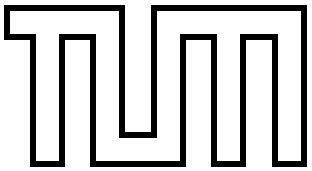

FAKULTÄT FÜR INFORMATIK

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A Survey of Existing and Future Mobile Social Networking Approaches on the Web

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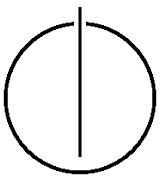

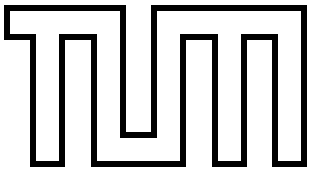

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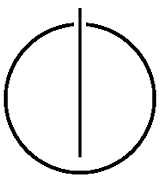
A Survey of Existing and Future Mobile Social Networking Approaches on the Web

Eine Studie über gegenwärtige und zukünftige Mobile Social Networking Ansätze im Web

Author:	Philip Daubmeier
Supervisor:	Prof. Dr. Johann Schlichter
Advisor:	Dr. Georg Groh
Date:	September 14, 2009



I assure the single handed composition of this bachelor's thesis only supported by declared resources.

München, September 14, 2009 Philip Daubmeier

Acknowledgments

I would like to acknowledge my supervisor Prof. Dr. Johann Schlichter for providing the possibility to do my Bachelor's Thesis on this subject as well as especially my advisor Georg Groh, Dipl.-Phys., Dipl.-Inform., Dr. rer. nat., for supporting me with ideas and giving me entry points to the general topic.

Furthermore I would like to thank my fellow students Philip Lorenz and Ferdinand Mayet for test reading and their constructive criticism in the earlier stages of this work.

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Abstract

This thesis provides a study on currently existing mobile social network implementations. After providing an introduction into the scope of this thesis, used terms and concepts will be definined. A key aspect will be the development of a classification pattern. Several discussed systems will then be arranged and grouped, according to this categorisation scheme. It is important to cover all functions, mobile social services offer today. An empirical survey will be given, pointing out similarities and differences between the presented systems. Possible future mobile social networking approaches are shown as a completion of this thesis.

Zusammenfassung

Diese Arbeit bietet eine Studie über aktuell existierende Mobile Social Network Implementierungen. Nachdem eine Einführung in den Rahmen dieser Arbeit gegeben wurde, werden relevante Begriffe und Konzepte erläutert. Ein wichtiger Aspekt ist die Entwicklung eines Klassifizierungsschemas. Die besprochenen Systeme werden dann Anhand dieser Kategorisierung ausgerichtet und gruppiert. Wichtig ist hierbei, alle Funktionen, die Mobile Social Services heute bieten, abzudecken. Weiterhin wird eine empirische Erfassung vorgestellt, die Gemeinsamkeiten und Unterschiede der vorgestellten Systeme darlegt. Zum Abschluss werden darüber hinaus mögliche zukünftige Mobile Social Networking Ansätze aufgezeigt.

Contents

Introduction

0.1. What are mobile social networks?

A social network service on the web is a virtual community for people to communicate and to share information. These communities often offer options to letting people with same interests or targets group together. People can keep track of their friends, see what they are doing or willing to do, as long as they publish this information.

A mobile social network [109, 99, 88] in turn is a social network that can be accessed by some mobile device, as there are mobile phones, smart phones, PDAs and others. Users of a mobile social network system can, like in most social networks, create their own profiles to present themselves to the community, link themselves with real life friends virtually, search for people sharing similar interests, or even share photos, videos and blogs all by their mobile devices.

Mobile social networks can be just an adoption of an existing PC-based social network to mobile devices. In contrast to that classical approach, some new mobile social networks are completely and solely designed for mobile application. Especially features as for example awareness of location, are only reasonable on mobile platforms, and enhance their functionality compared to classic social networks. Quite a number of new services are thinkable, if the system is aware of the users context. The users context could consist of several indicators: location, time, environment and some more. If these are combined to space-time trails, even more information can be deducted and makes it possible to seek for location and time specific information. This way, a channel is provided, which is not applicable to PC-based social networking. [112, 83]

0.2. Current issues for users

With high performance mobile devices getting more and more popular, that are capable of using high bandwidth technologies, such as GPRS or UMTS, new web-based services spread, that are specialized for mobile usage. Currently we find ourselves at the crossroads. Technologies especially for mobile social networking are at getting out of their infancy. As for the German market, mobile social applications and solutions are already existing, but not yet widely used by end users. There are several reasons why this is the case (As mentioned in [91]):

- Costs are too high. Either the data tariffs are to costly or flat rates are too strictly limited in capacity.
- Performance is not sufficient. Distribution of new high performance devices (with GPS, UMTS, large display and more) has not yet reached the mass-market.
- Mobile services do not offer real gain of value. Many web-based solutions are ported one-to-one to the mobile medium, without adequate adaptation.

- Users refuse the services. They are either not interested in using it, the application is to complicated or they feel harassed or uncomfortable with the service.

In spite of all that, it is observable that mobile applications are gaining ground. Many social networks are either ported to mobile versions from existing ones, and many more are newly developed for several current mobile platforms. Most of them are even market ready yet or about to become soon. So even though the number of mobile social network users is not very high at the moment, it can be assumed this systems will become much more popular soon [113].

0.3. Goal of this thesis

This thesis will present several mobile social networking services, categorize them and this way provide a overview over currently existing systems. Several possible schemes of categorization will be discussed, and reasons that finally led to the used one. To get an entrance to the general topic, main concepts will be discussed in the first chapter. To prevent misunderstandings, different types of systems will be explained, and terms will be stated in the section 'disambiguation'.

Having made the subject clear, all relevant services will be presented in chapter two, arranged in their respective categories. The goal here is not to list every one and single social network that is available at this moment, but rather to reach completeness in the sense of covering all subtypes of services and features built into systems today.

An empirical analysis will be made at the end of this work. All social networks will be compared using a couple of metrics, before comming to a conclusion at the very end and showing possible future applications.

Part I.

Concept discussion

1. Concept discussion

1.1. Disambiguation

Social Networks, as a topic of sociology, are structures made of individuals, which are connected by a kind of relationship, such as friendship [121]. These structures can be described with the mathematical concept of graph theory. The individuals represent the nodes in a graph, whereas the relationships are described by the edges.

Today, if we speak of social networks in the context of the world wide web, something different is meant. Social networks on the web are web applications or services that provide an interface for people to share messages or multimedia with friends. These applications are often referred as social networking services, or even just social networks. These services allow users to link themselves against other users. With this simple mechanism, users build up a virtual community, a mapping of real social networks of friends to the database of the service. This is where the name comes from: through linkage of users to friends of them, a giant social network graph is formed, with the users as nodes and friendships as edges.

The edges of such a graph can be directed or undirected, depending on the implementation of the service. In some social networks other users can be added to the friendlist without confirmation. This relates to directed graph edges. User A can be friend of user B in such a system, but does not demand user B to have user A as a friend. In most social networks, however, a friendship can only be requested by one user and has to be confirmed by the other. This way a relationship can only be developed symmetrical. This way both users have the other one in their friendlist and therefore directed graph edges are formed.

Users of social networks can do three primary things:

- Present themselves to others by creating a profile with pictures, contact details, interests, stories of their lifes, or even share favorite videos or music.
- Link themselves to other people, to become friends. Users can join groups of same interests or some sort of belonging (often called networks). With them beeing connected to others, they can write messages and share information privately.
- Make new acquaintances by looking through their friends' friendlists or by using search functions.

People were involved in online communities many years before, such as bulletin boards, instant messaging services and earlier in the usenet. The concept of social networking does not sound very different from these. All of them provide a platform for exchanging and

communicating and also for meeting new people.

The essential difference is, however, the different model structures. In contrary to a social network, a bulletin board does not have any model of linkage between its users. In a instant messaging service on the other hand, users do have a list of contacts. However, there is no underlying structure existing, that lets the user see any other part of the network, but his own friends. In a social network, a user can look at a friend's profile and see his friendlist. He can choose one contact in his friend's list and look at this profile in turn, and so on. Users can traverse the whole network of people and find out who is whose friend. This simple but essential function made social networks enormously successful and popular.

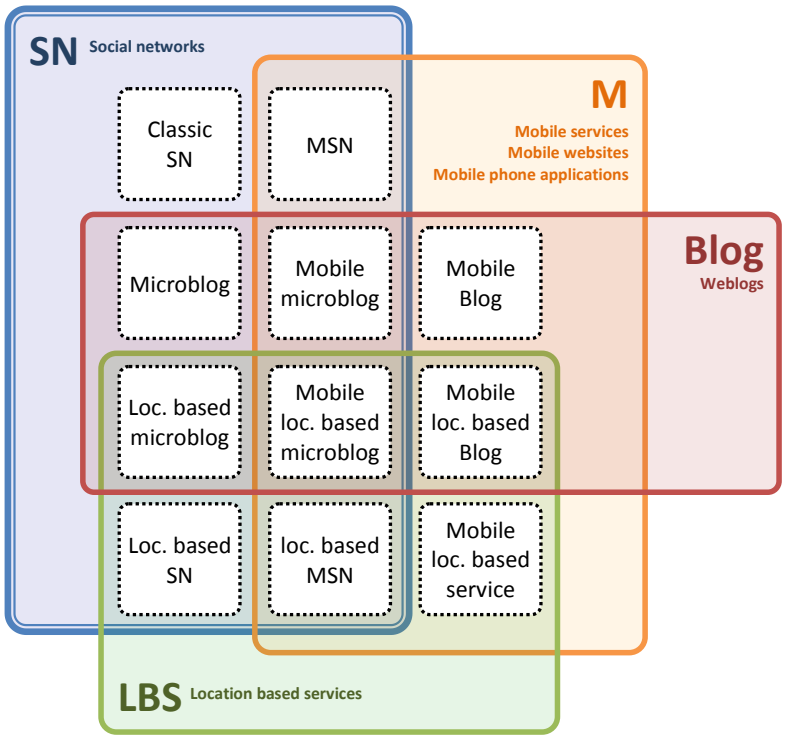


Figure 1.1.: The three main concepts, their combinations and their mobile versions. (Source: own work)

Three main concepts play a role within the scope of mobile social networking:

- Weblogs, or simply blogs. These are websites, where users tell, in a diary like manner, what they are doing or what they experienced. The entries are displayed in a reverse-chronological order, and can be commented or recited by other blog owners.
- Location based services. This concept includes all types of services related to geographic positions, such as to determine whereabouts of a person or an object. They can help to find friends, or provide information, like showing the nearest place of

interest and the shortest route there. Methods, with which users can be located by the system, are explained in section 1.2.

- Social networks, as explained above.

These three concepts can all be combinated, and additionally be accessable by mobile devices or not. Figure 1.1 now shows all permutations of these four possibilities. The shown concepts can either exist alone (large rectangles), or in combination with one or more others (small white squares).

Right in the intersection of blogs and social networks, Microblogs were placed. These systems allow users to publish small messages about what they are currently doing, or dealing with. Each user has its own channel that can be subscribed by others. This incident, the subscribing to a channel, is called 'following'. Users can then get notified about new messages of people they 'follow'.

Blogs are organized decentrally on seperate web pages. A microblog, on the other hand, is organized in a single system, where users register themselves and messages are stored. Microblogs show a large interconnectivity of their users, by them following others and beeing followed. These systems therefore form a social network, having microbloggers as nodes and directed edges between them ('followed by' relationships). Thus, microblogs are settled right in the cross section between blogs and social networks in this thesis.

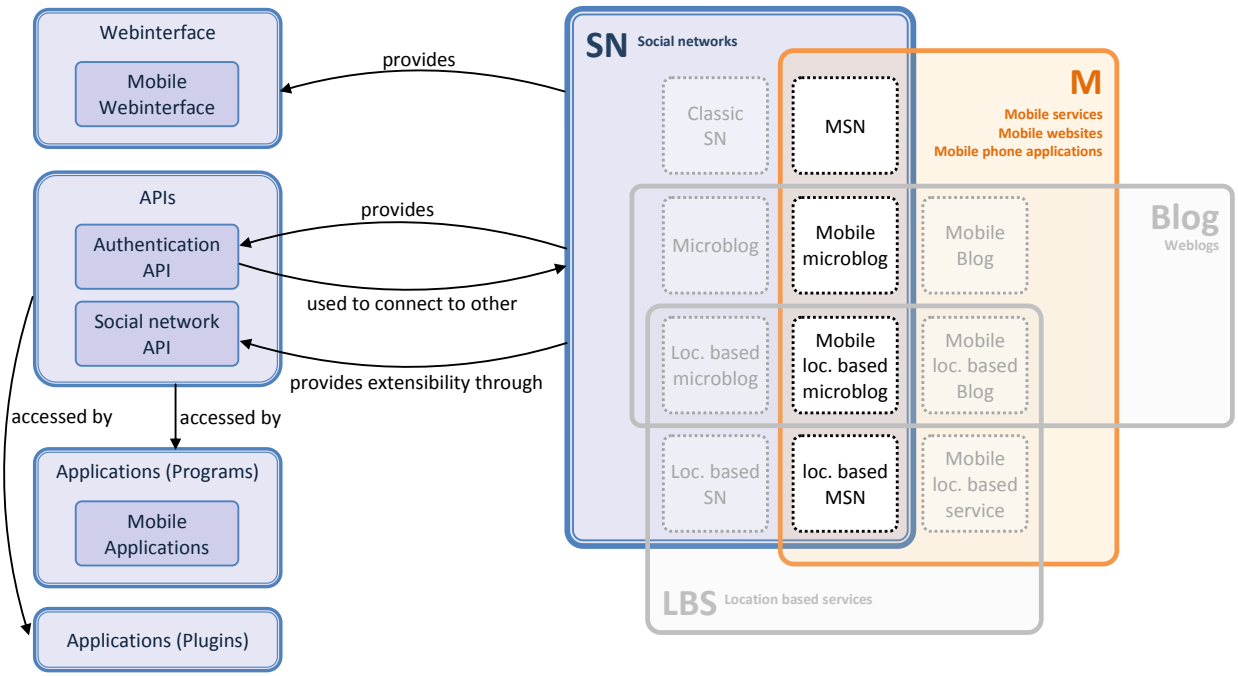


Figure 1.2.: Relevant systems for this topic, and their possibly built in technical extensions

Blogs may be seen as social networks in the broadest sense as well, but the line had to be drawn somewhere. Therefore, pure blogs will not be part of this work. However, the four relevant concepts discussed in this thesis are illustrated in figure 1.2. These are all lying in the cross section of 'mobile' and 'social network'. Moreover, several classic social networks, featuring a way to be accessable by mobile devices will also be discussed.

Figure 1.2 also shows extensions that are provided by social networks. Every system offers one or more of the following interfaces:

- A web interface, that lets users access and manage their accounts and profiles by using a web browser.
- A mobile web interface, which is optimised for beeing viewed on a mobile device and its web browsing application.
- An API (Application programming interface), allowing applications to access to the service. This makes the social networking service independent of its official web interfaces or applications, and allows everyone to write an own third party application. Furthermore it allows other social networks to reuse existing login information and connect together different accounts of a single user. It is also possible to automatically synchronize particular data between the connected networks, such as status updates, which are then changed in both systems synchronously. Such an API typically consists of the two fundamental parts:
  - An Authentication API, which verifies login data and grants access.
  - A Social network API, which allows for reading and changing profile data.
- Applications and mobile applications, either official ones or created by third party developers, using the API.

Figure 1.3.: The figure shows a social network service, its plug-ins, which extend its web interface (on the left hand side), and its different user interfaces (on the right hand side): a PC application, website, mobile website and mobile application (Source: OpenSocial Website[1])

It is important to point out, that some social networks also offer a possibility to be extended by plug-ins, enhancing the functionality of its web interface. These extensions are often called 'applications'. This term, however, must not be confused with programs, which are also called applications. The difference between these two terms is illustrated in figure 1.3. The plug-ins, as it showed up during the researches for this thesis, always just extend the web interfaces of the social networking systems.

1.2. Positioning methods

Location based mobile social networks must have some sort of postioning mechanism, in order to get the current position of their users. They can provide a possibility for the user to tell his current location by letting enter a address or a name of a known venue. This information is then going to be geocoded into position data (latitude and longitude). Another approach is to use a mobile application, which automatically determines the users position by using one of the following methods, or a combination of them:

- Network based systems: The cellular phone network provider can locate the phone. Therefore, no software is needed on the mobile device. The phone can even be located without knowing about it, it just has to be switched on and sending usual keep-alive broadcasts.
  - U-TDOA (Uplink Time Difference of Arrival) [114, 116] makes use of trilateration or multilateration of cell tower positions. Multilateration is based upon knowing positions of cell towers and their radius by knowing signal strengths of the mobile device to the antenna masts [110].

- Cell phone based systems: the mobile device has software installed that locates its own position.
  - Cell Identification identifies the base station, the mobile device is locked to, and thus is in most cases the nearest one. The software on the mobile phone sends its cell ID to a web service and gets the location of the cell tower and its range. The accuracy depends on the range of the respective network base station. It can be a few hundred meters in cities, but in rural areas only 30 kilometers or more in the worst case.
  - Enhanced Cell Identification [115] relies on the fact that phones constantly recieve the signals from the closest three to eight cell base stations, but lock only to the strongest signal. Cellular phone network providers then offer APIs, to which social network services can connect and send all known cell IDs and their signal strength. The API then sends back the centre of a circle and a radius representing the expected error. The circle thus represents the expected region the user is staying. This method makes use of multilateration of the given cell locations and their signal strengths and can get a precision similar to Cell Identification in urban regions, but for rural areas, have an accuracy of about 300 meters in the best case. Enhanced Cell Identification often is applied in situations where GPS and even A-GPS fail to perform, especially indoors and in the

first minutes after turning on the device, when GPS modules still have to search for satellites to initialize.

- E-OTD (Enhanced Observed Time Difference) is similar to U-TDOA, but the position is estimated by the mobile phone, not by the network. The precision of this method depends on the number of available nearby cell towers with LMUs (Location Measurement Units) and varies from 25 to 200 meters [84].
- GPS (Global Positioning System) enables the mobile device to locate its own position, without the use of the cellular network. Satellites continually transmit signals containing the time it was sent and their current orbit. A GPS receiver can then measure the distances to the several satellites that are within the range of vision. With trilateration of these distances and the satellites' orbits it obtains its own current location with an accuracy down to a few meters [90].
- Assisted-GPS relies largely on GPS technology and uses additional ground stations to correct GPS errors, caused by the atmosphere and topographic disturbing sources [122].
- WPSs (Wi-Fi Positioning Systems) make use of increasing spread of Wireless-LAN networks. MAC addresses of nearby wireless access points and their signal strengths are sent to a web service and there matched with a database containing many MAC addresses and their respective positions. Using the position of the nearest wireless network, or using multilateration of all received networks, the service calculates the cell phones position and sends it back to the mobile device. WPSs can determine the location of the mobile phone with a precision of about 20 to 50 meters [95]. This method only works if wireless networks are available, especially in urban areas.

1.3. Categorization design

1.3.1. Possible categorization schemes

During the investigation of existing mobile social networks, much more services were found than assumed. One of the emphases of this thesis lies on the categorization of these multitude of systems. Without that it would be hard to get a clear overview. Along these considerations, following possible schemas were made up:

1. Differentiate by the underlying social networking model:
   - Are edges of the network directed, weighted or typified or not?
   - Are friends appended automatically, or only manually? Is a confirmation mandatory?
2. Distinguish between availability of filtering or privacy features
3. Group by similar scales or dimensions of:
   - Popularity
   - Dynamic of the system or vitality/activity of users

- Attendance or just unique visitor numbers
- User count

4. Partition by used techniques, or supported platforms

5. Group by provided key features

6. Join networks of same type into one category (types as illustrated before in figure 1.1)

1.3.2. Discussion

Scheme 1 would not have lead into a meaningful overview. Sadly most current social networking approaches do not differ much from another in this point. Virtually all systems have undirected, unweighted and untypified relationships, with manual adding mechanisms for friends. The few exceptions that have directed friend relationship models are mostly small and new systems, or rather simple implementations. The lack of having the other user to confirm the relationship leads to privacy issues: If only a friend may see the full profile of a user, and everyone can add him/her to the friendlist, practically everyone can see the profile. In most cases users also do not want themselves to be in other friendlists without beeing in the know of it.

Weighted relationships are also not implemented yet in any of the systems, to be found in this thesis. Nevertheless, weighting connections to friends could get very useful, as described in the end of this thesis. Typifying edges of the users network is also not implemented in most of the currently existing services. Exceptions of this rule nearly only provide a simple friend grouping mechanism for better overlook over the personal friendlist, but no real services that could be imaginable with typified relationships. Those services could be advanced filtering or privacy settings. Just few systems (Groovr, see 2.8.6 and Whrrl, see 2.8.12) offer the possibility of assigning friends to one of two categories: the 'circle of trust' and 'friends'. Privacy settings can then be set separately for each of these types.

Scheme 2 would deal with the topic just mentioned: filtering and privacy. Observations showed that there are mainly two types of social network services: Ones that provide privacy features like hiding elements of the profile to non-friends, and ones that do not provide any privacy options. Even so, this division would not deliver pre-eminent benefits for an overview over the multitude of existing systems, and privacy, as a topic, should anyways not be that emphasized in this thesis.

Scheme 3 takes several empirical values into account. It was decided to deal with this information in a separate chapter, and not to use it here where the services are presented.

1.3.3. Final decision

The final scheme was build by combinating proposals 4 to 6. To achieve a sufficient granularity, but for all that not to have to make trade-offs in clearness, it was decided for a hierarchical order of categories. This can be seen in chapter 2, where the particular categories are described, and contain all relevant mobile social networking systems.

Part II.

Classification

2. Classification

2.1. Sources

To put together this list of mobile social networks, a couple of sites on the internet were used, which had lists of social networks [71, 21], location-based services [108] and mobile social applications [98, 87]. Moreover, several stores were completely looked through for mobile social applications, such as the iTunes application store, Android market and the Ovi store by Nokia. The most difficult point with this search was to administer this huge mass of information. A lot of systems had to be filtered out, which were labeled as social networks, but turned out to be just chatting, messaging, recommending or multimedia sharing systems without any social networking abilities.

2.2. Classic social networks

Facebook [17] is the most popular social networking site on the web, as it can be seen later in this thesis. Facebook's 'connect' mechanism is widely used by other social networks, and a multitude of applications are available, which use the the API to extend the social network. The story of the founding of Facebook is going to be filmed: the movie 'The Social Network' by David Fincher is going to be in cinemas in 2011 and is based on the book 'The Accidental Billionaires' [104, 85].

Friendster [19] is an early social network, gone online in 2003, and is very popular in Australia and Asia. This classical social network offers, aside from common functions, just few rather exceptional features. Friendster allows artists, musicians, organizations and other famous people to create fan pages, where Friendster users can add themselves as 'fans'. Since 2008, when the mobile web interface was launched, users can get SMS text alerts on friend requests, new messages etc [89]. Friendster offers, just like Facebook, a rich API, supports OpenSocial[1] and holds a myriad of applications (plugins, that extend functionality of the user interface).

MySpace [48] is one of the largest social networks today and was launched 2003. Since 2006 it provides a mobile web interface. There are lots of mobile applications for virtually every platform either from MySpace itself or made by third party developers. MySpace is known for its customisability of the personal profile page of a user, by letting users decide what colors, background pictures and stylesheets ought to be used. Furthermore, the network is famous for having

[1] http://www.opensocial.org/

a lot of musicians and bands registered, allowing artists to upload their songs and get in contact with their fans.

Hi5 [26] is one of the most popular classic social networks, according to their unique visitors (see chapter 3). The service was launched 2003, and has over 70 million users today [111]. The mobile webpage was launched in 2008.

Hyves [27] is another classical social network, launched in 2004. It is foremost popular in the Netherlands, with about two thirds of the about 9 million total users being Dutch.

Orkut [53] is a social network by Google, launched in 2004, which is very popular in Brazil (more than the half of all users [107]), and for this reason managed and operated by Google Brazil since 2008. Orkut has a mobile web interface since 2008.

Bebo [3] is a classical social network since 2005. It was acquired by AOL in 2008 [105]. It provides a mobile web interface[2] since 2007.

2.3. Microblogs

2.3.1. Classic microblogs

Twitter [68] is the most popular microblogging service today, and the place 13 of the most visited sites in the world (according to the Alexa traffic rank[3]). It is also often referred as social network, but in this thesis, is to be classified as pure microblogging system (see section 1.1, disambiguation). Twitter messages can be sent via SMS from the mobile phone, or by logging in to the web interface on a PC or a mobile browser. It provides a rich API which can be used by a multitude of third-party applications that are available on all platforms of mobile devices.

2.3.2. Location based microblogs

Zannel [75] is a location based mobile microblogging service with support of photo and video attachments. The location from where the message was sent can be set by a `#@location` keyword in a SMS, or is set by the mobile application by using the phones positioning abilities. Supported platform for a native application is only the iPhone OS yet, but Zannel can be accessed by a mobile web interface, too, supporting all mobile browsers.

[2] http://m.bebo.com
[3] http://www.alexa.com/siteinfo/twitter.com

Shizzow [63] is a location based microbloging system allowing users to 'shout' from a specific place. Users can not only see shouts of people they have subscribed to, but also geographically nearby shouts. Shouts can eiter be posted and read by the mobile web interface, or by the Android mobile application. Additionally messages can be sent by SMS, either containing the current location or the service uses the last known position of the user.

2.4. Mobile social networks

2.4.1. Messaging and chatting

Mokomobi [43] is a mobile social network, offering not only messaging services but also live chats, group chat rooms and photo and video sharing. Mobile applications are existing for J2ME enabled platforms and the iPhone OS. Furthermore a mobile web interface is available, like the URLs top level domain ('.mobi') already suggests.

Qeep [56] is a German mobile social network, featuring a J2ME mobile application, with which users can send text messages, play games, share photos and send so called 'sound attacks' - sounds that are played on the target phone after having received it.

2.4.2. Interest aware

Aka-aki [1] is a German social network, online since 2007. It features a J2ME based and a iPhone mobile application. Users can add 'stickers' to their profiles to communicate their interest to guests. Additionally a so called 'stick-o-meter' shows in a bar visualization how many of the users stickers match to the own ones and therefore tells, how much same interests are shared.

Seamee [62] is an Austrian mobile social network, offering a J2ME mobile application to access the service. Seamee is divided into the four subnetworks 'job', 'business', 'people' and 'love'. Users can decide in which of these subnetworks they want to participate, or take two or more of them at a time.

2.4.3. Multimedia sharing

Next2friends [49] is a mobile social network that lets share photos and live video streams and offers mobile applications for J2ME, Blackberry OS and iPhone OS platforms.

2.5. Peer-to-peer social networks

Peer-to-peer social networks let mobile devices themselves handle communication between them. Other services store users' messages on their servers waiting to be retrieved by the respective recipients. For this reason, privacy issues may occur, because the social network operator or potential attackers, that infiltrated the system are able to read all private messages of all users.

Peer-to-peer social networks do not exhibit this weak point, because messages are stored nowhere else but on the recipients' devices. Furthermore it does not demand much storage space and saves bandwidth of network operators' servers, if multimedia files such as photos and videos are sent directly to other users, rather than to be stored on central servers. The following two network systems work with a SMS based communication channel. Systems using IP based communication, however, potentially are appearing in the near future, as there are already such systems for desktop computers, such as Nuserub[4] for example.

2.5.1. SMS based

Cellmate [22] is a peer-to-peer mobile social network that is based on a J2ME application that uses the mobile phones short message service (SMS) for communication between two Cellmate applications. Therefore it does not need a central server, not even for brokering between the users, and no registration. Once the application is installed on the mobile device, it asks for mobile phone numbers of friends, that can be organized in groups afterwards. This way, a completely decentral social network is built up, with users only knowing of their direct friends. Conversations are displayed chronologically like in instant messaging programs. For planning an event, users can send checklists to all members of a group, or create polls which results are sent automatically back to the creator of the survey. Notifications for events can be created, that alarm all relating people. Because of the SMS based transmission channel, this application can produce expensive bills very quickly, if users do not have accordant cell phone contracts.

2.5.2. SMS based and location aware

Are you here? [2] is a location aware peer-to-peer mobile social network based on the platform 'Wanted Smiling', released by Clicmobile[5]. By sending 'ON' via SMS to the service, the user is set visible in the system and his location is shared to other people around him. The service sends back a list of people that are near, and sorts them according to the particular relationship: friend, friend of friend, and so on up to 6 degrees of acquaintanceship. The communication between the users then goes on by SMS. Therefore the network just functions as an agent to localize near people, while the communication works on a peer-to-peer basis by using the short message service (SMS).

[4] http://www.noserub.com/
[5] http://www.clicmobile.fr

2.6. Near field mobile social networks

This category lists social networks, which avail themselves of wireless technologies, working only in small distances up to several meters. Such technologies are for instance Bluetooth[6] and Wi-Fi, also known as Wireless Ethernet. Some of the following systems are peer-to-peer based. Nevertheless the peer-to-peer services were divide into the two categories 'Peer-to-peer social networks' and 'Near field mobile social networks', because of the completely different usage patterns that go along with the systems. Peer-to-peer systems in the previous section aim to provide a messaging platform, regardless of location and time. 'Are you here?', which is a location based network, allows its users to still communicate, even if they are not near to each other, and even if one participant has switched off his device. The SMS message, in this case, will arrive when the phone is switched on again. The systems shown below, however, are strongly dependant on time and the users' place.

2.6.1. Wi-Fi based networks

iFob [28] is a location aware mobile peer-to-peer social networking application. It just works within reach of WiFi hotspots, like in coffee shops. Users do not have to register on any central server, they just have to enter a 'tagline', which is used as a conversation opener, for example 'I like coffee'. This tagline is broadcasted in the Wi-Fi network and received by any other iFob users. 'iFob will become your beacon, sending out a local signal which says you might want company. Or set your copy of iFob so it just listens, showing you the other iFob users while letting you chose whom you might want to chat with' [28].

2.6.2. Social situations visualising systems

Jabberwocky is a location aware mobile social software. It is a project of members of the Urban Atmospheres group within Intel Research Berkeley [32]. The mobile application, executable in J2ME environments, uses Bluetooth technology to log every nearby mobile device, which has Bluetooth switched on. Other people do not have to have the application installed, but just have to set their phones to be visible by other Bluetooth devices. The application now visualises all persons in the proximity, likely beeing strangers, by drawing a red square on the upper edge of the display. As time passes, and the previously detected device gets out of reach, the square slowly moves to the bottom of the display and finally fades out after a while. Using this visualisation, shown in figure 2.1, the user can see at a glance when he was near strangers, and how many they were. Additionally he sees where he met them, because he knows where he

Figure 2.1.: Jabberwocky mobile application (Source: [33])

[6] http://www.bluetooth.com/

was at a specific time. If a stranger is detected, that the user encountered before, it will appear as a green square on the display, indicating a so called 'familiar stranger'. The visualisation takes into account the number of strangers nearby, the number of encounters with each stranger, the time spent near a stranger and the elapsed time between encountering a stranger again [34]. Jabberwocky thus builds up a social network, having weighted and typified edges, and saves it in a decentral manner only locally on the phone. The Jabberwocky developers describe in [33] two exemplary scenarios where the application can be useful:

- A person, new to a city, does not feel at home. Jabberwocky reassures him that people are nearby, he already encountered, without even knowing about it, and so grants confidence.
- A person feels like the large city seems more like a small town, after years of living and working there, and wants to escape the daily routine in his spare time. As he walks along, he can see on his mobile device how many familiar strangers are around him. Having found an unknown place, he feels much less crowded and explores new places in the city.

Encounter Bubbles is a location aware social visualisation software, which was presented by Zhanna Shamis and Sean Savage in [16]. Encounter Bubbles is built on top of a location based social service called Mobster. Only a PC software mockup is developed yet, an early prototype to prove the concept. A mobile version application is possibly going to be released in the future. The software takes a similar approach to Jabberwocky, but relies on a centralised platform and works with Wi-Fi hotspots for locating its users. With having all data stored centrally, information can be provided to the user that Jabberwocky is not aware of, such as looking at other users profiles. The user interface of the Encounter Bubbles software shows a bubble for every person that the user encountered with, and sorts them in a chronological order. Moreover, it can be scrolled to a specific time, whereupon the visualisation enlarges the selected point in time and displays it magnifying glass like. Screenshots of the user interface are shown in figure 2.2 (having inverted colors for printing).

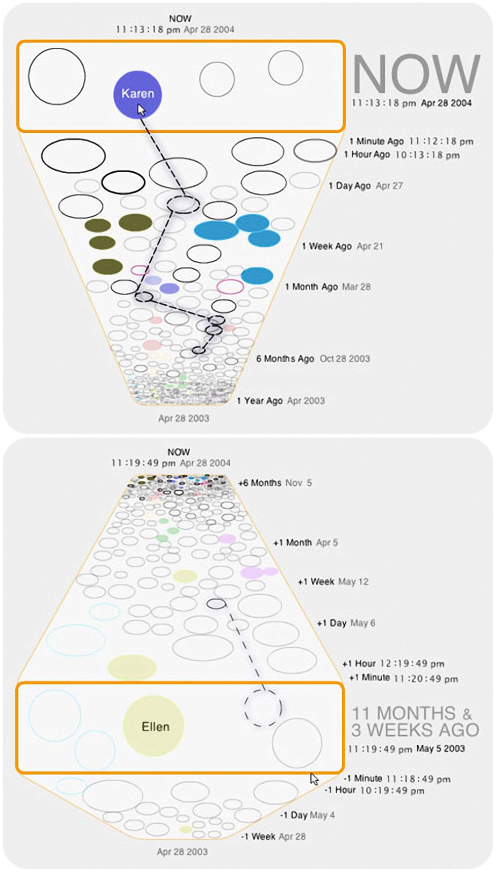


Figure 2.2.: Encounter Bubbles (Source: [16])

2.7. Multiple social network access and instant messaging

Fring [20] is a mobile application that allows to manage several social networks from only one application. Users can see if friends are online and send messages. In contrast to mobile web interfaces of these social networks, a native application like Fring needs less bandwidth and is more responsive. Only communication to the API has to be transmitted, not the complete website including the user interface. Fring also supports several instant messaging protocols and voice-over-ip communication with a Skype or SIP account.

Xumii [74] is a mobile social network, highly connected with other networks like Facebook and MySpace and several intant messaging protocols. It offers mobile applications for J2ME enabled phones, iPhone OS, Symbian and Blackberry OS, and a web interface for mobile browsers.

Nimbuzz [50] is a mobile socail network, providing mobile applications for nearly every platform: J2ME, Android, Symbian, Palm OS, Blackberry OS, Windows Mobile and iPhone OS. It integrates with Facebook, MySpace, Hyves and some more social networks and allows communication as well as photo sharing over these social networks. Just like Fring, Nimbuzz has grants access to several instant messaging accounts and Skype telephony.

2.7.1. Location aware

Buddymob [10] is a application for managing many profiles on several social networks and instant messaging services. It has location aware features like locating friends, or sending the own location to all logged in social networks.

2.8. Location based mobile social networks

Brightkite [7] is a well-established location aware social network, that provides a mobile web interface and a J2ME implemented application for most mobile devices and supports several smartphones by offering native applications for Android, Blackberry OS and the iPhone OS. It offers privacy by asking the user with whom he likes to share the information when he enters it, not only in some nested setting menus. The service offers possibilities to keep its users up-to-date in manifold ways: Users can see what their friends do or what is happening around their current location. They can look at posts they are mentioned in or read new comments on their posts.

Myrimis [47] is a location based mobile social network, predominantly used in Asia. It offers to create geotagged photo albums. Myrimis can be accessed by a mobile web interface or a J2ME or iPhone application.

2.8.1. Friend finding services

Loopt [38] is a location sensitive mobile social network since 2006. It is one of the first networks to integrate a friend finding service based on the location data updated by mobile applications. Those applications are available for J2ME enabled phones, Android, Blackberry OS and the iPhone OS. Loopt can connect to Facebook and Twitter accounts. Registration requires a US mobile phone number, which is checked for its validity with a code sent by SMS.

Google Latitude [35] is a location sensitive mobile social network launched by Google in February 2009. It is targeted to friend finding, and provides native mobile applications for all smart phone platforms, except for the Palm OS.

Moximity [45] is a location sensitive mobile social network, integrating friends from other networks such as Facebook and Twitter with usersâ location data. It overlays information about local venues such as restaurants and bars, so users can see at which establishments their friends are currently located. A Moximity mobile application is existing for the iPhone OS.

MyGeolog [46] is a location aware mobile social network, based on a J2ME implemented mobile application. The application allows for seeing nearby friends on a map view, updating the users location and publishing of geo-tagged photos and videos. It integrates with Facebook and Twitter and can even update Fireeagle (a location storage service) with the latest location data.

Plazes [54] is a location based mobile social network, integrating with Facebook, Twitter and is able to publish the current location on Fireeagle. A mobile application, called Plazer, is only available for the iPhone OS yet. Plazes has a mobile web interface, with which users can place themselves or create venues, annotated with the respective category. It is also possible to check-in the user's position by sending a SMS with the current address to the service as well as getting notified about updates via SMS.

Pocketlife [55] is a location aware mobile social network, letting people share not only their positions, interesting places and geotagged pictures, but also tracks. A J2ME mobile application, and one for the Blackberry OS and the iPhone OS are existing.

The Grid [23] is a South African location based mobile social network. Besides a friend finding service and the ability of posting geo-tagged photos, so called 'blips', The Grid sends status updates on demand as twitter posts together with the current location. Mobile applications are offered as J2ME version as well as for Android and the iPhone OS.

Locle [37] is a location aware mobile social network, primarily providing just a friend finding service. It connects with Facebook and soon with MySpace and Bebo [37]. It is one of the very few networks that offer a mobile application for every single platform: J2ME, Android, Blackberry OS, iPhone OS, Symbian, Windows Mobile and Palm OS.

Locatik [36] is a map based mobile social network, including a friend finding service and the possibility to add places with photo and description. Users can check-in their location via the mobile web interface, by sending a SMS with the current address or by using the mobile application, only available for Symbian yet.

Buddy Beacon [8] is a location aware mobile social network, with the primary target to be a friend finder service. It is a pure mobile application for the platforms: Blackberry OS, Palm OS, Android, iPhone OS and all J2ME capable platforms. It offers a map view to see the location of all friends, or a list view where it shows the distance in relation to one's own location. Users can of course decide whether to update the location automatically or not, or set themselves invisible to others.

Cometogethr [14] is a location based social network, with focus on mobile usage. It provides just basic features of a classical social network service, like having a friendlist, joining groups and messaging. It adds the location aware feature of seeing current locations of friends.

Mologogo [44] is a location aware mobile social network, offering basically a friend finding service via a mobile application, supporting J2ME phones, the Blackberry OS and Windows Mobile.

2.8.2. Locating

Sniff [65] is a mobile friend finding service with social network integration by a Facebook connection. The exceptional thing about this service is, that it does not use locations that have to be updated by an application, but uses the phone provider to determine the position by triangulation of cell towers within reach. Therefore it delivers relatively inaccurate positions, but works in real time and without any software needed on the mobile phone that ought to be localised.

Nowhere [51] is a German location based mobile social network, that allows users to locate their friends by using cellular phone network providers' positioning methods (For example U-TDOA, see 1.2). Nowhere users have to contract a subscription allowing them to locate friends 15 times for 2,99 Euro per week. These operations are independent from cell phone manufacturers or models and works with all German cellular network providers. Located friends do not have to have any software installed on their devices. But in order to be locatable, users have to be registered at Nowhere, be applied for the locating service, have to be a friend of the user that wants to locate him and agree with getting located by that particular user. Nowhere is accessable by a mobile web interface.

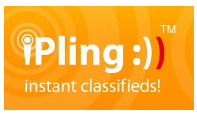
2.8.3. Tracking

Buddyway [11] is a location aware mobile social network with a rich tracking service. With Buddyway, users can search for their friends locations, and can let the service log their own location. By telling the system to start a 'trip', the application starts sending its current location to the service in short time intervals. For this purpose only accurate GPS locating makes sense, because of the much finer temporal and spatial resolution than other techniques. The system then allows for adding geo-tagged annotations to the trip like 'coffee stop' and displays information like duration of stops, or shows the point of having had the maximum speed. The recorded trips can be shared with friends, or just stored privately. Saved trips are displayed on a map, and additionally showing a height profile and a diagram that shows the speed over a time axis.

iPoki [30] is a location based mobile social network, focused on real time GPS tracking and friend finding services. Applications are existent for Windows Mobile, Blackberry OS and Symbian.

2.8.4. Meeting new people

Meetmoi [40] is a location tracking mobile social network for singles, offering to alert its user when people come near that match the users filters for gender and age. The service is accessible by a mobile web interface or by mobile applications for Android, Blackberry OS, Windows Mobile and Symbian.



iPling [29] is a location aware mobile social network, focused on meeting new people. Users tell their interests by entering tags. If users that have matching interests come near, iPling displays them on a map, and the users can start a conversation. The service is in a public beta test and supports the iPhone OS and a mobile web interface.

Buddycloud [9] is a location based mobile social network that offers conversations in so called 'channels'. These channels are similar to chat rooms or bulletin boards in which users organize themselves in topic or

interest related groups. The service allows to share favourite places and the own location with others. The service is described as offering "new ways to discover relevant people, places, and channels nearby", and is "an extension of your social life beyond your close friends". In contrast to most social networks this service aims to get users to meet new people that share the same interests, and not only staying in contact to already familiar friends.

Mobiluck [42] is a location aware mobile social network, based only on a mobile web interface. Mobiluck has no mobile applications and no possibility to automatically update the users' positions. The current whereabouts have to be either searched in the list of last used locations and favorite venues, or have to be entered as an address to be geocoded by the service. Mobiluck aims to be a service for finding new friends rather than only being a friend finding system. It offers a search for nearby Mobiluck users, or users that had a look at the own profile. It allows for discovering new places, restaurants and more, and integrates with Twitter.

2.8.5. Interest awareness

Match2blue [39] is a location- and interest-based mobile social networking service. Users search match2blue for users who have identical or similar interests to themselves. Businesses can send offers to users that are interested. Android and the iPhone OS are supported platforms of the mobile application.

Wenear [72] is a working concept of a location aware mobile social network, not online for the general public yet. Wenear users are able to create location- and interest-tagged messages. A message will be received by other Wenear users if they come near and the users interests match those set in the message. Immobile announcers like shopping malls or other businesses, can broadcast announcements to Wenear users who get in their proximity [118].

2.8.6. Friend finding, location sensitive content

IRL Connect [31] is a location based mobile social network, highly integrated with location based services. Facebook or Twitter users as well as groups can be viewed on the map, as long as they contain geo information. Via several map layers, users can overlay geographical positioned content such as news, Wikipedia articles, last.fm[7] music events, Panoramio[8] pictures, YouTube[9] videos and some more. The service only offers a mobile website and no application for any mobile devices, nevertheless users can check-in their position to IRL Connect by using Loki[10] or Fireeagle[11] services and their mobile applications.

[7] http://www.last.fm
[8] http://www.panoramio.com
[9] http://www.youtube.com
[10] http://www.loki.com
[11] http://fireeagle.yahoo.net/

Gypsii [25] is a location based mobile social network. Besides the friend finding service and geo-tagged photo sharing, Gypsii has so called 'Geo-bots', that can be added to the friendlist. These bots prepare location relevant news content, to show up on the map of interesting places.

Qiro [57] is a German location and interest aware mobile social network, offering its users to create 'buttons' they can attach to themselves, to show their interests. These buttons are arranged in categories such as 'music', 'movies', 'sports' and some more. A bar visualisation shows at first sight how many buttons a user has in the different categories, represented by differently color coded bar pieces. Moreover Qiro offers advertisers to promote their businesses by setting a position and a radius. All users within this region are shown the promotion. Qiro shows not only friends on its map view, but also geo relevant content taken from Qype[12], a location aware venue recommending and review service. Qiro can be used with a mobile application from any J2ME capable mobile device.

Urbian [69] 'is about your hyper-local social network, the people you meet in real life and the places you like' [69]. It is a location based social network, and features a friend finding service, as well as a database of places, entered by users, and polls. Furthermore so called 'hotspot modules' can be added, these are map layers with filtering mechanisms. The business module, for instance, allows for seeing all people who work in a selected specific industry are shown on the map, the love module for finding dates etc. Urbian provides the exceptional feature of having a 'history' function that shows how often the user met one specific friend and for how long, or shows how often the user went to a specific place in the last 6 months. Urbian is one of the only services that provide these statistic or analysis features of saved geo data, even though it has just very basic query options and no visualisation yet.

Groovr [24] is a location sensitive social network. It features incoming filtering of messages by letting through either all, only messages of friends, or only messages of the 'inner circle' of friends. Groovr describes itself as a friend finder service and furnishes information about local events, sharing multimedia and is capable of live chatting with friends.

Centrl [13] is a location based social network, that has mobile applications that work on Blackberry OS, Android and iPhone OS. It lets users discover locations of their friends, nearby strangers and geo-tagged offers or coupons that can be created by restaurants, shops, bars, and other businesses. It provides login via one of several social network accounts (it uses APIs of Facebook, MySpace, Hi5, Ning, Orkut, Bebo or Friendster), so that users do not have to register once again to even one more social network. It provides a integration of several third-party map layers like Yelp[13] (A recommendation and review site), geo-marked Wikipedia articles and some

[12] http://www.qype.com/
[13] http://www.yelp.com

more. These map layers are then shown on the map view, together with locations of Centrl users. Centrl in turn provides an API itself, to offer an interface for people to write their own application for centrl, or to include Centrl in their own systems as a service.

Nulaz [52] is a Dutch location based mobile social network. It connects with Facebook, Twitter and Hyves. The map view shows not only nearby friends, but also venues, pictures and geotagged content from Wikipedia and others. Venues can be categorized into the topics business, party, shopping, local info or friends, to enable users to filter them on the map view.

Scooble [61] is a German location based mobile social network and a friend finder service. Beyond that, it provides a map view with geo-tagged content from Wikipedia and Scooble users and rich filter possibilities. Scooble can get directions to a specific place, or allows to manage photo albums and link pictures to users. A mobile application is only existing for the iPhone OS yet.

2.8.7. City Guide

Buzzd [12] was launched in 2008 and is a location based mobile social network offering a mobile webpage and applications for the iPhone OS and Blackberry OS. Buzzd has partnerships with content providers which place geo-tagged information such as news, events, interesting venues and more on Buzzd's map. Buzzd thus represents a friend finding as well as a city guiding service.

2.8.8. Nightlife

MeetNowLive [41] is a North American location based mobile social network, targeted at people of cities and their nightlife plans and acquaintances. It started with the two metropolises New York and Los Angeles and was now extended by many other major cities in the United States. Besides seeing where their friends are, users can browse events in their cities and search for happy hours and other offers, which are shown on a map according to time range and distance filters. MeetNowLive mobile applications are published for Blackberry OS, iPhone OS and Palm OS yet, however the service can be also accessed by a mobile web interface.

2.8.9. Trips

Bliin [5] is a mobile social network that allows for managing and sharing several geo-relevant information. It lets check in the users current location as well as 'spots' (locations of interest), 'trips' (vacation residences or routes) or geo-tagged multimedia. The service can be accessed by a mobile web browser over a mobile web interface, as well as by an application that automatically refreshes the current location. This application currently runs on the platforms J2ME, Blackberry OS, Windows Mobile and iPhone OS. A full web interface for desktop PCs is also available, though the service was developed mainly for mobile usage.

Wayn [70] is a location aware social network, orientated towards traveling. It allows its users to plan trips and tell about their journeys in the past, together with visited sites and venues placed on a virtual map, photos and videos. The service has a virtual concurrency called 'credits' that can be used to send virtual gifts to friends or get a higher rank right up to getting a VIP status. Higher ranks allow users to spice up their profile pages with custom style templates. Credits can even be bought for real money, or just earned by writing reviews about venues. Wayn just offers a mobile webpage and no mobile application yet.

Rummble [60] is a location based mobile social network, with integration of Facebook and Twitter connections. It allows to add trips consisting of start and end date and a location. The map view shows places, so called 'rummbles', which consist of a picture, a description, a position, involved people, the overall rating, comments and are tagged with one ore more tags to be filterable. Rummble can be used by a web interface, or a mobile application available for Android and the iPhone OS yet.

2.8.10. Alerting when friends are nearby

Dodgeball [15] was a SMS powered pure mobile social network. Dodgeball was developed in 2000 by New York University students. The service could receive SMS messages with text containing the users current location/address and sent back a list of near friends and friends of friends, or interesting places around. It has been acquired by Google in 2005 [125], and went offline because of the launch of Google Latitude, that replaced the service completely.

2.8.11. Awarding systems

Skobbler [64] is a German location based mobile social network with a lot of geo-tagging and recommending services. Skobbler encourages its users to enter information about venues, rate them and give comments. Users can earn virtual 'karma' points the more they participate in the community. Moreover the system divides the world map in about two times two kilometer large grid squares. If a user has written more articles about places of interest than any other user, he becomes the 'Local Hero' in that grid square. A map view shows these grid squares with the current local hero and his challenger, red squares indicate that a stranger has occupied this region, yellow squares are held by friends and green ones are held by the user itself. These motivation methods keep Skobbler being interesting, like a game, and the service gets a rich database of places of interest, that people can browse through.

Foursquare [18] is a mobile social network. One of the founders was, amongst others, one of the founders of Dodgeball. The service leaves the impression like being a further development of Dodgeball. Users can still check in their location using SMS messages. Foursquare uses, however, more user interfaces like Dodgeball: a web interface, optimized for mobile browsers, and applications for

Blackberry OS and iPhone OS platforms. Foursquare motivates users to check in their location regularly by offering them badges. Moreover the system awards users, that check in more often than anyone else on one venue, the title 'Mayor' of this place. This awarding system is comparable to the 'Local Hero' awarding system built into Skobbler. These systems playfully push users to quickly fill the services databases with information to make the sites more popular.

2.8.12. Storytelling

Whrrl [73] is a location based mobile social network that is specialized on letting people create so called 'stories'. These stories are presentations with several slides that can be filled with pictures and text. With these stories users can 'share and remember their real-world stories as they happen' [119]. The story creator decides which users may collaborate, and sets the visibility to 'everyone', 'friends', 'trusted friends' or 'private'. Furthermore the story is geo-tagged to a specific location. Whrrl combines a photo album with geotags and the possibility to letting many people collaborate and sharing it to Facebook and Twitter, all from the mobile phone. The service features mobile applications for J2ME platforms and the iPhone OS as well as a SMS based story publishing. SMS messages can be sent to 94775 with several commands for creating stories, extending them, or setting the status etc. This is why Whrrl has such a unusual short name with only 5 letters: WHRRL = 94775. Of course Whrrl offers all common features of location based networks like finding friends' locations.

2.8.13. Location and distance aware bulletins

Zintin [76] is a pure mobile social network, that has a built in painting tool in its mobile application. Shot photos can be edited, or new pictures can be scribbled from scratch and shared with friends. Zintin offers the exceptional feature of providing bulletin boards attached citys. 'Pretty much every city in the world now has its own wall on zintin. A city's bulletin board is visible within a radius which grows with its population, so you will be able to see small towns which are very nearby, and larger cities which are a little further afield' [124]. Zintin is only available for the iPhone OS so far.

2.9. Mobile social networks with microblogging

Blummi [6] is a service that is built on top of the Twitter API. It extends Twitters microblogging service by adding several social networking features. Users are able to not only 'follow' people, but also to manage friends in friendlists, and write private messages. It offers location based functions like recommending places to friends or checking for current whereabouts of friends. It can also send a notification if a friend comes nearby. Blummi is, in contrast to the following five hybrid systems, not a social network that offers microblogging as an additional option, but is a microblogging service that offers classical social networking features as an add on.

2.9.1. Interest and location aware

Trackut [67] is a location based mobile social network, offering friend finding and tracking services. Users can share points of interests in channels, organized by different interests. Users can subscribe to channels and get a notification if they come near a venue that is listed in the channel, or if a friend comes nearby. Events, that are associated with a location and a specific date and time can be created and shared with friends. Mobile applications are currently available written in J2ME, and for the Android and Blackberry OS platforms.

Socialight [66] is a location based mobile social network, organized in topic-specific channels, where users can leave geo-tagged 'sticky notes'. The service is similar to Trackut 2.9.1, but acts passively. Instead of notifying users when they come nearby a note like Trackut does, Socialight lets look around its users if they search for something specific.

2.9.2. Location based geojournals

Belysio [4] is a location aware social network that provides a webpage optimized for mobile devices as well as a J2ME powered application for mobile phones. It allows for searching for people around the current location. The current location can either be set manually by the user, or sent automatically by the application on the mobile device at times. Users can also create so called 'geojournals' to post geotagged photos and messages, and share stories like vacation trips with friends. The service allows to 'follow' other users, to get notifications if new geojournals are published. This feature has a microblogging character, and therefore is being categorized under 'Mobile social networks with microblogging'.

2.9.3. Multimedia sharing

Radar [59] is a mobile social network, connecting with Facebook and specialized on photo sharing. Users can look at their friends' photos and profiles by using the mobile web interface, or with the mobile application on a Blackberry or iPhone. Photos can be also uploaded via MMS, sent to a unique email address. Radar provides such a email address for every user for that purpose. People can 'follow' other users' photo streams in a microblog fashion.

Rabble [58] is a mobile social network with microblogging and photo sharing functionality, accessable by a mobile web interface or the J2ME based mobile application.

Part III.

Empirical Analysis

3. Empirical Analysis

3.1. Social Network Crawler

For meassuring several numbers of social networks, like the dynamics of them, a crawler is needed. For that purpose, a crawler was written in C# using the .net framework. With this tool, it is possible to crawl a sufficient number of users' friendlists, to get the average number of friends, users have in the social network services. Moreover the application visualises the entire social networks that have been crawled, as shown in the appendix in figures A.3 and A.4.

By repeatedly crawling the exact same friendlists after a distinct time span, it is possible to compare the crawling results with the earlier ones and determine how many users were deleted and how many were added in the meantime. This method was implemented in a tool, called 'long-term crawler', inside the social network crawling application, to meassure the networks' dynamics over time. A screenshot of this tool is shown in the appendix A.5.

3.1.1. Crawling method

Most services use numeric ids for identifying their users. For crawling these services a large number of random numbers were generated, lying between the lowest and the highest id that was estimated. These approximations were made by trying several ids in a binary search manner and checking everytime, if a profile was linked to the respective id. Having generated a large set of ids, this was taken as the representative group for further crawling.

Some services use string based ids. Creating these strings randomly makes no sense, because the probability of matching with a existing string id is much to low. In this case it was searched for one or more users on the webpage to get entry points. These users' friendlists were then crawled down to a recursive depth of two or three levels. After having done that, all duplicates were removed and a fraction of these was randomly chosen. This fraction was then used as the representative group.

Having created such a set, mostly containing several thousand user ids, the long term crawler tool was started. Having completed the first crawl, just the users remained, who had at least one friend. Often just a tenth or less of all user ids were left over and never more than the half. This may have the following reasons:

- Users simply have no friends added to their friendlists yet. Maybe because they are new to the network or no one of their friends uses this service. Some accounts are

just registered for anyone having had an eye on the service because of beeing nosy, and afterwards were left unused.

- Ids are not associated with a user profile, because of deleted user accounts and unused ids.
- Users have blocked access on their friendlists by using privacy settings.
- Numerical ids are not distributed without gaps. Some services do not assign new ids sequentially, but only every n^{th} or at a random step size. Together with starting at a high number, this makes ids larger and lets the service look like it owns more users than it actually does.

3.2. Dynamics of social networks

3.2.1. Changing numbers of interconnections

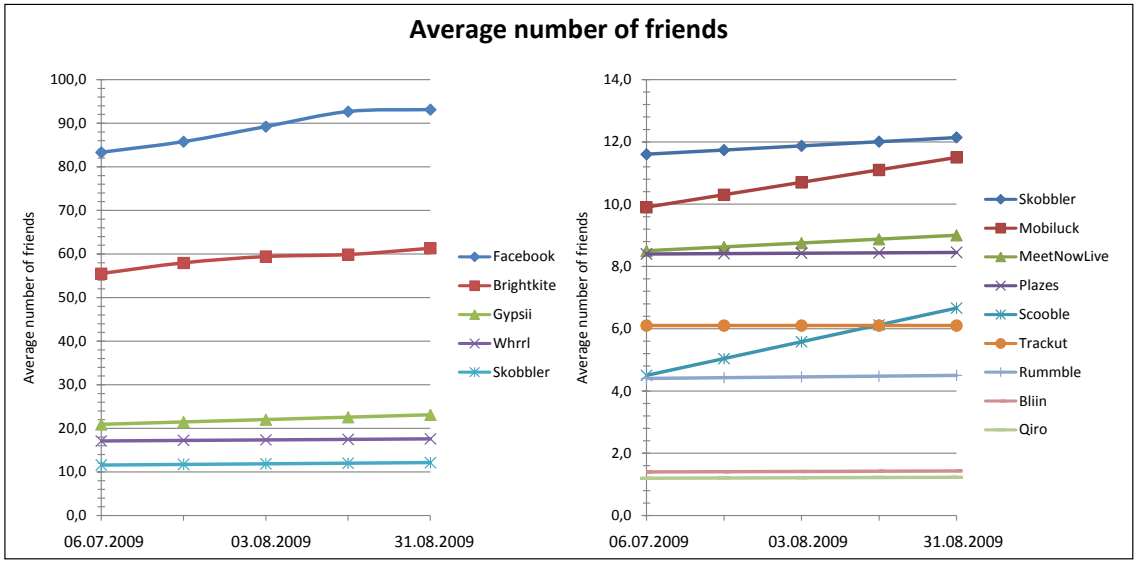


Figure 3.1.: The diagrams show the increasing average number of friends in users friendlists in several mobile social networks. The diagrams were split for more clarity, 'skobbler' is plotted in both for orientation. (source: own work)

To learn about the dynamics of different social networks, it is essential to know, how the edges in the social network graph change. To be precise, it is required to find out the number of interconnections between users and how many of them are deleted or added after a specified time span. In a social network service, these are the numbers of friends in a users friendlist. This is exactly what the long term crawler tool meassures.

Figure 3.1 illustrates the results of the long term crawling. It shows the average sizes of users' friends in the different networking systems, and their change over the meassured

time span. Some friends were deleted, but in all examined systems users added more friends than they deleted in average. The results also show, that sizes of friendlists highly depend on the size of the social network in total. Social network sizes, at least these which were found out, are shown later in figure 3.3, by listing their respective number of registered users.

However, the different social networks can be better compared, if the number of added and deleted friends are set relative to the sizes of the friendlists in the beginning. This is shown in figure 3.2. The numbers correspond to changes within exactly eight weeks, meassured between 6. July and 31. August 2009. In this diagram, the relative number of deleted friends substracted from the percentage of added friends is proportional to the derivation of the respective curve in figure 3.1, averaged over the entire meassurement period. In other words, it can be seen as the average gradient of the curves above.

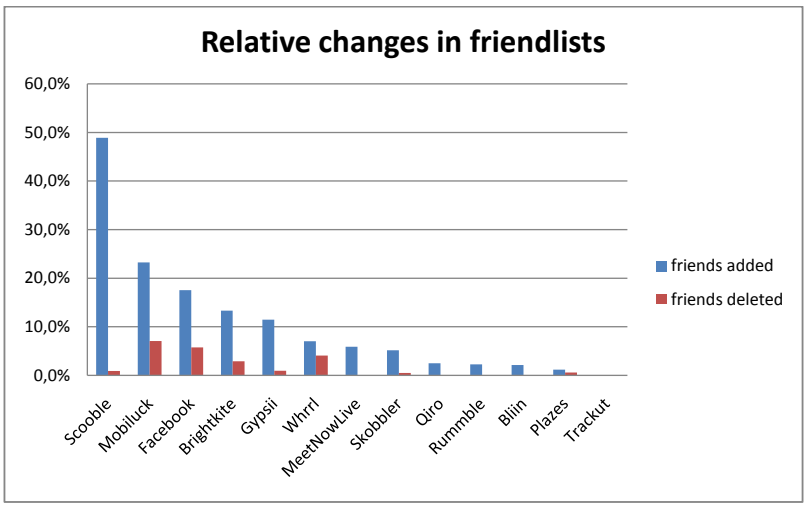


Figure 3.2.: Shows how many friends were added and deleted in average, relative to the number of friends at the beginning of the meassurement. (source: own work)

3.2.2. Social network sizes

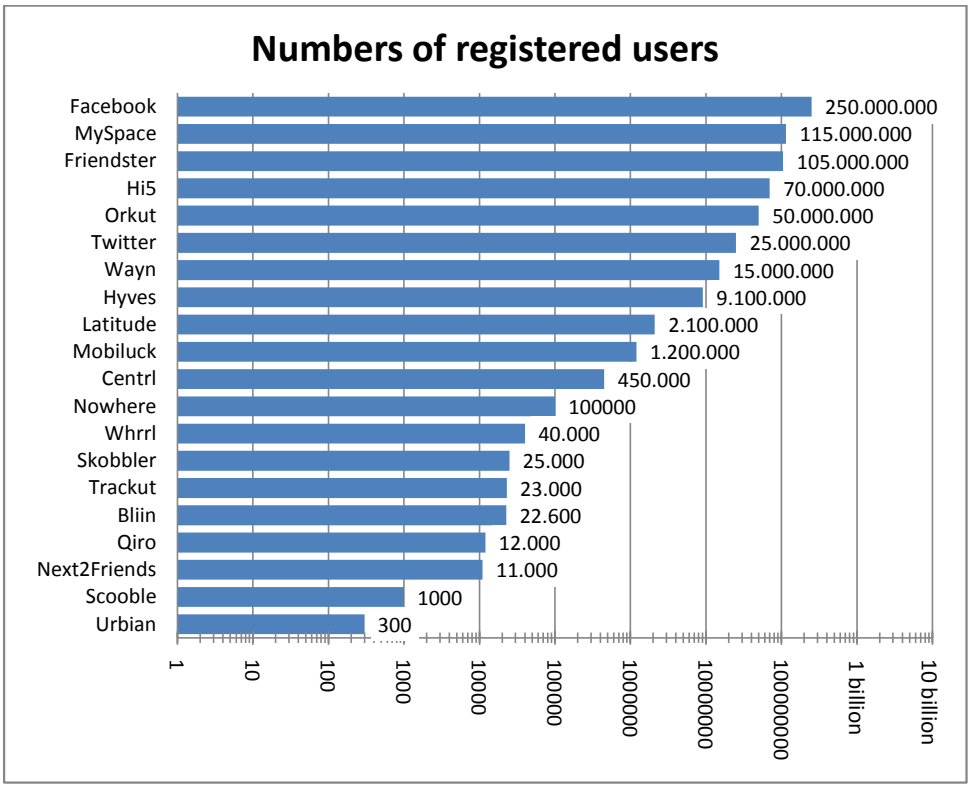


Figure 3.3.: A list of several social networks and the numbers of their registered users, shown on a logarithmic scale. (source: own work)

Figure 3.3 shows how much users are registered at the listed social networking systems. Only networks, that provided information about their user counts, are listed. All numbers are as of August 2009 and have only a tolerance of less than ten percent. Extrapolations based on crawling results or based on searching for specific keywords and projecting these, proportional to known numbers, turned out to be to inaccurate. Therefore networks, with numbers of users of insufficient precision were left out.

Numbers of unique visitors, which correspond to the popularity of the different services as well as to the activity of their users, can be found in the appendix in figure A.1.

It turnes out, that users in small social networks have less friends in their friendlists than users in larger social networks. This may be because not many of their real life friends are registered in this particular virtual network. This is the reason, new mobile social networks have relatively small cross linking degrees. Reasons for mobile social networks, in turn, to only have small numbers of total users may be:

- Old mobile phones are not designed for mobile internet browsing, and mobile applications are not comfortable to use because of the small display sizes. Therefore these mobile phone users mostly do not have a mobile internet data plan, and do not use internet based services at all.

- Smart phones with larger displays and touch screens are often used together with a data plan, but are not yet widely spread enough. Only 13% of all sold mobile phones in the first quarter of 2009 were smart phones [94].

- Even with cheap data plans, or flatrates, and appropriate mobile devices, the variety of mobile social networks is much too big, and until now it has not yet become apparent which network will establish itself like Facebook did before with classical social networks. In 2007 only 3.5% (USA) and 2.2% (Europe) of all mobile device users used mobile social networking services [103].

These reasons, together with lots of users having their friends already at the classic networks, have led many people to continue to use large networks like Facebook, Twitter, etc also from their mobile devices. Small and new mobile social networks predominantly denote small growth, while popular networks grow even futher (see figure 3.1).

3.2.3. Distribution of friendlist sizes

Figure 3.4 shows that many users in small networks have nearly no friends connected in their friendlists. Users either have left the service already or will do so, if the network does not offer a genuine added value, compared to established large social networks. Many small networks are built by early stage start-ups, without sufficient funds to start advertising and calling attention to their services. Many of these are compelled to shut down their service after a while, and many were shut down already.

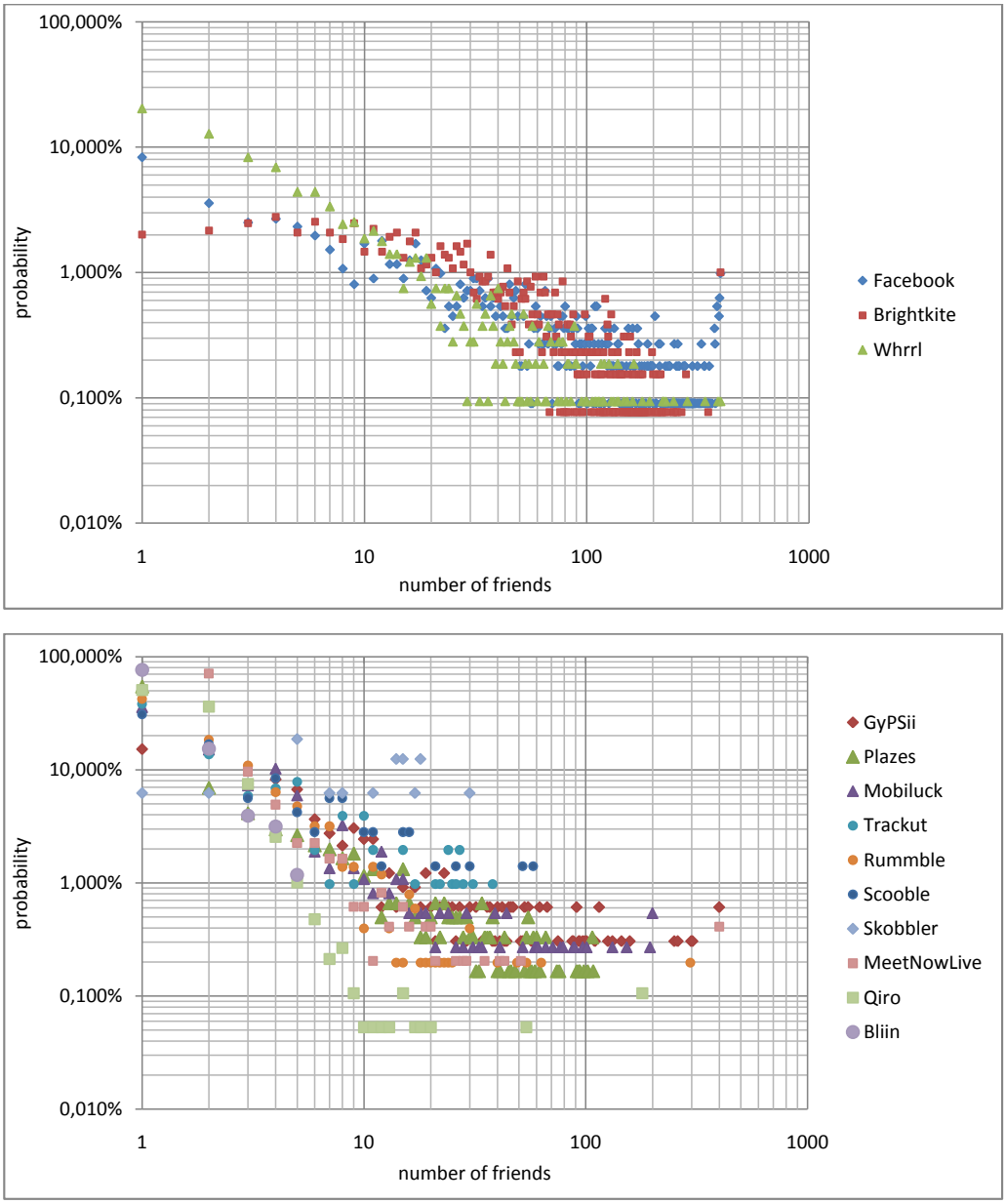


Figure 3.4.: The two diagrams above show the distrubution of friendlist sizes of several classic and mobile social networks. One data point denotes the probability of a user having this specific number of edges (friends). Both diagrams are identically scaled, and with all two axes logarithmised. (source: own work)

3.3. Development of mobile social network start-ups

SixDegrees was one of the first websites based on the model of social networking. It was launched in 1997 and named after the concept of six degrees of seperation, mentioned in

Milgrams 'The small world problem' [102], where it shows up that two randomly taken persons will most certainly know each other over six degrees of acquaintanceship. The service was disestablished in 2001, but the concept was soon adopted by many other websites, such as Facebook, Friendster, MySpace and LinkedIn. Even before the launch of Facebook in 2003, the first mobile social network, Dodgeball, was developed and finally published in 2000 [125], even though only beeing a SMS based service without static friendlists. Figure 3.5 illustrates the age of all social networks listed in this survey. The number of newly launched mobile networks virtually exploded in 2007.

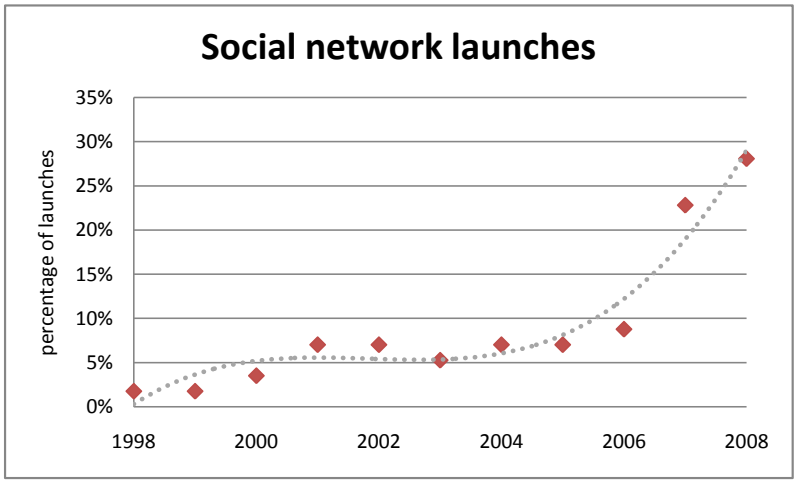


Figure 3.5.: Number of social networks launched in respective years. Percental fractions correspond to total number of launches of social networks, discussed in this thesis. The dotted line represents the polynomial trendline of third degree. (source: own researches)

It must be pointed out that this graphic contains most of all currently existing mobile social networks, but only the most popular classic social networks. It has to be considered, that nearly all mobile interfaces and application for classic social networks were developed after 2006. Therefore taking all other classic social networks also into account, would not have changed the meaning of the diagram. The launching dates were captured from the official blogs or press releases of the network service developers or by searching the Internet Archive[1] service. For this reason the dates may vary and may have only an accuracy of a whole year in the worst case. The year 2009 was omitted because the year was not over until the completion of this thesis.

[1] http://www.archive.org

3.4. Geographic dependencies in utilisation

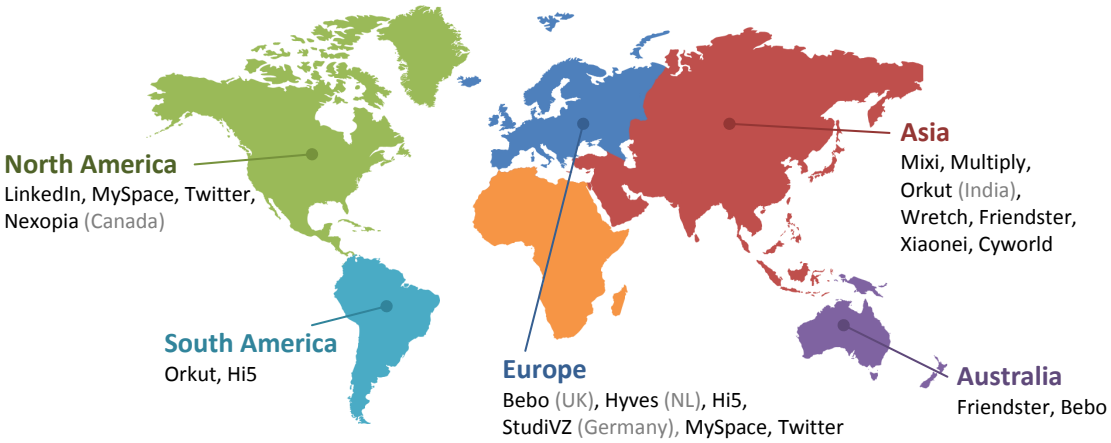


Figure 3.6.: Geographic dependencies of several social networks (data: [120] and own researches)

Users of every social network are never evenly distributed around the world, but rather clustered to a few regions. Every system has some few countries, where it has disproportionately high numbers of users. The region where a service was developed must not necessarily be one of the countries, it is very popular in. Orkut, for example, that was developed in California, USA, is now mainly used by Brazilian people [107]. Figure 3.6 shows some exemplary social networks and where they are popular.

3.5. Spread and usage of different mobile platforms

3.5.1. Usage of mobile platforms

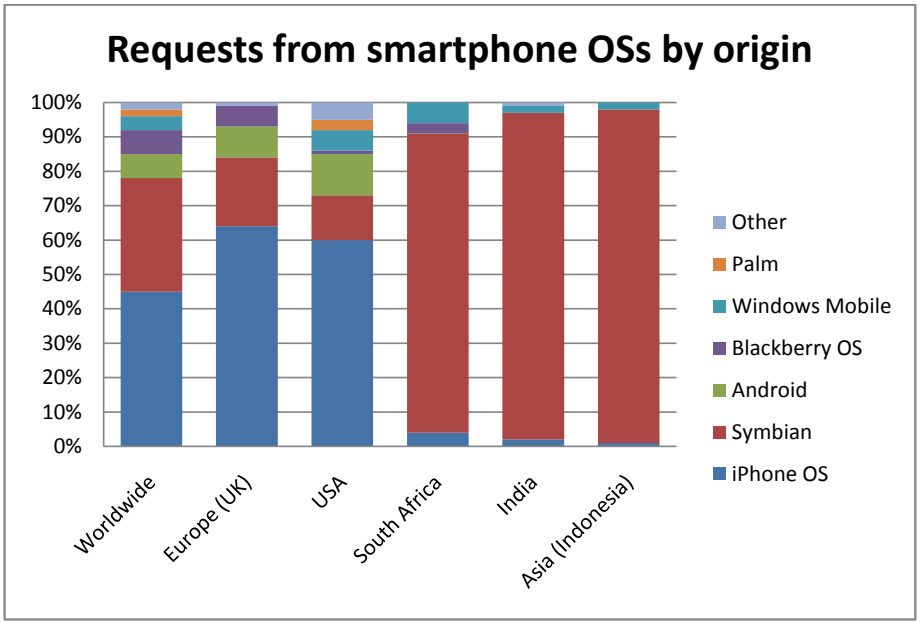


Figure 3.7.: Percental fractions of requests from smartphone operating systems, broken down into origin countries (numbers: AdMob Mobile Metrics Report 2009 [77]

For investigating mobile social networks and their applications, it is interesting to know on which platforms they will be most likely ran. In fact, there are a lot of different mobile platforms and even more devices on the market today. The distribution of such a particular device or platform, in terms of sales volumes, is not as important as the mobile internet usage behavior. As explained before in section 3.2.1, different cell phones are more or less likely to infer their owners' tariffs and therefore affect the intensity of mobile internet usage.

Figure 3.7 illustrates this fact, by showing the six most popular platforms, all beeing smart phone operating systems, and their proportion of total requests in the mobile internet of the respective region. In Europe, for instance, iPhone users produce about 64% of all mobile internet requests while the iPhone has just a market share of 1.5% of all cell phones. These are just 4 million sold devices of total 269 million phones in the first quarter of 2009 [94]. Therefore, web request numbers are much more significant than sales volumes.

The platforms Blackberry, Palm and Windows Mobile are very likely to find in business environments, whereas Symbian, the iPhone OS and Android in contrary are widely used for entertainment. This may explain the fact that the three last mentioned platforms alone generate 85% of all mobile web requests, while business tasks only demand email and not web access. Nearly all social networks target at entertainment and friend related usage

patterns. This may, in turn, be the reason for social network providers to not primarily develop mobile applications for Palm and Windows Mobile operating systems. That, indeed, only few social networks support these systems, can be seen in figure 3.8.

RIMs Blackberry system seems to be the sole exception and is not only used for business purposes but also a popular device for entertainment and social networking. 39% of all mobile social networks provide an application for Blackberry, especially these which are domiciled in the US. Having said that, Blackberry users in the US interestingly only make one percent of all internet requests.

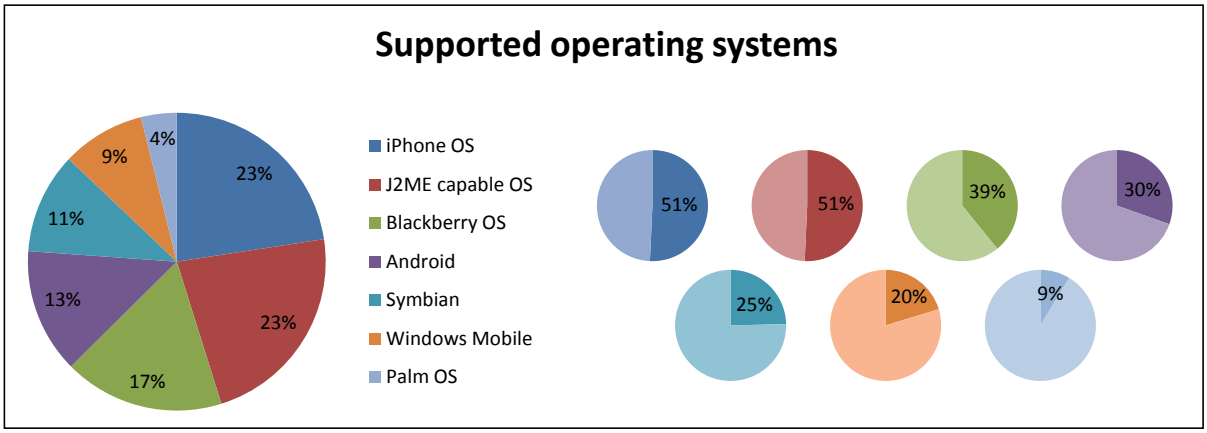


Figure 3.8.: The illustration shows, how all available social network applications distribute across the platforms. The small diagrams indicate how many social networks offer an application for the particular operating system.

Symbian and the iPhone operating system are apparently most popular worldwide for browsing the internet, as figure 3.7 shows. Users of these two platforms also have a great variety of mobile social software (see figure 3.8), considering that Symbian devices widely support J2ME applications.

Android, beeing the youngest of all six smartphone operating systems, is not this established yet. Many devices providing this platform are still to come, but internet requests from Android devices already amount to third most in the USA and Europe. 30% of all mobile social networks, presented in this thesis, already support the Android platform, as shown by the small diagram, corresponding to Android, in figure 3.8. Moreover, several press releases or blogs of social network providers state to deliver an Android based application for their services soon, as for instance Gypsii [123].

Because every mobile social networking system can support different numbers of platforms, figure 3.9 points out how this is distributed and how many services offer total platform independency.

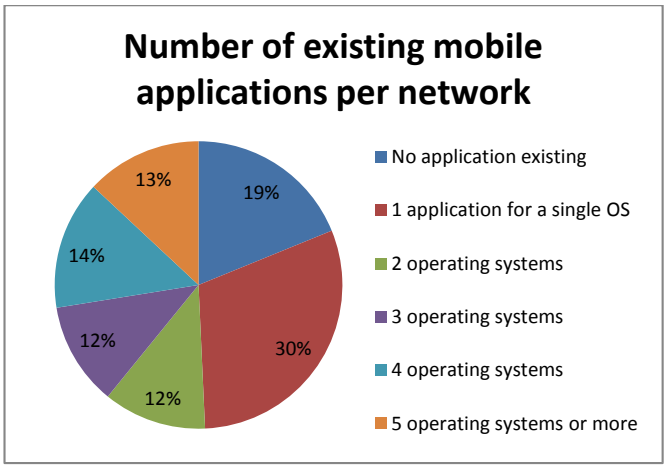


Figure 3.9.: It is shown, how many social networks are platform independent and how many depend on one to five special systems, or do not offer any mobile application at all.

To provide a detailed overview over all presented mobile social networks and their supported platforms, a tabular listing is shown in the appendix in figure A.2.

Part IV.

Conclusion

4. Conclusion

4.1. Imaginable future approaches

After having discussed all currently existing systems and the functionality they provide, the question arises: what new functions could social network systems offer in the future? Some approaches, systems could come up with, are shown in the following:

Weighted relations The relationship between users could be weighted with some parameters. For example, by counting the amount of messages that are sent to each other, or meassuring the time two users remain in near positions. A combination of these parameters could be used to rate relationships. These quantifications could then be used in the rendering of friendlists. Friends that a user spends most time with, would then be showed on the very top of his friendlist, while remote acquaintances would be appearing further behind.

A lot of social networks show their users an overview page containing the latest activities of their friends. These pages could be also enriched through quantified relationship information. Activities of narrower friends could be visually emphasised some way. Predecessors of this technique are for example Jabberwocky and Encounter Bubbles, discussed before in section 2.6.2.

Typified relations Semantic aspects like categorising relationships are also imaginable. In an examplary system, the user would have the possibility to add tags to a location, such as 'office' or 'sports ground'. Friends that the user predominantly meets at these places, would then be automatically classified by the system. He would find his friends grouped to 'colleagues' or 'soccer buddys', without having to manually enter this.

Enhanced services Future systems could offer a plenty of new services, which make life easier. If, for instance, the user has an appointment, the system could check the user's location a quarter of an hour before. If the system then recognizes that the user is too far away for arriving in time, it could send an automated excuse message to the other participants of the appointment. A similar service is already existing [91], and even additionally sends the estimated time of arrival. But the problem nowadays is, that there are many small services for just one purpose at a time. Concentrated in bigger systems these services could share different data, such as location and friendlists, and could get much more useful.

Context adaptive filtering Other possible options, that have not been implemented in any social network yet, are rich filtering features that are based on the current context. An

example would be: the user could choose a filter that hides all business related contacts and messages unless date, time and location match his office and working time.

Context aware offering Advertising is also a feature that can be very useful in some cases, not only for advertisers and system operators but especially for the users. This is the case, if it can be filtered according to own needs, or can be completely turned off according to current desires. This way advertising would not get annoying for people. The user could choose, that he wants to get the latest offers and happy hours, if he is within some defined radius around bars and clubs. This context could be further restricted by setting to recieve offers only at weekends or only within a preferred time span at night. That would be a service delivering useful information, which is passively received by the user, instead of having to search it every time. A similar technique, for finding offers by giving time ranges, is already used in the MeetNowLive mobile social network, presented in section 2.8.8.

Advanced visualisations With most of todays mobile social network applications only providing list view graphical interfaces, or at most a map view, more advanced user interfaces could appear in the future. Mobile devices have very limited capabilities for output, due to the relatively small display sizes. Therefore it is a very challenging task to develop a user interface that shows as much information as possible but simultaneously provides an overview and does not overstrain users. Approaches, which ought to be named within this scope, are:

- 3D map views, letting the user orientate by nearby buildings, pictured on the map view.
- Timeline based visualisations, like already implemented in Encounter Bubbles (see section 2.6.2).
- Augmented reality views, already available for Android, within the mobile application Layar[1]. This view avails itself of the camera, built into most mobile devices. With the devices positioning abilities, its digital compass and accelerometer, it is able to detect where the user stands and additionally where the camera is pointing to. This way the application can overlay the cameras picture with markers, showing geotagged content, such as positions of friends, places of interest and more.

4.2. Completeness of this thesis

As a conclusion, after broad researches, it can be assured that nearly all mobile social networks were covered with this thesis, that provide extra features compared to other networks. Surely, many small mobile social networks are existing, which were not presented. However, the popularity of such a system is often regionally restricted. Moreover these systems, as far as they were discovered during the researches, do not provide any added value or additional functionality compared to respective systems, discussed in this thesis.

[1] http://layar.eu/

4.3. Future researches

Further researches in this topic can take sources, listed in section 2.1, and all mobile social networks listed in chapter 2 as a point to start. Metrics and numbers, as explicated in chapter 3, could be compared with respective numbers in several months or years, to get an idea about how these mobile social systems evoled. It would be interesting to see how much functionality stayed the same, and which features were realised in newly launched services, or added to systems, existing today.

Appendix

A. Appendix

A.1. Unique visitor numbers

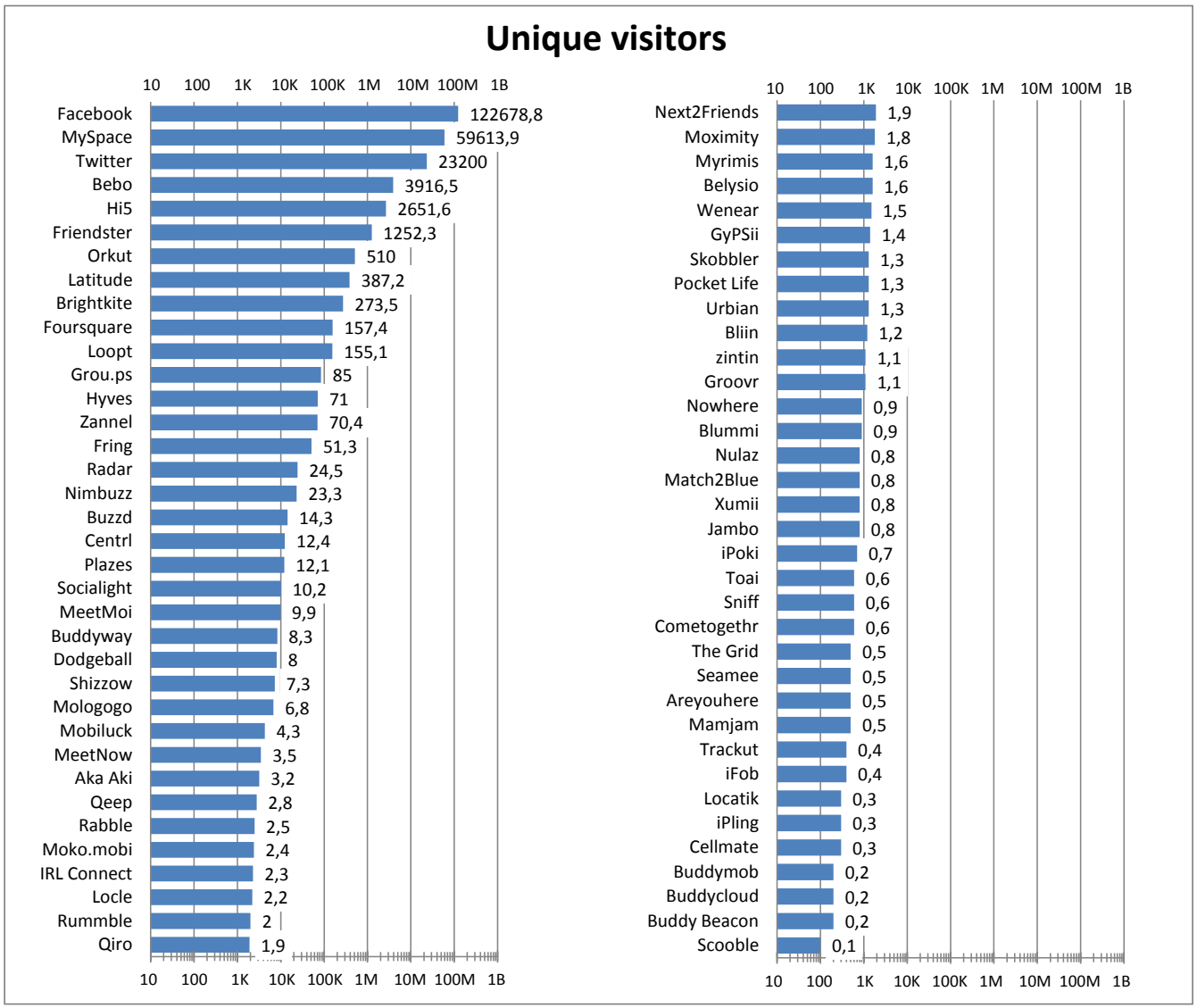


Figure A.1.: Lists all discussed social networks and their number of unique visitors per month, averaged over three months until August 2009. Adjacent values are in thousands. (Numbers: [93])

A.2. Detailed overview over supported platforms

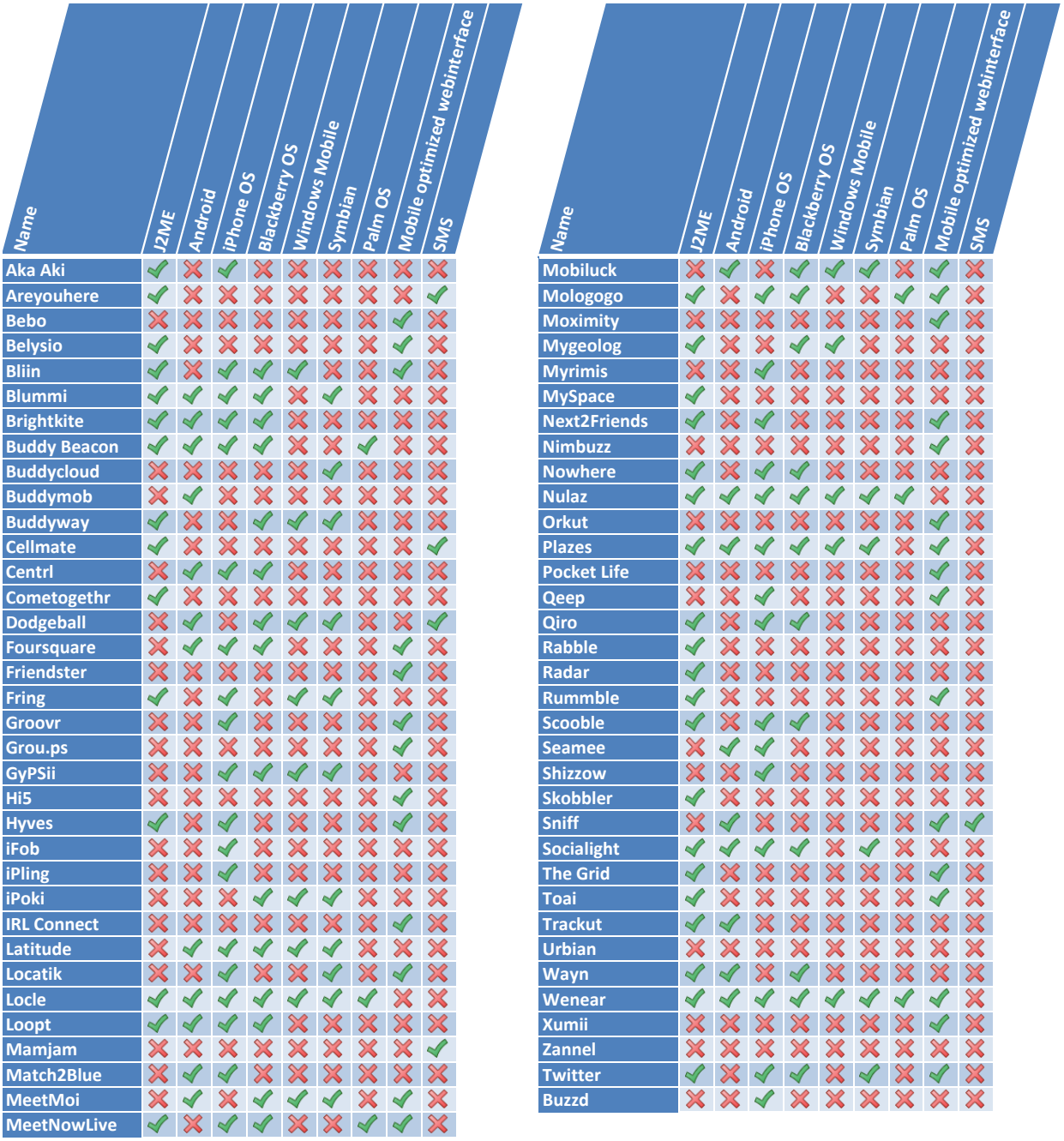


Figure A.2.: Listing of all discussed social networking services and their supported platforms and interfaces. (Source: own researches)

A.3. Social network crawling application

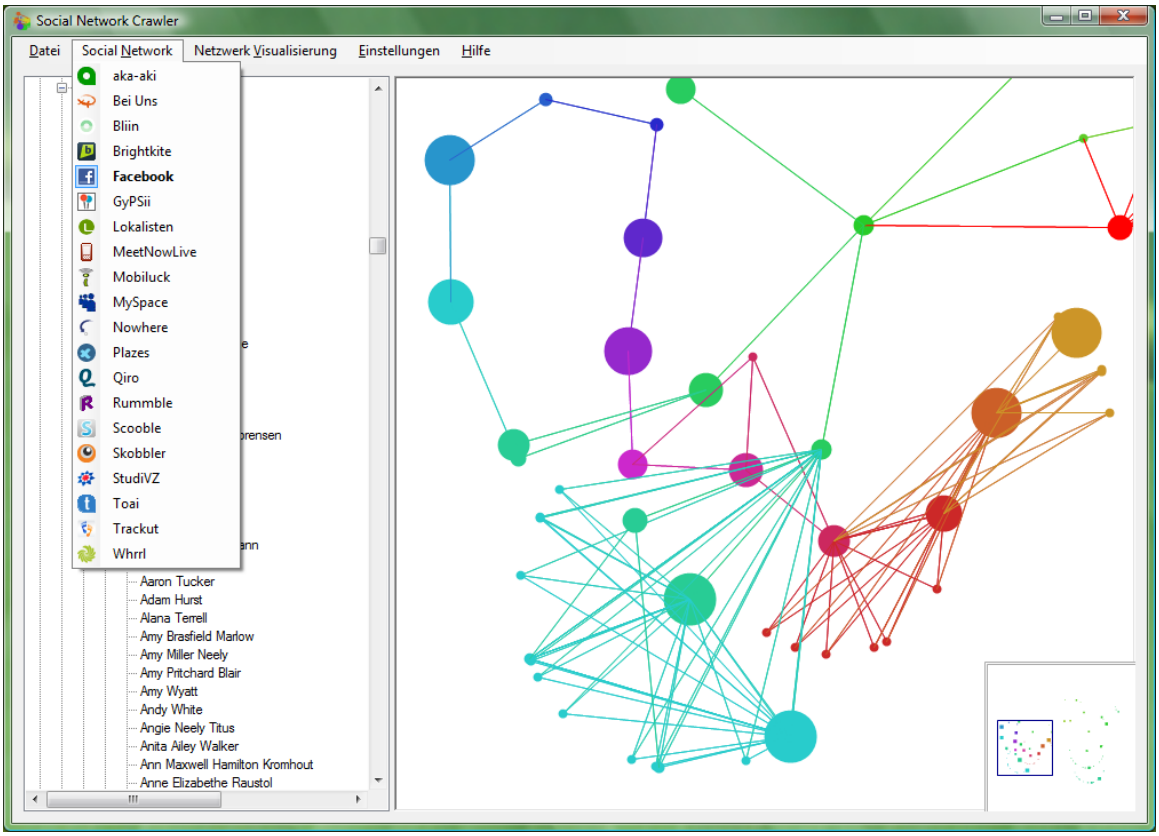


Figure A.3.: Screenshot of the graphical user interface for the social network crawling application, written for this thesis. It shows a visualisation of the crawled network, with all nodes that have less than two outgoing edges invisible. Nodes of the graph are color coded according to their distance to the 'root', beeing the initial person entered by the user. Radiuses of the circles, representing the nodes, are logarithmically proportional to the total number of connected edges.

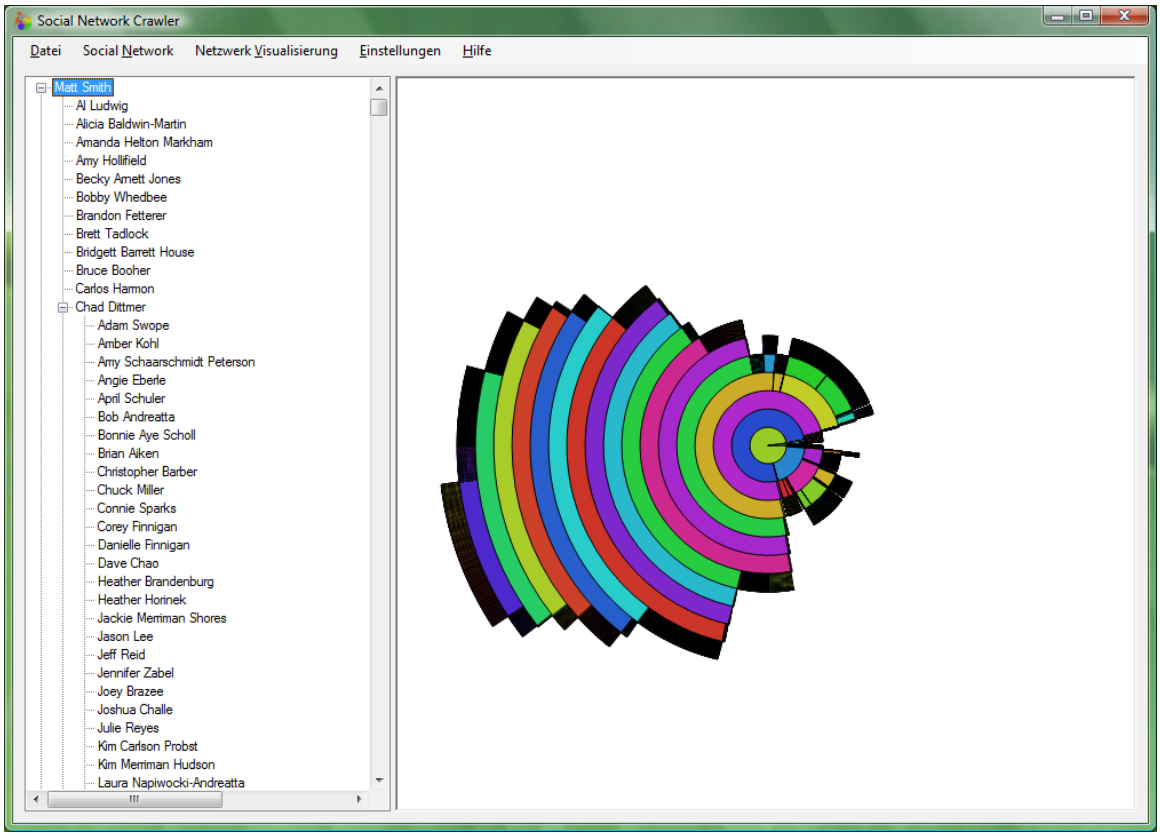


Figure A.4.: Another screenshot of the social network crawler interface, showing a pie visualisation, which represents a mapping of the hierarchical structure listed in the tree view control on the left side of the user interface.

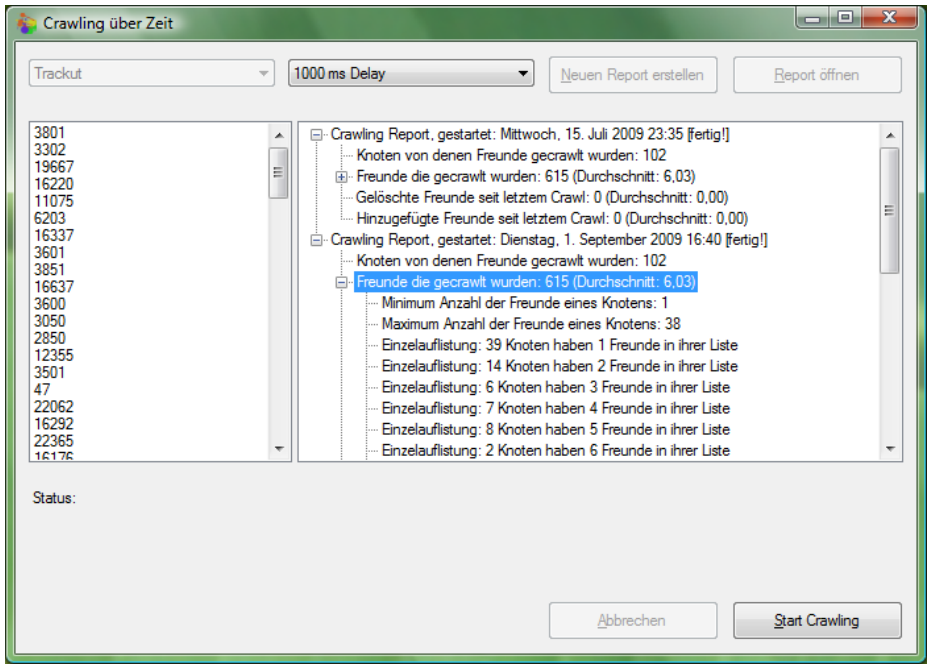


Figure A.5.: Screenshot of the long term crawling tool. Crawlings can be paused and saved in XML files, and resumed again at any time.

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