Mobile Communities – Extending Online Communities into the Real World

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Abstract: Communities offer a context for people to meet, communicate and collaborate. Tools to support communities usually provide a communication medium and functionalities to find communication partners. Thereby, they strengthen existing communities or enable completely new (virtual) communities. In this paper we briefly present some ideas towards the extension of community support to mobile environments from the ongoing project COSMOS[1]. The objectives of COSMOS are the development of new technologies and concepts for this support. We discuss ideas for mobile community support services, focus on a community centric view of positioning services, and lay out a plan for future work.

1 Introduction

Human beings are social creatures with an inherent desire for communication and interaction with others. The term „community" describes groups of people that identify themselves with a common idea (often reflected in common interests) and that have the means to communicate with each other, which they use to collaborate around the common idea.

Communities offer a context for people to meet and communicate and thereby support awareness of people and communication among each other. Community support systems help communities to form or function by providing a physical and/or virtual space where people can communicate and where they can find other people.

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A functioning community depends on the active participation of a significant percentage of its members. Hence, the availability and modality of access to the community support infrastructure can be considered a major issue, because only a broad participation in the community activities can sustain the functioning of the community. However, experience so far demonstrates that the common user base of community support systems is mainly composed of computer literate individuals, accessing the network with an already existing desktop computer at home or at the workplace. In fact, from the technology point of view community support systems are often based on large bulletin boards and the main user interface is usually a Web browser.

Electronic community support has been, till now, determined by boundaries of stationary computers and desktop based user interfaces. Ubiquitous computing and mobile computing are addressing these boundaries and offer possibilities for enlarging the reach of community support systems. In addition to enlarging the reach, mobile interfaces open completely new fields for community support – new functionalities and new scenarios can be contrived.

The new possibilities (new functionalities, new user groups, new situations where community support systems can be accessed) require the development of new service types and of new technological solutions, but also ask for new business models and organizational concepts. The project COSMOS aims at exploring possibilities and solutions in the area of mobile community support. In this paper we focus on identifying generic mobile community support services and on the discussion of positioning services in this context. In Section 2 we first review current work on the abstraction of community support and on tools to support communities. Section 3 builds on this work and motivates community support services that could profit from mobile access. Section 4 finally focuses on different strategies for acquiring positioning information in the special context of community support.

2 Communities and Community Support

The main activities in communities are finding other people and communication in order to collaborate or help each other. Therefore, community support usually can be seen as "communication and matchmaking support". In this context, the term communication is understood in a very broad sense. Communication can be classified as direct (email, SMS, chat, etc.) or indirect (publishing information for potential prospects, retrieving previously published information from the community information space etc.), synchronous or asynchronous, automatically triggered or manually triggered, and according to many more aspects.

In summary, the following basic support concepts can be derived:

- Providing a medium or channel for direct communication and for indirect exchange of information objects or comments on objects within the common scope (the information space) of the community.

  The information channel can be enhanced with features that use information about the community member to do (semi-)automatic filtering and personalization.

- Providing awareness of other members and helping to discover relationships (e.g. by visualizing them). This can help to find possible cooperation partners for direct interaction (matchmaking, expert finding).

Using networked computers for supporting communities can be tracked back to the beginnings of the Internet (Hafner and Lyon 1996). Current solutions mainly consist of bulletin board like systems, which are often integrated in different information offerings, and of different awareness and direct communication tools (see e.g. Ishida 1998a, Ishida 1998b, Michalski 1997).

We believe that electronic support for several types of communities, especially local communities (built around a locality, meetings in physical space) can only be successful if the access to the support infrastructure is broadly extended into the real places through new user interface metaphors mixed with classical community support media, and not only offered through home or work desktop computers. It should be possible to use community support platforms “anytime” and “anyplace” – one should no longer need to go to special (work-)places to interact with other community members .

Some projects have already started to tackle this objective. For example the project Campiello (Agostini et al. 2000, Grasso et al. 2000) was targeted towards the development of a community support system for the tourist domain. The main problem addressed was the fact that even while information systems are available anytime and anyplace they

- are not smoothly integrated into all interaction and task situations – some tourists would like to interact with the information system when walking around in a museum, and
- are not available to anyone – especially computer amateurs are quite reluctant when it comes to interacting with a community support application via desktop based Web user interfaces.

In Campiello we investigated the idea of using “the cheapest mobile device available”, namely paper forms, and worked on better interfacing of paper forms with electronic information systems. People could write their comments on paper cards and get recommendations in paper form (Koch et al. 1999) – this can be seen as an intermediate step to fully connected mobile devices.

3 Context-sensitive and Location-based (Mobile) Community Support Services

The first mobile services that can be used for community support are already deployed. The most popular service is the Short-Message-Service (SMS). This service enables users to send short messages from their mobile device to other users mobile devices. In addition to SMS several prototypic matchmaking or location-based information services are currently introduced (e.g. FriendZone by SwissCom). However, these services do not make extensive use of mobile context information or are technology-focused solutions not designed with the idea of community (support) in mind.

Much of the work in research on mobile services has dealt with technology issues such as limited battery life, portability and location discovery. User-centered research of mobile support emerged in the work support area and is just now extending into general collaboration support (see Churchill and Wakeford 2001, Grinter and Eldridge 2001, Luff and Heath 1998, Perry et al. 2001).

There is a need to explore the possible space of mobile community services in a more general manner. In the COSMOS project we have therefore started with some scenarios for mobile community support and then have derived basic categories for mobile community support services (based on the generic community support services motivated in Section 2).

Here one example for a usage scenario from the lifestyle support domain:

> *After a laborious college week, 20-year old student Susan is having dinner with her best friend Petra in the pub "Future". Via her mobile device, Susan is continuously connected to her mobile online community "Munich Community (Muccom)". Through Muccom she informs a group of ten friends (her "buddy" network) that she is currently staying at the "Future" pub and that she intends to go to a club at 11 p.m.. At 10 p.m. Susan's friends Stefan and Holger enter the pub. They have received the information (via Muccom) that Susan and Petra are there and that they intend to go to a club afterwards. Through the news service they receive the information that the club "In-Dance" will be giving a party tonight with the motto "Space-Night". The party is said to be very hip, at least according to the club, which posted the information in Muccom. Holger and Susan check whether somebody from their buddy-network is already at the club. Holger finds out that his friend Sven is there and contacts him. Sven dissuades him from coming, because the club is rather empty and drinks cost twice as much as usual. But Sven has found out through his "buddy network" that the club "Alternative" has spontaneously arranged a Samba party after the arrival of a group of Hispanic tourists. Holger contacts the other community members and tells them about the situation. They decide to visit the "Alternative" ...*

In addition to the anytime, anyplace features (access from everywhere and at anytime, being accessible anywhere and at anytime) the extension of support for communities into the real world via the integration of mobile end-devices makes a broad spectrum of context data available for communication services. The most important contextual information is the information of someone's whereabout (the current location). Other contextual data include the interaction in which the user is currently involved, the temperature outside, the velocity and direction of movement etc. In general we can understand the context of a (mobile) user as all data that is measurable by sensors and that can be reasonably represented in a computer in order to improve the quality of services.

Previous systems used contextual data in location based information services. For community support we are thinking of location and context based communication services. In the following we will discuss possible service categories according to the basic community support concepts presented in Section 2.

3.1 Services for matchmaking

Matchmaking is the process of bringing together people that have common attributes. This can be done proactively by pointing to a person that might be interesting to contact

(and displaying an explanation why) or non-proactively by simply providing information about who is around (a topic, a place) and visualizing interesting (public) features of these persons.

The features of mobile devices that can provide new services are

1) that it is possible to query from everywhere or to be notified of possible contacts at any place, and
2) that location and other context attributes can be taken into consideration for selecting contacts. These features make it possible to use matchmaking for spontaneous activities and for immediately meeting face to face (if contacts where selected based on similar location).

Implementing such features in a community (platform) might help in addressing the privacy issues that usually come up when using and presenting user profile information. A community can be a perfect place to control access to such attributes by capturing and defining relationship networks that can be used to define access control.

3.2 Services that support synchronous communication

Synchronous (speech) communication is currently the most important use of mobile devices. Synchronous communication can profit from being embedded into a community in different ways. First, community platforms can provide more powerful functions for reachability management. Users can specify rules and parameters in their profiles that enable other community members to look up the reachability status of someone they want to call before actually placing the call.

Knowledge of other user's profiles and contextual data (which can conceptually be regarded as part of the profile) can substantially increase the power of a reachability management component by e.g. automatically detecting a business meeting by deducing it from the fact that a certain number of co-workers are in a room together. By monitoring not only the motions and contexts of single persons but also the motions and contexts of groups of persons, a much broader basis for the application of machine learning algorithms for inductively learning reachability patterns will be given.

3.3 Services that support asynchronous communication

Sending asynchronous messages (email, SMS, etc.) is a very effective way of communicating and profits much of the community scenario and the mobile scenario as well. Sending messages to groups of people that are defined through combinations of attributes is one possible application. E.g. the groups can be defined as "the group of people with a current location near me" or "the group of people with a future location near xy" (tagging messages to places). Besides manually triggered asynchronous communication, automatically triggered communication (push services) are very useful too. E.g. the system can inform users of other community members around, or of information that is useful to groups of community members around.

3.4 Current state of the project

We are currently in the state of implementing a basic server infrastructure providing the services that have been described in the previous parts. Since context-awareness and especially location awareness is one of our main goals we put a strong emphasis on a suitable framework for the detection, storage and transformation of positional data. In view of transformation of positional data we rely on commercial geocoding services and commercial geo-spatial data-sets which allow to transform different location representations into one another.

4 Community Positioning

The location and positioning services are a central part of mobile community services. They are needed for information service like “where is the next pub”, for communication services like “who is at the moment in this special pub”, and for group communication services like “where are my friends and where is the best meeting point”. The location information has a very special role. The more exact and the more current the position of the community members is known, the better location based services can be offered to the community members. The ideal situation would be to have a database with the exact current position of each community member, which is refreshed every second. Unfortunately, by now, it is not possible to have such a system. The computation of the position depends on the technology, which is used. E.g. the GPS (Global Positioning System) is very exact, but the receiver costs a lot of money and even the stand-by function consumes a lot of power. For mobile devices as used in mobile communities, there is not much power available. Less exact positioning can be provided with mobile networks like they are used for mobile phones. There is even no additional hardware needed for some positioning methods. Unfortunately, the positioning process costs money, so it is worth considering different refreshing methods for the community member’s position. Questions like this will be discussed and answered in the following sections.

4.1 Differences between Location-Based Information Services and Mobile Communities with Location-Based Context

Location based services are not a brand new thing. GPS (Global Positioning System) based services like car navigation, fleet management or tracking services are available for several years now. Five years ago, another way to provide location-based services has been developed: In mobile phone networks, it is possible to get the position from the surrounding base stations. With a WAP (Wireless Application Protocol) mobile, it is possible to get location-based services like finder services or accounting services. One big advantage of this method is, that no expensive additional hardware is needed to use one of this services.

But all in all, most of the available location-based services have all the same characteristics: The user wants to get information in context to his current position to use this information on his own. The services are typically “pull” information services. The initiator

asks for special location-based information, and therefore the position is calculated. There is no interference with any other user or member of the system.

The mobile community with location context is different. The location-based services developed for the COSMOS project are implemented in a central server. The positions of all community members should be known in the server in order to provide the services. The services consist of complex instructions with mostly communication character (E.g. friend finder services, or location based push services).

The mobile community with location context can be seen as evolution of the location-based information services. In location-based information services one's location information was only important for oneself. In location-based community services the location information from each community member will help all the other community members. With this information, the community is able to offer services, which have not been seen by now.

4.2 Positioning techniques for mobile communities and mobile networks

There are a lot of different positioning techniques to get the member's position. These techniques differ in many characteristics: handling, exactness, technical request and costs. We now will discuss the different techniques in the context of mobile community support.

4.2.1 Manual input

The manual input of the position is the easiest possibility to get position information. There is no additional work needed, because the community member finds out his position and sends it to the system (e.g. he knows his position or uses a GPS receiver). This can be done in different formats:

1. Area format, e.g. town, district or municipal area. (E.g. friend finding or weather information)
2. Exact position input with address input. (location based services like stick a information at one geographical point)
3. Exact position input in geographical format. (the most exact positioning technique with extra hardware like GPS receiver)

In order to enter the position information manually, an input mask should be offered to the community member. Except connection charge, there are no additional costs.

To make entering positioning information more convenient for community members, a smart input method could be used. (E.g. the user type in the first letters of his address and the system shows him a choice of possible addresses. Now the user chooses the right one.).

The most convenient method of the manual input method is the input via pre-defined locations. Therefore, the user has to define the locations he will be at usually. Then he only chooses the location he's located at the moment. Even community wide keywords are possible, which all members can choose from (e.g. special places in a town). Therefore

all community members help to create a big database with all important location keywords for the community.

A timetable of locations could as well be possible (e.g. from Monday to Friday 8 a.m. to 3 p.m. I am at work at Munich, Arcisstr. 10, on Tuesday 7 p.m. till 9 p.m. I'm on my sports lesson in location xy). The user can define his rules to describe exactly his location movements.

The main advantage of manual input is its flexibility, the low requirements additional for hardware and network infrastructure, and the user control of privacy. The main problem is the need for user action to update the location information. When up to date information is needed automatic update and implementation of privacy control on the server is preferred.

4.2.2 Positioning in wireless networks

- In mobile phone networks there is the possibility to calculate the position relative to base stations. This is done by triangulation with the signal arrival times from different base station to the mobile terminal. The information about the base stations' location it needed in order to translate the relative position to geographical positions.

Network based positioning in wireless networks

Here the mobile networks include a location server. It calculates on demand the positioning information for each user in geographical format. With interfaces, the third party service provider can get the positioning information in order to offer location-based services. All known methods for positioning are possible. This is the most common method for location-based services in mobile phone networks.

Terminal based positioning in wireless networks

For terminal based positioning, a logical unit in the mobile terminal and information about the base stations' geographical position is needed. The logical unit reads out the important positioning information (Cell ID and/or signal strength and/or surrounding cells) and sends them to an independent location server, which has a big database with the base stations' geographical positions. Then the server calculates the geographical position and returns it to the mobile terminal. Logical units in the mobile terminal could be Smart Phones, PDAs or even the SIM Application Toolkit. The biggest problem for terminal based positioning is to get the base stations' geographical positions, because the mobile network operators are not releasing this information.

4.2.3 Positioning in wired networks

Mobile community members will not only work with mobile terminals. Some of the interaction in the community will also take place from wired computers (home computers, computers at work/university or even computers in internet cafes).

So we should also look at retrieving position information when the user is working from a stationary computer. Since stationary computers are not part of a mobile network, the main information for the location is the computers' IP address. An IP address is a unique number in the whole Internet. It is separated into net-id and host-id. If the community server has a database with information about IP address and geographical position available (globally or only selectively for the supported area and the community members), the system is able to derive the client's position (e.g. the IP addresses from the university are best known as well as the geographical position). This database has to be built with reference to the users' profiles. Even if there is IP address masquerading by the Internet service provider, the community server is able to find out the network id and therefore the service provider. Then the community server knows the member's profile (user xx always uses service provider yy to connect to the Internet at home), then it is possible to get the position of a community members which is connected through a stationary computer to the community system.

4.3 Transfer protocols and positioning requests

In mobile networks, each byte sent or each second online time, costs money. Therefore, the mobile community communication protocol for the positioning aspect should be very effective in order to be not too expensive to the community member. Unneeded overhead is not acceptable. There are three different position update methods for achieving this goal:

1. Manual controlled position update: The community member decides when there should be a position update. With user profiles and position timetables (described in manual input) this method is the cheapest method. The community user only pays when he wants to be positioned.
2. Time controlled permanent update: The other extreme. Each predefined interval, the community member's position will be updated. This method is useful for community members, who're always on the move with unknown locations.
3. Location update on demand: The user's position is calculated on demand. If there is a positioning request for a special user by the community system or an other community member in order to use it for a special service , the system requests the positioning information from the user, calculates and then uses the result for location based services. This is this most effective, but slowest method. For each positioning request on each user, the system has to ask for the user's position. This means traffic and time delay.

In addition to the positioning request methods, there are several transfer protocols for sending the positioning information to the community server. The most common protocols are:

1. CSD (Circuit Switched Data): The normal dial up connection to a WAP Proxy. It is charged time orientated.
2. GPRS (General Packet Radio Service): A new service for high data transfer rates. The mobile terminal is always connected. This service is charged volume based.

3. SMS (Short Message Service): A very popular service to send small messages (<160 letters). The positioning information could be sent by SMS to the system server.

All in all, there is no optimal positioning request method for mobile communities. The optimum depends on the hardware, the positioning method and the transfer protocol in combination. E.g. for terminal based positioning with GPRS, the permanent positioning could be useful and not too expensive (if you have a programmable terminal.) But if you need network based positioning, the positioning request method should be another one, because for each calculated position the network provider requests money. Here the positioning method "on demand" or "manual controlled" would be best.

The positioning request methods, the transfer protocols and the positioning methods all depends on the user's desire and payment will. There can even be a strategic alliance with network operator found in order to get a cheaper positioning. But all depends on the community members desires. If he wants the community to get his exact position at any time (best for every location based service in the mobile Community), he should get it 8and pay for it), as well as if he doesn't want to spend too much money (and get a worse positioning method). The user should decide him self. The mobile community system must be able to deal with all users' desires.

5 Conclusions and Future Work

In this paper we have given a brief introduction to mobile community support and have presented some ideas for mobile community support services. The main points here were to make the anytime, anyplace feature and the additional context information available for different communication and matchmaking services. Embedding this functionality in a community platform can help with different trust and privacy issues.

In the project COSMOS we are building on these first ideas. We are currently designing services and a support platform for two prototype communities in the domains lifestyle and healthcare. With these prototype communities we will test and further develop our ideas about useful services and continue our work on the basic challenges with mobile community support. Thereby, we will address both technical challenges like server platforms that support different kinds of devices, modules that do context adaptation, sensors for generating context information, and non technical ones like the thorough analysis of community needs with a sociological perspective and business models for the platforms. Results will be published on the project website at http://www.cosmos-community.org/.

In addition to our work on COSMOS we are also looking into implications of mobile community support for the workplace of the future. Here we think, that the introduction of mobile access technology and of community platforms might lead to a revolution similar to the one started by the introduction of networked personal computers. This area goes further than the one addressed in COSMOS – as telework and groupwork it will involve several disciplines from Economics, Business Administration, Informatics to Psychology and Sociology.

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