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State of the Art in Mobile Social Networking on the Web

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Abstract

This contribution presents a study on currently existing mobile social network (MSN) platforms. We briefly discuss the basics of mobile social networking and defines our view on related terms and concepts. We then discuss and develop a classification pattern for MSN platforms and services. Several such systems are arranged and grouped, according to this categorization scheme. Finally, an empirical survey is presented, pointing out key dynamics, similarities and differences between the presented systems.

Contents

1 Introduction

Mobile Social Networking (MSN) is an important field in mobile and social computing. The rich possibilities for acquiring individual and social context in the mobile domain of use and the interesting new classes of services that allow for usefully augmenting social life with added value services represent a natural further development of the paradigm of desktop based Social Networking as realized in platforms as Facebook. It is not the goal to review and cover all the approaches in scientific literature (such as context aware computing, social signal processing, reality mining etc.) that may contribute to or are relavant for mobile social networking. The goal of this contribution is to analyze the current state of the art of mobile social networking services and platforms existing on the (mobile) Web as of September 2009.

1.1 Mobile Social Networking

Social Networking (SN) platforms such as Facebook [1] or MySpace [2] are among the most popular applications or platforms on the Web as of early 2010 (see e.g. [3]). These platforms evolved from community platforms (with their bundle of communication-, information- and awareness-services [4]) by adding explicit models of social networks and corresponding service

bundles. Many of the most popular SN-platforms also offer UIs specially designed for mobile access. But merely interacting with Facebook's Website from an I-Phone should not be considered as mobile social networking. Social Networking, in general, can be defined as a collaborative or social **computing paradigm**, that

- makes use of an **explicit social network model**
- (selectively) **opens** parts of the participating **user's information spaces** to other users from the social network
- offers useful **communication-**, **information-**, and **awareness**-services that can operate on these parts

The concept of **Mobile Social Networking** can be defined as an extension or broadening of this paradigm by

- **detecting and modeling** the user's **individual and social context**
- **using** these context models and selectively opening them (as part of the individual information space) to other users from the network to enhance the service bundle and increasing its **usefulness** especially in mobile interaction scenarios

The **social context** e.g. encompasses dyadic social relations on small time and space-scales or models for social situations while the individual context encompasses current location etc.. Detecting and modeling social relationships on small space- and time-scales is the realm of the emerging field **Social Signal Processing** [5, 6, 7]. **Earlier approaches** [8, 9, 10] limited the definition of mobile social networking merely to SN platforms with mobile access. While mobile access patterns to "conventional´´ SN-services may certainly differ in some aspects from desktop interaction with the same SN-services, e.g. with respect to the context-sensitivity (e.g. spatio-temporal relevance / validity) of the communicated contents, the bundle of services remains basically identical and does usually not use individual and social contexts in an innovative way.

Another innovative field that is related, with respect to some aspects, to mobile social networking is **decentralized social networking** [11, 12, 13, 14]. Decentralized social networking gives up central servers hosting the social networking platforms and relies on Peer to Peer (P2P) paradigms allowing each user to be socially "represented" by a peer (or even an agent). Besides the general advantages of P2P (such as scalability, reliability etc.), distributing social networking solves the cross-platform problem of not being able to easily span modeled social structures, context model instances and other entities across platform boundaries in a natural way. In decentralized social networks each user autonomously manages her profile (including her ties in the SN, access control etc.), which gives back more control to the user. Besides the advantages, in decentralized SN some problems may become harder than in centralized SN, e.g. the problem of group-formation and demaraction [15]

1.2 Goals

While the definition of mobile social networking of the previous section is well founded, it is mainly oriented towards the future of mobile social networking. The goal of this paper is a survey of **existing** mobile social networking approaches, platforms or systems on the Web

today. With "existing" we mean such approaches, platforms or systems (commercial or not) in at least roughly beta-stage that that are open to the public and that have a non-trivial user-base, meaning that it is not limited to the developers only. This may include research prototypes of a certain maturity.

We aim at including all approaches, platforms or systems that

- implement key aspects of social networking and
- offer a mobile UI

in order to allow for a broad classification of these systems in view of establishing, justifying and developing an agreeable definition of mobile social networking. In other words, the goal of this paper is to thoroughly characterize the current state of MSN in order to be able to identify and characterize existing problems and possibilities for future developments and research in this field on the basis of this characterization. It provides a basis on which the desirable concept definition for MSN given above builds on.

1.3 Outline

In section 2 present a classification system for mobile social networking services and platforms (according to their most prominent services) is presented and several options for such a classification schema are discussed. In section 3 the available mobile social network platforms and services are classified according to the classification system and for each a short discussion is given, describing key features and properties. Section 4 presents empirical analysis of the dynamics of key properties of mobile social network platforms such as the growth rates of the social network, distribution with respect to operating systems, geographical distribution etc. Section 5 concludes this contribution by discussing future trends and research challenges.

2 Concept disambiguation

For today's mobile social networking, three main concepts play an important role:

- Weblogs, or simply Blogs (see e.g. [16] for an early discussion).
- Location based services (see e.g. [17] for a general overview on context-aware systems including LBS).
- Social networking (see 1.1).

Figure 1 shows flavors and combinations of these concepts with a mobile and non-mobile interaction paradigm. Euclidean distance is intended to resemble the conceptual similarity between the depicted concepts as far as possible.

At the intersection of blogs and social networks, Microblogs were placed. A prominent example is Twitter [18]. 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 ('following'). While many Blogs are organized on separate Web-pages in a decentralized way,

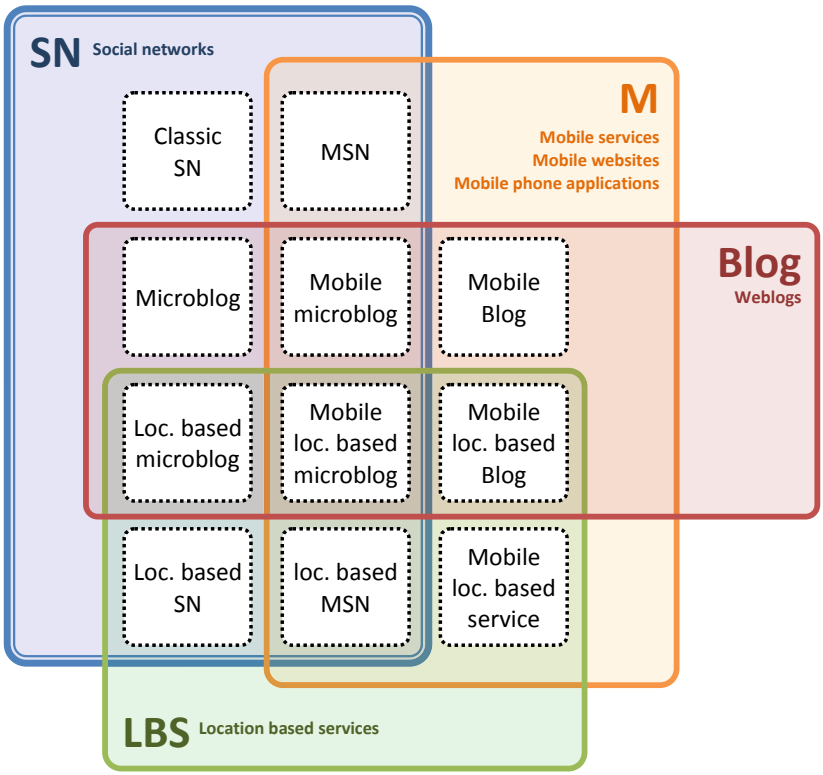


Figure 1: Three main concepts, their combinations and their mobile versions.

implementing 1:n anonymous communication, microblogging is featured mostly on centralized platforms such as Twitter. Through the directed 'follows' relations, which party de-anonymizes the 1:n communication, a loose social network is formed, which justifies the placement in the diagram.

In the figure, MSN (Mobile (access to) Social Networking) represents mobile access versions of classic (desktop-oriented) social networking (SN). These versions include adapted mobile UIs (e.g. adapted Web-pages or -applications or native mobile applications) that go slightly beyond merely accessing the given UI (e.g. Web-pages) with a micro-browser from a UI perspective but that do not offer substantially new services that make use of mobile context.

Four concepts that can be justified to comprise the current state of mobile social networking are illustrated in figure 2, all lying in the cross section of 'mobile' and 'social network' (MSN, Mobile microblog, Mobile location based microblog and location-based MSN). While other classes of figure 1 like e.g. Blogs may also exhibit aspects of social networking and can, in principle, also be accessed and interacted with via a mobile device (e.g. via a micro-browser), we limited ourselves to systems, approaches and platforms that fall into one of the depicted four classes.

Social networking platforms usually offer a range of services, UIs and extension mechanisms which are also shown in figure 2:

- A web interface, that lets users access and manage their accounts and profiles and access the platforms SN-services by using a web browser.
- A mobile web interface (MSN) (see above).

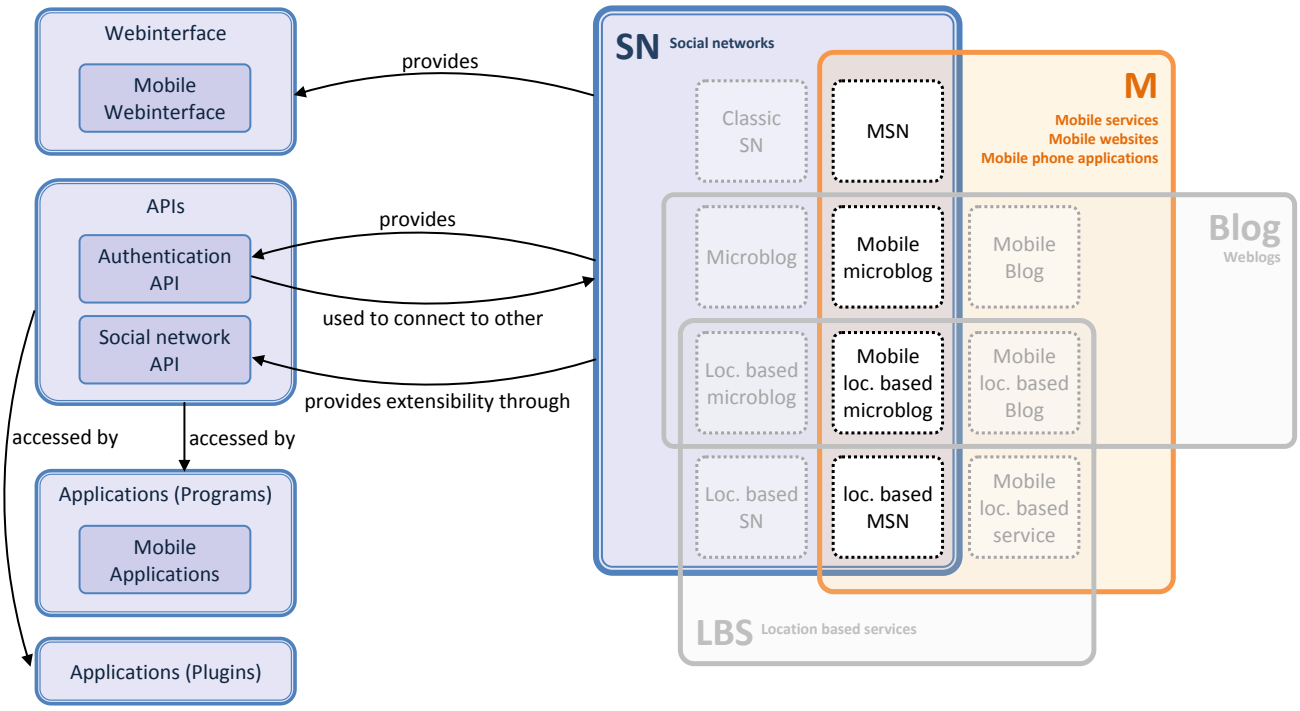


Figure 2: Mobile social networking systems

- An API (Application programming interface), allowing third party applications to access to the service. Furthermore it may allow other social networks to partly 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 (including social network data).

2.1 Categorization design

During the investigation of existing mobile social networks, many platforms and service-bundles were found. Figure 1 already provided a coarse introductory grouping / classification of approaches relevant to mobile social networking. In order to more thoroughly structure and differentiate between the various approaches, besides the classification schema of figure 1, several other / augmentable classification schemes are imaginable:

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. Classify according to privacy concepts implemented.
3. Group by statistical measures such as:
    - Popularity
    - Dynamics of the system or vitality/activity of users
    - Attendance or just unique visitor numbers
    - User count
4. Partition technologically by used implementation techniques, standards, APIs, programming languages, platform toolkits, etc...
5. Group by provided key features and services (information-, communication or awareness-services)
6. Group by the degree of provision of semantic meta-data (amount of usage of Social Semantic Web [19][20])
7. Group by the fact whether it is centralized or decentralized.
8. Group by the degree of interoperability with other platforms.

Schema 1 is inappropriate for our overview, because almost all existing social network platforms or mobile social network approaches use undirected unweighted and untypified relationships, with manual adding mechanisms for friends via two-way handshakes. The few exceptions that have directed friend relationship models are mostly small and new systems, or rather simple implementations. Weighted relationships are also not implemented yet in any of the systems found that have a non-trivial user-base. Typifying edges of the users network is also not implemented in most of the currently existing services. Nearly all exceptions of this rule only provide a simple friend grouping / friend-list mechanism such as in Facebook, with certain possible implications for privacy (managing information access levels). Few other systems (Groovr, see 3.8.6 and Whrrl, see 3.8.12) 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.

Schema 2 (structuring according to privacy) is also not very expressive. 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.

Schema 3 takes several empirical values into account. We will discuss these statistical data in a separate section. However, most of these statistical measures are not suitable for an expressive classification for our purposes since the goal of our classification, as it was stated in 1.1, is to thoroughly characterize the current state of MSN in order to be able to identify and characterize existing problems and possibilities for future developments and research in this field.

Schema 4 is mainly only interesting in view of the elements of schema 5 to 9. The mere technological implementation details are not interesting in view of the goals of this survey.

Schema 6 and 7 are indeed interesting but at the time of this survey, almost no platforms with non-trivial user-base use. Social Semantic web or operates in a decentralized way.

Thus, we classify the approaches according to the schema in 1 and use augmented characterizations 5 and 8 where appropriate.

3 Classification

3.1 Sources

To create this overview of mobile social networks, besides our own research we used Web-sources listing social networks like [21, 22], location-based services [23] and mobile social applications [24, 25]. Moreover, several app-stores were investigated w.r.t. mobile social applications, such as the iTunes application store, Android market and the Ovi store by Nokia. Many 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.

3.2 MSN: Mobile Versions of 'Classic' Social Networking Platforms

In this section we very briefly review established social networking platforms that also have a mobile version (either versions of the Web-pages optimized for mobile access or a stand-alone mobile Application). Since these platforms are well known and have been broadly discussed, we refrain from discussing them in a very detailed way.

Facebook [1] is the most popular social networking site on the web [3]. Facebook's 'connect' mechanism is widely used by other social networks, and a multitude of applications are available, which use the Facebook's API to extend the social network.

Friendster [26] is one of the first social network platforms, gone online in 2003, and is very popular in Australia and Asia. This social network platform offers, aside from common functions, just few rather exceptional features. Friendster allows artists, musicians, organizations and other celebrities 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 [27]. Friendster offers, just like Facebook, a rich API, supports OpenSocial [28] and holds a myriad of applications (plugins), that extend functionality of the user interface).

MySpace [2] is one of the largest social network platforms at the time of assembly of this paper 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 customizability of the personal profile page of a user, by letting users decide what colors, background pictures and style-sheets ought to be used. Furthermore, the platform is famous for having a lot of musicians and bands registered, allowing artists to upload their songs and get in contact with their fans.

Hi5 [29] is one of the most popular classic social networking platforms, according to their unique visitors (see section 4). The service was launched 2003, and has over 70 million users. [30]. The mobile webpage was launched in 2008.

Hyves [31] is another classical social network platform, launched in 2004. It is foremost popular in the Netherlands, with about two thirds of the about 9 million total users being Dutch.

Orkut [32] is a social networking platform acquired by Google, launched in 2004, which is very popular in Brazil (more than the half of all users [33]), and for this reason managed and operated by Google Brazil since 2008. Orkut has a mobile web interface since 2008.

Bebo [34] is a classical social network platform since 2005. It was acquired by AOL in 2008 [35]. It provides a mobile web interface [36] since 2007.

3.3 Microblogs

3.3.1 Classic Microblogs

Twitter [18] 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 [37]). It is also often referred as social network, but in this paper, is to be classified as pure microblogging system (see section 2). 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.

3.3.2 Location Based Microblogs

Location based microblogs make use of the geo-location, a user currently resides in.

Zannel [38] 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. Currently, the only supported platform for a native application is iPhone OS, but Zannel can be accessed by a mobile web interface too, supporting all mobile browsers.

Shizzow [39] 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 either 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.

3.4 MSN: Distinctly Mobile Social Networking Platforms

In this section we review social networking platforms that are mainly targeted for mobile use. We classify them according to their main purposes and services.

3.4.1 Messaging and Chatting

Mokomobi [40] is a mobile social networking platform, offering not only messaging services but also live chats, group chat rooms and photo and video sharing. Mobile applications exist for J2ME enabled platforms and iPhone OS. Furthermore, a mobile Web interface is available, as the URLs top level domain ('.mobi') already suggests.

Qeep [41] is a German mobile social network platform, 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.

3.4.2 Interest Aware

Aka-aki [42] is a German social network, online since 2007. It features a J2ME based and an 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 the user how many interests are shared.

Seamee [43] 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.

3.4.3 Multimedia Sharing

Next2friends [44] is a mobile social network that allows to share photos and live video streams and offers mobile applications for J2ME, Blackberry OS and iPhone OS platforms.

3.5 Peer-to-peer mobile social networks

Peer-to-peer social networking platforms let peers (e.g. mobile devices) themselves autonomously handle communication between them. In contrast to that, conventional platforms store users' messages on their servers waiting to be retrieved by the respective recipients. For this reason, privacy issues with respect to the social network operator or potential attackers that infiltrated the system may occur.

Peer-to-peer social networks do not exhibit this weak point, because messages are stored on the recipients' devices ins distributed way. 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 will appear in the near future as there are already such systems for desktop computers, such as Noserub [13] for example.

3.5.1 SMS based

Cellmate [45] 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 decentralized 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 be quite expensive for the user.

3.5.2 SMS based and location aware

Are you here? [46] is a location aware peer-to-peer mobile social network based on the platform 'Wanted Smiling', released by Clicmobile [47]. By sending 'ON' via SMS to the service, the user is set as visible in the system and his location is shared with 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).

3.6 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 [48] and Wi-Fi. Some of the following systems are peer-to-peer based. Nevertheless the peer-to-peer services were divided into the two categories 'Peer-to-peer mobilesocial 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.

3.6.1 Wi-Fi based networks

iFob [49] 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' [49].

3.6.2 Social situations vizualising systems

Jabberwocky is a location aware mobile social software. It is a project of members of the Urban Atmospheres group within Intel Research Berkeley [50]. 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 vizualises 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 visualization, shown in figure 3, 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 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 visualization 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 [52]. Jabberwocky thus builds up a social network, having weighted and typified edges, and saves it in a decentralized manner only locally on the phone. In [51] the Jabberwocky developers describe two exemplary scenarios where the application can be useful:

Figure 3: Jabberwocky mobile application (Source: [51])

- 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.

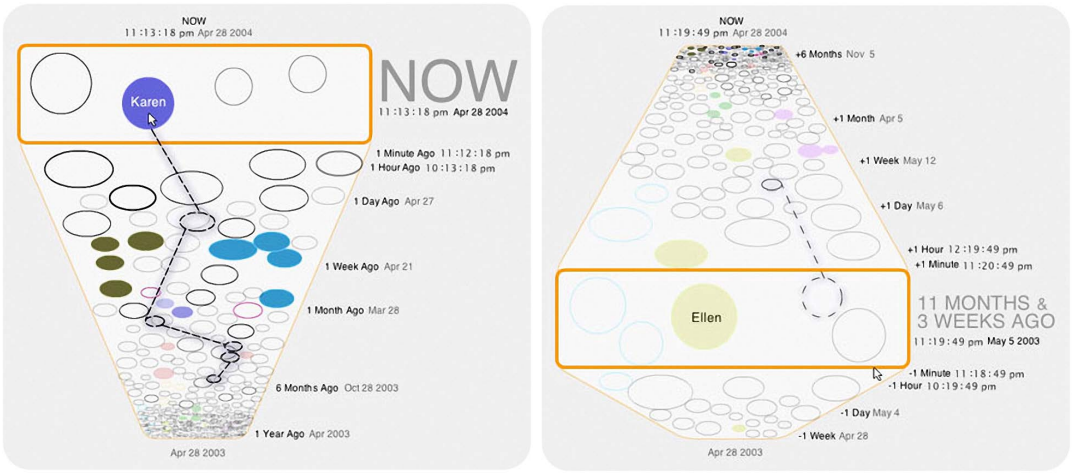


Figure 4: Encounter Bubbles (Source: [53])

Encounter Bubbles is a location aware social vizualisation software, which was presented by Zhanna Shamis and Sean Savage in [53]. Encounter Bubbles is built on top of a location based social service called Mobster. Only a PC software mock-up 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 centralized 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 vizualisation enlarges the selected point in time and displays it magnifying glass like. Screenshots of the user interface are shown in figure 4 (having inverted colors for printing).

3.7 Multiple social network access and instant messaging

Fring [54] 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 [55] is a mobile social network, highly connected with other networks like Facebook and MySpace and several instant messaging protocols. It offers mobile applications for J2ME enabled phones, iPhone OS, Symbian and Blackberry OS, and a web interface for mobile browsers.

Nimbuzz [56] is a mobile social 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.

3.7.1 Location aware versions

Buddymob [57] 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.

3.8 Location based mobile social networks

Brightkite [58] 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 smart-phones 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 [59] 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.

3.8.1 Friend finding services

Loopt [60] 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 [61] 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 [62] is a location sensitive mobile social network, integrating friends from other networks such as Facebook and Twitter with users' 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 exists for the iPhone OS.

MyGeolog [63] 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 [64] 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 [65] 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 exist.

The Grid [66] 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 [67] is a location aware mobile social network, primarily providing just a friend finding service. It connects with Facebook and soon with MySpace and Bebo [67]. 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 [68] 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 [69] is a location aware mobile social network, with the primary target to be a friend finder service. It is a purely 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 [70] 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 friend-list, joining groups and messaging. It adds the location aware feature of seeing current locations of friends.

Mologogo [71] 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.

3.8.2 Locating

Sniff [72] 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 localized.

Nowhere [73] 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). Nowhere users have to contract a subscription allowing them to locate friends 15 times for a few Euros 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 accessible by a mobile web interface.

3.8.3 Tracking

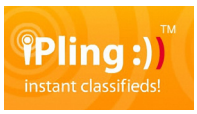
Buddyway [74] is a location aware mobile social network with a rich tracking service. With Buddyway, users can search for their friends locations, and can let the service log their own location. By telling the system to start a 'trip', the application starts sending its current location to the service 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 [75] is a location based mobile social network, focused on real time GPS tracking and friend finding services. Applications exist for Windows Mobile, Blackberry OS and Symbian.

3.8.4 Meeting new people

Meetmoi [76] 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 [77] 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 [78] 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 favorite 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 [79] 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.

3.8.5 Interest awareness

Match2blue [80] 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 [81] 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 [82].

3.8.6 Friend finding, location sensitive content

IRL Connect [83] 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 [84] music events, Panoramio [85] pictures, YouTube [86] 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 [87] or Fireeagle [88] services and their mobile applications.

Gypsii [89] 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 friend-list. These bots prepare location relevant news content, to show up on the map of interesting places.

Qiro [90] 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 vizualisation 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 [91], a location aware venue recommending and review service. Qiro can be used with a mobile application from any J2ME capable mobile device.

Urbian [92] 'is about your hyper-local social network, the people you meet in real life and the places you like' [92]. 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 vizualisation yet.

Groovr [93] 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 [94] 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 [95] (A recommendation and review site), geo-marked Wikipedia articles and some 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 [96] 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 geo-tagged 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 [97] 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 only exists for the iPhone OS yet.

3.8.7 City Guide

Buzzd [98] was launched in 2008 and is a location based mobile social network offering a mobile web-page 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.

3.8.8 Nightlife

MeetNowLive [99] 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.

3.8.9 Trips

Bliin [100] 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 [101] 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 web-page and no mobile application yet.

Rummble [102] 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.

3.8.10 Alerting when friends are nearby

Dodgeball [103] 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 [104], and went offline because of the launch of Google Latitude, that replaced the service completely.

3.8.11 Awarding systems

Skobbler [105] 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

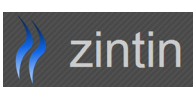
virtual 'karma' points the more they participate in the community. Moreover the system divides the world map in about two times two kilometer large grid squares. If a user has written more articles about places of interest than any other user, he becomes the 'Local Hero' in that grid square. A map view 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 are targetted to keep Skobbler interesting, comparable to a game, and the service thus gets a rich database of places of interest, that people can browse through.

Foursquare [106] is a mobile social network whose founders were partly involved with 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.

3.8.12 Storytelling

Whrrl [107] 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' [108]. 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 a certain phone number (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.

3.8.13 Location and distance aware bulletins



Zintin [109] is a purely 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' [110]. Zintin is only available for the iPhone OS so far.

3.9 Mobile social networks with microblogging

Blummi [111] 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 friend-lists, 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.

3.9.1 Interest and location aware

Trackut [112] 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 [113] 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 3.9.1, 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.

3.9.2 Location based geojournals

Belysio [114] is a location aware social network that provides a web-page 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 geo-tagged 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 categorized under 'Mobile social networks with microblogging'.

3.9.3 Multimedia sharing

Radar [115] 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 [116] is a mobile social network with microblogging and photo sharing functionality, accessible by a mobile web interface or the J2ME based mobile application.

4 Empirical Analysis

Besides the characterization and classification of platform- and service-concepts, a natural goal when characterizing Mobile Social Networking (MSN) is statistically characterizing the usage patterns in the MSN universe. Unfortunately, as of September 2009, it is a complicating factor that a large share of the more innovative platform- and service-concepts in MSN characterized in the previous part 3 do not have a user basis that is broad enough for meaningful quantitative studies. Furthermore, data about usage patterns of their mobile versions are hard to acquire. We therefore first also reviewed and investigated the dynamics in conventional social networking platforms having a mobile version, in order to be able to infer insights about potential dynamics of their mobile versions, where necessary.

4.1 Social Network Crawler

For our investigations we selected a number of MSN platforms on the basis of a set of criteria:

- platforms that could also be accessed via non-mobile network in order to be able to efficiently investigate them.
- platforms that allowed for crawling the social network at all
- platforms that had a non trivial user-base and were "alive´´ (had sufficient traffic (quantity and up-to-date-ness)
- Facebook should be included as a reference

A crawler was written in C# that crawled the raw social network graph from several SN-platforms using anonymization for the profile- nodes. The application allows for comparative visualization of the resulting graphs. For SN-platforms with numerical user-ids, random ids were created and checked for validity. If valid, the corresponding network edges were crawled from the respective profiles. For networks with string-based ids, we started from several known user-ids and crawled the graph depth first until a depth of three. After that, duplicates were removed. For both crawling styles we subsequently removed nodes with no adjacent edges.

Both approaches do not guarantee a strict statistical representativeness, but due to the small world-like structure of social networks (see e.g. [117]), a sufficient degree of representativeness to monitor the dynamics of these social networks can be assumed.

We crawled the networks from a selection of mobile social network platforms weekly for exactly eight weeks, between 6. July and 31. August 2009, in order to analyze the dynamics of these networks.

4.2 Network dynamics

Figures 5 and 6 shows the absolute and relative dynamics of the average number of friends in several (mobile) social networks. The analysis reveals that on average 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. (Compare figure 7). It turns out that average friendlist sizes (average numbers of

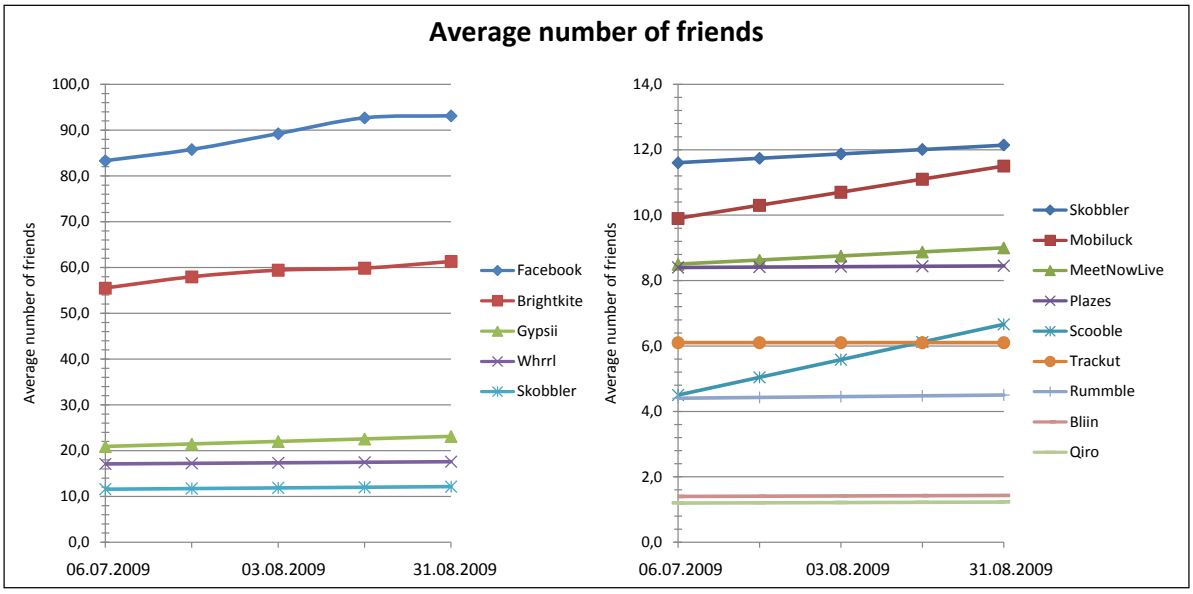


Figure 5: Dynamics of the average number of adjacent edges of a node in several mobile social networks. ('skobbler' is plotted in both for orientation.)

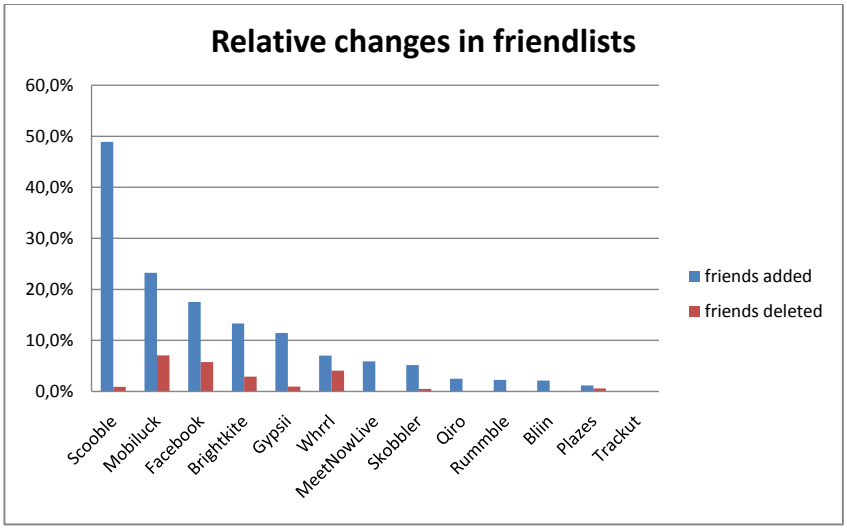


Figure 6: Relative dynamics of average number of adjacent edges.

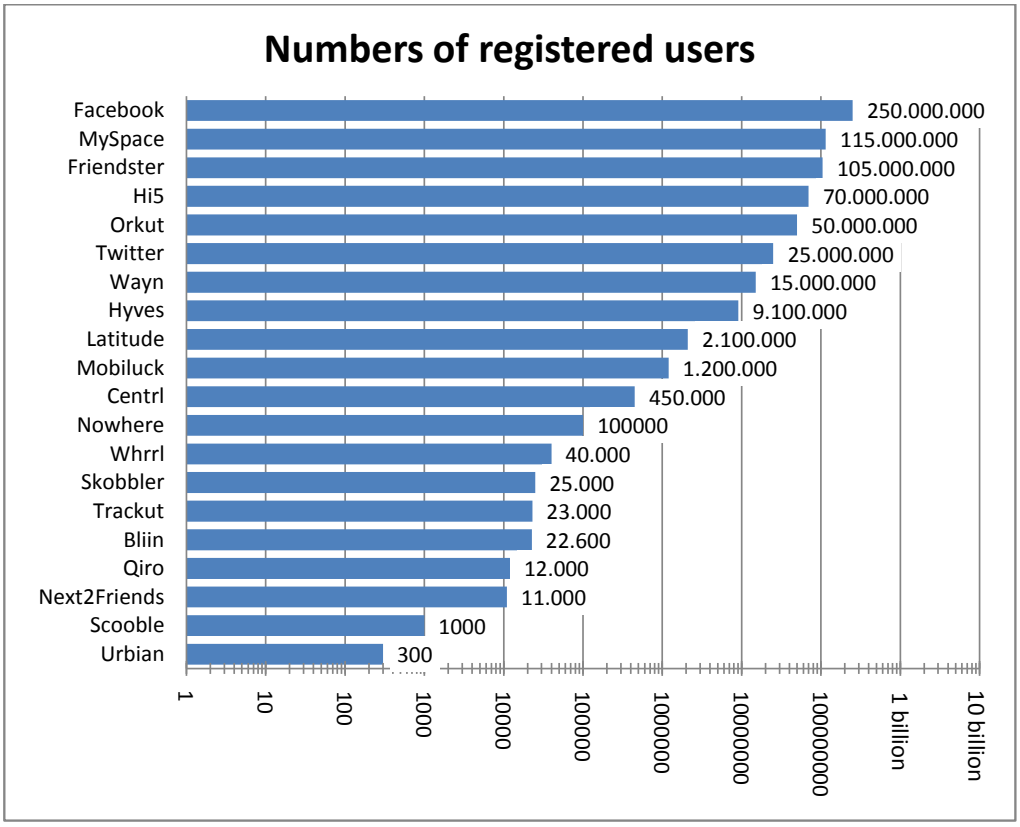


Figure 7: Numbers of their registered users (August 2009), shown on a logarithmic scale.

adjacent nodes) scale relative to the absolute sizes of the overall social network of the respective platforms. The obvious reason for this phenomenon is that for an average person the total share of friends registered in a small platform is also small. This is one reason why the market for mobile social networking is dominated by the existing large SN-platforms. Small and new mobile social networks predominantly denote small growth, while popular networks grow even futher (see figure 5)

Other reasons for startup difficulties of new innovative mobile SN platforms may be, that only 13% of all sold mobile phones in the first quarter of 2009 were smart phones [118] that provided a basic UI (screen size, maturity of input techniques etc.) sufficient for both mobile web-browser based or application based mobile SN services. In 2007 only 3.5% (USA) and 2.2% (Europe) of all mobile device users used mobile social networking services [119]. Furthermore, sufficiently cost effective flat-rates for mobile data-transfer are only becoming to be widespread as of August 2009, so that MSN is still quite costly, especially for the SMS-bases services.

Figure 8 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 8 complements the overview of figure 7 and further illustrates the findings just discussed,

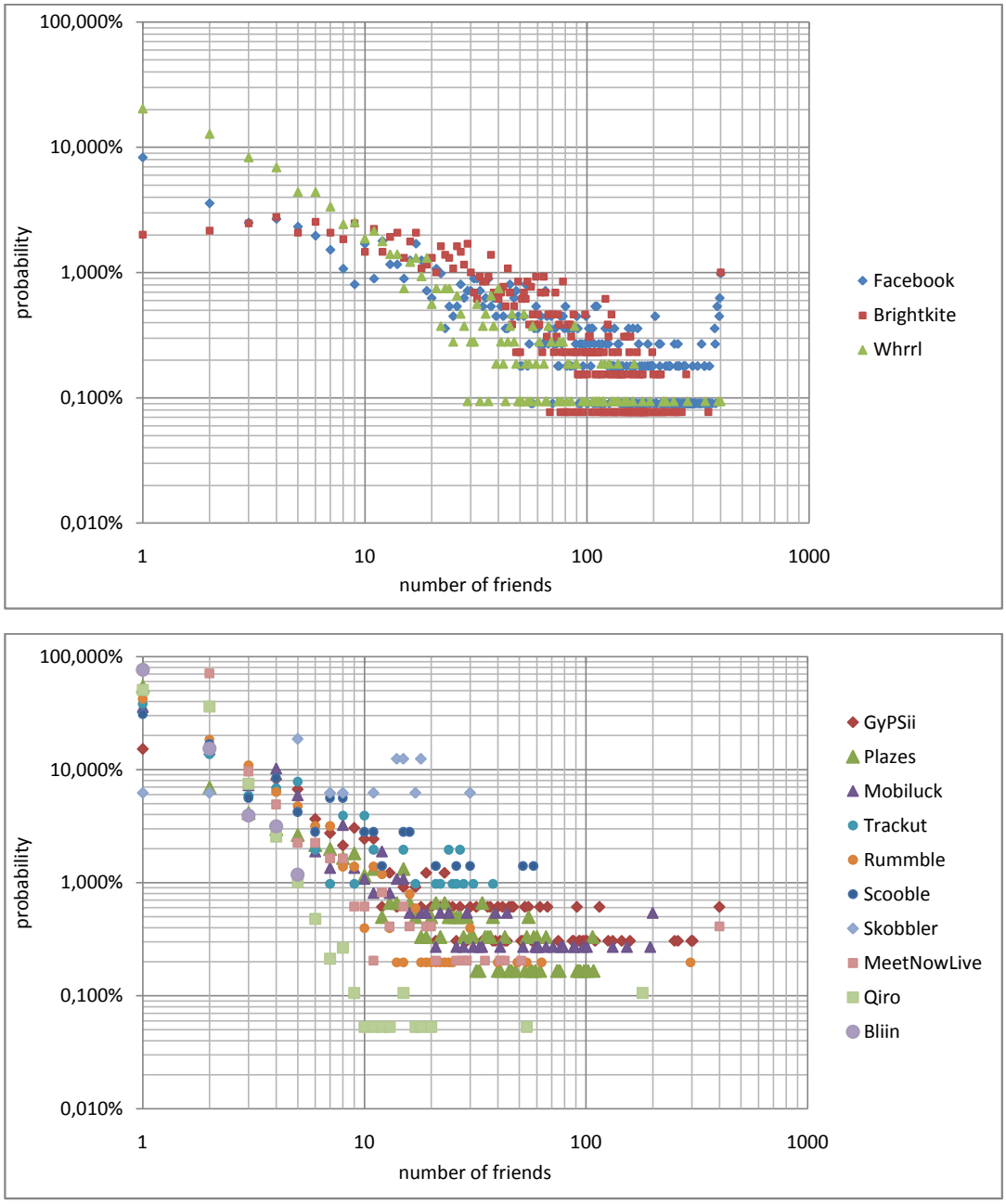


Figure 8: The distribution of friend-list sizes of several classic social networks (with mobile version) and distinctly mobile social networks. One data point denotes the probability of a user having this specific number of edges (friends). Both diagrams are identically logarithmically scaled.

showing the distribution of friend-list sizes. We see that small new mobile networks have distributions with a high probability of having very few friends which directly competing against the established players gives them a small chance of sustained presence in the market.

4.2.1 Development of mobile social network start-ups

Since the end of the 1990s mobile social networking concepts enjoyed mixed success. Early MSN platforms like the SixDegrees platform (launched 1997, ceased 2001) or Dodgeball (launched in 2000) showed that while the market was not yet ready for these kind of concepts, some of their ideas prevailed and were integrated in later platforms. The number of newly launched mobile networks virtually exploded in 2007. Of all MSN platforms, the figure contains our

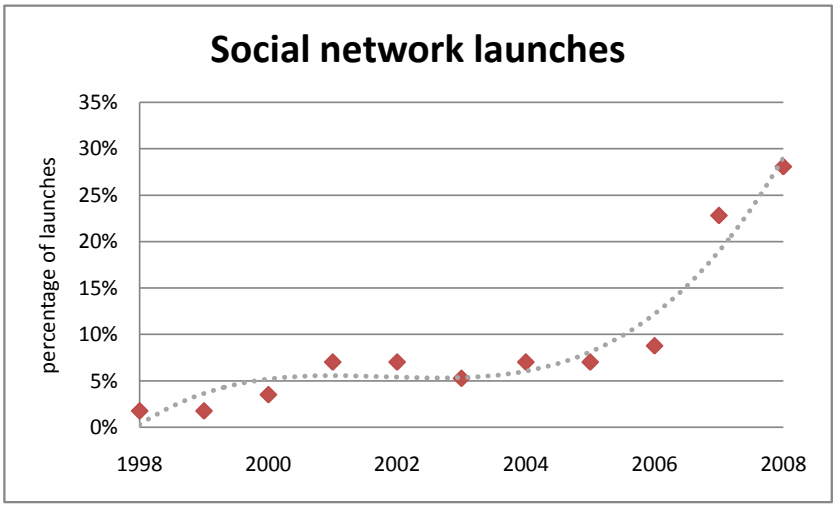


Figure 9: Number of social networks launched in respective years. Fractions correspond to total number of launches of social networks, discussed in this contribution.

complete selection of pure MSN platforms and only the most popular "classic´´ SN platforms with additional mobile interfaces. nearly all mobile interfaces and application for classic social networks were developed after 2006. The launching dates were captured from the official blogs or press releases of the network service developers or by searching the Internet Archive [120] 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 contribution.

4.3 Geographic dependencies in utilisation

The user-base of most platforms are concentrated in a certain region of the world. Region of origin and region of highest polularity can differ: Orkut was developed in California, USA and is now mainly used by Brazilian people [33].

4.4 Spread and usage of different mobile platforms

4.4.1 Usage of mobile platforms

In view of the question what OS platforms are used for mobile social networking, no direct usage data are available for this contribution. Indirect reasoning may however may be accomplished by analyzing the distribution of mobile internet traffic with respect to the various platforms (see

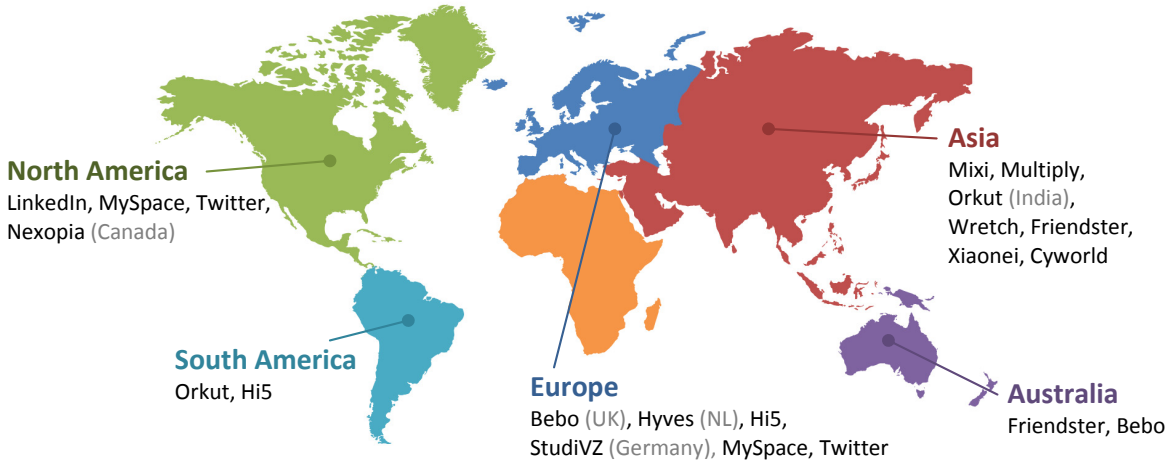


Figure 10: Geographic dependencies of several social networks (data: [121] and own research)

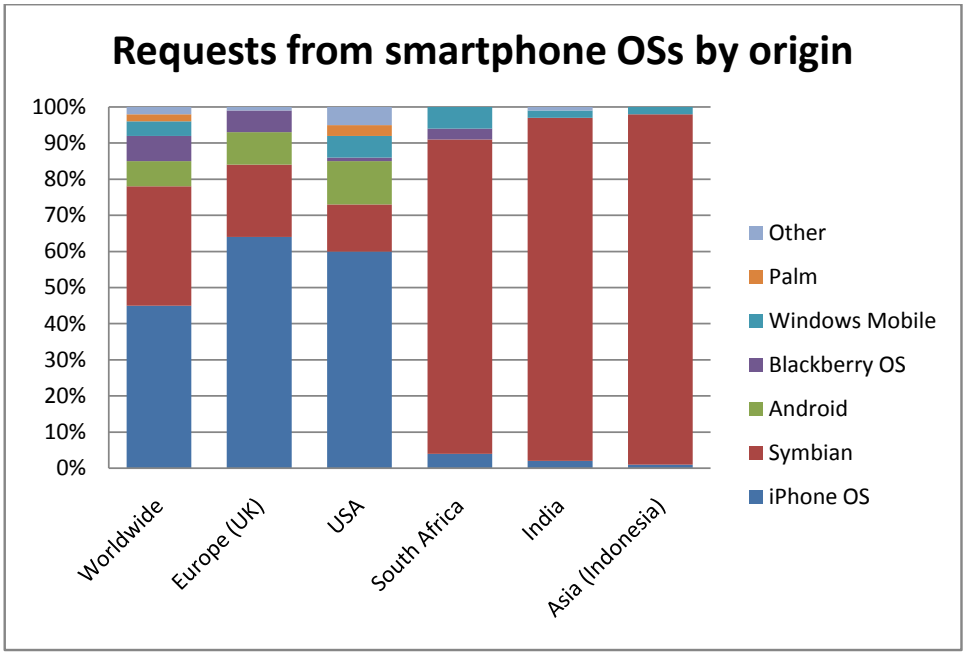


Figure 11: Percental fractions of requests from smartphone operating systems, broken down into origin countries (numbers: AdMob Mobile Metrics Report 2009 [122]

figure 11). Sales figures of these platforms are in general not a good indicator, since the actual internet usage may strongly depend on the tariffs chosen by the users.

Figure 11 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 [118]. 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 12.

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.

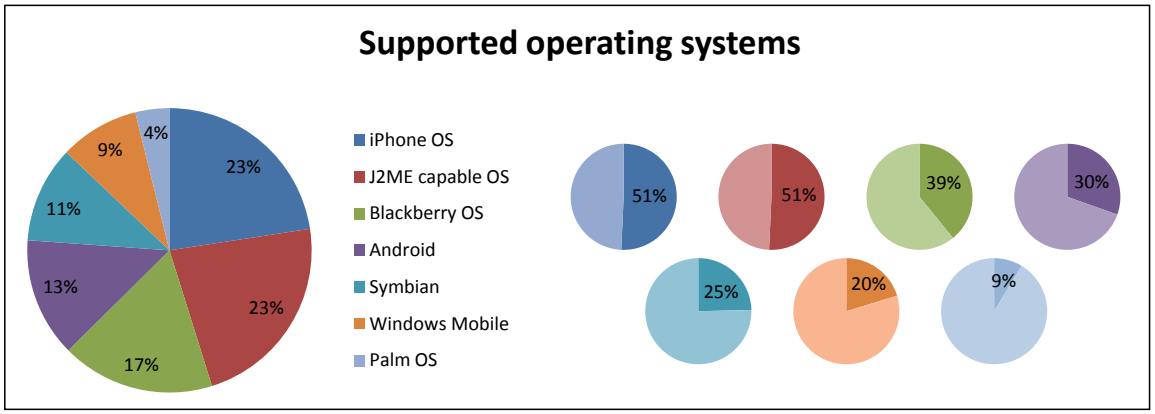


Figure 12: Distribution of available social network applications across the platforms. The small diagrams indicate how many social networks offer an application for the particular operating system.

Symbian and the iPhone operating system are apparently most popular worldwide for browsing the internet, as figure 11 shows. Users of these two platforms also have a great variety of mobile social software (see figure 12), 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 12. 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

13 points out how this is distributed and how many services offer total platform independence. To provide a detailed overview over all presented mobile social networks and their supported

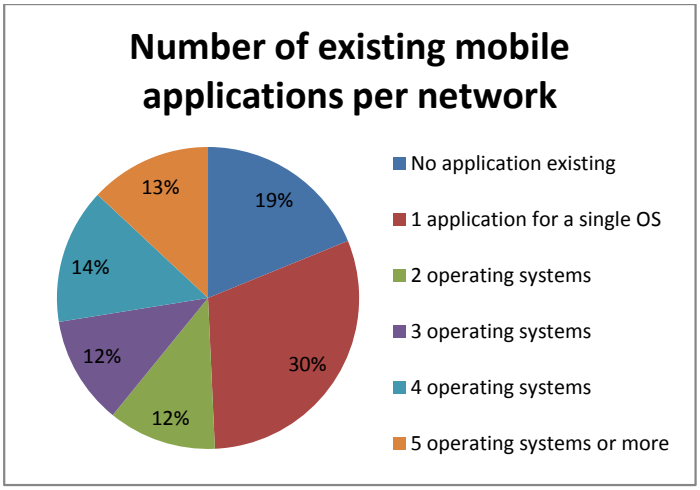


Figure 13: Distribution of social network platforms as either platform independent, dependent on one to five special systems, or not offering any mobile application at all.

platforms, a tabular listing is shown in figure 14.

5 Conclusion

In this contribution we reviewed current mobile social networking platforms and services in order to give an overview of the practical state of the art in this field. We discussed a classification system for current MSN services and provided a short discussion and classification of the currently existing approaches. We regarded those MSN platforms that fulfilled certain maturity criteria (e.g. have a non-trivial user-base (as of August 2009)). We then presented an empirical analysis on MSN platforms, e.g. analyzing the dynamics of the underlying social networks, the distribution with respect to mobile OS platforms used, the geographical distribution etc. Having discussed current MSN systems and the functionality they provide, it is interesting to regard possibilities and prerequisites for future services in the field of MSN.

5.1 Future approaches in MSN

Weighted and directed relations Introducing further attributes to the social relations such as weights or a direction is an interesting possibility. In desktop-based SN platforms, weights and directions can be deduced from statistical properties of communication acts (frequency, reciprocity, temporal variations (e.g. burst-behavior) etc. see e.g. [4]). In mobile social networking, social context such as co-presence (e.g. modeled by social situations [124][125]) allows for an even richer ground for deducing weights of social relations. Weighted relations could be used in a variety of ways: Awareness services could focus on relations with lower weights for example, privacy settings could be formulated according to edge weights etc.

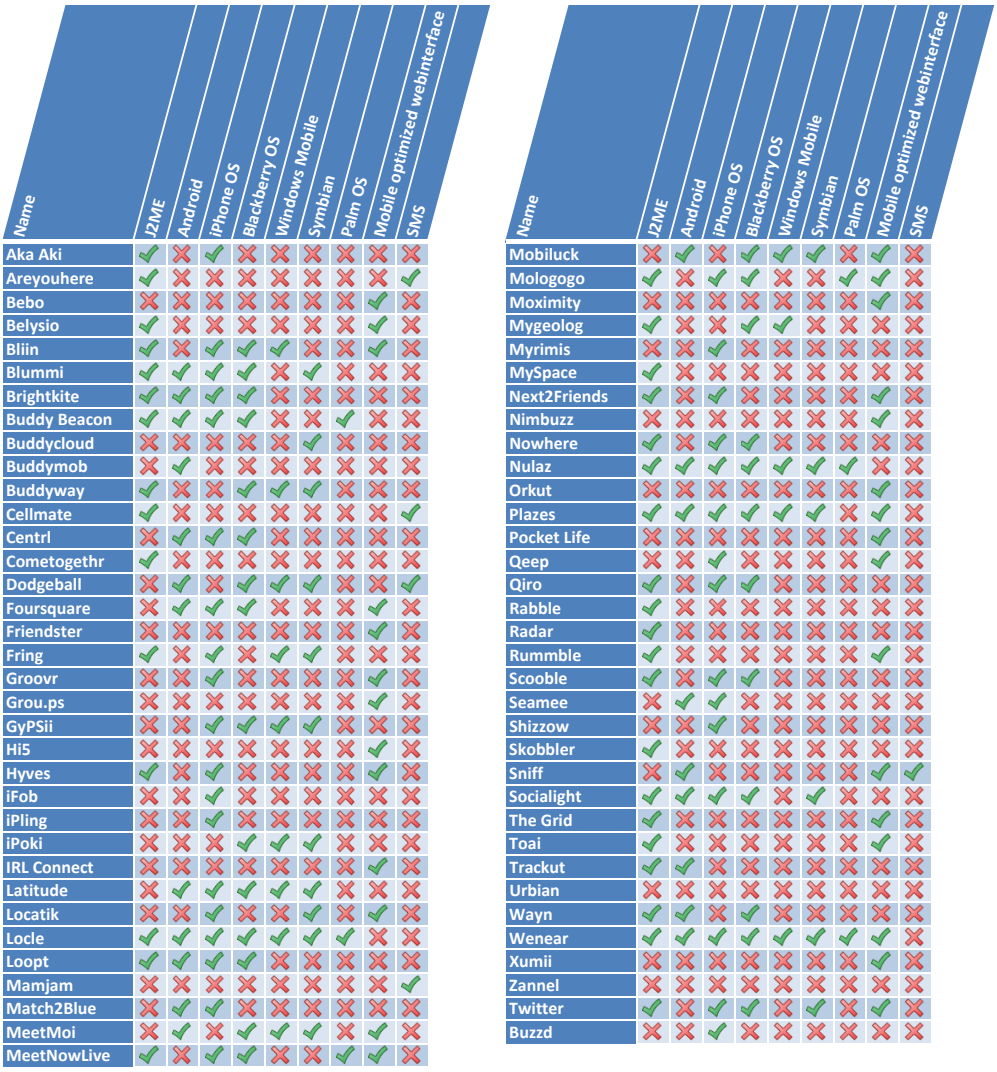


Figure 14: Listing of all discussed social networking services and their supported platforms and interfaces.

Typified relations Typified social relations also have an interesting potential for new applications in SN and MSN. They may be used for privacy settings (e.g. restricting access to certain parts of the personal information space only to users to whom a person has a relation of a certain super-type), customizing awareness services or communication services (e.g. addressing people with certain relations to the sender). Assigning social relations to one or more concepts or types can either be done manually (as in a restricted way already realized by e.g. Facebook groups) or potentially by analyzing the contents of communication between two parties. The conceptualization itself can also be manually created (either by a platform provider or by a certain group of users) or automatically deduced (e.g. as a folksonomy of relations from tags). It can be a formal ontology (see e.g. [126][127]) or a simple flat or hierarchical taxonomy.

Individual and social context Mobile social networking allows for richer possibilities for acquiring data on individual and social context. Examples have been discussed in section 1. A typical example for individual context is location. Classes of services in individual mobile information management (see e.g. [128]) that may use location include reminder-services, where 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 already exists [129], and even additionally sends the estimated time of arrival. Classes of services in MSN may especially use co-location in form of social situation models for awareness- and communication services like Social Life Logging or SocioCast (see e.g. [125]. Especially interesting is the automatic deduction of social context on the basis of social signals as discussed in 1 (see e.g. [124]). Location may be used in MSN for collaborative advertising and information markets. 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 receive offers by special users only or 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 specifying time ranges, is already used in the MeetNowLive mobile social network, presented in section 3.8.8.

Advanced visualisations Orthogonal to the aforementioned possibilities, advanced visualization of and using context information is also an interesting aspect of future MSN services. With most of today's 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.
- More advanced views of the current social context: Friend-finder services, dynamics of parts of the personal social network (e.g. dynamics of the instantiations of certain social relations in social situations [125]) etc.
- Timeline based visualisations (e.g. of parts of the social network), like already implemented in Encounter Bubbles (see section 3.6.2). (see also e.g. [130]).
- 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 geo-tagged social networking content, such as positions of friends, places of interest and more.

[1] http://layar.eu/

5.2 Completeness of this contribution

As a conclusion, after broad researches, it can be assured that nearly all relevant mobile social networks as of September 2009 were covered with this thesis, that provide extra features compared to other networks. Surely, many small mobile social networks exist, 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 research, do not provide any added value or additional functionality compared to respective systems, discussed in this thesis.

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