarks, registered designs and unregistered designs) protect a wide variety of property including literary and artistic works, computer programs, inventions, designs and marks used to identify goods and services. Intellectual property (IP) can be a valuable asset and substantial income can be generated through its successful exploitation. The nature of the University's activities, in particular its research activities, often gives rise to the creation of valuable IP which can benefit the University, its staff and students, as well as third parties.

2. OWNERSHIP OF IP

- 2.1 The following section clarifies the University's position with regard to IP ownership.

Employees

- 2.2 Under English law, notably the Patents Act 1977 and the Copyright, Designs & Patents Act 1988, IP generated in the course of a person's normal employment belongs to the substantive employing organisation. Thus, in the absence of any agreements to the contrary, the University assumes ownership of all IP generated by staff.
- 2.3 The University, however, does not usually intend to assert ownership of copyright in books, articles, lectures and artistic works, other than those which are capable of commercial exploitation, specifically commissioned by the University or are of benefit to a partner institution of the University, for example Xi'an Jiaotong-Liverpool University (XJTLU). In such cases, Level 1

Heads will decide the use of such works and, where required, will be offered training to help them exercise that judgement.

- 2.4 The University does not, however, relinquish ownership of copyright in computer software.
- 2.5 It is generally accepted that most academic staff wish to publish articles in learned journals. As a general rule the University will preserve the rights of academic staff to publish material arising from research as they think fit. In cases where commercial exploitation of the results is a possibility, however, the University requires that publication be withheld until appropriate protection can be put in place.

Employees Working at Other Institutions

- 2.6 University staff are frequently offered honorary appointments within other institutes and universities. In such circumstances, University staff should ensure through Legal Risk & Compliance that an appropriate agreement is in place between the University and the host institution for IP ownership and exploitation.

Employees Working at Partner NHS Trusts

- 2.7 University staff with clinical duties may also hold *honorary* contracts of employment with the relevant NHS partner trust. In such circumstances the ownership of IP will remain with the University. However, it should be noted the University has agreed specific arrangements with partner trusts for IP identification, ownership and exploitation. Further guidelines can be sought from the IP Manager within Partnership & Innovation.

Non-employees

- 2.8 The University offers honorary or visiting professorial positions to individuals who are not employed by the University. In such cases, individuals are usually required to transfer to the University any IP they create in the course of their honorary activities for the University, as if they were a University employee. Given the wider benefits such appointments bring to the University some discretion will, however, be allowed and agreement about ownership and exploitation of IP should be reached (through Human Resources and the IP Manager) at the time of appointment by the University.

Students

- 2.9 As part of the registration process students assign to the University any commercially-exploitable IP which they generate as a consequence of their studies or research, or which is created using University facilities. In assigning their ownership rights to the University, a student is accorded the same rights

as a member of staff, e.g. with respect to revenue sharing. It is recognised that where a student is sponsored by a third party, the terms of that sponsorship may override this position, and require the student to assign IP to the sponsoring organisation.

- 2.10 Students are able and encouraged to publish their research work in journals or dissertations, with agreement of their course director or research supervisor and subject to any appropriate prior IP protection.
- 2.11 The policy applies to students registered at the University (including any registered as University students as part of agreements with other institutions or through on-line programmes), whoever is their supervisor, course director or equivalent.
- 2.12 For the avoidance of doubt, the University does not seek to interfere in students' rights insofar as they relate to free use of lecture notes that may or may not be subject to copyright or IP generated outside their studies or research.
- 2.13 Students registered elsewhere but whose supervisors include University employees are not subject to this policy.

Third Parties

- 2.14 The University frequently enters into agreements with third parties which specify ownership of IP generated by University staff and students in research collaborations. In such cases IP may be owned by the University, the third party or jointly. In the majority of cases a lead party is mutually agreed before the collaboration is undertaken. If the collaboration is likely to produce commercially valuable IP, terms to be agreed in respect of IP will be through the Department of Legal, Risk & Compliance and may from time to time involve Partnerships & Innovation.

3. GOVERNANCE

Liverpool Intellectual Property

- 3.1 The University exploits IP in a variety of ways but the preferred route is through the Liverpool Intellectual Property (LIP) unit within the department of Partnerships & Innovation. LIP was established in order to generate the maximum societal and commercial impact of University activities through an academic focussed process of IP identification, evaluation, management and exploitation. It is the responsibility of LIP to maximise the commercial exploitation of University IP; however, it is recognised that such exploitation should not prejudice the University's core activities of research, teaching and Knowledge Exchange. LIP should also take into account the wider strategies and policies of the University in determining the exploitation route.

Operations Team

- 3.2 The Operations Team (“the Operations Team”) is the LIP working group responsible for the operational oversight and monitoring of the services provided by the Commercial Partner. It meets on a monthly basis.

Investment Panel

- 3.3 The Investment Panel (“the Panel”) is the group responsible for consideration of proposals to establish spin-out companies. It meets at the request of the Operations Team.

Commercial Board

- 3.4 The Commercial Board (“the Board”) is the group responsible for the strategic oversight of the services provided by LIP and the CP. The Board, which has a lay chair and a mixture of lay and University members, reports to the University’s Planning and Resources Committee. The Board operates under an appropriate scheme of delegation granted by the Committee and meets on a quarterly basis.

4. COMMERCIAL PARTNER

Appointment of a Partner

- 4.1 In September 2011 the University procured the IP management services of a Commercial Partner (CP) to aid the assessment of IP generated by the University through its research and other activities. The LIP and CP will work seamlessly to deliver services to University staff and students. Under the terms of the Consultancy Agreement the CP will provide IP exploitation services. Any disclosure made to the CP by the University will be held Confidential and will not affect the ownership rights to the IP. The University retains all the rights to the ownership of the IP and none will be diluted by the CP.

Timescales

- 4.2 The Operations Team will usually make a decision as to whether to support and, where appropriate, formally protect the disclosure, for example by filing for patent protection, within 8 weeks of disclosing the invention to the CP.
- 4.3 The timescale for exploitation of any given set of IP depends significantly on market conditions as well as the state of development of the IP. The discussions between LIP, the Inventor, and the CP should agree a reasonable initial timetable with regular review points. All parties involved have responsibilities in achieving successful exploitation and need to be aware that circumstances will change as the process develops. Exploitation of IP might

take the form of licensing, assignment or creation of a spin-out or start-up company.

5. EXTERNALLY-FUNDED RESEARCH PROJECTS

- 5.1 As well as disclosures from staff and students, LIP and the CP will monitor the University's externally-funded research projects to attempt to identify suitable opportunities. LIP will ensure that such monitoring is, where appropriate, carried out in conjunction with Business Gateway, the Research Support Office, the Contracts Office and academic staff to ensure consistency of approach, particularly if the monitoring involves discussions with external funders of research.

6. FURTHER DEVELOPMENT OF IP

- 6.1 It is recognised that it is often difficult to secure funding to develop research commercially as this often falls outside the funder's remit. Early development work can be the biggest hurdle to securing future commercial interest and funding for projects. In view of this, the University is seeking to establish separate funding to support those projects with the highest potential.

Investment Fund

- 6.2 There are a number of ways in which IP can be developed further to make it attractive to potential investors or customers and to improve the return for the University and the Inventors. The University intends to establish an Investment Fund to support the development of specific commercial activities. The Fund will be administered by the LIP and investment decisions will be taken by the Planning and Resources Committee following recommendations from the Board, in conjunction with relevant individuals from the University, e.g. Heads of School/Department in respect of an Inventor's time and any other resources required to undertake the project. In reaching a decision to invest in a project through the Investment Fund the University will need to be convinced not only that the project merits support, because of its commercial promise, but also that all other potential sources of external funding had been explored.

Commercial Activity Fund

- 6.3 There are a number of ways in which non-patent protectable opportunities can be developed further and exploited. The University also intends to establish its own Commercial Activity Fund (CAF). This will be administered by the LIP and investment decisions will be taken by the Planning and Resources Committee following recommendations from the Operations Team, in conjunction with relevant individuals from the University, e.g. Heads of School/Department in respect of an Inventor's time and any other resources required to undertake the project. Distribution of returns from non-patentable

commercial projects (for example, service based activities) will be agreed by the Head of School and considered in the light of the individual circumstances. Where the commercial activities are successful, following receipt of CAF investment, then the CAF investment will be repaid in full plus 15%.

7. COMMERCIALISATION THROUGH SPIN-OUT OR START-UP COMPANIES

- 7.1 Where exploitation involves the creation of a spin-out company (i.e. a company formed as a consequence of University IP) or a start-up company (a company created by a third party in which the University is invited to participate) the involvement of the Inventor in providing ongoing or future services to that company must be governed by an appropriate agreement, e.g. for the provision of consultancy or research services. Legal, Risk & Compliance will be responsible for drafting, reviewing and completing such agreements for the University.

Inventor(s) services

- 7.2 Inventor(s) are permitted to provide services (either as a director of the company or simply as an advisor) subject to the University's normal policy on consultancy and outside work activities. (See the University's Consultancy Services/CPD Policy). Inventors may also be seconded to the company subject to the normal contracting and approval processes, and in particular that it is subject in all cases to the full recovery of cost (including the use of University facilities and services). In general, such companies should not operate from University premises, except under a specific licence to occupy which would normally be in a defined incubator space.

Conflicts of Interest

- 7.3 The University's Conflicts of Interest Policy should be complied with in all circumstances. In particular, staff specifically employed to further the University's commercial activities are not normally permitted to acquire equity in spin-out companies whilst remaining as an employee of the University.

8. COMPANY DIRECTORSHIPS

- 8.1 Inventors are permitted to accept appointment to directorships in spin-out or start-up companies, subject to the agreement of their Head of School/Department and the Commercial Board. Individuals undertaking such roles should note that they are personally liable as a director and should ensure that they fully understand the legal responsibilities involved. In general, staff in senior positions and business development roles within the University should not undertake directorships as they may be conflicted with their University position.

9. DISTRIBUTION OF BENEFITS ARISING FROM EXPLOITATION

- 9.1 Returns from the commercialisation of University IP belong to the University. The University has a policy of granting a generous share of the returns to provide an incentive to the Inventors. The University only seeks to retain more of the returns based on its ownership of the IP if such returns are so substantial that it would be inappropriate as a charitable organisation for them not to be reinvested in the University's charitable objects.

Income Arising from IP Licensing, Selling or Assignment

- 9.2 The University is responsible for collecting income from third parties in respect of exploitation of IP. Where IP has been sold, assigned or licensed, this would usually take the form of milestone and/or royalty payments. As a guide to income distribution, after recovery of eligible costs such as external legal fees and distribution of any revenue sharing with the funders of the original research or third party collaborators, the surplus balance is distributed 80% to the Inventor(s) and 20% to the School of the Inventors for the first £100k and 50% Inventor(s), 20% Faculty and 30% the University over and above £100k.

Principles for Allocation of Income

- 9.3 The exact allocation of income will be determined by the Commercial Board according to the following principles:
- whether the invention was made in the course of normal duties
 - whether the circumstances were such that an invention might reasonably be expected to result from the carrying out of those duties
 - whether, because of their special responsibilities, the Inventor had a special obligation to further the interests of the University
 - the nature of his/her duties, the remuneration and other advantages which the Inventor has derived from their position with the University
 - the effort and skill which the Inventor has devoted to making the invention
 - the extent to which the invention was made jointly by the Inventor with any other person and the effort and skill which such other person has devoted to the invention

Payment of Income

- 9.4 The funds allocated to the Inventor(s) may, at the discretion of the Inventor, take the form of a personal payment (in which case payment will be made via the University payroll and cover the University's National Insurance contribution) or be paid into a nominated University account.

Determining the Inventor

- 9.5 Many people may be involved with the work that leads up to the creation of IP and the work that is subsequently undertaken to exploit the IP. However, as a result of IP law, many of those involved will not actually be an Inventor as they have not been involved at the actual point of creation.
- 9.6 Where more than one Inventor has created the IP the Inventors may decide between themselves as to how they will share the Inventors' distributed funds. Where the Inventors cannot agree as to how to share the Inventors' distributed funds, then after further consultation with the CP to establish the inventive contribution of all Inventors, the Operations Team will decide.

Allocation of Equity within a Spin-out or Company Formation

- 9.7 In those cases where the consideration for commercialisation of University IP is equity (e.g. as part of a company formation) this will be allocated on the basis of 60% to University and 40% to the Inventor(s) who will usually hold such equity in a personal capacity. Inventor(s) should note that they will be liable for any relevant personal taxes in such holdings and they are advised to seek independent legal and financial advice. The University will identify and appoint an appropriate representation on the board.

Mixture of Equity and Royalties

- 9.8 Where the University receives a mixture of equity and royalties as payment for IP, the sum of both will be combined to meet the overall allocation to the Inventor as described above.

10. ADDITIONAL CONSIDERATION

- 10.1 Where the Operations Team have decided that an opportunity is non-patentable, or where the LIP and the CP have been unable to commercialise all or any part of the IP, then upon request from the Inventor(s), the University may, subject to any previous term or conditions assign all its rights, title and interest in such IP to the Inventor(s) in return for a perpetual non-exclusive royalty-free licence with the right to sub-licence.
- 10.2 Where the Inventor(s) successfully commercialise any IP created by them, following assignment of such IP to them, then the Inventor(s) will reimburse any expenses previously incurred by the University in connection with protection of such IP, including legal costs and a 10% share of any income generated by or on behalf of the Inventor(s) from the commercialisation of such IP.

(Approved by the University of Liverpool Council on 11 January 2012)

C.7 Included Works

Despite them being present in the repo, we did not write or create the following:

- writeup/latex/tikz-uml.sty
- writeup/latex/todonotes.sty
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- The text of any legal licence
- client/web_interface_mockup/jquery.js
- client/web_interface_mockup/turtles.ttf

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3.
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Appendix D

TODO

D.1 General

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D.2 Requirements Weeks 1-3

1. Project Desc.

- **COMPLETE** Project being done for (Peter)
- **COMPLETE** Mission Statement (Luke)
- **COMPLETE** Mission Objective (Luke)
- **COMPLETE** Threat Model (Luke)

2. Statement of Deliverables

- **COMPLETE** Desc. of anticipated documentation (Luke)
- **COMPLETE** Desc. of anticipated software (Aishah)
- **COMPLETE** Desc. + Eval. of any anticipated experiments + blackbox (Louis)
- **COMPLETE** User view and requirements (Luke)
- **COMPLETE** System requirements (Luke)
- **COMPLETE** Transaction requirements (Aishah)

3. Project and Plan

- **COMPLETE** Facebook research (Leon)
- **COMPLETE** Case Study: Tor (Luke)
- **COMPLETE** Case Study: alt.anonymous.messages and mix networks (Luke)
- **COMPLETE** Case Study: PGP and E-Mail (Luke)
- **COMPLETE** Implementation Stage (Peter)
- **COMPLETE** Milestone Identification (Milestones can most easily be recognised as deliverables) (Mike)
- **COMPLETE** Gantt Chart (Mike)
- **COMPLETE** Risk Assessment (Mike)

4. Bibliography

- **COMPLETE** Bibliography framework (Luke)
- **COMPLETE** Add citations where relevant (Everyone, in their own sections)

D.3 Design Weeks 4-X

- **COMPLETE** Use Case Diagram (Mike)
- **COMPLETE** Glossary (Mike)
- **COMPLETE** Mobile GUI Design (Leon)
- **COMPLETE** Sequence Diagram (Luke/Leon)
- **COMPLETE** HTML GUI Design (Louis)
- **COMPLETE** DB Design (Aishah)
- **COMPLETE** Transaction Design (Aishah)
- **COMPLETE** Server GUI Design (Peter)
- **COMPLETE** Class Interfaces (Luke)
- **COMPLETE** Protocol (Luke)

- **COMPLETE** Architecture (Luke)
- **COMPLETE** Data Flow Diagrams (Luke)
- **COMPLETE** Pseudocode (Luke)
- **COMPLETE** Class Diagram (Luke)

5. Portfolio

- **DRAFTED** Deviations from requirements and design (Luke)
- **INCOMPLETE** Sample screenshots (Louis)
- **DRAFTED** Test strategy and results (Louis)
- **DRAFTED** Description of team members and rolls (Peter)
- **INCOMPLETE** Achievement of objectives (Luke)
- **INCOMPLETE** Evaluation (Peter)
- **INCOMPLETE** Professional Issues (???)

6. Other

- **COMPLETE** Licensing (Luke)
- **COMPLETE** Source Listing (Luke)
- **INCOMPLETE** Minutes (Luke)
- **INCOMPLETE** Individual Submission (Luke)
- **DRAFTED** Individual Submission (Peter)
- **COMPLETE** Individual Submission (Mike)
- **COMPLETE** Individual Submission (Louis)
- **COMPLETE** Individual Submission (Aishah)
- **DRAFTED** Individual Submission (Leon)

Appendix E

~~Bugs~~ Accidental Features

- Entering the wrong password erases the database.

Todo list

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