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.

> "ItâĂŹs 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

[1] While 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.

[2] size 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 [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:

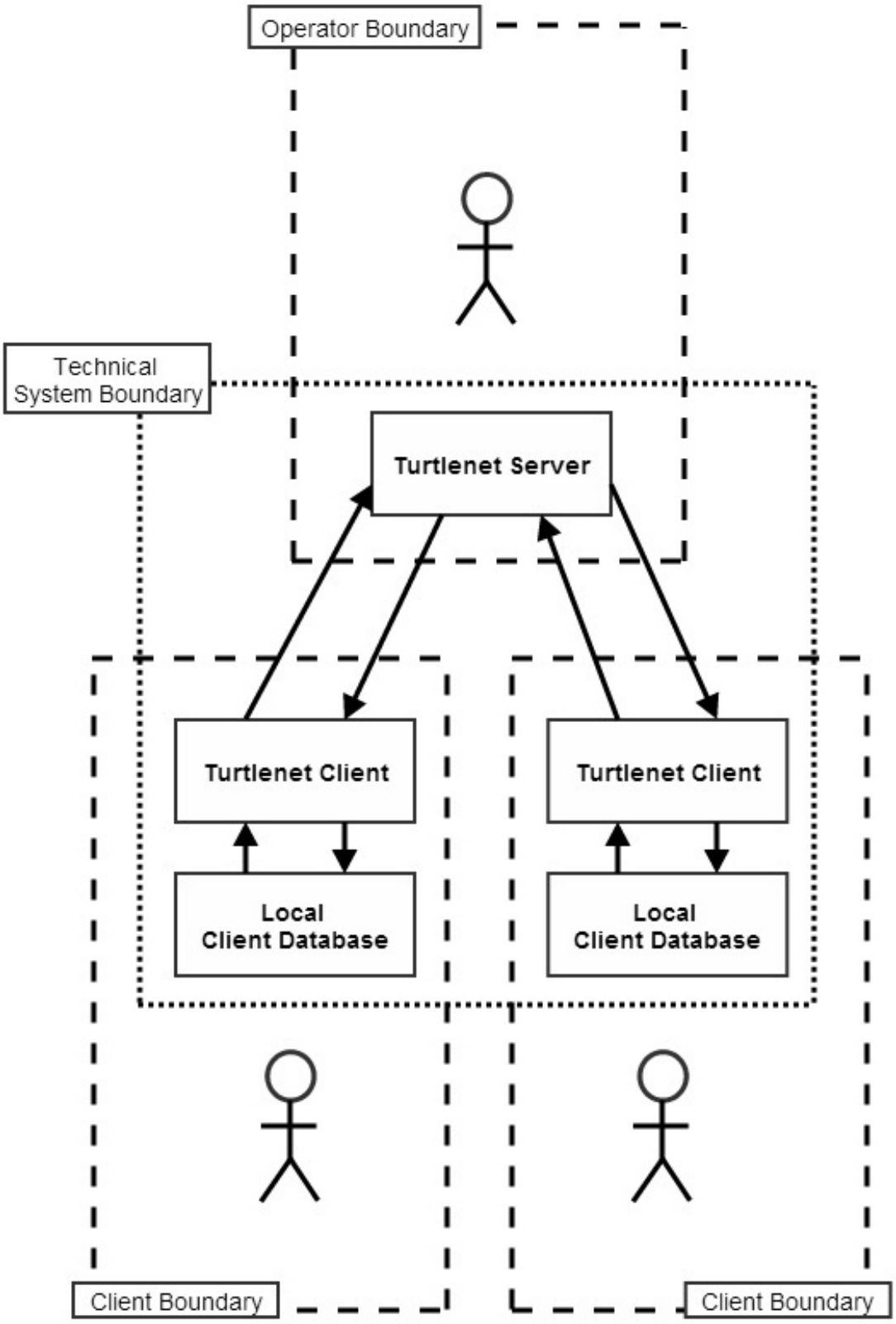


Figure 8.1: System Boundary Diagram

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 appropriate[1]. 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.

[1] This 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 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-nailed[2].

[2]client 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 plaintext, 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 severs 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 facebooks 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 facebooks 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 facebooks 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 facebooks 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 RSA[1] 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 challenge [2]. 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 hypothesis[3][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.

[1] and a symmetric cipher

[2] Our 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

[3] The 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 newsgroup[1] 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.

[1] It 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

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*no_of_users)/24)*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 14.1: 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 15

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

15.1 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 databse will be required to store these.

15.2 Adding of user relations

Communication between people on Turtlenet requires that one is in possesion of the public key of the recipient, and should they wish to respond then they must be in possesion of your public key. We define 'A being related to B' to mean that A is in possesion of B's public key, and B is in possesion 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.

15.3 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.

15.4 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 databse 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.

15.5 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.

15.6 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.

15.7 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 verfying the signature and the content added to the database. It is in this manner that all content is passed from server to client.

Chapter 16

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

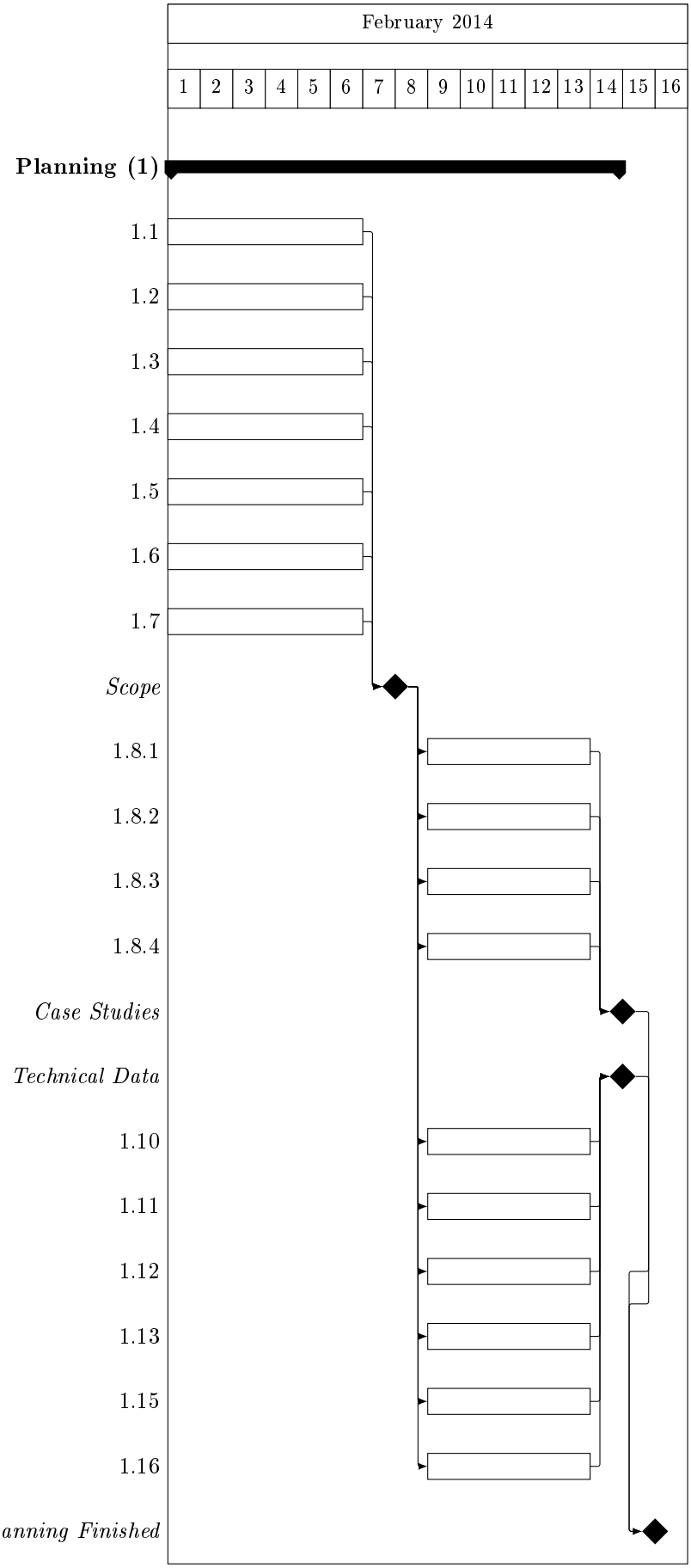
Chapter 17

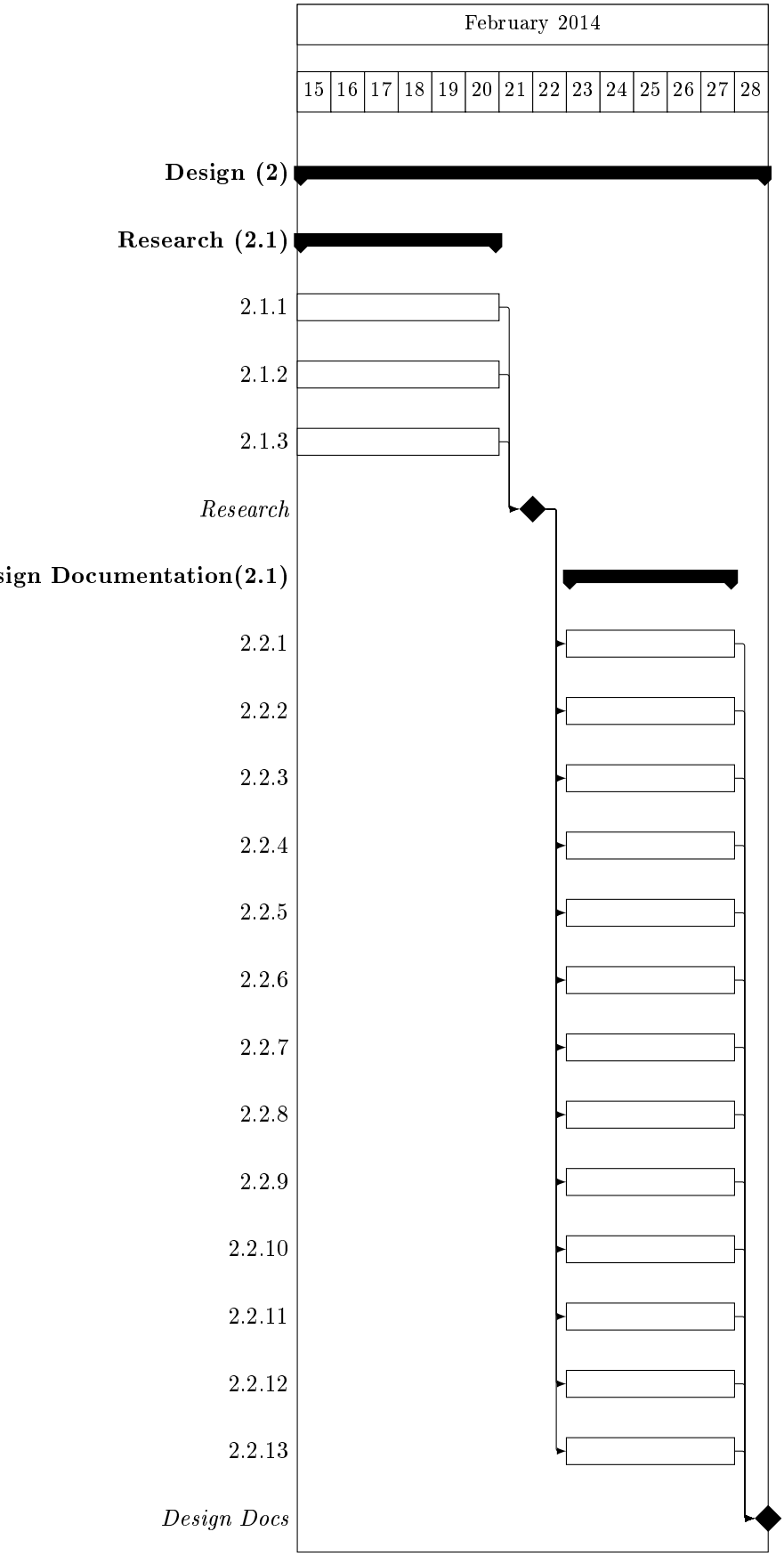
Gantt Chart

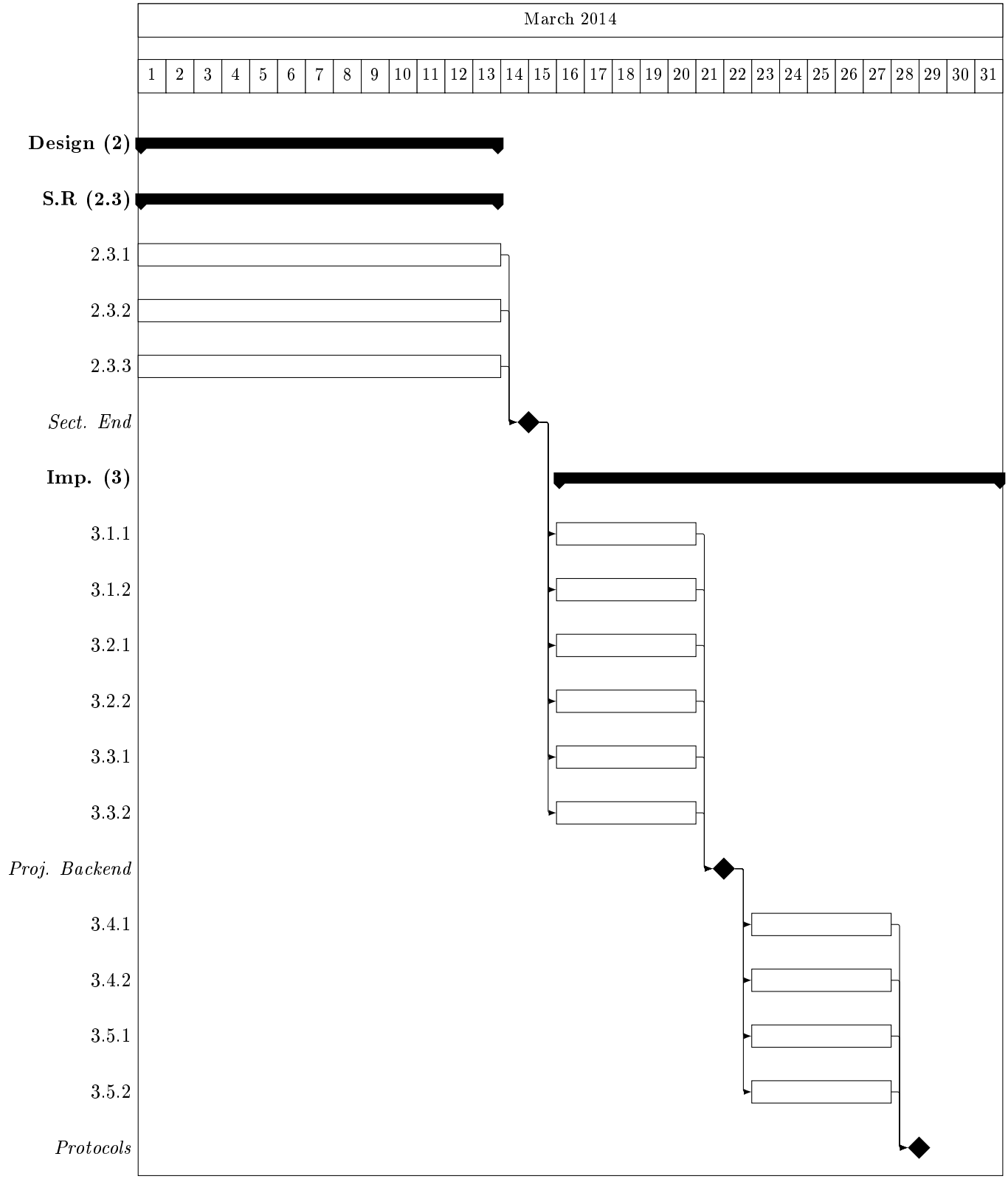
The following are Gantt Charts of the project. They are developed from looking at overall requirements for the project, and to act as a base for us to follow when developing the project.

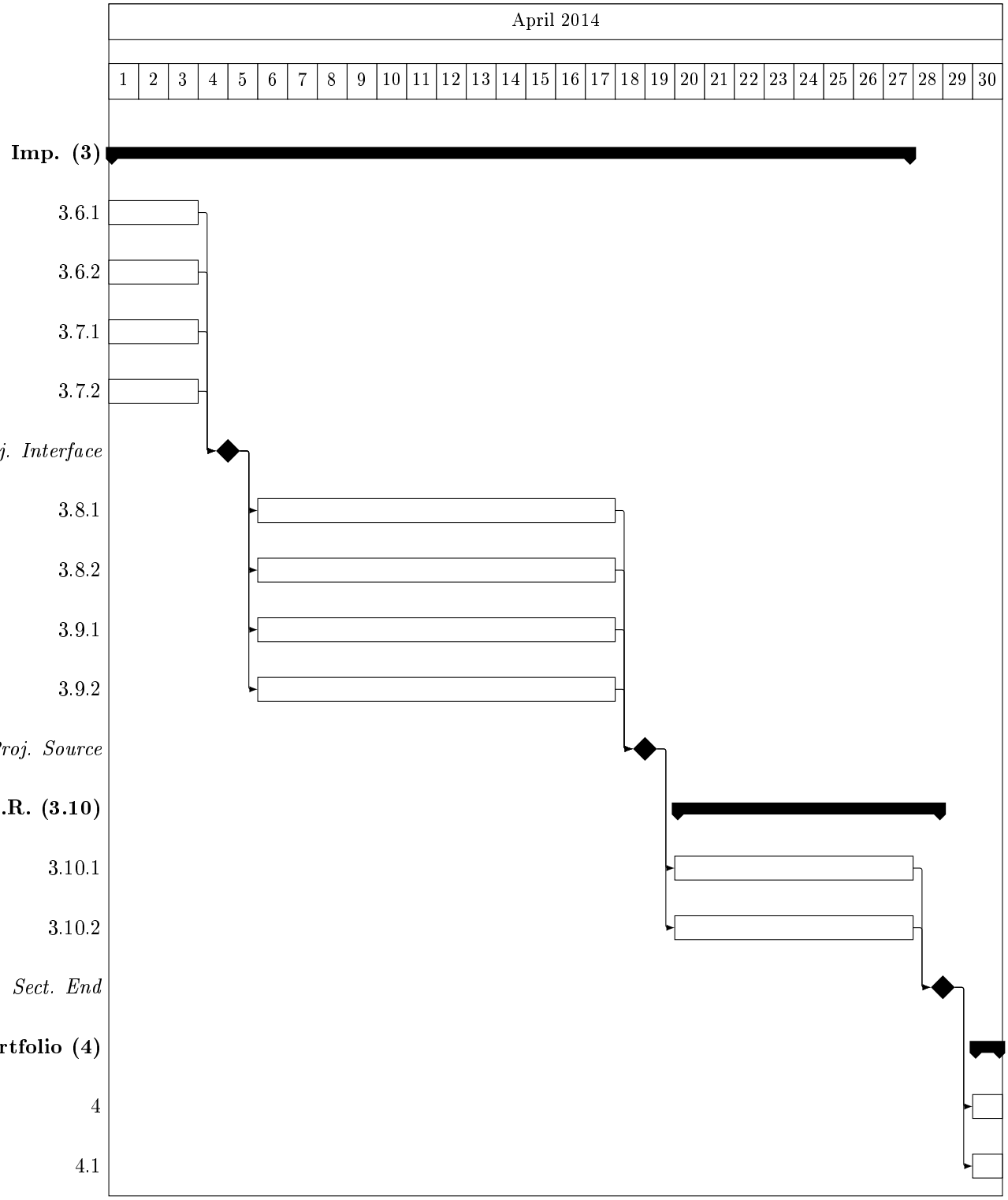
It is a graphical representation of the Task List documented prior to the charts. They have been split up either monthly or bi-monthly basis to allow acceptable formatting, due to differing workloads between months.

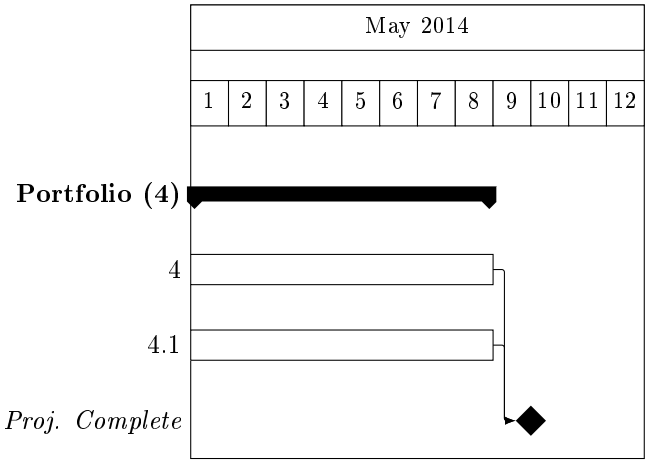
February is the most work intensive as it is providing the foundations of the project and is therefore detailed to reduce the risk of the project failing. April is the most lax of the working months (apart from May being project clean up) as the group members will be concentrating on the larger tasks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


February 2014
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Planning (1)
1.1
1.2
1.3
1.4
1.5
1.6
1.7
Scope
1.8.1
1.8.2
1.8.3
1.8.4
Case Studies
Technical Data
1.10
1.11
1.12
1.13
1.15
1.16
Planning Finished


February 2014
15
16
17
18
19
20
21
22
23
24
25
26
27
28
Design (2)
Research (2.1)
2.1.1
2.1.2
2.1.3
Research
sign Documentation(2.1)
2.2.1
2.2.2
2.2.3
2.2.4
2.2.5
2.2.6
2.2.7
2.2.8
2.2.9
2.2.10
2.2.11
2.2.12
2.2.13
Design Docs


March 2014
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Design (2)
S.R (2.3)
2.3.1
2.3.2
2.3.3
Sect. End
Imp. (3)
3.1.1
3.1.2
3.2.1
3.2.2
3.3.1
3.3.2
Proj. Backend
3.4.1
3.4.2
3.5.1
3.5.2
Protocols


April 2014
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Imp. (3)
3.6.1
3.6.2
3.7.1
3.7.2
j. Interface
3.8.1
3.8.2
3.9.1
3.9.2
roj. Source
.R. (3.10)
3.10.1
3.10.2
Sect. End
rtfolio (4)
4
4.1


May 2014
1
2
3
4
5
6
7
8
9
10
11
12
Portfolio (4)
4
4.1
Proj. Complete

Chapter 18

Risk Assessment

18.1 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.

18.2 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 of 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.

18.3 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.

18.4 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.

18.5 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 befell 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.

18.6 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].

18.7 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.

18.8 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.

18.9 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.

18.10 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.

18.11 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 oneâĂŹs 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.

18.12 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.

18.13 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.

18.14 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 19

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 20

Architecture

20.1 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 recipient[1] 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).

[1] using RSA/AES, see protocol for details

20.2 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->b denotes that data passes from module a to module b, and a<->b similarly denotes that data passes both from a to b and from b to a.

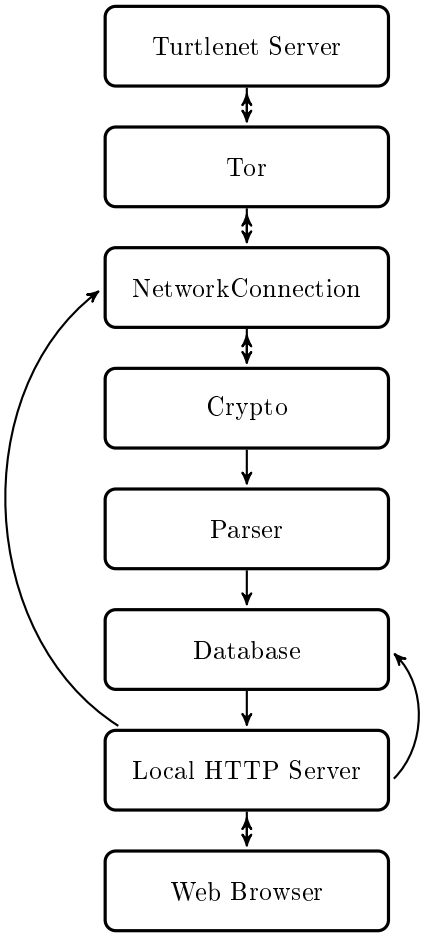


Figure 20.1: Module Interaction

20.3 Data Flow Diagram

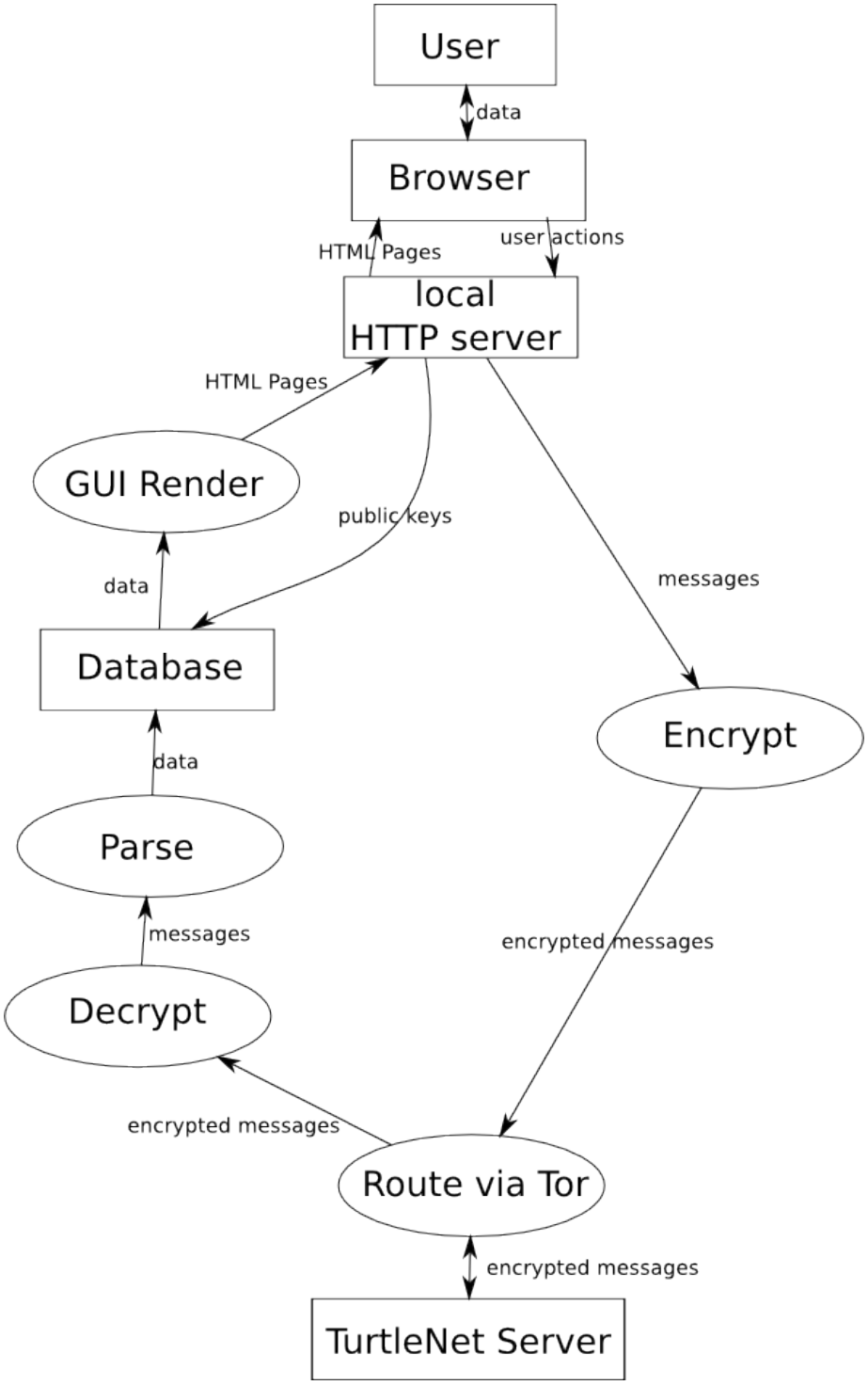
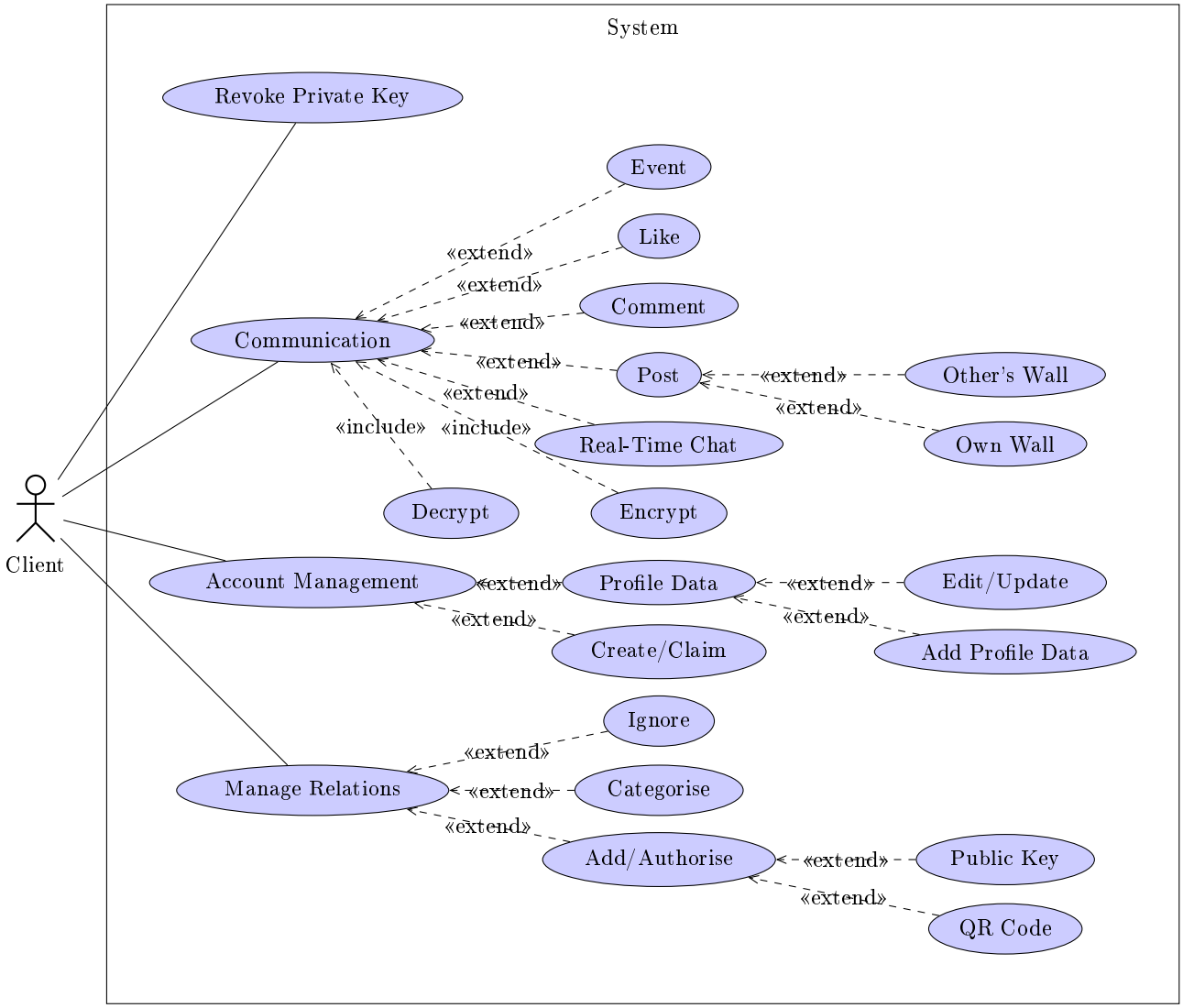


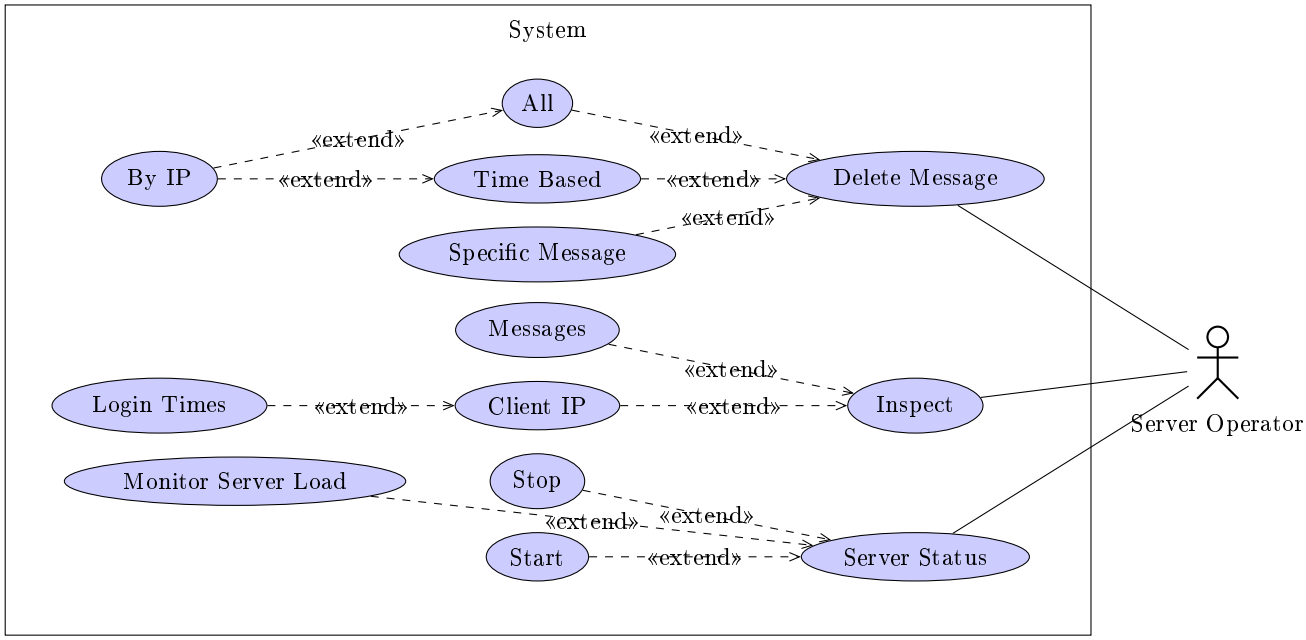
Figure 20.2: Data Flow Diagram

Chapter 21

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.


System
Revoke Private Key
Event
Like
Comment
Communication
Post
Other's Wall
Own Wall
Real-Time Chat
Decrypt
Encrypt
Client
Account Management
Profile Data
Edit/Update
Create/Claim
Add Profile Data
Ignore
Manage Relations
Categorise
Add/Authorise
Public Key
QR Code
«extend»
«include»


System
All
By IP
Time Based
Delete Message
Specific Message
Messages
Login Times
Client IP
Inspect
Monitor Server Load
Stop
Start
Server Status
«extend»
Server Operator

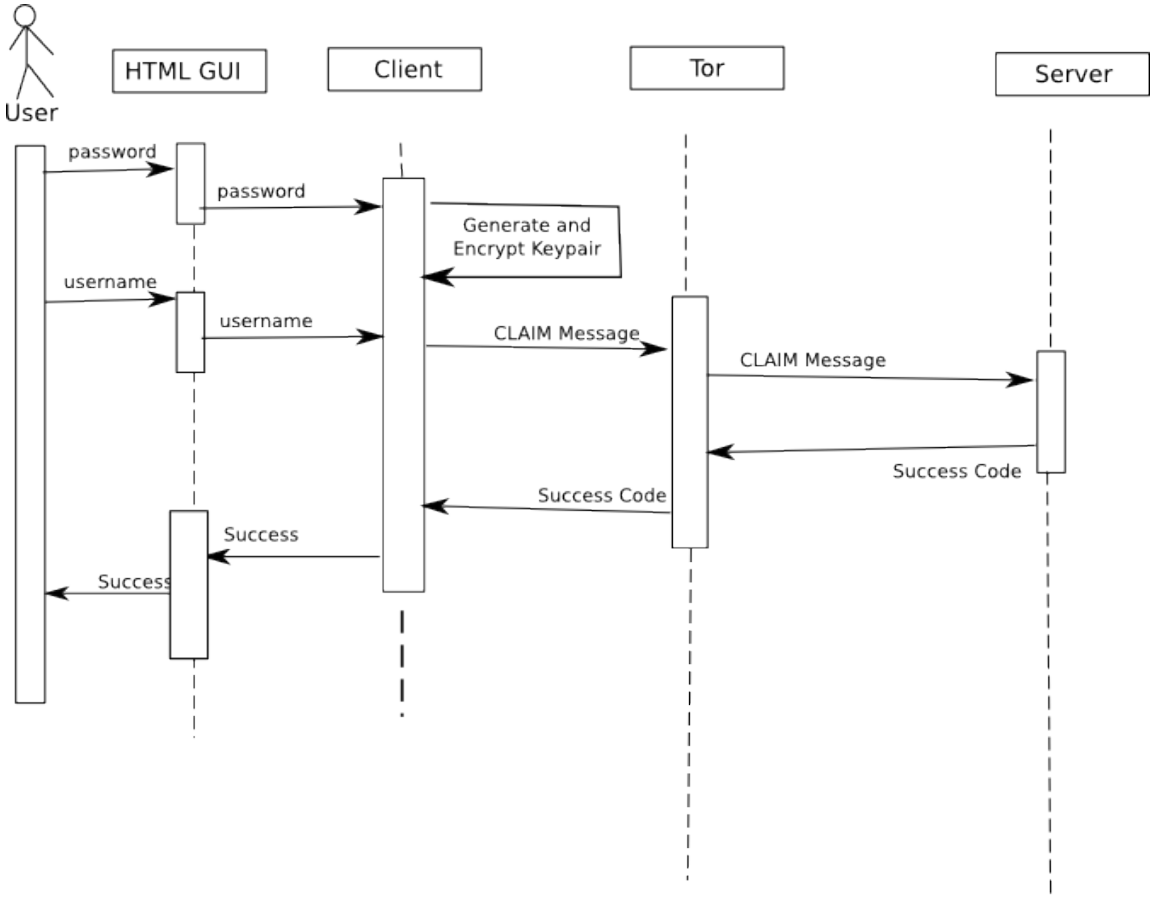


Figure 21.1: Sequence Diagram - Registering

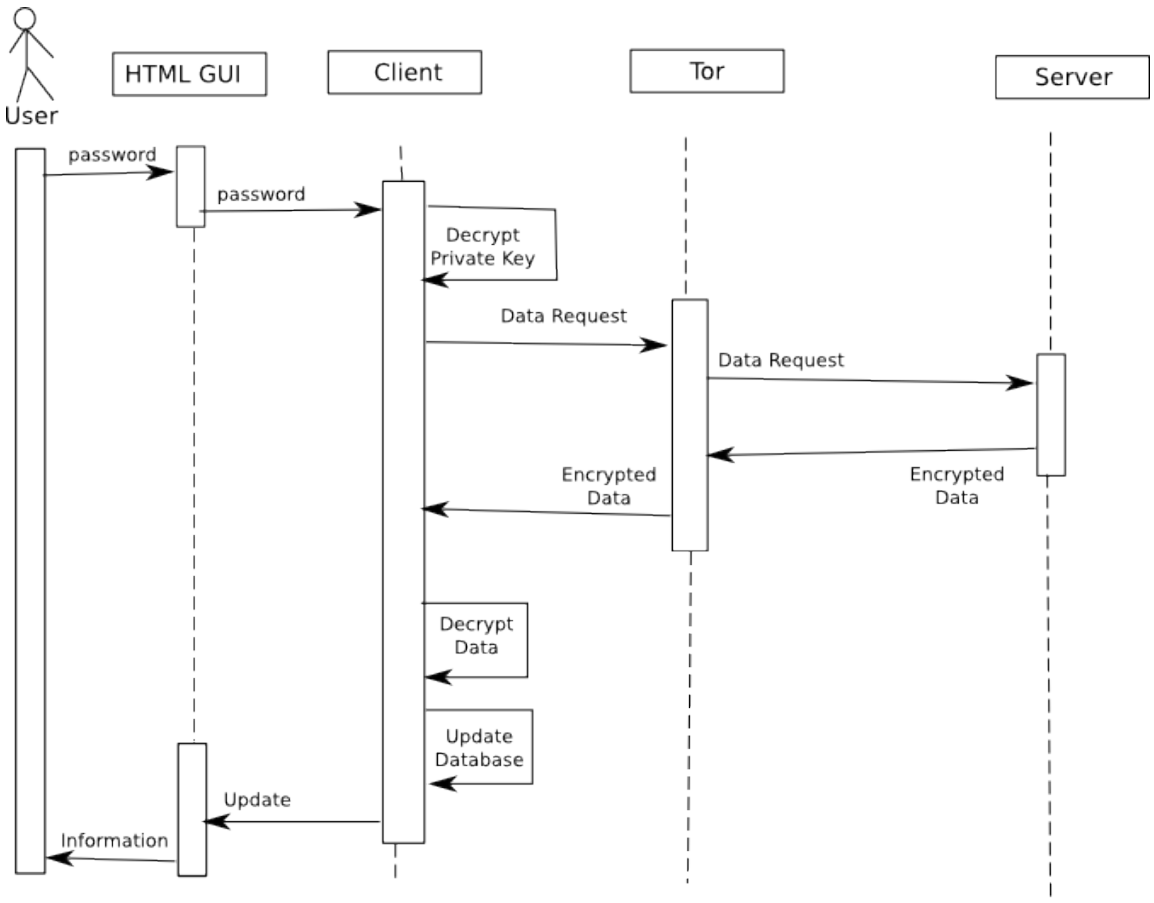


Figure 21.2: Sequence Diagram - Recieving Data

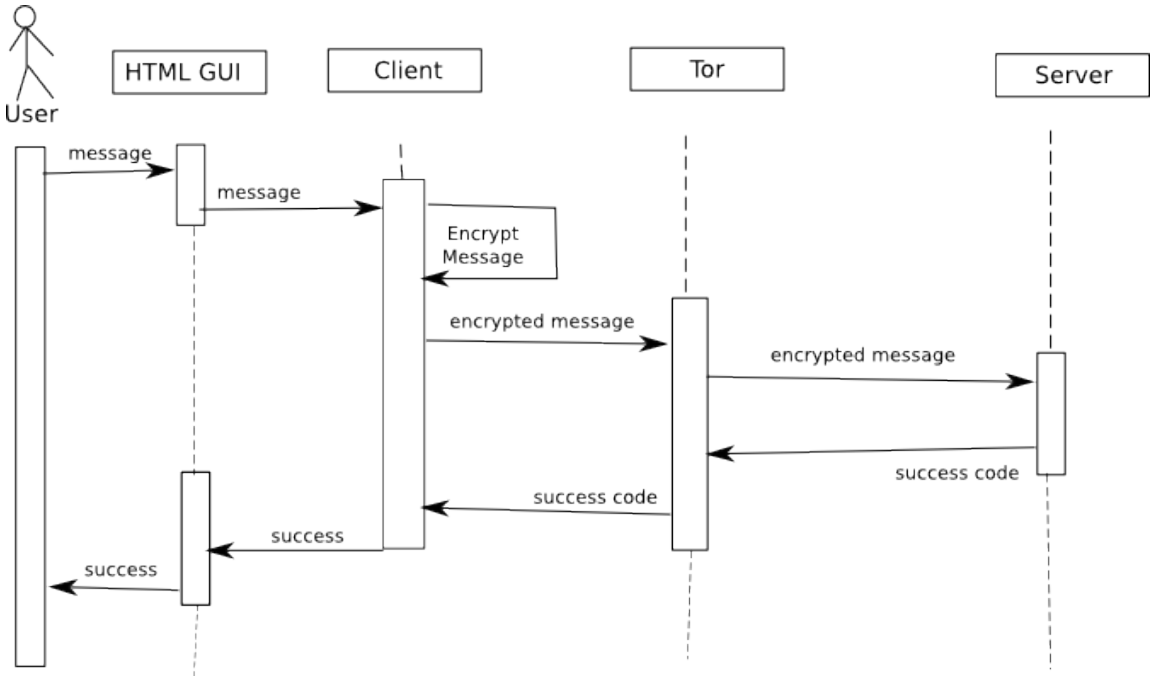


Figure 21.3: Sequence Diagram - Sending Data

Chapter 22

Protocol

22.1 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/CMNT/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.

22.2 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 *utf-8_text*	send messages	the text sent is stored on the server
get *ms_unix_time*	get new messages	every message stored since the given time is sent
c *utf-8_text*	claim a username	the text sent is stored on the server, with a special filename

Table 22.1: 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>*.

22.3 Client-Client Protocol

22.4 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.

22.5 Message Formatting

22.5.1 Unecrypted 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:

$$<command>\backslash<signature>\backslash<content>\backslash<timestamp>$$

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

An example follows:

$$\text{POST}\backslash<signature>\backslash\text{Hello, World!}\backslash 1393407435547$$

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.

22.5.2 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:

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

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

22.6 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 sent an unencrypted CLAIM message to the server. The format follows:

$$\text{CLAIM}\backslash<signature>\backslash<username>\backslash<timestamp>$$

22.7 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:

$$\text{REVOKE}\backslash<signature>\backslash<time>\backslash<timestamp>$$

22.8 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:

$$\text{PDATA}\backslash<signature>\backslash<values>\backslash<timestamp>$$

The format for values follows:

$$<field>: <value>; \ldots$$

An example follows:

$$\text{PDATA}\backslash<signature>\backslash\text{name:Luke Thomas;dob:1994;}\backslash<timestamp>$$

22.9 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:

$$\text{CHAT}\backslash<signature>\backslash<keys>\backslash<timestamp>$$

The format for keys follows:

$$<key>: <another\_key>\ldots$$

An example follows:

$$\text{CHAT}\backslash<signature>\backslash<key1>:<key2>\backslash<timestamp>$$

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

$$\text{PCHAT}\backslash<signature>\backslash<conversation>:<message>\backslash<timestamp>$$

Whereby $<conversation>$denotes the signature present on the establishing message. An example follows:

$$\text{PCHAT}\backslash<signature>\backslash\text{9f86d081884c7d659a2feaa0c55ad015a3bf4f1b2b0b822cd15d6c15b0f00a08:First!}\backslash<timestamp>$$

22.10 Posting to own wall

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

$$\text{POST}\backslash<signature>\backslash<message>\backslash<timestamp>$$

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":

$$\text{POST}\backslash<signature>\backslash\text{Hello, World!}$$
$$\text{foo}\backslash\backslash\text{bar}\backslash\backslash\text{baz}\backslash<timestamp>$$

22.11 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).

22.12 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*>

22.13 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*>

22.14 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 23

Class Interfaces

23.1 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 23.1: Server

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

Table 23.2: 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 23.3: 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 23.4: Crypto

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

Table 23.5: 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 revokes 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 usernamne, 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 23.6: 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 23.7: 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 23.8: 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 23.9: Pair<A, B>

23.2 Class Diagram

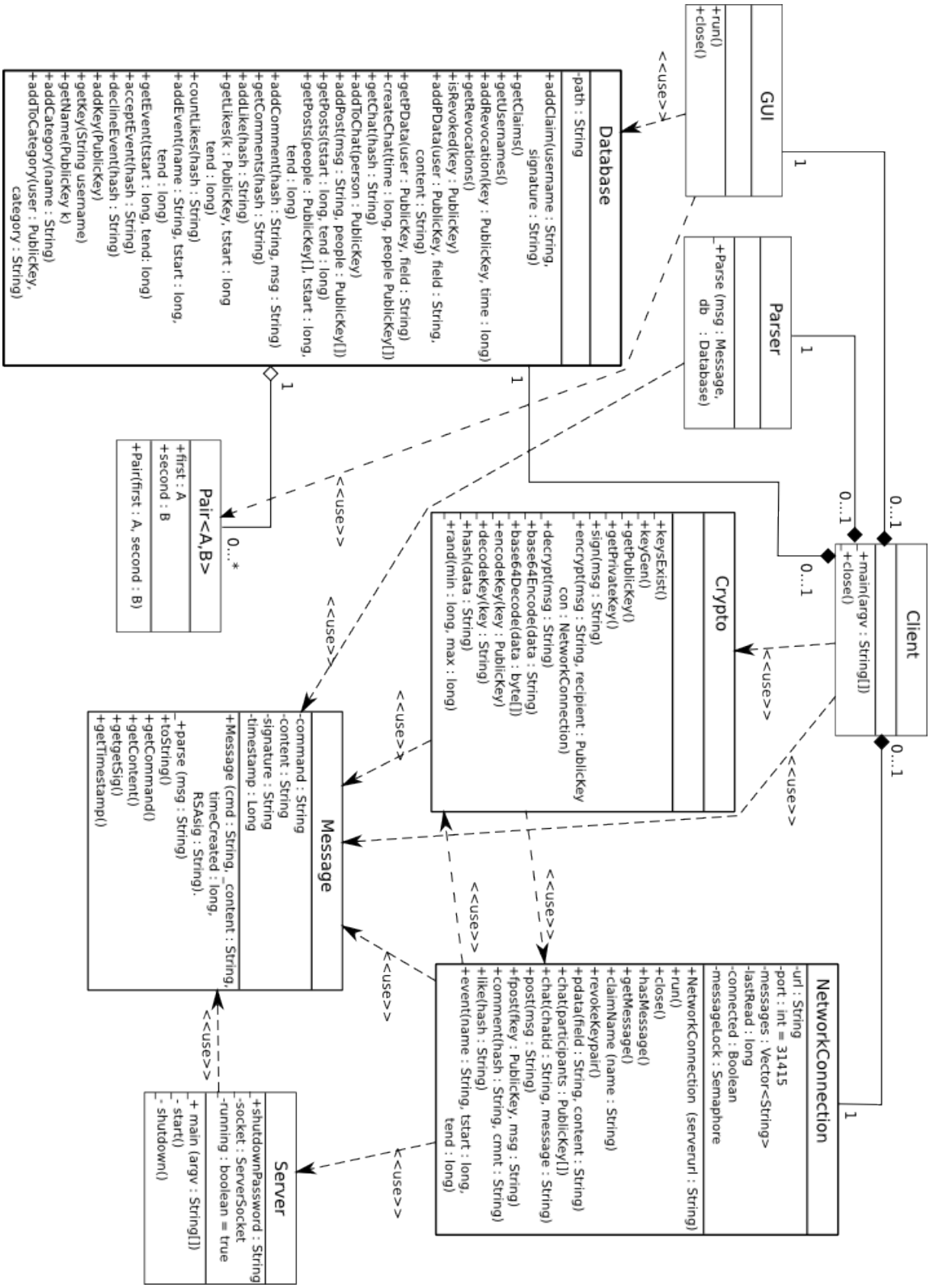


Figure 23.1: UML Class Diagram

Chapter 24

Pseudocode

24.1 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()
}
```

24.2 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)
}
```

24.3 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 initalization 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\ciper 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)
}
```

24.4 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)
}
```

24.5 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", 90
    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);
}
```

24.6 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 25

Database

25.1 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.

25.1.1 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.

25.1.2 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.

25.1.3 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.

25.1.4 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 a 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.

25.1.5 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.

25.1.6 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.

25.1.7 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.

25.1.8 user, has_comment table

Users can also comment on comments itself. This will create and 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.

25.1.9 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.

25.1.10 message_claim table

This tables 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.

25.1.11 key_revoke table

This stores key revocation messages. If a user suspects that there 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.

25.1.12 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.

25.2 Table layout of the database

NB: Public keys are 217 characters long, all id's are auto-incremented.

Table 25.1: user

Name	Datatype	Key
user_id	INT	PK
username	VARCHAR(25)	
name	VARCHAR(30)	
birthday	DATE	
sex	VARCHAR(1)	
email	VARCHAR(30)	
public_key	VARCHAR(600)	PK

Table 25.2: is_in_category

Name	Datatype	Key
is_in_id	INT	PK
category_id	INT	FK
user_id	INT	FK

Table 25.3: category

Name	Datatype	Key
category_id	INT	PK
name	VARCHAR(30)	

Table 25.4: private_message

Name	Datatype	Key
message_id	INT	PK
from	INT	
content	VARCHAR(50)	
time	DATE	

Table 25.5: is_in_message

Name	Datatype	Key
is_in_id	INT	PK
time	DATETIME	
message_id	INT	FK
user_id	INT	FK

Table 25.6: wall_post

Name	Datatype	Key
wall_id	INT	PK
from	INT	FK
to	INT	FK
content	VARCHAR(50)	
time	DATETIME	

Table 25.7: allowed_to

Name	Datatype	Key
allowed_to_id	INT	PK
user_id	INT	FK
category_id	INT	FK
post_id	INT	FK

Table 25.8: has_comment

Name	Datatype	Key
comment_id	INT	PK
comment_content	VARCHAR(50)	
post_id	INT	FK
user_id	VARCHAR(50)	FK
comment_comment_id	INT	FK
time	DATETIME	

Table 25.9: has_like

Name	Datatype	Key
like_id	INT	PK
post_id	INT	FK
user_id	INT	FK
comment_id	INT	FK
time	DATETIME	

Table 25.10: events

Name	Datatype	Key
event_id	INT	PK
title	VARCHAR(10)	
content	VARCHAR(40)	
time	DATETIME	
start_date	DATETIME	
end_date	DATETIME	
from	INT	FK

Table 25.11: is_invited

Name	Datatype	Key
is_invited_id	INT	PK
user_id	INT	FK
is_in_category_id	INT	FK
event_id	INT	FK
decision	BIT	

Table 25.12: login_logout_log

Name	Datatype	Key
log_id	INT	PK
login_time	DATETIME	
logout_time	DATETIME	

Table 25.13: key_revoke

Name	Datatype	Key
revoke_id	INT	PK
signature	VARCHAR(45)	
time	DATETIME	

Table 25.14: message_claim

Name	Datatype	Key
username	VARCHAR(25)	PK
signature	VARCHAR(45)	

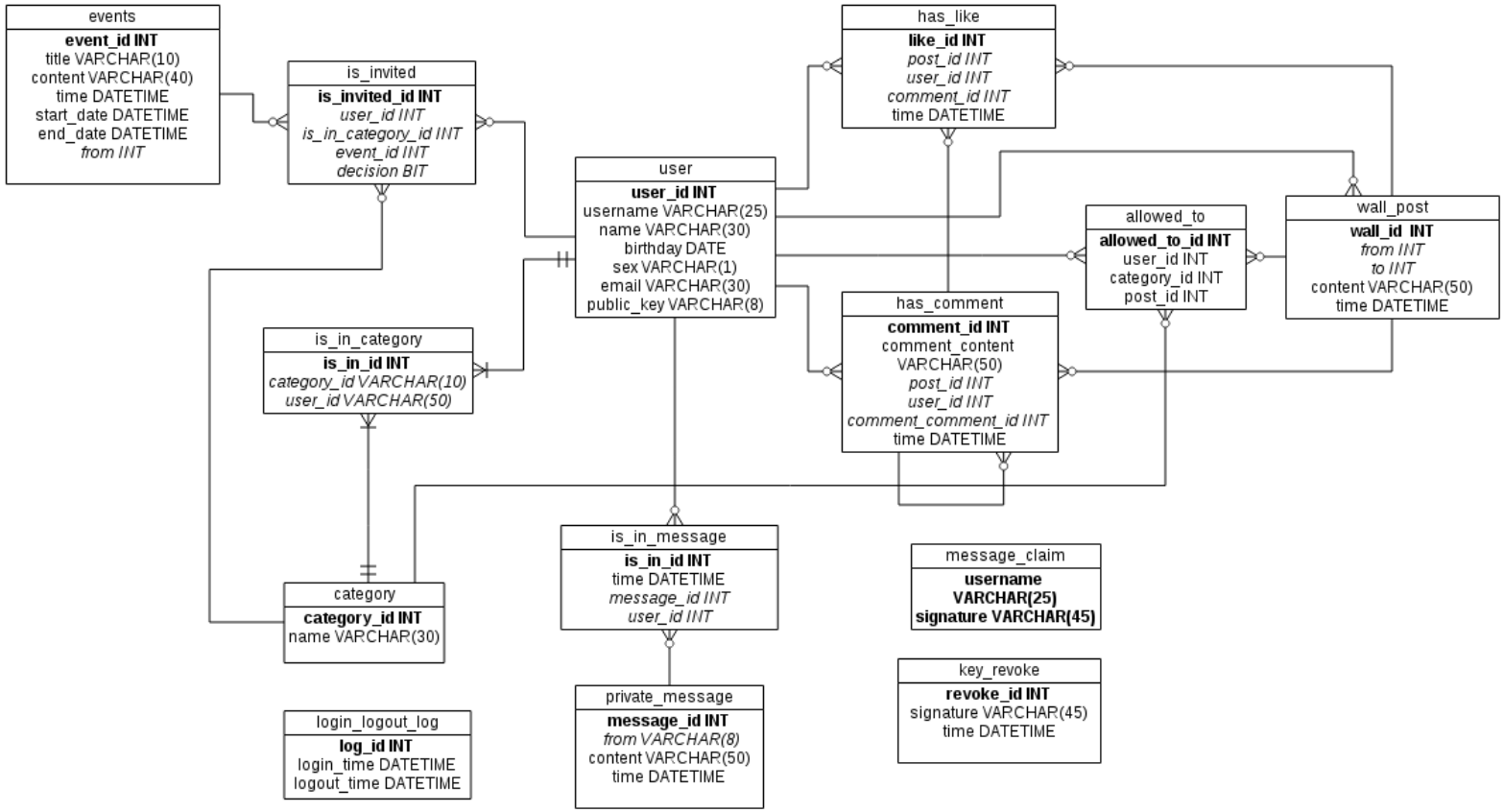


Figure 25.1: Database Entity Relationship diagram

Chapter 26

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 27

User Interfaces

27.1 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.

27.1.1 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.

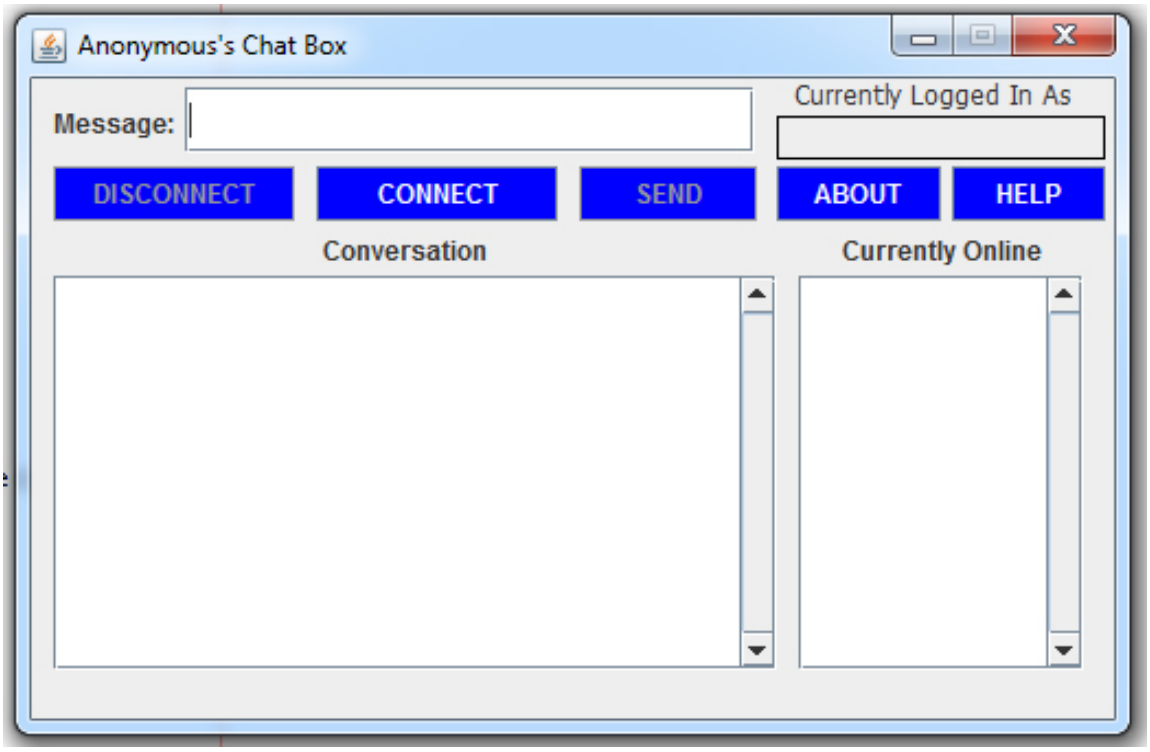


Figure 27.1: Swing Instant Messaging Application

27.1.2 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.

27.1.3 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.

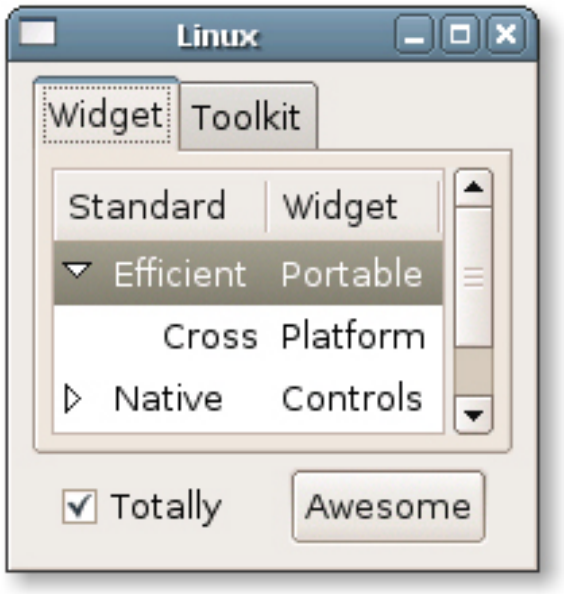


Figure 27.2: SWT Appearance Style

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.

27.1.4 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.

27.1.5 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.

27.2 GUI Design

27.2.1 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.

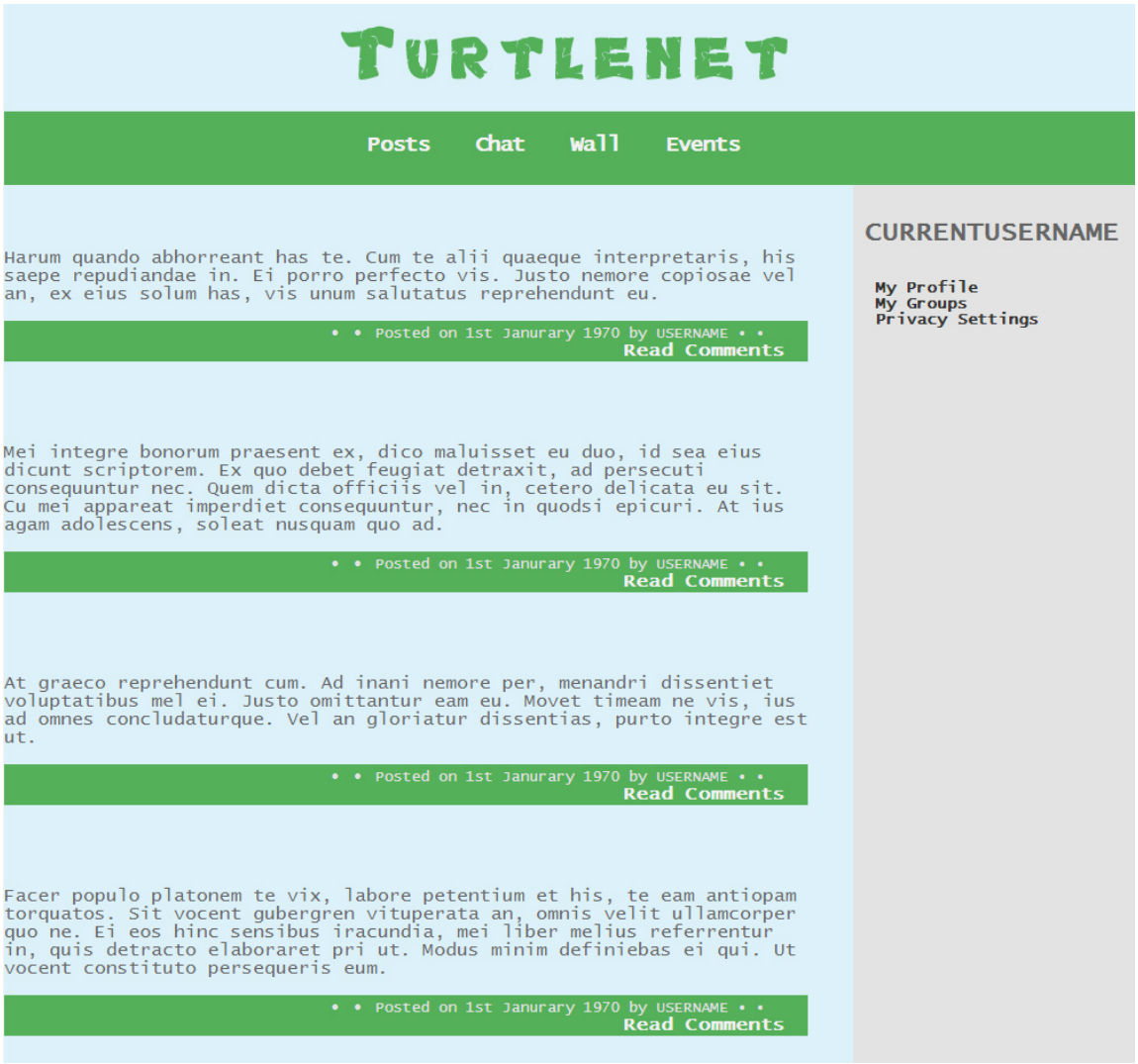


Figure 27.3: Client Design Image

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.

27.2.2 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.

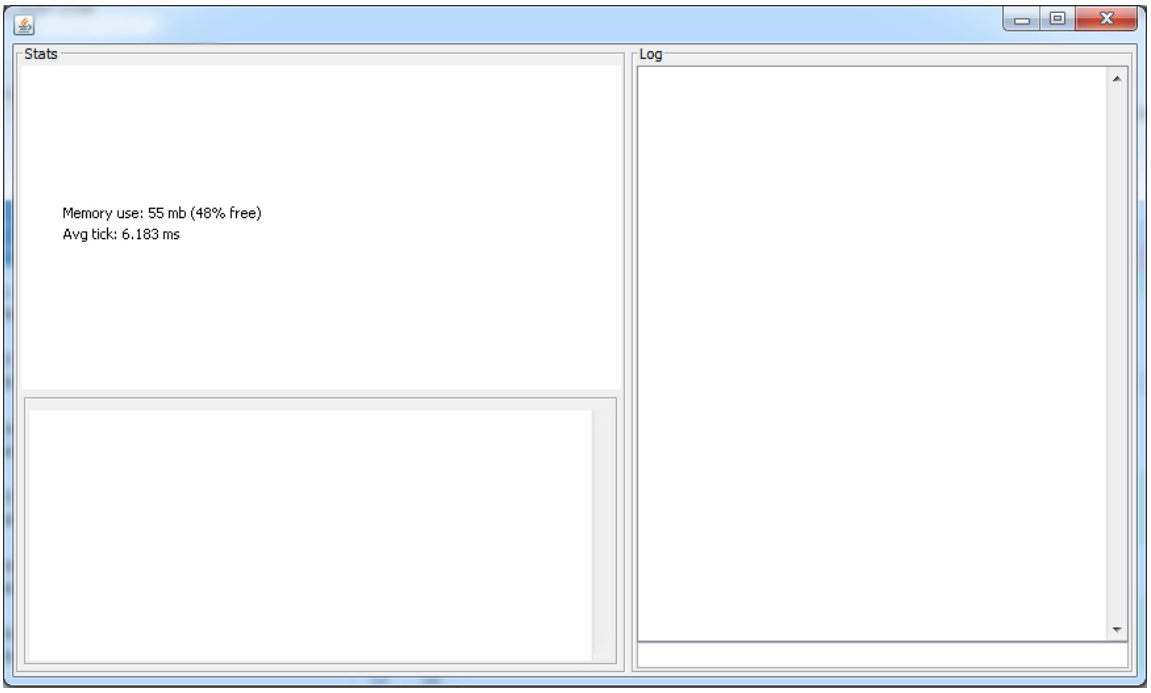


Figure 27.4: Server Design Image

27.3 Future Work

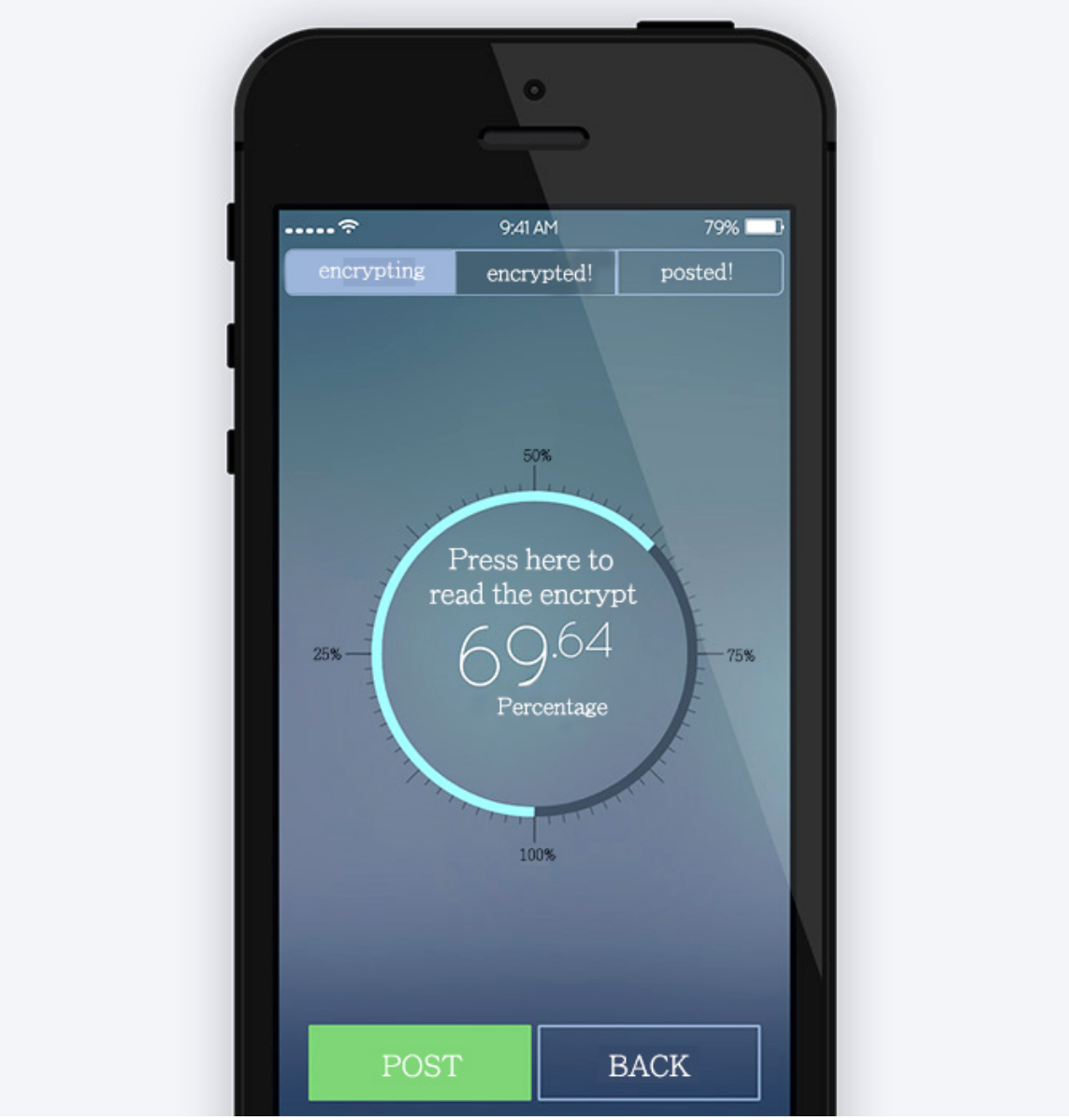


Figure 27.5: Mobile Sending Stage GUI

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 27.6: 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.

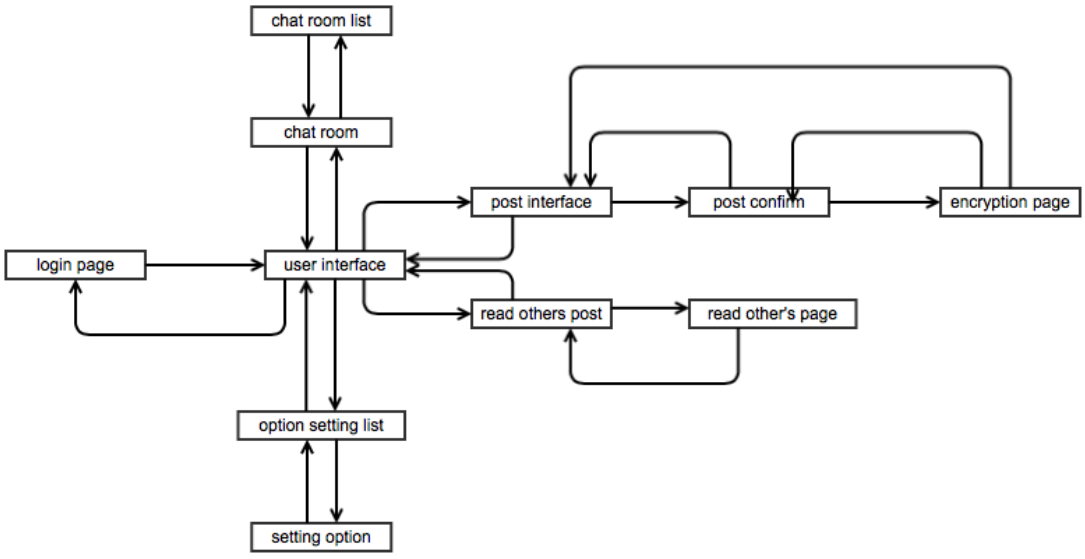


Figure 27.7: Mobile Data Flow Diagram

Chapter 28

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.

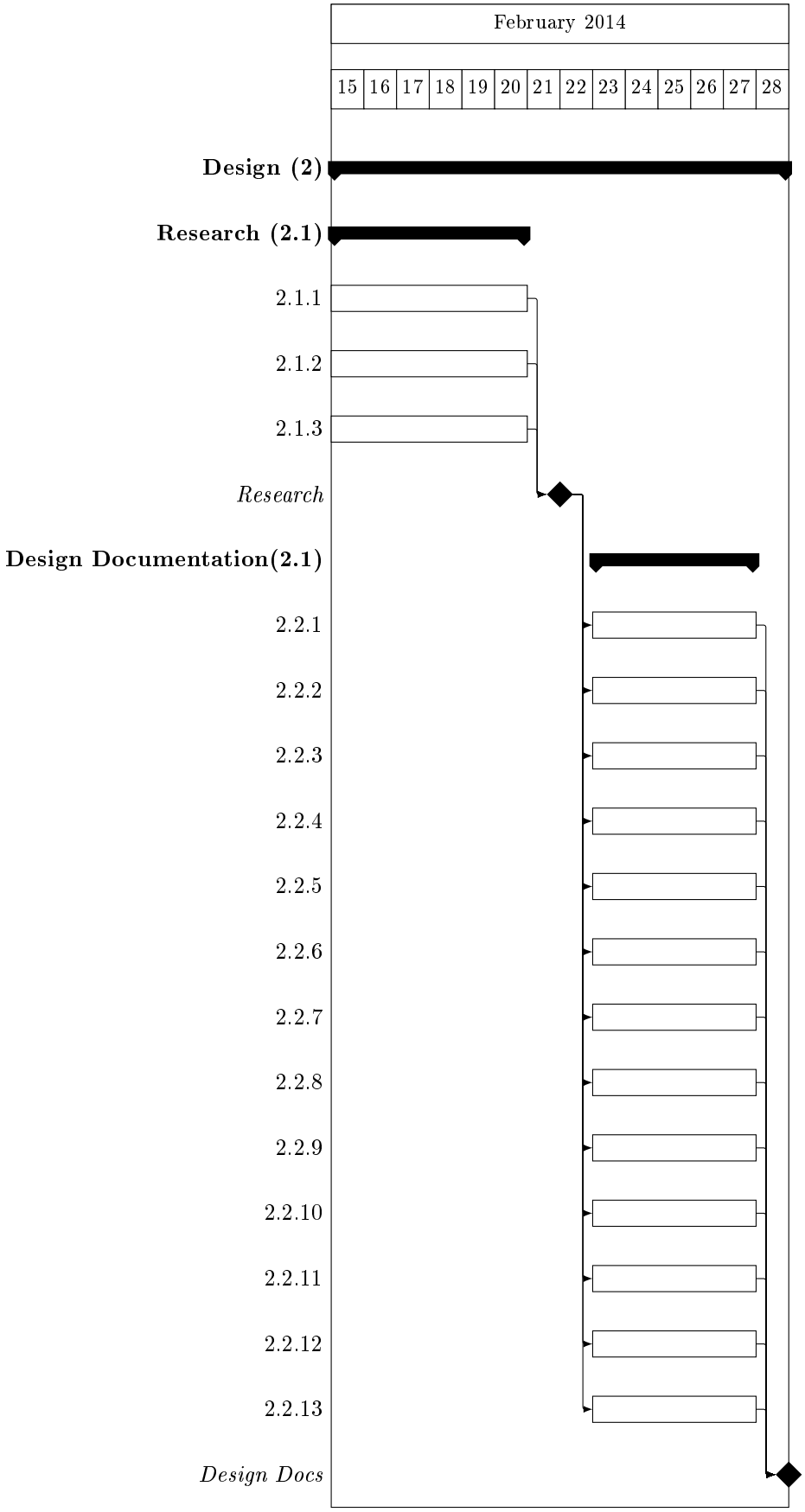
Chapter 29

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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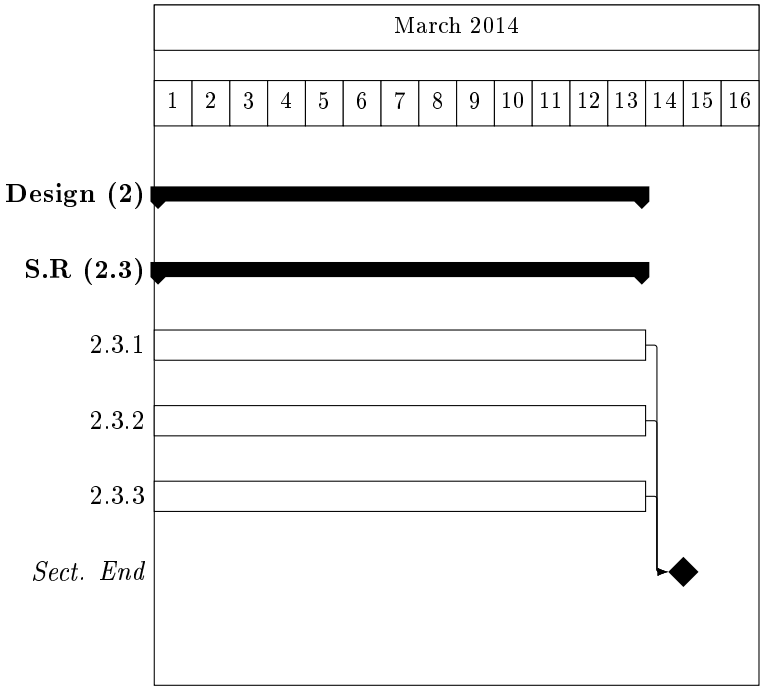
Design Docs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Design (2)
S.R (2.3)
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2.3.2
2.3.3
Sect. End

Chapter 30

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 reptitive 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.

[1] See 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

Contents

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:

- p.duff@turtlenet.com
- l.thomas@turtlenet.com
- a.senin@turtlenet.com
- 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

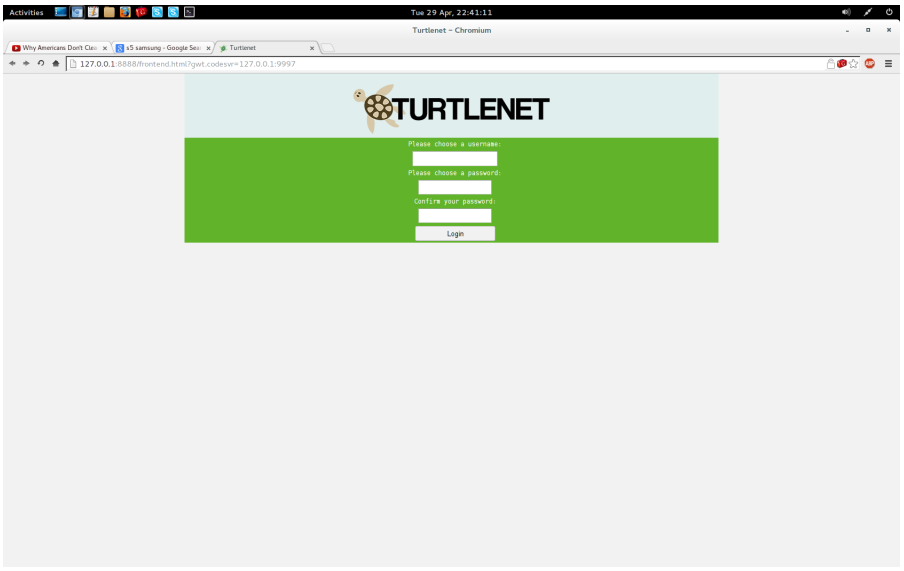
Using the System

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.

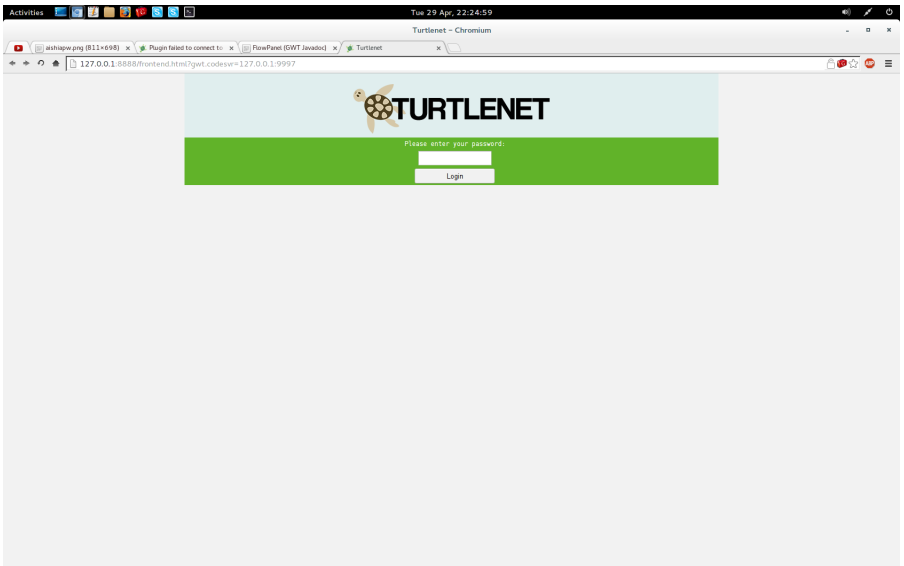
- Your password should be easy to remember but difficult for anyone else to guess. A good method for coming up with new passwords is to use four or five words, in a phrase. An example would be 'ThisIsTurtlenetzPassword'. This is better and easier to remember than what is usually suggested which is a 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 transfered 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:

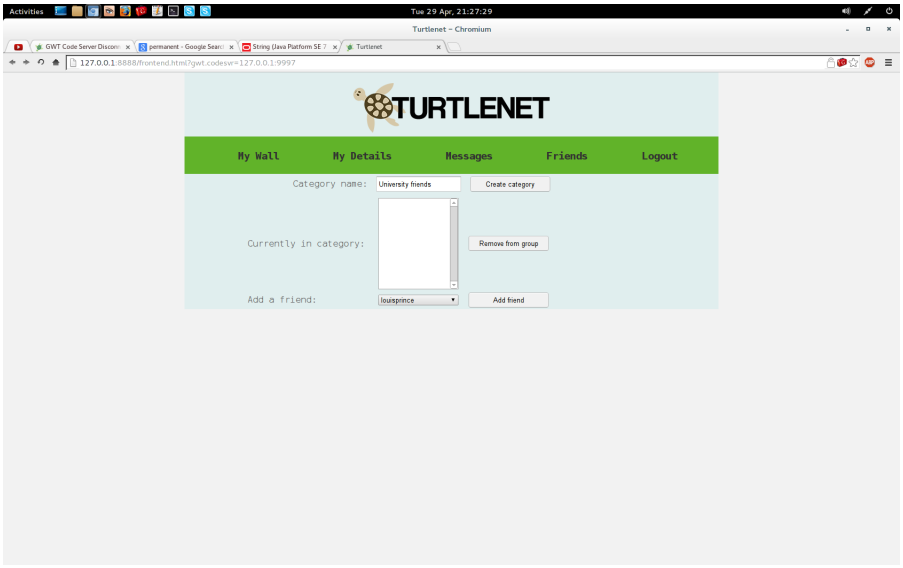
In the image above, the current user has added themselves to their friends list. Simply repeat the process as it takes you back to the main section for the friends tab.

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

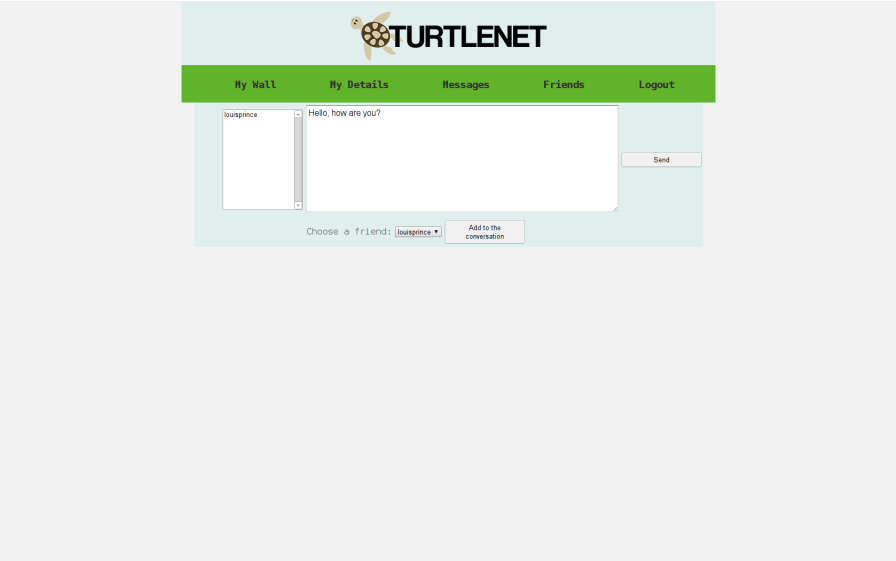
In Turtlenet you can associate other users with categories, custom made by you. This is useful if you want to send the same message to a number of people. To do this, whilst you are in the friends section of the client, click the 'Create category' button on the right. It should take you to this screen:



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:



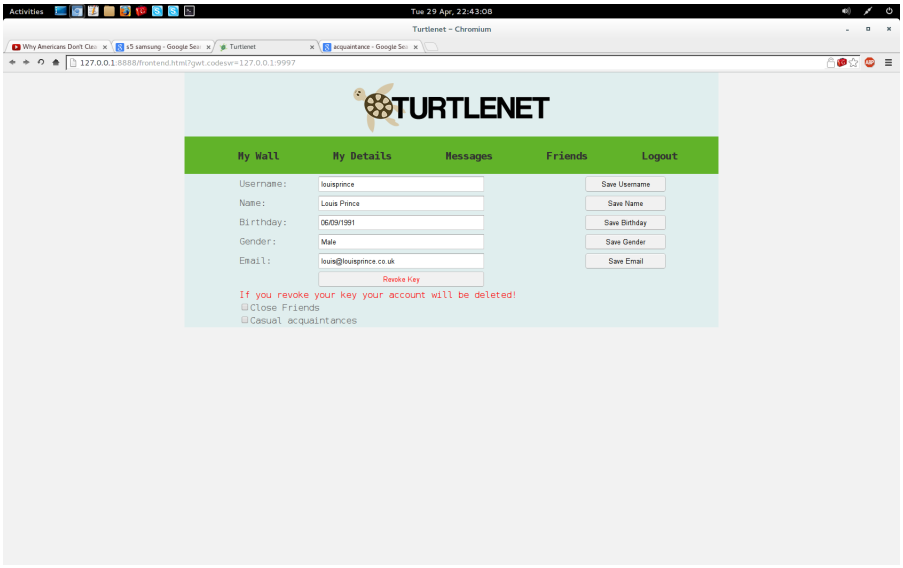
- the box at the left hand side is for your available recipients - our example user only has himself at the moment. This will fill up over time when you add public keys from other users.

- 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.

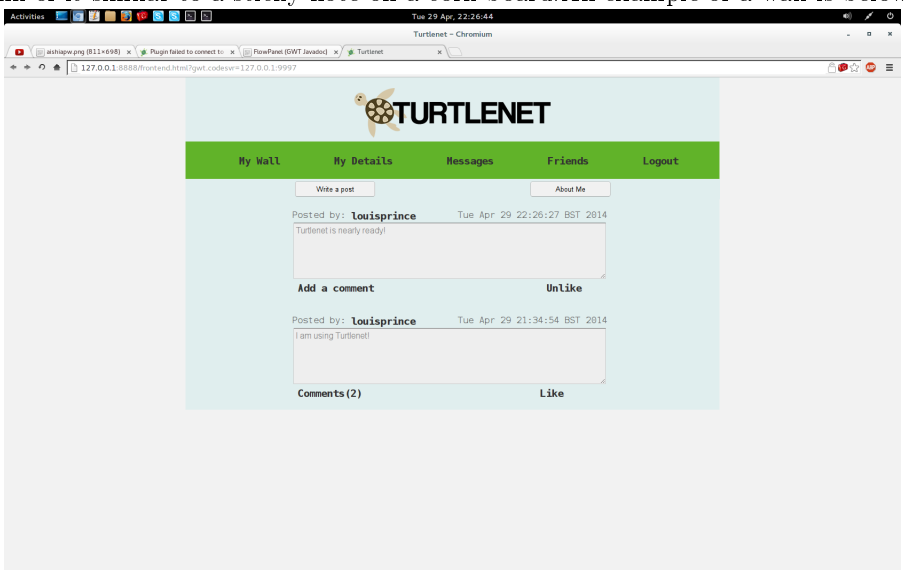
Below these fields is a list of categories you have created, check the box next to a category and members of it will be able to see your personal data. Unchecking the box hides any futures changes in it from them.

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.

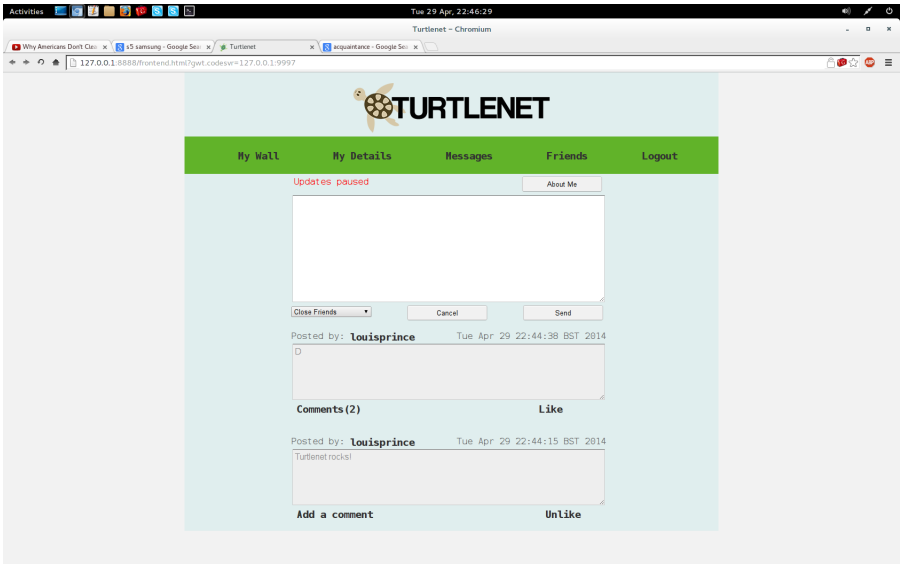
In Turtlenet a post is the generic way of talking about a message being left for another user - think of it similar to a sticky note on a cork board.An example of a wall is below:



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 clicked 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 seperate the content people can see then categories are a better solution, and future versions of Turtlenet will allowing 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.

Part IV

Portfolio

Chapter 31

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 experiance. 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, soley 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 relevent 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 foriegn key in our entire database: tCategoryMembers.catID references tCategory.catID, and even that is tenuous at best as 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 extracing information from different types of messages.

9. The DBStrings class was added so as to keep SQL query strings seperate 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 javas existing Tokenizer class because we needed a tokenizer automatically convertable to javascript. A factory class was required because the Message class cannot contain constructors not automatically convertable 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 32

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 33

Testing

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Chapter 34

Future Development

34.1 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.

34.2 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.

34.3 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

```java
package ballmerpeak.turtlenet.server;

import java.util.Date;
import java.util.Scanner;

public class TNClient implements Runnable {
    public NetworkConnection connection;
    public Thread networkThread;
    public Database db = null;
    public String password = "NOT SET";
    public boolean running = true;
    public boolean dbReady = false;

    public TNClient (String pw) {
        password = pw;
    }

    public void run () {
        if (!Crypto.keysExist())
            Crypto.keyGen();

        connection    = new NetworkConnection("turtle.turtlenet.co.uk");
        networkThread = new Thread(connection);
        db            = new Database(password);

        networkThread.start();
        dbReady = true;

        while (running)
            while (connection.hasMessage())
                Parser.parse(Crypto.decrypt(connection.getMessage()), db);

        connection.close();
        db.dbDisconnect();
        Logger.close();
    }
}
```

```java
package ballmerpeak.turtlenet.remoteserver;

import ballmerpeak.turtlenet.shared.Message;
import java.io.*;
import java.net.*;
import java.util.Date;
import java.util.StringTokenizer;
import javax.xml.bind.DatatypeConverter;

public class Server
{
    public  static String shutdownPassword = "SHUTDOWN 83eea84d472df09f5e64468996fdff0e";
    private static ServerSocket socket;
    private static boolean running = true;

    public static void start (int port) {
        Socket incoming;
        Thread t;

        try {
            socket = new ServerSocket(port);

            while (running) {
                incoming = socket.accept();
                t = new Thread(new Session(incoming));
                t.start();
            }
        } catch (Exception e) {
            if (running)
                System.out.println("ERROR: " + e.getMessage());
        } finally {
            shutdown();
        }
    }

    public static void shutdown() {
        running = false;

        try {
            socket.close();
        } catch (Exception e) {
            System.out.println("ERROR: " + e.getMessage());
            System.exit(1);
        }
    }

    public static void main (String[] argv) {
        System.out.println("Server running...");
        start(31415);
    }
}

class Session implements Runnable
{
    private Socket client;

    Session (Socket s) {
        client = s;
    }

    // execute()s the clients command and then closes the connection.
    public void run() {
        System.out.println("Connection from " + client.getInetAddress().getHostAddress());
        BufferedReader in = null;
        PrintWriter out = null;

        try {
            in = new BufferedReader
              (new InputStreamReader(client.getInputStream()));
            out = new PrintWriter
              (new OutputStreamWriter(client.getOutputStream()));

            execute(in.readLine(), in, out);
        } catch (IOException e) {
            System.out.println("ERROR: " + e.getMessage());
        }
        out.flush();
        //close everything related to this session
        try {
            in.close();
        } catch (Exception e) {}

        try {
            out.close();
        } catch (Exception e) {}

        try {
            client.close();
        } catch (Exception e) {}
    }

    //Protocol:
    //NB: The universe came into existance 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     }
```

```
body {
        margin: 0;
        background: #F2F2F2;
        color: #666666;
        font-family: "Lucida Console", monospace;
}

h1 {
        font-size: 5em;
        margin: 0;
        letter-spacing: 10px;
        font-weight: lighter;
        padding: 10px 0 0 0;
        text-align: center;
}

#header {
        width: 1000px;
        height: 120px;
        margin: 0 auto;
        background: #E0EEEE;
        font-family: Sans-Serif;
        color: #61B329;
}

#loading {
    width: 1000px;
        margin: 0 auto;
        text-align: center;
        font-size: 1.25em;
}

.gwt-login {
        width: 1000px;
        margin: 0 auto;
        background: #61B329;
        text-align: center;
        font-size: 0.75em;
        color: #000000;
}

.gwt-navigation {
        width: 1000px;
        height: 70px;
        margin: 0 auto;
        background: #61B329;
        text-align: center;
        padding: 25px 75px 0 0;
}

.gwt-friends-list {
        width: 1000px;
        margin: 0 auto;
        background: #E0EEEE;
        color: #666666;
}

.gwt-post-panel {
        width: 700px;
        margin: 0 auto;
        background: #E0EEEE;
        color: #666666;
        padding: 20px 100px 20px 200px;
}

.gwt-comments-contents {
        width: 675px;
        margin: 0 auto;
        background: #E0EEEE;
        color: #666666;
        padding: 20px 0 20px 60px;
}

.gwt-comments {
    width: 700px;
        margin: 0 auto;
        background: #E0EEEE;
        color: #666666;
}

.gwt-wall {
        width: 1000px;
        margin: 0 auto;
        background: #E0EEEE;
        color: #666666;
}

.gwt-wall-control {
        width: 1000px;
        margin: 0 auto;
        background: #E0EEEE;
        color: #666666;
        padding: 0 150px 0 200px;
```

```
}

.gwt-create-post {
        width: 800px;
        margin: 0 auto;
        background: #E0EEEE;
        color: #666666;
        padding: 0 0 0 200px;
}

.gwt-post-contents-footer {
    width: 700px;
        margin: 0 auto;
        background: #E0EEEE;
        color: #666666;
        padding: 0 100px 0 10px;
}

.gwt-edit-group {
        width: 1000px;
        margin: 0 auto;
        background: #E0EEEE;
        color: #666666;
        padding: 0 300px 0 115px;
}

.gwt-new-group {
        width: 1000px;
        margin: 0 auto;
        background: #E0EEEE;
        color: #666666;
        padding: 0 300px 0 200px;
}

.gwt-friend {
        width: 1000px;
        margin: 0 auto;
        background: #E0EEEE;
        color: #666666;
    padding: 0 0 0 200px;
}

.gwt-conversation-list {
        width: 1000px;
        margin: 0 auto;
        background: #E0EEEE;
        color: #666666;
        padding: 0 200px 0 50px;
}

.gwt-conversation {
        width: 950px;
        margin: 0 auto;
        background: #E0EEEE;
        color: #666666;
        padding: 0 0 0 50px;
}

.gwt-my-details {
        width: 1000px;
        margin: 0 auto;
        background: #E0EEEE;
        color: #666666;
        padding: 0 0 0 200px;
}

.gwt-my-details-permissions {
        width: 1000px;
        margin: 0 auto;
        background: #E0EEEE;
        color: #666666;
        padding: 0 200px 0 200px;
}

.gwt-friends-details {
        width: 1000px;
        margin: 0 auto;
        background: #E0EEEE;
        color: #666666;
        padding: 0 0 10px 200px;
}

.gwt-Anchor {
        font-size: 1.2em;
        font-weight: bold;
        color: #333333;
}

.gwt-Anchor:visited {
        color: #666666;
}

.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     }
```

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
        <head>
                <meta http-equiv="Content-Type" content="text/html;charset=utf-8" />
                <title>Turtlenet</title>
                <link href="frontend.css" rel="stylesheet" type="text/css" />
                <link href="favicon.ico" rel="shortcut icon" type="image/x-icon" />
                <link rel="icon" type="image/png" href="favicon.png" />
                <script type="text/javascript" language="javascript" src="frontend/frontend.nocache.js"></script>
        </head>

        <body>
                <iframe src="javascript:''" id="__gwt_historyFrame" tabIndex='-1'
style="position:absolute;width:0;height:0;border:0"></iframe>

                <div id="header">
                        <h1><img src="turtlenet.png" alt="Turtlenet" /></h1>
                </div>

                <div id = "loading">
                    <style type="text/css">
                        #loading {
                            padding: 20px 0 0 0;
                        }
                    </style>
                    Loading Turtlenet...
                </div>
        </body>
</html>
```

```java
package ballmerpeak.turtlenet.client;

import ballmerpeak.turtlenet.shared.CommentDetails;
import ballmerpeak.turtlenet.shared.PostDetails;
import ballmerpeak.turtlenet.shared.Message;
import ballmerpeak.turtlenet.shared.Conversation;

import com.google.gwt.core.client.*;
import com.google.gwt.event.dom.client.*;
import com.google.gwt.user.client.ui.*;
import com.google.gwt.event.logical.shared.*;
import com.google.gwt.user.client.Window;
import com.google.gwt.user.client.rpc.AsyncCallback;
import com.google.gwt.dom.client.Style.FontWeight;
import com.google.gwt.dom.client.DivElement;
import com.google.gwt.dom.client.Document;
import com.google.gwt.user.client.Timer;
import com.google.gwt.user.client.Window;
import java.util.Date;

public class frontend implements EntryPoint, ClickListener {

    // Create remote service proxy to talk to the server-side Turtlenet service
    private final TurtlenetAsync turtlenet = GWT.create(Turtlenet.class);
    //private final TurtlenetAsync msgfactory = GWT.create(MessageFactory.class);
    public void onModuleLoad() {
        // Remove loading indicatior from frontend.html
        DivElement loadingIndicator = DivElement.as(Document.get().getElementById("loading"));
        loadingIndicator.setInnerHTML("");

        /* Add handler for window closing */
        Window.addCloseHandler(new CloseHandler<Window>() {
                public void onClose(CloseEvent<Window> event) {
                    turtlenet.stopTN(new AsyncCallback<String>() {
                    public void onFailure(Throwable caught) {
                        //pretend nothing happened
                    }
                    public void onSuccess(String result) {
                        //bask in success
                    }
                });
            }
        });

        // Call method to load the initial login page
        login();
    }

    private String location = new String("");
    private String refreshID = new String("");

    // LOUISTODO May need to remove ' = new FlexTable()'
    private FlexTable loginPanel = new FlexTable();
    private void login() {
        location = "login";
        refreshID = "";
        RootPanel.get().clear();
        loginPanel = new FlexTable();
        loginPanel.clear();
        RootPanel.get().add(loginPanel);

        // Create login panel widgets
        final Button loginButton = new Button("Login");
        loginButton.addClickListener(this);
        final PasswordTextBox passwordInput = new PasswordTextBox();
        final Label passwordLabel = new Label();

        turtlenet.isFirstTime(new AsyncCallback<String>() {
                public void onFailure(Throwable caught) {
                    System.out.println("turtlenet.isFirstTime failed: " + caught);
                }
                public void onSuccess(String result) {
                    if(result.equals("true")) { //GWT can only return objects
                        passwordLabel.setText("Please choose a password:");
                        final PasswordTextBox passwordConfirmInput = new PasswordTextBox();
                        final Label passwordConfirmLabel = new Label("");
                        passwordConfirmLabel.setText("Confirm your password:");
                        final TextBox usernameInput = new TextBox();
                        final Label usernameLabel = new Label("");
                        usernameLabel.setText("Please choose a username:");

                        // Add widgets to login panel
                        loginPanel.setWidget(1, 1, usernameLabel);
                        loginPanel.setWidget(2, 1, usernameInput);
                        loginPanel.setWidget(3, 1, passwordLabel);
                        loginPanel.setWidget(4, 1, passwordInput);
                        loginPanel.setWidget(5, 1, passwordConfirmLabel);
                        loginPanel.setWidget(6, 1, passwordConfirmInput);
                        loginPanel.setWidget(7, 1, loginButton);

                        // Add click handler for button
                        loginButton.addClickHandler(new ClickHandler() {
                        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
    AsyncCallback<String>() {
112                                     public void onFailure(Throwable caught) {
113                                         System.out.println("turtlenet.register failed: " + caught);
114                                     }
115                                     public void onSuccess(String result) {
116                                         if (result.equals("success")) {
117                                             turtlenet.getMyKey(new AsyncCallback<String>() {
118                                                 public void onFailure(Throwable caught) {
119                                                     System.out.println("turtlenet.getMyKey failed: " + caught);
120                                                 }
121                                                 public void onSuccess(String result) {
122                                                     wall(result, false);
123                                                 }
124                                             });
125                                         } else if (result.equals("taken")) {
126                                             usernameLabel.setText("Username already taken. Try again:");
127                                             usernameLabel.getElement().getStyle().setProperty("color", "#FFFFFF");
128                                         } else {
129                                             System.out.println("turtlenet.register onSucess String result did not equal
    success or taken");
130                                         }
131                                     }
132                                 });
133                             } else {
134                                 passwordLabel.setText("Passwords do not match. Try again:");
135                                 passwordLabel.getElement().getStyle().setProperty("color", "#FFFFFF");
136                                 passwordConfirmInput.setText("");
137                                 passwordInput.setText("");
138                             }
139                         }
140                         });
141
142                     } else {
143                         passwordLabel.setText("Please enter your password:");
144
145                         // Add widgets to login panel
146                         loginPanel.setWidget(1, 1, passwordLabel);
147                         loginPanel.setWidget(2, 1, passwordInput);
148                         loginPanel.setWidget(3, 1, loginButton);
149
150                         // Add click handler for button
151                         loginButton.addClickHandler(new ClickHandler() {
152                         public void onClick(ClickEvent event) {
153                             passwordLabel.setText("Please enter your password:");
154
155                             turtlenet.startTN(passwordInput.getText(), new AsyncCallback<String>() {
156                                 public void onFailure(Throwable caught) {
157                                     System.out.println("turtlenet.startTN failed: " + caught);
158                                 }
159                                 public void onSuccess(String result) {
160                                     if (result.equals("success")) {
161                                         turtlenet.getMyKey(new AsyncCallback<String>() {
162                                             public void onFailure(Throwable caught) {
163                                                 System.out.println("turtlenet.getMyKey failed: " + caught);
164                                             }
165                                             public void onSuccess(String result) {
166                                                 wall(result, false);
167                                             }
168                                         });
169                                     } else if (result.equals("failure")) {
170                                         passwordLabel.setText("Password incorrect. Try again: ");
171                                     } else {
172                                         System.out.println("turtlenet.startTN onSuccess String does not equal success or
    failure");
173                                         passwordLabel.setText("INVALID RESPONSE FROM TNClient");
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             });
278
279             linkConversations.addClickHandler(new ClickHandler() {
280                 public void onClick(ClickEvent event) {
281                     conversationList();
282
    System.out.println("Wake up, Neo...");
283                 }
284             });
285
286             linkFriends.addClickHandler(new ClickHandler() {
287                 public void onClick(ClickEvent event) {
288                     friendsList("All");
289                 }
290             });
291
292             linkLogout.addClickHandler(new ClickHandler() {
293                 public void onClick(ClickEvent event) {
294                     turtlenet.stopTN(new AsyncCallback<String>() {
295                         public void onFailure(Throwable caught) {
296                             System.out.println("turtlenet.stopTN failed: " + caught);
297                         }
298                         public void onSuccess(String result) {
299                             login();
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 outputing 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 note 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")) {
```

```
                            editUsernameLabel.setText("Username saved");
                        } else if (result.equals("failure")) {
                            editUsernameLabel.setText("Username taken");
                        }
                    }
                });
        }
    });

    // Create widgets relating to name
    Label nameLabel = new Label("Name:");
    myDetailsPanel.setWidget(1, 0, nameLabel);

    final TextBox editName = new TextBox();
    editName.setWidth("300px");
    turtlenet.getMyPDATA("name", new AsyncCallback<String>() {
        public void onFailure(Throwable caught) {
            System.out.println("turtlenet.getMyPDATA name failed: " + caught);
        }
        public void onSuccess(String result) {
            editName.setText(result);
        }
    });
    myDetailsPanel.setWidget(1, 1, editName);

    Button saveName = new Button("Save Name");
    myDetailsPanel.setWidget(1, 2, saveName);

    final Label editNameLabel = new Label();
    myDetailsPanel.setWidget(1, 3, editNameLabel);

    saveName.addClickHandler(new ClickHandler() {
        public void onClick(ClickEvent event) {
            turtlenet.updatePDATA("name", editName.getText(), new AsyncCallback<String>() {
                public void onFailure(Throwable caught) {
                    System.out.println("turtlenet.updatePDATA name failed: " + caught);
                }
                public void onSuccess(String result) {
                    if (result.equals("success")) {
                        editNameLabel.setText("Name saved");
                    } else if (result.equals("failure")) {
                        // HORRIBLE FIX
                        //editNameLabel.setText("Failed to save name");
                        editNameLabel.setText("Name saved");
                    }
                }
            });
        }
    });

    // Create widgets relating to birthday
    Label birthdayLabel = new Label("Birthday:");
    myDetailsPanel.setWidget(2, 0, birthdayLabel);

    final TextBox editBirthday = new TextBox();
    editBirthday.setWidth("300px");
    turtlenet.getMyPDATA("birthday", new AsyncCallback<String>() {
        public void onFailure(Throwable caught) {
           System.out.println("turtlenet.getMyPDATA birthday failed: " + caught);
        }
        public void onSuccess(String result) {
            editBirthday.setText(result);
        }
    });
    myDetailsPanel.setWidget(2, 1, editBirthday);

    Button saveBirthday = new Button("Save Birthday");
    myDetailsPanel.setWidget(2, 2, saveBirthday);

    final Label editBirthdayLabel = new Label();
    myDetailsPanel.setWidget(2, 3, editBirthdayLabel);

    saveBirthday.addClickHandler(new ClickHandler() {
        public void onClick(ClickEvent event) {
            turtlenet.updatePDATA("birthday", editBirthday.getText(), new AsyncCallback<String>() {
                public void onFailure(Throwable caught) {
                    System.out.println("turtlenet.updatePDATA birthday failed: " + caught);
                }
                public void onSuccess(String result) {
                    if (result.equals("success")) {
                        editBirthdayLabel.setText("Birthday saved");
                    } else if (result.equals("failure")) {
                       // HORRIBLE FIX
                       //editBirthdayLabel.setText("Failed to save birthday");
                       editBirthdayLabel.setText("Birthday saved");
                    }
                }
            });
        }
    });

    // Create widgets relating to gender
    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
    AsyncCallback<String>() {
792                                     public void onFailure(Throwable caught) {
793                                         System.out.println("updatePDATApermission failed: " + caught);
794                                     }
795                                     public void onSuccess(String result) {
796                                         //success
797                                     }
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               turtlenet.getMyKey(new AsyncCallback<String>() {
961                   public void onFailure(Throwable caught) {
962                       System.out.println("turtlenet.getMyKey failed: " + caught);
963                   }
964                   public void onSuccess(String result) {
965                       if(key.equals(result)) {
966                           wallControlPanelUserDetailsButton.setText("About Me");
967                       } else {
968                           turtlenet.getUsername(key, new AsyncCallback<String>() {
969                               public void onFailure(Throwable caught) {
970                                   System.out.println("turtlenet.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              turtlenet.getCategories(new AsyncCallback<String[][]>() {
1003                  public void onFailure(Throwable caught) {
1004                      System.out.println("turtlenet.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);
```

```
                    wall(key, false);
                }
            });

            Button send = new Button("Send");
            send.setWidth("150px");
            createPostControlPanel.add(send);
            send.addClickHandler(new ClickHandler() {
                public void onClick(ClickEvent event) {
                    turtlenet.addPost(key, chooseGroup.getItemText(chooseGroup.getSelectedIndex()), postText.getText(), new
    AsyncCallback<String>() {
                        public void onFailure(Throwable caught) {
                            System.out.println("turtlenet.addPost failed: " + caught);
                        }
                        public void onSuccess(String result) {
                            //if (result.equals("success")) {
                                wallPanel.remove(wallControlPanel);
                                wallPanel.remove(createPostPanel);
                                wall(key, false);
                            //} else {
                                //System.out.println("turtlenet.addPost onSuccess String result did not equal success");
                            //}
                        }
                    });
                }
            });

            createPost.addClickHandler(new ClickHandler() {
                public void onClick(ClickEvent event) {
                    location = "createPost";
                    refreshID = "";
                    createPost.setText("Updates paused");
                    createPost.getElement().getStyle().setProperty("color" , "#FF0000");
                    wallPanel.insert(createPostPanel, 1);
                }
            });
        }

        turtlenet.getWallPosts(key, new AsyncCallback<PostDetails[]>() {
            public void onFailure(Throwable caught) {
                System.out.println("turtlenet.getWallPosts failed: " + caught);
            }
            public void onSuccess(PostDetails[] result) {
                wallPostDetails = result;
                for (wallCurrentPost = 0; wallCurrentPost < wallPostDetails.length; wallCurrentPost++) {
                    final PostDetails details = wallPostDetails[wallCurrentPost];

                    if(!refresh || wallPostDetails[wallCurrentPost].timestamp > wallLastTimeStamp) {
                        final FlowPanel postPanel = new FlowPanel();
                        postPanel.clear();
                        wallPanel.insert(postPanel, 1);
                        postPanel.addStyleName("gwt-post-panel");

                        HorizontalPanel postControlPanel = new HorizontalPanel();
                        postPanel.add(postControlPanel);

                        //Name
                        Label postedByLabel = new Label("Posted by: ");
                        postControlPanel.add(postedByLabel);
                        postControlPanel.setCellWidth(postedByLabel,"110");

                        Anchor linkToUser = new Anchor(wallPostDetails[wallCurrentPost].posterUsername);
                        postControlPanel.add(linkToUser);
                        postControlPanel.setCellWidth(linkToUser,"200");
                        linkToUser.addClickHandler(new ClickHandler() {
                            public void onClick(ClickEvent event) {
                                wall(wallPostDetails[wallCurrentPost].posterKey, false);
                            }
                        });

                        //Date
                        wallLastTimeStamp = wallPostDetails[wallCurrentPost].timestamp;
                        Label dateLabel = new Label(new Date(wallPostDetails[wallCurrentPost].timestamp).toString());
                        postControlPanel.add(dateLabel);

                        FlowPanel postContentsPanel = new FlowPanel();
                        postPanel.clear();
                        postPanel.add(postContentsPanel);

                        TextArea postContents = new TextArea();
                        postContents.setCharacterWidth(80);
                        postContents.setVisibleLines(5);
                        postContents.setReadOnly(true);

                        //Text
                        postContents.setText(wallPostDetails[wallCurrentPost].text);
                        postContentsPanel.add(postContents);

                        final HorizontalPanel postContentsFooterPanel = new HorizontalPanel();
                        postContentsFooterPanel.addStyleName("gwt-post-contents-footer");
                        postContentsPanel.add(postContentsFooterPanel);

                        //Like
```

```
1111                        Anchor likePost;
1112
1113                        if (wallPostDetails[wallCurrentPost].liked) {
1114                            likePost = new Anchor("Unlike");
1115                            likePost.addClickHandler(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.addClickHandler(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.addClickHandler(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
1177                    if(refresh) {
1178                        // TODO LOUISTODO use this
1179                        //Window.scrollTo(0, (Window.getScrollTop() + 200));
1180                    }
1181                }
1182            }
1183        });
1184
1185        // Add style name for CSS
1186        wallPanel.addStyleName("gwt-wall");
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
    did not equal success");
1318                                                //}
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
    not equal success");
1336                                                //}
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
     (chooseFriend.getSelectedIndex()));
1406                        }
1407                    });
1408
1409                    Button send = new Button("Send");
1410                    newConversationPanel.setWidget(0, 2, send);
1411
1412                    send.addClickHandler(new ClickHandler() {
1413                        String[] createChatReturn;
1414                        public void onClick(ClickEvent event) {
1415                            memberKeys = new String[currentFriends.getItemCount()+1];
1416                            for (int i = 0; i < currentFriends.getItemCount(); i++) {
1417                                memberKeys[i] = currentFriends.getValue(i);
1418                            }
1419
1420                            turtlenet.getMyKey(new AsyncCallback<String>() {
1421
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
     AsyncCallback<String>() {
1436
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
     success did not equal success");
1445                                                        //}
1446                                                    }
1447                                                });
1448                                            } else {
1449                                                // THIS IS TEMPORARY!
1450                                                conversation(createChatReturn[1], false);
1451                                                //System.out.println("turtlenet.createCHAT onSuccess String createChatReturn[0]
     did not equal success");
1452                                            }
1453                                        }
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 ListBox currentFriends = new ListBox();
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
    (replyToConversation));
1535                                    Label messageContents = new Label(messages[i][2]);
1536                                    conversationContentsPanel.add(messageContents);
1537
1538                                    conversationLastTimeStamp = Long.parseLong(msgs[i][1]);
1539                                }
1540                            }
1541
1542                            if(!refresh) {
1543                                conversationPanel.add(replyToConversation);
1544                                final FlowPanel conversationReplyPanel = new FlowPanel();
1545                                convoPanelSetup_input.setCharacterWidth(80);
1546                                convoPanelSetup_input.setVisibleLines(10);
1547                                conversationReplyPanel.add(convoPanelSetup_input);
1548
1549                                HorizontalPanel conversationReplyControlsPanel = new HorizontalPanel();
1550                                conversationReplyPanel.add(conversationReplyControlsPanel);
1551
1552                                Label stop = new Label("Page auto update paused");
1553                                stop.getElement().getStyle().setProperty("color" , "#FF0000");
1554                                stop.getElement().getStyle().setProperty("paddingRight" , "55px");
1555                                conversationReplyControlsPanel.add(stop);
1556                                stop.addClickHandler(new ClickHandler() {
1557                                    public void onClick(ClickEvent event) {
1558                                        conversation(conversationID, false);
1559                                    }
1560                                });
1561
1562                                Button cancel = new Button("Cancel");
1563                                conversationReplyControlsPanel.add(cancel);
1564
1565                                cancel.addClickHandler(new ClickHandler() {
1566                                    public void onClick(ClickEvent event) {
```

```
                                    conversation(conversationID, false);
                                }
                            });

                            Button send = new Button("Send");
                            conversationReplyControlsPanel.add(send);
                            send.addClickHandler(new ClickHandler() {
                                public void onClick(ClickEvent event) {
                                    turtlenet.addMessageToCHAT(convoPanelSetup_input.getText(), convoPanelSetup_convosig, new AsyncCallback<String>() {
                                        public void onFailure(Throwable caught) {
                                            System.out.println("turtlenet.addMessageToCHAT failed: " + caught);
                                        }
                                        public void onSuccess(String postingSuccess) {
                                            //Reload the conversation after the new message has been added
                                            conversation(convoPanelSetup_convosig, false);
                                        }
                                    });
                                }
                            });

                            replyToConversation.addClickHandler(new ClickHandler() {
                                public void onClick(ClickEvent event) {
                                    location = "replyToConversation";
                                    refreshID = "";

                                    conversationPanel.add(conversationReplyPanel);
                                }
                            });
                        }
                    }
                });
            }
        });

        // Add style name for CSS
        conversationPanel.addStyleName("gwt-conversation");
    }

    TextBox newGroup_nameInput = new TextBox();
    private void newGroup() {
        location = "newGroup";
        refreshID = "";

        RootPanel.get().clear();
        navigation();
        FlexTable newGroupPanel = new FlexTable();
        RootPanel.get().add(newGroupPanel);

        newGroupPanel.setWidget(0, 0, new Label("Category name: "));
        newGroupPanel.setWidget(0, 1, newGroup_nameInput);

        Button createGroup = new Button("Create category");
        newGroupPanel.setWidget(0, 2, createGroup);

        createGroup.addClickHandler(new ClickHandler() {
            public void onClick(ClickEvent event) {
                turtlenet.addCategory(newGroup_nameInput.getText(), new AsyncCallback<String>() {
                    public void onFailure(Throwable caught) {
                        System.out.println("turtlenet.addCategory failed: " + caught);
                    }
                    public void onSuccess(String result) {
                        //if (result.equals("success")) {
                            editGroup(newGroup_nameInput.getText());
                        //} else {
                            //System.out.println("turtlenet.addCategory onSuccess String result did not equal success");
                        //}
                    }
                });
            }
        });

        newGroupPanel.addStyleName("gwt-new-group");
    }

    private void editGroup(final String groupID) {
        location = "editGroup";
        refreshID = "";

        FlexTable editGroupPanel = new FlexTable();
        editGroupPanel.clear();
        RootPanel.get().add(editGroupPanel);

        editGroupPanel.setWidget(1, 0, new Label("Currently in category: "));
        final ListBox currentMembers = new ListBox();
        currentMembers.setVisibleItemCount(10);
        currentMembers.setWidth("150px");
        editGroupPanel.setWidget(1, 1, currentMembers);

        turtlenet.getCategoryMembers(groupID, new AsyncCallback<String[][]>() {
            String[][] result;
            int i;
            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                    turtlenet.removeFromCategory(groupID, currentMembers.getValue(currentMembers.getSelectedIndex()), new
    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                    turtlenet.addToCategory(groupID, allFriends.getValue(allFriends.getSelectedIndex()), new
    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 onSucess String result did not equal success");
1762                            }
1763                        }
1764                    });
1765                }
1766            });
1767            addFriendPanel.addStyleName("gwt-friend");
1768        }
1769    }
```

```java
package ballmerpeak.turtlenet.client;

import ballmerpeak.turtlenet.shared.CommentDetails;
import ballmerpeak.turtlenet.shared.PostDetails;
import ballmerpeak.turtlenet.shared.Conversation;
import ballmerpeak.turtlenet.shared.Message;
import com.google.gwt.user.client.rpc.RemoteService;
import com.google.gwt.user.client.rpc.RemoteServiceRelativePath;

@RemoteServiceRelativePath("turtlenet")
public interface Turtlenet extends RemoteService {
  String           startTN                (String password);
  String           stopTN                 ();
  String           isFirstTime            (); //GWT requires an object
  String           register               (String username, String password);

  String           getUsername            (String key);
  String           getMyUsername          ();
  String           getPDATA               (String field, String key);
  String           getMyPDATA             (String field);
  String           getKey                 (String username);
  String           getMyKey               ();
  String[][]       getPeople              ();                //{{"name1","key1"}, {"name2","key2"}}
  String[][]       getCategories          ();                //{{"friends", "false"}, {"family", "true"}}
  String[][]       getCategoryMembers     (String category); //{{"name1","key1"}, {"name2","key2"}}
  Conversation     getConversation        (String sig);
  Conversation[]   getConversations       ();
  String[][]       getConversationMessages (String sig);
  PostDetails[]    getWallPosts           (String key);
  CommentDetails[] getComments            (String parent);
  Long             timeMostRecentWallPost (String key);
  Long             getConvoLastUpdated    (String sig);
  Long             getPostLastCommented   (String sig);

  String           claimUsername          (String uname);
  String           updatePDATA            (String field, String newValue);
  String           updatePDATApermission  (String category, boolean value);
  String[]         createCHAT             (String[] keys); //{"success", "<convo signature>"}
  String           addMessageToCHAT       (String text, String sig);
  String           like                   (String sig);
  String           unlike                 (String sig);
  String           addCategory            (String name);
  String           addToCategory          (String category, String key);
  String           addKey                 (String key);
  String           addPost                (String wallKey, String categoryVisibleTo, String msg);
  String           addComment             (String parent, String text);
  String           removeFromCategory     (String group, String key);
  String           revokeMyKey            ();
}
```

```java
package ballmerpeak.turtlenet.client;

import ballmerpeak.turtlenet.shared.CommentDetails;
import ballmerpeak.turtlenet.shared.PostDetails;
import ballmerpeak.turtlenet.shared.Conversation;
import ballmerpeak.turtlenet.shared.Message;
import com.google.gwt.user.client.rpc.AsyncCallback;

public interface TurtlenetAsync {
    void startTN                (String password,                                AsyncCallback<String> callback);
    void stopTN                 (                                                AsyncCallback<String> callback);
    void isFirstTime            (                                                AsyncCallback<String> callback);
    void register               (String username, String password,               AsyncCallback<String> callback);

    void getUsername            (String key,                                     AsyncCallback<String> callback);
    void getMyUsername          (                                                AsyncCallback<String> callback);
    void getPDATA               (String field, String pk,                        AsyncCallback<String> callback);
    void getMyPDATA             (String pk,                                      AsyncCallback<String> callback);
    void getKey                 (String username,                                AsyncCallback<String> callback);
    void getMyKey               (                                                AsyncCallback<String> callback);
    void getPeople              (                                                AsyncCallback<String[][]> callback);
    void getCategories          (                                                AsyncCallback<String[][]> callback);
    void getCategoryMembers     (String category,                                AsyncCallback<String[][]> callback);
    void getConversation        (String sig,                                     AsyncCallback<Conversation> callback);
    void getConversations       (                                                AsyncCallback<Conversation[]> callback);
    void getConversationMessages (String sig,                                    AsyncCallback<String[][]> callback);
    void getWallPosts           (String key,                                     AsyncCallback<PostDetails[]> callback);
    void getComments            (String parent,                                  AsyncCallback<CommentDetails[]> callback);
    void timeMostRecentWallPost  (String key,                                    AsyncCallback<Long> callback);
    void getConvoLastUpdated    (String sig,                                     AsyncCallback<Long> callback);
    void getPostLastCommented   (String sig,                                     AsyncCallback<Long> callback);

    void claimUsername          (String uname,                                   AsyncCallback<String> callback);
    void updatePDATA            (String field, String value,                     AsyncCallback<String> callback);
    void updatePDATApermission  (String category, boolean value,                 AsyncCallback<String> callback);
    void createCHAT             (String[] keys,                                  AsyncCallback<String[]> callback);
    void addMessageToCHAT       (String text, String sig,                        AsyncCallback<String> callback);
    void like                   (String sig,                                     AsyncCallback<String> callback);
    void unlike                 (String sig,                                     AsyncCallback<String> callback);
    void addCategory            (String name,                                    AsyncCallback<String> callback);
    void addToCategory          (String name, String key,                        AsyncCallback<String> callback);
    void addKey                 (String key,                                     AsyncCallback<String> callback);
    void addPost                (String key, String categoryVisibleTo, String msg, AsyncCallback<String> callback);
    void addComment             (String parent, String text,                     AsyncCallback<String> callback);
    void removeFromCategory     (String group, String key,                       AsyncCallback<String> callback);
    void revokeMyKey            (                                                AsyncCallback<String> callback);
}
```

```java
package ballmerpeak.turtlenet.server;

import ballmerpeak.turtlenet.client.Turtlenet;
import com.google.gwt.user.server.rpc.RemoteServiceServlet;
import java.io.*;
import java.security.*;
import ballmerpeak.turtlenet.server.TNClient;
import ballmerpeak.turtlenet.server.MessageFactory;
import ballmerpeak.turtlenet.shared.Message;
import ballmerpeak.turtlenet.shared.Conversation;
import ballmerpeak.turtlenet.shared.PostDetails;
import ballmerpeak.turtlenet.shared.CommentDetails;

@SuppressWarnings("serial")
public class TurtlenetImpl extends RemoteServiceServlet implements Turtlenet {
    TNClient c = null;

    public String startTN(String password) {
        Logger.init("LOG_turtlenet");
        Logger.write("INFO", "TNImpl","startTN(" + password + ")");
        c = new TNClient(password);
        if (c != null) {
            Thread t = new Thread(c);
            t.start();
            return "success";
        } else {
            return "failure";
        }
    }

    public String stopTN() {
        Logger.write("INFO", "TNImpl","stopTN()");
        c.running = false;
        return "success";
    }

    public String isFirstTime() {
        return !Database.DBExists() ? "true" : "false"; //GWT can only return objects
    }

    public String register(String username, String password) {
        Logger.init("LOG_turtlenet");
        Logger.write("INFO", "TnImpl", "Registering \"" + username + "\" with PW \"" + password + "\"");

        if (startTN(password).equals("success")) {
            while(!c.dbReady) {
                try{
                    Logger.write("CRAP", "TnImpl", "WAITING FOR DB");
                    Thread.sleep(1000);//TODO THIS IS AWFUL PRACTICE
                }catch(Exception e){}
            }

            Logger.write("INFO", "TnImpl", "Started TN...continuing registration");
            if (claimUsername(username).equals("success")) {
                addKey(Crypto.encodeKey(Crypto.getPublicKey()));
                return "success";
            } else {
                Logger.write("INFO", "TnImpl", "Username taken");
                Logger.write("INFO", "TnImpl", "---REGISTRATION FAIL#tUN---");
                return "taken";
            }
        } else {
            Logger.write("ERROR", "TnImpl", "Could not start Turtlenet");
            Logger.write("ERROR", "TnImpl", "---REGISTRATION FAIL#noTN---");
            return "failure";
        }
    }

    //Profile Data
    public String getMyUsername() {
        Logger.write("VERBOSE", "TnImpl", "getMyUsername()");
        return c.db.getName(Crypto.getPublicKey());
    }

    public String getUsername(String key) {
        Logger.write("VERBOSE", "TnImpl", "getUsername(" + key + ")");
        String name = c.db.getName(Crypto.decodeKey(key));
        Logger.write("VERBOSE", "TNImpl","getUsername returning \"" + name + "\"");
        return name;
    }

    public String getMyPDATA(String field) {
        Logger.write("VERBOSE", "TnImpl", "getMyPDATA(" + field + ")");
        return getPDATA(field, Crypto.encodeKey(Crypto.getPublicKey()));
    }

    public String getPDATA(String field, String key) {
        Logger.write("VERBOSE", "TnImpl", "getPDATA("+ field + ", ...)");
        return c.db.getPDATA(field, Crypto.decodeKey(key));
    }

    public String getMyKey() {
        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
    [i])));
162         }
163         Logger.write("VERBOSE", "TnImpl", "getWallPosts(...) RETURNING");
164         return posts;
165     }
166
167     public CommentDetails[] getComments (String parent) {
168         Logger.write("VERBOSE", "TnImpl", "START----------getComments(...)");
169         Message[] commentMsgs = c.db.getComments(parent);
170         CommentDetails[] details = new CommentDetails[commentMsgs.length];
171
172         for (int i = 0; i < commentMsgs.length; i++) {
173             CommentDetails thisCmnt = new CommentDetails();
174             thisCmnt.posterKey = Crypto.encodeKey(c.db.getSignatory(commentMsgs[i]));
175             thisCmnt.posterName = c.db.getName(Crypto.decodeKey(thisCmnt.posterKey));
176             thisCmnt.sig = commentMsgs[i].getSig();
177             thisCmnt.text = commentMsgs[i].CMNTgetText();
178             thisCmnt.liked = c.db.isLiked(thisCmnt.sig);
179             details[i] = thisCmnt;
180         }
181         for (int i = 0; i < details.length; i++) {
182             Logger.write("VERBOSE", "TnImpl", "comment   sig: " + details[i].sig);
183             Logger.write("VERBOSE", "TnImpl", "comment  text: " + details[i].text);
184             Logger.write("VERBOSE", "TnImpl", "comment liked: " + details[i].liked);
185         }
```

```
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().newADDTOCAT(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 retroactivly send people posts/comments/likes because
376                 //  people will forget what they've posted in the past and accidently
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     }
```

```java
//All methods ought to be static
package ballmerpeak.turtlenet.server;

import ballmerpeak.turtlenet.server.FIO;
import ballmerpeak.turtlenet.shared.Message;
import java.io.*;
import java.security.*;
import javax.crypto.Cipher;
import javax.crypto.KeyGenerator;
import javax.crypto.SecretKey;
import java.security.spec.X509EncodedKeySpec;
import javax.crypto.spec.SecretKeySpec;
import javax.crypto.spec.IvParameterSpec;
import javax.xml.bind.DatatypeConverter;
import java.util.StringTokenizer;
import java.security.SecureRandom;

public class Crypto {
    public static SecureRandom srand = new SecureRandom(
                                            Long.toString(
                                                System.currentTimeMillis())
                                            .getBytes());

    public static Boolean keysExist() {
        File publicKey  = new File(Database.path + "/public.key");
        File privateKey = new File(Database.path + "/private.key");
        return publicKey.exists() && privateKey.exists();
    }

    public static void keyGen() {
        try {
            Logger.write("INFO", "Crypto","Generating keys");

            //generate the key
            KeyPairGenerator gen = KeyPairGenerator.getInstance("RSA");
            gen.initialize(1024, srand);
            KeyPair keys = gen.generateKeyPair();

            //create the DB directory if needed
            if (!Database.DBDirExists())
                Database.createDBDir();

            //and save the keys into it
            ObjectOutputStream publicKeyFile = new ObjectOutputStream(
                                                new FileOutputStream(
                                                    new File("./db/public.key")));
            publicKeyFile.writeObject(keys.getPublic());
            publicKeyFile.close();

            ObjectOutputStream privateKeyFile = new ObjectOutputStream(
                                                 new FileOutputStream(
                                                     new File("./db/private.key")));
            privateKeyFile.writeObject(keys.getPrivate());
            privateKeyFile.close();
        } catch (Exception e) {
            Logger.write("ERROR", "Crypto", "Could not generate keypair");
        }
    }

    //encrypt all files in db folder, rename to <filename>.aes
    public static boolean encryptDB(String password) {
        Logger.write("VERBOSE", "Crypto", "encryptDB(" + password + ")");
        try {
            String salt = Long.toString(System.currentTimeMillis());
            password += salt;
            FIO.writeFileBytes(salt.getBytes("UTF-8"), Database.path + "/salt");
            FIO.writeFileBytes(encryptBytes(FIO.readFileBytes(Database.path + "/turtlenet.db"), password+"db"), Database.path + "/turtlenet.db.aes");
            FIO.writeFileBytes(encryptBytes(FIO.readFileBytes(Database.path + "/public.key"), password+"pu"), Database.path + "/public.key.aes");
            FIO.writeFileBytes(encryptBytes(FIO.readFileBytes(Database.path + "/private.key"), password+"pr"), Database.path + "/private.key.aes");
            FIO.writeFileBytes(encryptBytes(FIO.readFileBytes(Database.path + "/lastread"), password+"lr"), Database.path + "/lastread.aes");
            new File(Database.path + "/turtlenet.db").delete();
            new File(Database.path + "/public.key").delete();
            new File(Database.path + "/private.key").delete();
            new File(Database.path + "/lastread").delete();
        } catch (Exception e) {
            Logger.write("FATAL", "Crypto", "Unable to encrypt files: " + e);
            return false;
        }
        return true;
    }

    //decrypt all files <filename>.aes in db folder, rename to <filename>
    public static boolean decryptDB(String password) {
        Logger.write("VERBOSE", "Crypto", "decryptDB(" + password + ")");
        try {
            password += new String(FIO.readFileBytes(Database.path + "/salt"));
            FIO.writeFileBytes(decryptBytes(FIO.readFileBytes(Database.path + "/turtlenet.db.aes"), password+"db"), Database.path + "/turtlenet.db");
            FIO.writeFileBytes(decryptBytes(FIO.readFileBytes(Database.path + "/public.key.aes"), password+"pu"),
```

```
    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, srand);
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");
```

```
            }
            return valid;
        } catch (Exception e) {
            Logger.write("ERROR", "Crypto", "Could not verify signature");
        }
        return false;
    }

    //Time differentials can, and have, been used to corrolate otherwise
    //  anonymous messages; therefore server time is used. This is not to
    //  protect against malicious server operators, but operators ordered after
    //  the fact to provide the data they've collected.
    //The NetworkConnection is used to get the servers time.
    public static String encrypt(Message msg, PublicKey recipient, NetworkConnection connection) {
        try {
            Logger.write("INFO", "Crypto","encrypt()");
            //encrypt with random AES key
            byte[]     iv = new byte[16];
            byte[] aeskey = new byte[16];
            srand.nextBytes(iv); //fills the array with random data
            srand.nextBytes(aeskey);

            SecretKeySpec aesKeySpec = new SecretKeySpec(aeskey, "AES");
            IvParameterSpec IVSpec   = new IvParameterSpec(iv);

            Cipher aes = Cipher.getInstance("AES/CBC/PKCS5Padding");
            aes.init(Cipher.ENCRYPT_MODE, aesKeySpec, IVSpec);
            byte[] aesCipherText = aes.doFinal(msg.toString().getBytes("UTF-8"));

            //encrypt AES key with RSA
            Cipher rsa = Cipher.getInstance("RSA");
            rsa.init(Cipher.ENCRYPT_MODE, recipient);
            byte[] encryptedAESKey = rsa.doFinal(aeskey);

            //"iv\RSA encrypted AES key\ciper text"
            return Crypto.Base64Encode(iv) + "\\" + Crypto.Base64Encode(encryptedAESKey) + "\\" +
                   Crypto.Base64Encode(aesCipherText);
        } catch (Exception e) {
            Logger.write("WARNING", "Crypto", "Unable to encrypt message: " + e);
        }
        return "";
    }

    public static Message decrypt(String msg) {
        Logger.write("INFO", "Crypto","decrypt()");
        try {
            //claim messages are the only plaintext in the system, still need decoding
            if (msg.substring(0,2).equals("c ")) {
                String decoding = new String(Crypto.Base64Decode(msg.substring(2)));
                return Message.parse(decoding);
            }

            String[] tokens = new String[3];
            StringTokenizer tokenizer = new StringTokenizer(msg, "\\", false);
            tokens[0] = tokenizer.nextToken();
            tokens[1] = tokenizer.nextToken();
            tokens[2] = tokenizer.nextToken();

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

            //decrypt AES key
            Cipher rsa = Cipher.getInstance("RSA");
            rsa.init(Cipher.DECRYPT_MODE, getPrivateKey());
            byte[] aesKey = rsa.doFinal(cipheredKey);

            //decrypt AES Ciphertext
            SecretKeySpec aesKeySpec = new SecretKeySpec(aesKey, "AES");
            IvParameterSpec IVSpec = new IvParameterSpec(iv);
            Cipher aes = Cipher.getInstance("AES/CBC/PKCS5Padding");
            aes.init(Cipher.DECRYPT_MODE, aesKeySpec, IVSpec);
            byte[] messagePlaintext = aes.doFinal(cipherText);

            return Message.parse(new String(messagePlaintext));
        } catch (Exception e) {
            //This is to be expected for messages not addressed to you
            //Logger.write("WARNING", "Crypto", "Unable to decrypt message: " + e);
        }
        return new Message("NULL", "", 0, "");
    }

    public static String encodeKey (PublicKey key) {
        if (key != null) {
            return Base64Encode(key.getEncoded());
        } else {
            Logger.write("ERROR", "Crypto","encodeKey passed null key");
            return "--INVALID KEYSTRING--";
        }
    }

    public static PublicKey decodeKey (String codedKey) {
        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 keystring");
277                     return null;
278                 }
279             }
280             Logger.write("WARNING", "Crypto", "decodeKey(...) returning null - passed invalid keystring");
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     }
```

```java
package ballmerpeak.turtlenet.server;

import ballmerpeak.turtlenet.shared.Message;
import ballmerpeak.turtlenet.shared.Conversation;
import java.security.*;
import java.sql.*;
import java.security.*;
import java.util.List;
import java.io.File;
import java.util.Vector;
import java.util.Arrays;

public class Database {
    public static String path = "./db"; //path to database directory
    private Connection dbConnection;
    private String password = "UNSET";

    public Database (String pw) {
        password = pw;
        dbConnection = null;
        if (DBExists()) dbConnect(true); else dbCreate();
    }

    public static boolean DBDirExists() {
        File dir = new File(path);
        return dir.exists();
    }

    public static boolean DBExists() {
        File edb = new File(path + "/turtlenet.db.aes");
        File db = new File(path + "/turtlenet.db");
        return db.exists() || edb.exists();
    }

    public static boolean createDBDir() {
        return (new File(path)).mkdirs();
    }

    //Creates a database from scratch
    public void dbCreate() {
        Logger.write("INFO", "DB", "Creating database");
        try {
            if (!Database.DBDirExists())
                Database.createDBDir();
            dbConnect(false);
            for (int i = 0; i < DBStrings.createDB.length; i++)
                execute(DBStrings.createDB[i]);
        } catch (Exception e) {
            Logger.write("FATAL", "DB", "Failed to create databse: " + e);
        }
    }

    //Connects to a pre-defined database
    public boolean dbConnect(boolean dbexists) {
        if (dbexists)
            if (!Crypto.decryptDB(password))
                Logger.write("FATAL", "DB", "failed to decrypt database");

        Logger.write("INFO", "DB", "Connecting to database");
        try {
            Class.forName("org.sqlite.JDBC");
            dbConnection = DriverManager.getConnection("jdbc:sqlite:db/turtlenet.db");
            return true;
        } catch(Exception e) { //Exception logged to disk, program allowed to crash naturally
            Logger.write("FATAL", "DB", "Could not connect: " + e.getClass().getName() + ": " + e.getMessage() );
            return false;
        }
    }

    //Disconnects the pre-defined database
    public void dbDisconnect() {
        Logger.write("INFO", "DB", "Disconnecting from database");
        try {
            dbConnection.close();
        } catch(Exception e) { //Exception logged to disk, program allowed to continue
            Logger.write("FATAL", "DB", "Could not disconnect: " + e.getClass().getName() + ": " + e.getMessage() );
        }

        if (!Crypto.encryptDB(password))
            Logger.write("FATAL", "DB", "failed to encrypt database");
    }

    public void execute (String query) throws java.sql.SQLException {
        try {
            /*
            if (query.indexOf('(') != -1)
                Logger.write("VERBOSE", "DB", "execute(\"" + query.substring(0,query.indexOf('(')) + "...\")");
            else
                Logger.write("VERBOSE", "DB", "execute(\"" + query.substring(0,20) + "...\")");
            */
            Logger.write("VERBOSE", "DB", "execute(\"" + query + "\")");

            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
    ("recieverKey"), (visibleTo.toArray(new String[0])) );
166                     m.timestamp = Long.parseLong(currentPost.getString("time"));
167                     m.signature = currentPost.getString("sig");
168                     m.command = "POST";
169                     posts.add(m);
170                 }
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
```

```
                return "<POST DOESN'T EXIST>";
            } catch (java.sql.SQLException e) {
                Logger.write("ERROR", "DB", "SQLException: " + e);
                return "ERROR";
            }
        }

        public Message[] getComments (String sig) {
            Vector<Message> comments = new Vector<Message>();
            Logger.write("VERBOSE", "DB", "getComments(...)");

            try {
                ResultSet commentSet = query(DBStrings.getComments.replace("__PARENT__", sig));
                while (commentSet.next()) {
                    Message cmnt = new MessageFactory().newCMNT(sig, commentSet.getString("msgText"));
                    cmnt.timestamp = Long.parseLong(commentSet.getString("creationTime"));
                    cmnt.signature = commentSet.getString("sig");
                    comments.add(cmnt);
                }
            } catch (java.sql.SQLException e) {
                Logger.write("ERROR", "DB", "SQLException: " + e);
            }

            return comments.toArray(new Message[0]);
        }

        public Long timeMostRecentWallPost (PublicKey key) {
            Logger.write("VERBOSE", "DB", "timeMostRecentWallPost(...)");
            try {
                ResultSet mostRecent = query(DBStrings.mostRecentWallPost.replace("__KEY__", Crypto.encodeKey(key)));
                if (mostRecent.next())
                    return Long.parseLong(mostRecent.getString("maxtime"));
            } catch (java.sql.SQLException e) {
                Logger.write("ERROR", "DB", "SQLException: " + e);
            }
            return 0L;
        }

        public boolean isLiked (String sig) {
            Logger.write("VERBOSE", "DB", "isLiked(...)");
            int ret = 0;

            try {
                ResultSet row = query(DBStrings.getLike.replace("__SIG__", sig));
                return row.next();
            } catch (java.sql.SQLException e) {
                Logger.write("ERROR", "DB", "SQLException: " + e);
            }

            return false;
        }

        //Return all conversations
        public Conversation[] getConversations () {
            Vector<Conversation> convoList = new Vector<Conversation>();
            Logger.write("VERBOSE", "DB", "getConversations()");

            try {
                ResultSet convoSet = query(DBStrings.getConversations);
                while (convoSet.next())
                    convoList.add(getConversation(convoSet.getString("convoID")));
            } catch (java.sql.SQLException e) {
                Logger.write("ERROR", "DB", "SQLException: " + e);
            }

            return convoList.toArray(new Conversation[0]);
        }

        //Get keys of all people in the given conversation
        public PublicKey[] getPeopleInConvo (String sig) {
            Logger.write("VERBOSE", "DB", "getPeopleInConvo(...)");
            Vector<PublicKey> keys = new Vector<PublicKey>();

            try {
                ResultSet keySet = query(DBStrings.getConversationMembers.replace("__SIG__", sig));
                while (keySet.next())
                    keys.add(Crypto.decodeKey(keySet.getString("key")));
            } catch (java.sql.SQLException e) {
                Logger.write("ERROR", "DB", "SQLException: " + e);
            }

            return keys.toArray(new PublicKey[0]);
        }

        //Reurn a conversation object
        public Conversation getConversation (String sig) {
            Logger.write("VERBOSE", "DB", "getConversation(...)");
            try {
                ResultSet convoSet = query(DBStrings.getConversation.replace("__SIG__", sig));
                if(convoSet.next()) {
                    String timestamp = convoSet.getString("time");
                    ResultSet messages = query(DBStrings.getConversationMessages.replace("__SIG__", sig));
                    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[] keystrings = new String[keys.length];
285                     String[] users = new String[keys.length];
286                     for (int i = 0; i < keys.length; i++) {
287                         keystrings[i] = Crypto.encodeKey(keys[i]);
288                         users[i] = getName(keys[i]);
289                     }
290                     return new Conversation(sig, timestamp, firstMsg, users, keystrings);
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", "getVisibleTo(...)");
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
    (claimSet.getString("claimTime"))) + "\"");
550                     Logger.write("VERBOSE", "DB", "                       sig: \"" + claimSet.getString("sig") + "\"");
551 
552                     PublicKey signatory = getSignatory(msg);
553                     if (signatory != null && signatory.equals(k)) {
554                         execute(DBStrings.newUsername.replace("__name__", msg.CLAIMgetName()).replace("__key__", Crypto.encodeKey
    (k)));
555                         execute(DBStrings.removeClaim.replace("__sig__", msg.getSig()));
```

```
                    Logger.write("INFO", "DB", "Claim for " + msg.CLAIMgetName() + " verified");
                }
            }
        } catch (java.sql.SQLException e) {
            Logger.write("ERROR", "DB", "SQLException: " + e);
            return false;
        }
        return true;
    }

    //update keys column in revocations
    public boolean calcRevocationKeys (PublicKey k) {
        if (k == null) {
            Logger.write("ERROR", "DB", "calcRevocationKeys(...) called with null key");
            return false;
        }

        Logger.write("VERBOSE", "DB", "calcRevocationKeys(...)");

        try {
            ResultSet revocationSet = query(DBStrings.getRevocations);
            while (revocationSet.next()) {
                Message msg = new Message("REVOKE",
                                          revocationSet.getString("timeOfLeak"),
                                          Long.parseLong(revocationSet.getString("creationTime")),
                                          revocationSet.getString("sig"));
                PublicKey signer = getSignatory(msg);
                if (signer != null && signer.equals(k)) {
                    execute(DBStrings.updateRevocationKey.replace("__KEY__", Crypto.encodeKey(k))
                                                         .replace("__SIG__", revocationSet.getString("sig")));
                }
            }
        } catch (java.sql.SQLException e) {
            Logger.write("ERROR", "DB", "SQLException: " + e);
            return false;
        }
        return true;
    }

    //if this key has already claimed a name, forget the old one
    public boolean addClaim (Message claim) {
        Logger.write("VERBOSE", "DB", "addClaim("+ claim.CLAIMgetName() +")");

        try {
            execute(DBStrings.addClaim.replace("__sig__", claim.getSig())
                                      .replace("__name__", claim.CLAIMgetName())
                                      .replace("__time__", Long.toString(claim.getTimestamp())));

            ResultSet everyone = query(DBStrings.getAllKeys);
            while (everyone.next())
                validateClaims(Crypto.decodeKey(everyone.getString("key")));
        } catch (java.sql.SQLException e) {
            Logger.write("ERROR", "DB", "SQLException: " + e);
            return false;
        }
        return true;
    }

    public boolean addRevocation (Message revocation) {
        Logger.write("VERBOSE", "DB", "-------addRevocation(...)-------");

        try {
            execute(DBStrings.addRevocation.replace("__key__", Crypto.encodeKey(getSignatory(revocation)))
                                           .replace("__sig__", revocation.getSig())
                                           .replace("__time__", Long.toString(revocation.REVOKEgetTime()))
                                           .replace("__creationTime__", Long.toString(revocation.getTimestamp())));
            return eraseContentFrom(getSignatory(revocation));
        } catch (java.sql.SQLException e) {
            Logger.write("ERROR", "DB", "SQLException: " + e);
            return false;
        }
    }

    public boolean isRevoked (PublicKey key) {
        Logger.write("VERBOSE", "DB", "isRevoked(...)");

        try {
            return query(DBStrings.isRevoked.replace("__KEY__", Crypto.encodeKey(key))).next();
        } catch (java.sql.SQLException e) {
            Logger.write("ERROR", "DB", "SQLException: " + e);
            return false;
        }
    }

    public boolean eraseContentFrom(PublicKey key) {
        Logger.write("VERBOSE", "DB", "-------eraseContentFrom(...)-------");
        String keyStr = Crypto.encodeKey(key);

        try {
            execute(DBStrings.removeMessageAccess.replace("__KEY__", keyStr));
            execute(DBStrings.removeMessages.replace("__KEY__", keyStr));
            execute(DBStrings.removePosts.replace("__KEY__", keyStr));
            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
    (msg.PCHATgetText()))
717                         duplicate = true;
718 
719                 if (!duplicate) {
720                     execute(DBStrings.addMessageToConvo.replace("__convoID__", msg.PCHATgetConversationID())
721                                                        .replace("__sendersKey__", Crypto.encodeKey(getSignatory(msg)))
722                                                        .replace("__msgText__", msg.PCHATgetText())
723                                                        .replace("__time__", Long.toString(msg.getTimestamp())));
724                 }
725             } catch (java.sql.SQLException e) {
726                 Logger.write("ERROR", "DB", "SQLException: " + e);
727                 return false;
728             }
729 
730             return true;
731         }
732 
733         public boolean addComment (Message comment) {
734             Logger.write("VERBOSE", "DB", "addComment(...)");
735 
736             try {
737                 execute(DBStrings.addComment.replace("__sig__", comment.getSig())
738                                             .replace("__msgText__", comment.CMNTgetText())
739                                             .replace("__parent__", comment.CMNTgetItemID())
740                                             .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++)
```

```
                    if (!keys.contains(memberKeys[i]))
                        keys.add(memberKeys[i]);
            }
        } catch (java.sql.SQLException e) {
            Logger.write("ERROR", "DB", "SQLException: " + e);
        }

        return keys.toArray(new PublicKey[0]);
    }

    //no duplicate names
    public boolean addCategory (Message msg) {
        return addCategory(msg.ADDCATgetName(), msg.ADDCATgetValue());
    }

    public boolean addCategory (String name, boolean can_see_private_details) {
        Logger.write("VERBOSE", "DB", "addCategory(...)");
        try {
            execute(DBStrings.addCategory.replace("__catID__", name)
                                         .replace("__canSeePDATA__", can_see_private_details?"1":"0"));
        } catch (java.sql.SQLException e) {
            Logger.write("ERROR", "DB", "SQLException: " + e);
            return false;
        }

        return true;
    }

    public boolean addToCategory (Message msg) {
        return addToCategory(msg.ADDTOCATgetName(), Crypto.decodeKey(msg.ADDTOCATgetKey()));
    }

    public boolean addToCategory (String category, PublicKey key) {
        Logger.write("VERBOSE", "DB", "addToCategory(" + category + ", ...)");

        PublicKey[] members = getCategoryMembers(category);
        if (Arrays.asList(members).contains(key)) {
            return false;
        }

        try {
            execute(DBStrings.addToCategory.replace("__catID__", category)
                                           .replace("__key__", Crypto.encodeKey(key)));
        } catch (java.sql.SQLException e) {
            Logger.write("ERROR", "DB", "SQLException: " + e);
            return false;
        }

        return true;
    }

    public boolean removeFromCategory (Message msg) {
        return removeFromCategory(msg.REMFROMCATgetCategory(), Crypto.decodeKey(msg.REMFROMCATgetKey()));
    }

    public boolean removeFromCategory (String category, PublicKey key) {
        Logger.write("VERBOSE", "DB", "removeFromCategory(" + category + ", ...)");
        try {
            execute(DBStrings.removeFromCategory.replace("__catID__", category)
                                                .replace("__key__", Crypto.encodeKey(key)));
        } catch (java.sql.SQLException e) {
            Logger.write("ERROR", "DB", "SQLException: " + e);
            return false;
        }

        return true;
    }

    public boolean like (String sig) {
        Logger.write("VERBOSE", "DB", "like(...)");
        try {
            execute(DBStrings.addLike.replace("__parent__", sig)
                                     .replace("__likerKey__", Crypto.encodeKey(Crypto.getPublicKey())));
        } catch (java.sql.SQLException e) {
            Logger.write("ERROR", "DB", "SQLException: " + e);
            return false;
        }

        return true;
    }

    public boolean unlike (String sig) {
        Logger.write("VERBOSE", "DB", "like(...)");
        try {
            execute(DBStrings.removeLike.replace("__parent__", sig)
                                        .replace("__likerKey__", Crypto.encodeKey(Crypto.getPublicKey())));
        } catch (java.sql.SQLException e) {
            Logger.write("ERROR", "DB", "SQLException: " + e);
            return false;
        }

        return true;
    }
```

```
927     }
```

```
1   package ballmerpeak.turtlenet.server;
2
3   class DBStrings {
4       public static final String[] createDB = {
5           "CREATE TABLE tConvos ("+
6           "convoID     TEXT,"+                //sig
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,"+                //person whos wall it was posted on
30          "sendersKey  TEXT,"+
31          "PRIMARY KEY (sig));",
32
33          "CREATE TABLE tPostVisibleTo ("+
34          "pk      INTEGER PRIMARY KEY AUTOINCREMENT,"+
35          "postSig TEXT,"+
36          "key     TEXT"+
37          ");",
38
39          "CREATE TABLE tUser ("+
40          "key      TEXT,"+
41          "username TEXT,"+
42          "knowName INT,"+                    //1 if we know the username for this key, 0 otherwise
43          "email    TEXT,"+
44          "name     TEXT,"+
45          "gender   TEXT,"+
46          "birthday TEXT,"+
47          "PRIMARY KEY (key));",
48
49          "CREATE TABLE tCategory ("+
50          "catID       TEXT,"+                //sig
51          "canSeePDATA INT,"+                 //1 if category can see pdata, 0 otherwise
52          "PRIMARY KEY (catID));",
53
54          "CREATE TABLE tCategoryMembers ("+
55          "pk      INTEGER PRIMARY KEY AUTOINCREMENT,"+
56          "catID   TEXT,"+
57          "userKey TEXT"+
58          ");",
59
60          "CREATE TABLE tEvent ("+
61          "sig          TEXT,"+
62          "startTime    TEXT,"+
63          "endTime      TEXT,"+
64          "creatorKey   TEXT,"+
65          "accepted     INT,"+                //1 if accepted, 0 otherwise
66          "name         TEXT,"+
67          "creationTime TEXT,"+
68          "PRIMARY KEY (sig));",
69
70          "CREATE TABLE tClaim ("+
71          "sig       TEXT,"+
72          "name      TEXT,"+
73          "claimTime TEXT,"+
74          "PRIMARY KEY (sig));",
75
76          "CREATE TABLE tLike ("+
77          "pk       INTEGER PRIMARY KEY AUTOINCREMENT,"+
78          "likerKey TEXT,"+
79          "parent   TEXT"+                    //sig of thing being liked
80          ");",
81
82          "CREATE TABLE tComment ("+
83          "sig          TEXT,"+
84          "msgText      TEXT,"+
85          "senderKey    TEXT,"+
86          "parent       TEXT,"+               //sig of thing being commented
87          "creationTime TEXT,"+
88          "PRIMARY KEY (sig));",
89
90          "CREATE TABLE tRevocations ("+
91          "key          TEXT,"+
92          "sig          TEXT,"+
93          "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
    recieverKey) AS temp "+
124                                                         "ON tPost.recieverKey = temp.recieverKey AND tPost.time = temp.maxtime
    "+
125                                                         "WHERE tPost.recieverKey = '__KEY__';";
126
127     public static final String addPost               = "INSERT INTO tPost (sig, msgText, time, recieverKey, sendersKey)" +
128                                                             "VALUES ('__SIG__', '__msgText__', '__time__', '__recieverKey__',
    '__sendersKey__');";
129     public static final String addPostVisibility     = "INSERT INTO tPostVisibleTo (postSig, key)"+
130                                                             "VALUES ('__postSig__', '__key__');";
131     public static final String addKey                = "INSERT INTO tUser (key) VALUES ('__key__');";
132     public static final String newUsername           = "UPDATE tUser SET username = '__name__' WHERE key = '__key__';";
133     public static final String removeClaim           = "DELETE FROM tClaim WHERE sig = '__sig__';";
134     public static final String addClaim              = "INSERT INTO tClaim (sig, name, claimTime) VALUES ('__sig__',
    '__name__', '__time__');";
135     public static final String addRevocation         = "INSERT INTO tRevocations (key, sig, timeOfLeak, creationTime) VALUES
    ('__key__', '__sig__', '__time__', '__creationTime__');";
136     public static final String updateRevocationKey   = "UPDATE tRevocations SET key = '__KEY__' WHERE sig = '__SIG__';";
137     public static final String addPDATA              = "UPDATE tUser SET __field__ = '__value__' WHERE key = '__key__';";
138     public static final String addConvo              = "INSERT INTO tConvos (convoID, timeCreated) VALUES ('__sig__',
    '__time__');";
139     public static final String addConvoParticipant   = "INSERT INTO tConvoKeys (convoID, key) VALUES ('__sig__', '__key__');";
140     public static final String addMessageToConvo     = "INSERT INTO tConvoMessages (convoID, sendersKey, msgText, time)"+
141                                                             "VALUES ('__convoID__', '__sendersKey__', '__msgText__',
    '__time__');";
142     public static final String addComment            = "INSERT INTO tComment (sig, msgText, senderKey, parent, creationTime)"+
143                                                             "VALUES ('__sig__', '__msgText__', '__senderKey__', '__parent__',
    '__creationTime__');";
144     public static final String addLike               = "INSERT INTO tLike (likerKey, parent) VALUES ('__likerKey__',
    '__parent__');";
145     public static final String removeLike            = "DELETE FROM tLike WHERE likerKey = '__likerKey__' AND parent =
    '__parent__';";
146     public static final String addEvent              = "INSERT INTO tEvent (sig, startTime, endTime, creatorKey, accepted,
    name, creationTime)"+
147                                                             "VALUES ('__sig__', '__startTime__', '__endTime__',
    '__creatorKey__', '__accepted__', '__name__', '__creationTime__');";
148     public static final String acceptEvent           = "UPDATE tEvent SET accepted = 1 WHERE sig = '__sig__';";
149     public static final String declineEvent          = "UPDATE tEvent SET accepted = -1 WHERE sig = '__sig__';";
150     public static final String updatePDATApermission = "UPDATE tCategory SET canSeePDATA = __bool__ WHERE catID =
    '__catID__'";
151     public static final String addCategory           = "INSERT INTO tCategory (catID, canSeePDATA) VALUES ('__catID__',
    __canSeePDATA__);";
152     public static final String addToCategory         = "INSERT INTO tCategoryMembers (catID, userKey) VALUES ('__catID__',
    '__key__');";
153     public static final String removeFromCategory    = "DELETE FROM tCategoryMembers WHERE catId = '__catID__' AND userKey =
    '__key__';";
154
155     //revocation stuff
156     public static final String removeMessageAccess   = "DELETE FROM tConvoKeys WHERE key = '__KEY__';";
157     public static final String removeMessages        = "DELETE FROM tConvoMessages WHERE sendersKey = '__KEY__';";
158     public static final String removePosts           = "DELETE FROM tPost WHERE sendersKey = '__KEY__';";
159     public static final String removePostVisibility  = "DELETE FROM tPostVisibleTo WHERE key = '__KEY__';";
160     public static final String removeUser            = "DELETE FROM tUser WHERE key = '__KEY__';";
161     public static final String removeFromCategories  = "DELETE FROM tCategoryMembers WHERE userKey = '__KEY__';";
162     public static final String removeLikes           = "DELETE FROM tLike WHERE likerKey = '__KEY__';";
163     public static final String removeComments        = "DELETE FROM tComment WHERE senderKey = '__KEY__';";
164     public static final String removeEvents          = "DELETE FROM tEvent WHERE creatorKey = '__KEY__';";
165 }
```

```java
//File IO

package ballmerpeak.turtlenet.server;
import java.io.*;
import ballmerpeak.turtlenet.server.Logger;

public class FIO {
    public static byte[] readFileBytes (String filename) {
        RandomAccessFile f = null;
        byte[] bytes = null;

        try {
            f = new RandomAccessFile(filename, "r");
            Long lsize = f.length();
            int  isize = (int)f.length();
            if (lsize == isize) {
                bytes = new byte[isize];
                f.readFully(bytes);
            } else {
                Logger.write("FATAL", "FIO", filename + " is too large, could not read file.");
            }
            f.close();
        } catch (IOException e) {
            Logger.write("FATAL", "FIO", "Could not read file: " + e);
            return bytes = null;
        }

        return bytes;
    }

    public static boolean writeFileBytes (byte[] data, String filename) {
        FileOutputStream out;
        try {
            out = new FileOutputStream(new File(filename));
            out.write(data);
            out.close();
            return true;
        } catch (IOException e) {
            Logger.write("FATAL", "FIO", "Could not write file: " + e);
            return false;
        }
    }
}
```

```java
/* Message Levels:
 * UNIMPL
 * VERBOSE  - Way to much detail
 * INFO     - Normal running, useful to follow execution
 * WARNING  - Something wierd is going on, someone fucked up
 * RED      - Recoverable error (one query failing, one timeout)
 * ERROR    - Something went badly wrong
 * FATAL    - Going to crash, far more worrying if it doesn't crash
 * CRITICAL - Fuck everything, the moon is purple
*/

package ballmerpeak.turtlenet.server;

import java.io.*;
import java.util.Date;

public class Logger {
    static boolean started = false;
    static String path;
    static PrintWriter log;

    public static void init (String logfile) {
        if (!started) {
            started = true;
            path = logfile;

            try {
                log = new PrintWriter(new BufferedWriter(new FileWriter(path)));
                log.println("===== Turtlenet started at " + new Date() + "=====");
                log.flush();
            } catch (Exception e) {
                throw new RuntimeException("ERROR: Unable to open log: " + e);
            }
        }
    }

    public static void close () {
        if(started) {
            log.println("===== Turtlenet closed  at " + new Date() + "=====");
            log.flush();
            log.close();
        }
    }

    public static void write (String level, String place, String s) {
        if (started) {
            log.println((System.currentTimeMillis()/1000L) + " " + level + getTabs(level) + place + "\t" + s);
            log.flush(); //In case of a crash we don't want to be digging up the wrong code
        }
    }

    private static String getTabs (String s) {
        s = (System.currentTimeMillis()/1000L) + " " + s;
        if (s.length() < 16)  return "\t\t"; else return "\t";
    }
}
```

```java
//Can not be Message constructors because of GWT
//These methods can't be static like they should be because of GWT

package ballmerpeak.turtlenet.server;
import ballmerpeak.turtlenet.shared.Message;
import ballmerpeak.turtlenet.server.Crypto;
import java.security.*;


public class MessageFactory {
    public MessageFactory(){
    }

    public  Message newMessage(String cmd, String content) {
        long timestamp = System.currentTimeMillis();
        Message msg = new Message(cmd, content, timestamp, "");
        msg.signature = Crypto.sign(msg);
        return msg;
    }

    public Message newCLAIM(String username) {
        return newMessage("CLAIM", username);
    }

    public Message newREVOKE(long time) {
        return newMessage("REVOKE", ""+time);
    }

    public Message newPDATA(String field, String value) {
        return newMessage("PDATA", field + ":" + value + ";");
    }

    public Message newPDATA(String[] fields, String[] values) {
        String content = "";
        for (int i = 0; i < fields.length; i++)
            content += (values[i] + ":" + fields[i] + ";");
        Logger.write("VERBOSE", "MsgF", "constructed pdata message: " + content);
        return newMessage("PDATA", content);
    }

    public Message newCHAT(PublicKey[] keys) {
        String keyString = "";
        String delim = "";
        for (int i = 0; i < keys.length; i++) {
            keyString += delim + Crypto.encodeKey(keys[i]);
            delim = ":"; /*intentional*/
        }
        return newMessage("CHAT", keyString);
    }

    public Message newCHAT(String[] keys) {
        String keyString = "";
        String delim = "";
        for (int i = 0; i < keys.length; i++) {
            keyString += delim + keys[i];
            delim = ":"; /*intentional*/
        }
        return newMessage("CHAT", keyString);
    }

    public Message newPCHAT(String convoSig, String msg) {
        return newMessage("PCHAT", convoSig + ":" + msg);
    }

    public Message newPOST(String msg, String wall, String[] visibleTo) {
        String content = wall;
        for (int i = 0; i < visibleTo.length; i++)
            content += (":" + visibleTo[i]);
        content += (":" + msg);
        return newMessage("POST", content);
    }

    public Message newCMNT(String itemSig, String comment) {
        return newMessage("CMNT", itemSig + ":" + comment);
    }

    public Message newLIKE(String itemSig) {
        return newMessage("LIKE", itemSig);
    }

    public Message newUNLIKE(String itemSig) {
        return newMessage("UNLIKE", itemSig);
    }

    public Message newEVNT(long start, long end, String descrip) {
        return newMessage("EVNT", start + ":" + end + ":" + descrip);
    }

    public Message newADDCAT(String name, boolean canSeePDATA) {
        return newMessage("ADDCAT", (canSeePDATA?"true":"false") + ":" + name);
    }

    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     }
```

```java
package ballmerpeak.turtlenet.server;

import ballmerpeak.turtlenet.shared.Message;
import java.util.Vector;
import java.util.Date;
import java.security.*;
import java.io.*;
import java.net.*;
import java.util.concurrent.Semaphore;

public class NetworkConnection implements Runnable {
    public NetworkConnection (String serverurl) {
        url         = serverurl;
        messages    = new Vector<String>();
        lastRead    = 0;
        messageLock = new Semaphore(1);
        connected   = true;
        tor         = true;

        //parse db/lastread
        File lastReadFile = new File("./db/lastread");
        if (lastReadFile.exists()) {
            try {
                BufferedReader reader = new BufferedReader(
                                        new FileReader(lastReadFile));
                lastRead = Long.parseLong(reader.readLine());
                Logger.write("INFO", "NetCon","Read lastRead from file");
            } catch (Exception e) {
                Logger.write("ERROR", "NetCon", "Could not read lastread from file");
            }
        }
    }

    public void run () {
        Logger.write("INFO", "NetCon","NetworkConnection started");
        while (connected) {
            try {
                Thread.sleep(1000); //update every second
            } catch (Exception e) {
                Logger.write("WARNING", "NetCon", "Sleep interrupted: " + e);
            }
            downloadNewMessages();
        }
    }

    public void close () {
        Logger.write("INFO", "NetCon","close()");
        connected = false;
        try {
            File lastReadFile = new File("./db/lastread");

            if (lastReadFile.exists())
                lastReadFile.delete();

            BufferedWriter writer = new BufferedWriter(
                                    new FileWriter(lastReadFile));
            writer.write(Long.toString(lastRead));
            writer.close();
            Logger.write("INFO", "NetCon","Saved lastRead to disk");
        } catch (Exception e) {
            Logger.write("ERROR", "NetCon", "Unable to save lastRead: " + e);
        }
    }

    //returns true if a message is available
    public Boolean hasMessage () {
        try {
            messageLock.acquire();
            boolean haveMessage = messages.size() >= 1;
            messageLock.release();
            return haveMessage;
        } catch (Exception e) {
            Logger.write("WARNING", "NetCon", "Acquire interrupted");
        }
        return false;
    }

    //get the next message in the queue, and remove it from the queue
    public String getMessage() {
        try {
            messageLock.acquire();
            String m = messages.get(0);
            messages.removeElementAt(0);
            messageLock.release();
            return m;
        } catch (Exception e) {
            Logger.write("WARNING", "NetCon", "Acquire interrupted");
        }
        return new Message("NULL", "", 0, "").toString();
    }

    public long getTime () {
        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 retreive 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","\t sig: " + 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, recieve 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         //recieve 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     }
```

```java
//All methods ought to be static
//Most real parsing occurs in the Message class, this just passes commands to DB
package ballmerpeak.turtlenet.server;

import ballmerpeak.turtlenet.shared.Message;

public class Parser {
    /* Useful to ID the type of message on behalf of the DB so it can use type
     * specific get methods (e.g.: Message.PCHATgetConversationID()). Most
     * parsing actually occurs in the Message class itself. Maybe this should
     * be changed so parsing occurs here, e.g.: Parser.LIKEgetItemID(msg), but
     * msg.LIKEgetItemID() is more natual.
     */
    public static void parse (Message msg, Database db) {

        Logger.write("VERBOSE", "PARSE", "parsing message");

        escape(msg);

        if (db.isRevoked(db.getSignatory(msg)))
            Logger.write("WARNING", "PARSE", "Revoked key in use, message dropped");
        else if (msg.getCmd().equals("POST"))       //post to own wall
            db.addPost(msg);
        else if (msg.getCmd().equals("CLAIM"))      //claim a username
            db.addClaim(msg);
        else if (msg.getCmd().equals("REVOKE"))     //revoke private key
            db.addRevocation(msg);
        else if (msg.getCmd().equals("PDATA"))      //create or update profile data
            db.addPDATA(msg);
        else if (msg.getCmd().equals("CHAT"))       //establish chat
            db.addConvo(msg);
        else if (msg.getCmd().equals("PCHAT"))      //add message to chat
            db.addMessageToChat(msg);
        else if (msg.getCmd().equals("CMNT"))       //comment
            db.addComment(msg);
        else if (msg.getCmd().equals("LIKE"))       //like
            db.addLike(msg);
        else if (msg.getCmd().equals("UNLIKE"))     //like
            db.unlike(msg.UNLIKEgetItemID());
        else if (msg.getCmd().equals("EVNT"))       //event
            db.addEvent(msg);
        else if (msg.getCmd().equals("ADDCAT"))     //add category
            db.addCategory(msg);
        else if (msg.getCmd().equals("UPDATECAT"))  //update categorys canSeePDATA
            db.updatePDATApermission(msg);
        else if (msg.getCmd().equals("ADDTOCAT"))   //add key to category
            db.addToCategory(msg);
        else if (msg.getCmd().equals("REMFROMCAT")) //remove key from category
            db.removeFromCategory(msg);
        else if (msg.getCmd().equals("ADDKEY"))     //add public key
            db.addKey(msg);
        else if (msg.getCmd().equals("NULL"))
            Logger.write("VERBOSE", "PARSE", "undecryptable message"); //not for us
        else if (!msg.getCmd().equals("FPOST"))
            Logger.write("ERROR", "PARSE", "Unknown message type: \"" + msg.getCmd() + "\"");

        if (msg.getCmd().equals("FPOST"))
            Logger.write("WARNING", "PARSE", "FPOST is depreciated");
    }

    private static void escape (Message m) {
        m.content = m.content.replace("'", "''");
    }
}
```

```java
package ballmerpeak.turtlenet.shared;

import ballmerpeak.turtlenet.shared.Tokenizer;
import java.security.*;
import java.io.Serializable;
import java.util.Arrays;

public class Message implements Serializable {
    //You shouldn't use this, rather use MessageFactory.newMessage(command, data)
    //GWT cannot use the factory, it shouldn't construct messages but pass their
    //    data as arguments to whatever needs it. Maybe have an async factory?
    public Message (String cmd, String _content, long timeCreated, String RSAsig) {
        command   = cmd;
        content   = _content;
        signature = RSAsig;
        timestamp = timeCreated;
    }

    public Message () {
        command = "NULL";
        content = "";
        signature = "";
        timestamp = -1;
    }

    /* "POST\520adfc4\Hello, World!\123" -> new Message("POST", "Hello, World!", "520adfc4", 123) */
    public static Message parse (String msg) {
        String[] tokens = new String[4];
        Tokenizer tokenizer = new Tokenizer(msg, '\\');
        tokens[0] = tokenizer.nextToken(); //command
        tokens[1] = tokenizer.nextToken(); //signature
        tokens[2] = msg.substring(msg.indexOf("\\", msg.indexOf("\\",0)+1)+1, msg.lastIndexOf("\\")); //message content
        tokens[3] = msg.substring(msg.lastIndexOf("\\")+1); //timestamp
        long ts = Long.parseLong(tokens[3]);

        return new Message(tokens[0], tokens[2], ts, tokens[1]);
    }

    public String toString () {
        return command + "\\" + signature + "\\" + content + "\\" + timestamp;
    }

    /* universal */
    public String getCmd () {
        return command;
    }

    public String getSig () {
        return signature;
    }

    public String getContent () {
        return content;
    }

    public long getTimestamp () {
        return timestamp;
    }

    /* type specific */
    public String POSTgetText() {
        Tokenizer tokenizer = new Tokenizer(content, ':');
        String[] colonPairs = new String[tokenizer.countTokens()];
        for (int i = 0; tokenizer.hasMoreTokens(); i++)
            colonPairs[i] = tokenizer.nextToken();
        return colonPairs[colonPairs.length-1];
    }

    public String POSTgetWall() {
        Tokenizer tokenizer = new Tokenizer(content, ':');
        String[] colonPairs = new String[tokenizer.countTokens()];
        for (int i = 0; tokenizer.hasMoreTokens(); i++)
            colonPairs[i] = tokenizer.nextToken();
        return colonPairs[0];
    }

    public String[] POSTgetVisibleTo() {
        Tokenizer tokenizer = new Tokenizer(content, ':');
        String[] colonPairs = new String[tokenizer.countTokens()];
        for (int i = 0; tokenizer.hasMoreTokens(); i++)
            colonPairs[i] = tokenizer.nextToken();
        return Arrays.copyOfRange(colonPairs, 1, colonPairs.length-1);
    }

    public String CLAIMgetName() {
        return content;
    }

    //content in form "field1:value1;field2:value2;"
    public String[][] PDATAgetValues() {
        //Split into colon pairs, semicolon delimiter
        Tokenizer tokenizer = new Tokenizer(content, ';');
        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           return keys;
116       }
117
118       /* PCHAT adds messages to a conversation */
119       /* returns <conversation ID, messageText> */
120       public String PCHATgetText() {
121           Tokenizer st = new Tokenizer(content, ':');
122           String convoID = st.nextToken();
123           String text    = st.nextToken();
124           return text;
125       }
126
127       public String PCHATgetConversationID() {
128           Tokenizer st = new Tokenizer(content, ':');
129           String convoID = st.nextToken();
130           String text    = st.nextToken();
131           return convoID;
132       }
133
134       public String CMNTgetText() {
135           Tokenizer st = new Tokenizer(content, ':');
136           String itemID  = st.nextToken();
137           String text    = st.nextToken();
138           return text;
139       }
140
141       public String CMNTgetItemID() {
142           Tokenizer st = new Tokenizer(content, ':');
143           String itemID  = st.nextToken();
144           String text    = st.nextToken();
145           return itemID;
146       }
147
148       public String LIKEgetItemID() {
149           return content;
150       }
151
152       public String UNLIKEgetItemID() {
153           return content;
154       }
155
156       public String EVNTgetName() {
157           Tokenizer st = new Tokenizer(content, ':');
158           long start  = Long.parseLong(st.nextToken());
159           long end    = Long.parseLong(st.nextToken());
160           String name = st.nextToken();
161           return name;
162       }
163
164       public long EVNTgetStart() {
165           Tokenizer st = new Tokenizer(content, ':');
166           long start  = Long.parseLong(st.nextToken());
167           long end    = Long.parseLong(st.nextToken());
168           String name = st.nextToken();
169           return start;
170       }
171
172       public long EVNTgetEnd() {
173           Tokenizer st = new Tokenizer(content, ':');
174           long start  = Long.parseLong(st.nextToken());
175           long end    = Long.parseLong(st.nextToken());
176           String name = st.nextToken();
177           return end;
178       }
179
180       /* time of revocation, not timestamp of message */
181       /* there cannot be a REVOKEgetKey due to GWT */
182       public long REVOKEgetTime() {
183           try {
184               return Long.parseLong(content);
185           } catch (Exception e) {
186               //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     }
```

```java
package ballmerpeak.turtlenet.server;

import java.security.PublicKey;

public class Friend {
    public Friend (String _name, PublicKey _key) {
        name = _name;
        key = _key;
    }

    public String getName () {
        return name;
    }

    public void setName (String nname) {
        name = nname;
    }

    public PublicKey getKey () {
        return key;
    }

    private String name;
    private PublicKey key;
}
```

```java
package ballmerpeak.turtlenet.server;

public class Pair<A,B> {
    public Pair(A f, B s) {
        first = f;
        second = s;
    }

    public A first;
    public B second;
}
```

```java
//To reduce RPC calls

package ballmerpeak.turtlenet.shared;

import java.io.Serializable;

public class CommentDetails implements Serializable {
    public CommentDetails () {
    }

    public CommentDetails (String _posterKey, String _posterName, String _sig, String _text, boolean _liked, Long _timestamp) {
        posterKey = _posterKey;
        posterName = _posterName;
        sig = _sig;
        text = _text;
        liked = _liked;
        timestamp = _timestamp;
    }

    public String posterKey;
    public String posterName;
    public String sig;
    public String text;
    public boolean liked;
    public Long timestamp;
}
```

```java
package ballmerpeak.turtlenet.shared;

import java.io.Serializable;

public class Conversation implements Serializable {
    public Conversation () {
        signature = "<SIGNATURE NOT KNOWN>";
        timestamp = "0";
        firstMessage = "<FIRST MESSAGE NOT KNOWN>";
        users = new String[0];
        keys = new String[0];
    }

    public Conversation (String sig, String time, String fmsg, String[] _users, String[] _keys) {
        signature = sig;
        timestamp = time;
        firstMessage = fmsg;
        users = _users;
        keys = _keys;
    }

    public String concatNames() {
        String names = "";
        for (int i = 0; i < users.length; i++)
            names += users[i] + " ";
        return names;
    }

    public String signature;
    public String timestamp;
    public String firstMessage;
    public String[] users; //usernames
    public String[] keys;  //keys[0] is the key of users[0], etc.
}
```

```java
//To reduce RPC calls

package ballmerpeak.turtlenet.shared;

import java.io.Serializable;

public class PostDetails implements Serializable {
    public PostDetails () {
    }

    public PostDetails (String _sig, boolean _liked, int _commentCount, Long _timestamp, String _posterUsername, String _text, String _posterKey) {
        sig = _sig;
        liked = _liked;
        commentCount = _commentCount;
        timestamp = _timestamp;
        posterKey = _posterKey;
        posterUsername = _posterUsername;
        text = _text;
    }

    public String  sig;
    public boolean liked;
    public int     commentCount;
    public Long    timestamp;
    public String  posterKey;
    public String  posterUsername;
    public String  text;
}
```

```java
//Can't user java.util.StringTokenizer because of GWT
package ballmerpeak.turtlenet.shared;

public class Tokenizer {
    String[] tokens;
    int i = 0;

    public Tokenizer (String s, char c) {
        String regex = "" + c;
        if (c == '\\')
            regex = "\\\\";
        tokens = s.split(regex);
    }

    public String nextToken () {
        return tokens[i++];
    }

    public boolean hasMoreTokens () {
        return i < tokens.length;
    }

    public int countTokens () {
        return tokens.length;
    }
}
```

```java
package ballmerpeak.turtlenet.remoteserver;

import javax.xml.bind.DatatypeConverter;
import java.security.MessageDigest;

class Hasher {
    public static String hash (String data) {
        try {
            MessageDigest hasher = MessageDigest.getInstance("SHA-256");
            byte[] hash = hasher.digest(data.getBytes("UTF-8"));
            return DatatypeConverter.printHexBinary(hash);
        } catch (Exception e) {
            System.out.println("SHA-256 isn't supported.");
        }
        return "not_a_hash";
    }
}
```

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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C.6 Limitations places upon Turtlenet by The University of Liverpool

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
- writeup/latex/ulem.sty
- tikz-styles.sty
- writeup/images/appendicies/licence.png (CC0 licence logo)
- The text of any legal licence
- client/web_interface_mockup/jquery.js
- client/web_interface_mockup/turtles.ttf

C.8 The turtle image used as a favicon and in the banner

This was dedicated to the public domain by its creator. The UK both is a signatory of the berne convention and has precedent holding that licencing cannot be retroactivly rescinded.

C.9 jquery.js Licence

C.10 todonotes.sty licence

C.11 The LaTeX Project Public License

C.11.1 PREAMBLE

The LaTeX Project Public License (LPPL) is the primary license under which the LaTeX kernel and the base LaTeX packages are distributed.

You may use this license for any work of which you hold the copyright and which you wish to distribute. This license may be particularly suitable if your work is TeX-related (such as a LaTeX package), but it is written in such a way that you can use it even if your work is unrelated to TeX.

The section 'WHETHER AND HOW TO DISTRIBUTE WORKS UNDER THIS LICENSE', below, gives instructions, examples, and recommendations for authors who are considering distributing their works under this license.

This license gives conditions under which a work may be distributed and modified, as well as conditions under which modified versions of that work may be distributed.

We, the LaTeX3 Project, believe that the conditions below give you the freedom to make and distribute modified versions of your work that conform with whatever technical specifications you wish while maintaining the availability, integrity, and reliability of that work. If you do not see how to achieve your goal while meeting these conditions, then read the document 'cfgguide.tex' and 'modguide.tex' in the base LaTeX distribution for suggestions.

C.11.2 DEFINITIONS

In this license document the following terms are used:

'Work' Any work being distributed under this License.

'Derived Work' Any work that under any applicable law is derived from the Work.

'Modification' Any procedure that produces a Derived Work under any applicable law – for example, the production of a file containing an original file associated with the Work or a significant portion of such a file, either verbatim or with modifications and/or translated into another language.

'Modify' To apply any procedure that produces a Derived Work under any applicable law.

'Distribution' Making copies of the Work available from one person to another, in whole or in part. Distribution includes (but is not limited to) making any electronic components of the Work accessible by file transfer protocols such as FTP or HTTP or by shared file systems such as Sun's Network File System (NFS).

'Compiled Work' A version of the Work that has been processed into a form where it is directly usable on a computer system. This processing may include using installation facilities provided by the Work, transformations of the Work, copying of components of the Work, or other activities. Note that modification of any installation facilities provided by the Work constitutes modification of the Work.

'Current Maintainer' A person or persons nominated as such within the Work. If there is no such explicit nomination then it is the 'Copyright Holder' under any applicable law.

'Base Interpreter' A program or process that is normally needed for running or interpreting a part or the whole of the Work.

A Base Interpreter may depend on external components but these are not considered part of the Base Interpreter provided that each external component clearly identifies itself whenever it is used interactively. Unless explicitly specified when applying the license to the Work, the only applicable Base Interpreter is a 'LaTeX-Format' or in the case of files belonging to the 'LaTeX-format' a program implementing the 'TeX language'.

C.11.3 CONDITIONS ON DISTRIBUTION AND MODIFICATION

1. Activities other than distribution and/or modification of the Work are not covered by this license; they are outside its scope. In particular, the act of running the Work is not restricted and no requirements are made concerning any offers of support for the Work.

2. You may distribute a complete, unmodified copy of the Work as you received it. Distribution of only part of the Work is considered modification of the Work, and no right to distribute such a Derived Work may be assumed under the terms of this clause.

3. You may distribute a Compiled Work that has been generated from a complete, unmodified copy of the Work as distributed under Clause 2 above, as long as that Compiled Work is

distributed in such a way that the recipients may install the Compiled Work on their system exactly as it would have been installed if they generated a Compiled Work directly from the Work.

4. If you are the Current Maintainer of the Work, you may, without restriction, modify the Work, thus creating a Derived Work. You may also distribute the Derived Work without restriction, including Compiled Works generated from the Derived Work. Derived Works distributed in this manner by the Current Maintainer are considered to be updated versions of the Work.

5. If you are not the Current Maintainer of the Work, you may modify your copy of the Work, thus creating a Derived Work based on the Work, and compile this Derived Work, thus creating a Compiled Work based on the Derived Work.

6. If you are not the Current Maintainer of the Work, you may distribute a Derived Work provided the following conditions are met for every component of the Work unless that component clearly states in the copyright notice that it is exempt from that condition. Only the Current Maintainer is allowed to add such statements of exemption to a component of the Work.

   a. If a component of this Derived Work can be a direct replacement for a component of the Work when that component is used with the Base Interpreter, then, wherever this component of the Work identifies itself to the user when used interactively with that Base Interpreter, the replacement component of this Derived Work clearly and unambiguously identifies itself as a modified version of this component to the user when used interactively with that Base Interpreter.

   b. Every component of the Derived Work contains prominent notices detailing the nature of the changes to that component, or a prominent reference to another file that is distributed as part of the Derived Work and that contains a complete and accurate log of the changes.

   c. No information in the Derived Work implies that any persons, including (but not limited to) the authors of the original version of the Work, provide any support, including (but not limited to) the reporting and handling of errors, to recipients of the Derived Work unless those persons have stated explicitly that they do provide such support for the Derived Work.

   d. You distribute at least one of the following with the Derived Work:

      (a) A complete, unmodified copy of the Work; if your distribution of a modified component is made by offering access to copy the modified component from a designated place, then offering equivalent access to copy the Work from the same or some similar place meets this condition, even though third parties are not compelled to copy the Work along with the modified component;

(b) Information that is sufficient to obtain a complete, unmodified copy of the Work.

7. If you are not the Current Maintainer of the Work, you may distribute a Compiled Work generated from a Derived Work, as long as the Derived Work is distributed to all recipients of the Compiled Work, and as long as the conditions of Clause 6, above, are met with regard to the Derived Work.

8. The conditions above are not intended to prohibit, and hence do not apply to, the modification, by any method, of any component so that it becomes identical to an updated version of that component of the Work as it is distributed by the Current Maintainer under Clause 4, above.

9. Distribution of the Work or any Derived Work in an alternative format, where the Work or that Derived Work (in whole or in part) is then produced by applying some process to that format, does not relax or nullify any sections of this license as they pertain to the results of applying that process.

10. **a.** A Derived Work may be distributed under a different license provided that license itself honors the conditions listed in Clause 6 above, in regard to the Work, though it does not have to honor the rest of the conditions in this license.

    b. If a Derived Work is distributed under a different license, that Derived Work must provide sufficient documentation as part of itself to allow each recipient of that Derived Work to honor the restrictions in Clause 6 above, concerning changes from the Work.

11. This license places no restrictions on works that are unrelated to the Work, nor does this license place any restrictions on aggregating such works with the Work by any means.

12. Nothing in this license is intended to, or may be used to, prevent complete compliance by all parties with all applicable laws.

C.11.4 NO WARRANTY

There is no warranty for the Work. Except when otherwise stated in writing, the Copyright Holder provides the Work 'as is', without warranty of any kind, either expressed or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. The entire risk as to the quality and performance of the Work is with you. Should the Work prove defective, you assume the cost of all necessary servicing, repair, or correction.

In no event unless required by applicable law or agreed to in writing will The Copyright Holder, or any author named in the components of the Work, or any other party who may distribute and/or modify the Work as permitted above, be liable to you for damages, including any general, special, incidental or consequential damages arising out of any use of the Work or out of inability to use

the Work (including, but not limited to, loss of data, data being rendered inaccurate, or losses sustained by anyone as a result of any failure of the Work to operate with any other programs), even if the Copyright Holder or said author or said other party has been advised of the possibility of such damages.

C.11.5 MAINTENANCE OF THE WORK

The Work has the status 'author-maintained' if the Copyright Holder explicitly and prominently states near the primary copyright notice in the Work that the Work can only be maintained by the Copyright Holder or simply that it is 'author-maintained'.

The Work has the status 'maintained' if there is a Current Maintainer who has indicated in the Work that they are willing to receive error reports for the Work (for example, by supplying a valid e-mail address). It is not required for the Current Maintainer to acknowledge or act upon these error reports.

The Work changes from status 'maintained' to 'unmaintained' if there is no Current Maintainer, or the person stated to be Current Maintainer of the work cannot be reached through the indicated means of communication for a period of six months, and there are no other significant signs of active maintenance.

You can become the Current Maintainer of the Work by agreement with any existing Current Maintainer to take over this role.

If the Work is unmaintained, you can become the Current Maintainer of the Work through the following steps:

1. Make a reasonable attempt to trace the Current Maintainer (and the Copyright Holder, if the two differ) through the means of an Internet or similar search.

2. If this search is successful, then enquire whether the Work is still maintained.

   a. If it is being maintained, then ask the Current Maintainer to update their communication data within one month.

   b. If the search is unsuccessful or no action to resume active maintenance is taken by the Current Maintainer, then announce within the pertinent community your intention to take over maintenance. (If the Work is a LaTeX work, this could be done, for example, by posting to comp.text.tex.)

3. **a.** If the Current Maintainer is reachable and agrees to pass maintenance of the Work to you, then this takes effect immediately upon announcement.

   b. If the Current Maintainer is not reachable and the Copyright Holder agrees that maintenance of the Work be passed to you, then this takes effect immediately upon announcement.

4. If you make an 'intention announcement' as described in 2b. above and after three months your intention is challenged neither by the Current Maintainer nor by the Copyright Holder nor by other people, then you may arrange for the Work to be changed so as to name you as the (new) Current Maintainer.

5. If the previously unreachable Current Maintainer becomes reachable once more within three months of a change completed under the terms of 3b) or 4), then that Current Maintainer must become or remain the Current Maintainer upon request provided they then update their communication data within one month.

A change in the Current Maintainer does not, of itself, alter the fact that the Work is distributed under the LPPL license.

If you become the Current Maintainer of the Work, you should immediately provide, within the Work, a prominent and unambiguous statement of your status as Current Maintainer. You should also announce your new status to the same pertinent community as in 2b) above.

C.11.6 WHETHER AND HOW TO DISTRIBUTE WORKS UNDER THIS LICENSE

This section contains important instructions, examples, and recommendations for authors who are considering distributing their works under this license. These authors are addressed as 'you' in this section.

Choosing This License or Another License

If for any part of your work you want or need to use *distribution* conditions that differ significantly from those in this license, then do not refer to this license anywhere in your work but, instead, distribute your work under a different license. You may use the text of this license as a model for your own license, but your license should not refer to the LPPL or otherwise give the impression that your work is distributed under the LPPL.

The document 'modguide.tex' in the base LaTeX distribution explains the motivation behind the conditions of this license. It explains, for example, why distributing LaTeX under the GNU General Public License (GPL) was considered inappropriate. Even if your work is unrelated to LaTeX, the discussion in 'modguide.tex' may still be relevant, and authors intending to distribute their works under any license are encouraged to read it.

A Recommendation on Modification Without Distribution

It is wise never to modify a component of the Work, even for your own personal use, without also meeting the above conditions for distributing the modified component. While you might intend

that such modifications will never be distributed, often this will happen by accident – you may forget that you have modified that component; or it may not occur to you when allowing others to access the modified version that you are thus distributing it and violating the conditions of this license in ways that could have legal implications and, worse, cause problems for the community. It is therefore usually in your best interest to keep your copy of the Work identical with the public one. Many works provide ways to control the behavior of that work without altering any of its licensed components.

How to Use This License

To use this license, place in each of the components of your work both an explicit copyright notice including your name and the year the work was authored and/or last substantially modified. Include also a statement that the distribution and/or modification of that component is constrained by the conditions in this license.

Here is an example of such a notice and statement:

```
%% pig.dtx
%% Copyright 2005 M. Y. Name
%
% This work may be distributed and/or modified under the
% conditions of the LaTeX Project Public License, either version 1.3
% of this license or (at your option) any later version.
% The latest version of this license is in
%   http://www.latex-project.org/lppl.txt
% and version 1.3 or later is part of all distributions of LaTeX
% version 2005/12/01 or later.
%
% This work has the LPPL maintenance status `maintained'.
%
% The Current Maintainer of this work is M. Y. Name.
%
% This work consists of the files pig.dtx and pig.ins
% and the derived file pig.sty.
```

Given such a notice and statement in a file, the conditions given in this license document would apply, with the 'Work' referring to the three files 'pig.dtx', 'pig.ins', and 'pig.sty' (the last being generated from 'pig.dtx' using 'pig.ins'), the 'Base Interpreter' referring to any 'LaTeX-Format', and both 'Copyright Holder' and 'Current Maintainer' referring to the person 'M. Y. Name'.

If you do not want the Maintenance section of LPPL to apply to your Work, change 'main-

tained' above into 'author-maintained'. However, we recommend that you use 'maintained', as the Maintenance section was added in order to ensure that your Work remains useful to the community even when you can no longer maintain and support it yourself.

Derived Works That Are Not Replacements

Several clauses of the LPPL specify means to provide reliability and stability for the user community. They therefore concern themselves with the case that a Derived Work is intended to be used as a (compatible or incompatible) replacement of the original Work. If this is not the case (e.g., if a few lines of code are reused for a completely different task), then clauses 6b and 6d shall not apply.

Important Recommendations

Defining What Constitutes the Work

The LPPL requires that distributions of the Work contain all the files of the Work. It is therefore important that you provide a way for the licensee to determine which files constitute the Work. This could, for example, be achieved by explicitly listing all the files of the Work near the copyright notice of each file or by using a line such as:

```
% This work consists of all files listed in manifest.txt.
```

in that place. In the absence of an unequivocal list it might be impossible for the licensee to determine what is considered by you to comprise the Work and, in such a case, the licensee would be entitled to make reasonable conjectures as to which files comprise the Work.

C.12 CC0 licence and licence.png licence

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C.13.1 Section 1 - Definitions.

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e. Exceptions and Limitations means fair use, fair dealing, and/or any other exception or limitation to Copyright and Similar Rights that applies to Your use of the Licensed Material.

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g. Licensed Rights means the rights granted to You subject to the terms and conditions of this Public License, which are limited to all Copyright and Similar Rights that apply to Your use of the Licensed Material and that the Licensor has authority to license.

h. Licensor means the individual(s) or entity(ies) granting rights under this Public License.

i. Share means to provide material to the public by any means or process that requires permission under the Licensed Rights, such as reproduction, public display, public performance, distribution, dissemination, communication, or importation, and to make material available to the public including in ways that members of the public may access the material from a place and at a time individually chosen by them.

j. Sui Generis Database Rights means rights other than copyright resulting from Directive 96/9/EC of the European Parliament and of the Council of 11 March 1996 on the legal protection of databases, as amended and/or succeeded, as well as other essentially equivalent rights anywhere in the world.

k. You means the individual or entity exercising the Licensed Rights under this Public License. Your has a corresponding meaning.

C.13.2 Section 2 - Scope.

a. License grant .

1. Subject to the terms and conditions of this Public License, the Licensor hereby grants You a worldwide, royalty-free, non-sublicensable, non-exclusive, irrevocable license to exercise the Licensed Rights in the Licensed Material to:

A. reproduce and Share the Licensed Material, in whole or in part; and

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4. Media and formats; technical modifications allowed. The Licensor authorizes You to exercise the Licensed Rights in all media and formats whether now known or hereafter created, and to make technical modifications necessary to do so. The Licensor waives and/or agrees not to assert any right or authority to forbid You from making technical modifications necessary to exercise the Licensed Rights, including technical modifications necessary to circumvent Effective Technological Measures. For purposes of this Public License, simply making modifications authorized by this Section 2(a)(4) never produces Adapted Material.

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2. Patent and trademark rights are not licensed under this Public License.

3. To the extent possible, the Licensor waives any right to collect royalties from You for the exercise of the Licensed Rights, whether directly or through a collecting society under any voluntary or waivable statutory or compulsory licensing scheme. In all other cases the Licensor expressly reserves any right to collect such royalties.

C.13.3 Section 3 - License Conditions.

Your exercise of the Licensed Rights is expressly made subject to the following conditions.

a. Attribution .

1. If You Share the Licensed Material (including in modified form), You must:

   A. retain the following if it is supplied by the Licensor with the Licensed Material:

   i. identification of the creator(s) of the Licensed Material and any others designated to receive attribution, in any reasonable manner requested by the Licensor (including by pseudonym if designated);

   ii. a copyright notice;

   iii. a notice that refers to this Public License;

   iv. a notice that refers to the disclaimer of warranties;

   v. a URI or hyperlink to the Licensed Material to the extent reasonably practicable;

   B. indicate if You modified the Licensed Material and retain an indication of any previous modifications; and

   C. indicate the Licensed Material is licensed under this Public License, and include the text of, or the URI or hyperlink to, this Public License.

2. You may satisfy the conditions in Section 3(a)(1) in any reasonable manner based on the medium, means, and context in which You Share the Licensed Material. For example, it

may be reasonable to satisfy the conditions by providing a URI or hyperlink to a resource that includes the required information.

3. If requested by the Licensor, You must remove any of the information required by Section 3(a)(1)(A) to the extent reasonably practicable.
4. If You Share Adapted Material You produce, the Adapter's License You apply must not prevent recipients of the Adapted Material from complying with this Public License.

C.13.4 Section 4 - Sui Generis Database Rights.

Where the Licensed Rights include Sui Generis Database Rights that apply to Your use of the Licensed Material:

a. for the avoidance of doubt, Section 2(a)(1) grants You the right to extract, reuse, reproduce, and Share all or a substantial portion of the contents of the database;

b. if You include all or a substantial portion of the database contents in a database in which You have Sui Generis Database Rights, then the database in which You have Sui Generis Database Rights (but not its individual contents) is Adapted Material; and

c. You must comply with the conditions in Section 3(a) if You Share all or a substantial portion of the contents of the database.

For the avoidance of doubt, this Section 4 supplements and does not replace Your obligations under this Public License where the Licensed Rights include other Copyright and Similar Rights.

C.13.5 Section 5 - Disclaimer of Warranties and Limitation of Liability.

a. Unless otherwise separately undertaken by the Licensor, to the extent possible, the Licensor offers the Licensed Material as-is and as-available, and makes no representations or warranties of any kind concerning the Licensed Material, whether express, implied, statutory, or other. This includes, without limitation, warranties of title, merchantability, fitness for a particular purpose, non-infringement, absence of latent or other defects, accuracy, or the presence or absence of errors, whether or not known or discoverable. Where disclaimers of warranties are not allowed in full or in part, this disclaimer may not apply to You.

b. To the extent possible, in no event will the Licensor be liable to You on any legal theory (including, without limitation, negligence) or otherwise for any direct, special, indirect, incidental, consequential, punitive, exemplary, or other losses, costs, expenses, or damages arising out of this Public License or use of the Licensed Material, even if the Licensor has been advised of the possibility of such losses, costs, expenses, or damages. Where a limitation of liability is not allowed in full or in part, this limitation may not apply to You.

c. The disclaimer of warranties and limitation of liability provided above shall be interpreted in a manner that, to the extent possible, most closely approximates an absolute disclaimer and waiver of all liability.

C.13.6 Section 6 - Term and Termination.

a. This Public License applies for the term of the Copyright and Similar Rights licensed here. However, if You fail to comply with this Public License, then Your rights under this Public License terminate automatically.

b. Where Your right to use the Licensed Material has terminated under Section 6(a), it reinstates:

1. automatically as of the date the violation is cured, provided it is cured within 30 days of Your discovery of the violation; or
2. upon express reinstatement by the Licensor.

For the avoidance of doubt, this Section 6(b) does not affect any right the Licensor may have to seek remedies for Your violations of this Public License.

c. For the avoidance of doubt, the Licensor may also offer the Licensed Material under separate terms or conditions or stop distributing the Licensed Material at any time; however, doing so will not terminate this Public License.

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Appendix D

TODO

D.1 General

Errors shouldn't just display a message, they should be properly handled Get a real DB
REVOKE claims and messages after a certain date if private key leaked
escape backslashes in message content
chang all references to ascii text to UTF-8 text

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 relevent (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 (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)

Appendix E

Bugs

- The 'DB' allows adding a friend multiple times, no reason to fix because the whole thing needs rewriting as a real DB anyway

Todo list

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