LBCS – Location Based Community Services – Proactive LBS Services for Mobile Communities in the Research Project COSMOS

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Abstract

In this paper we introduce Location Based Community Services (LBCS) as a natural advancement of ordinary Location Based Services (LBS). We shortly review some basic notions of LBS and argue why embedding LBS into a collaborative environment such as a virtual community facilitates new possibilities for LBS. We describe how LBS can evolve to LBCS and investigate the prerequisites for establishing these services. We shortly review the notion of virtual communities and discuss the pragmatics of handling location information for LBCS. We will introduce a portfolio of LBCS that was established in a pilot test in the COSMOS project at the Technische Universität München, Germany and describe first experiences with user reception. Furthermore we will mention privacy issues in connection with LBS and discuss special privacy aspects when handling location information in a community.

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1. Introduction

Location Based Services are a main focus of modern telecommunication. Applications involving the GPS system are already in use in a great variety of systems (e.g. car navigation systems) and are well known to customers. The high network coverage and high density of transmission facilities of modern mobile telephone networks also allow for an alternative position strategy using the cell infrastructure.

New LBS have been built on the basis of these techniques by mobile telephone network operators like location based information retrieval ("find the next gas station"), emergency call positioning, or location dependent accounting models (E.g. O2 Genion in Germany). A common characteristic of all these services is that a single user benefits from transmitting his location by being able to access special geographically dependent (information-)services.

Logic further developments are location based services which involve more than one user and are more communication centric. We aim at supporting mobile communities, which are characterized as loose groups of people that share a communication-focussed commonality (e.g. a common interest) and use mobile and stationary computing devices for their communication. **Location Dependent Community Services (LBCS)** are proactive location dependent services with a central communication and personal interaction component. LBCS include services and service-aspects which are characterized as "Inform me, if a friend is near", "Open a communication channel to the person that is near", "Stick a Virtual Post It to this location telling all my friends that this is a good place for shopping" etc.. LBCS require the participation and interaction of many community members and help all the members of a community. They can be viewed as an evolution from the classic location dependent services.

We will now briefly investigate what the requirements of a mobile virtual Community are.

2. Requirements for Context Sensitive Community Support

Virtual mobile Communities are loosely coupled sets of users that share a **common interest** and **communicate** with each other electronically over mobile devices [Groh2004,Koch2002]. Most of the interactions that take place within usual communities can be modelled as **communication acts** with varying degrees of synchronicity, multiplicity, direction etc.. E.g. a posting in a community discussion board is a semi-asynchronous, 1:n, direct or indirect communication act. Accessing information from a community associated website is part of a 1:n, asynchronous, indirect communication act. The contents of these communication acts can be modelled as elements (information items) in a **shared, collaborative information space** and the community's interest can in many cases be identified with the maintenance and enhancement of this information space [Groh2004]. Besides **information items**, such a community space contains **member profiles** and **models for relations**. Member profiles contain highly dynamic (contextual) information (such as a user's location) as well as less dynamic information (e.g. the user's name, communication preferences and interests) that can be used for personalization. Relation models can model user-item-relations, item-item-relations and user-

user-relations. The last category of relations is especially interesting for modelling the complex social network in a community [Galla2004] which can be used for e.g. expert-finding services.

The **dense social net** that exists between the community members implies that one main support requirement is **community communication services** with an emphasis on multiple recipients. A mobile environment allows to incorporate context features such as location dependence into communication. Multiple recipients and locally dependence adhere to the idea of collaboratively constructing an information space the contents of which are locally and socially distributed while still allowing access for a substantial part of the community. Another requirement following from the emphasis on social interaction is **access to contextual profile information** such as a user's location which will foster awareness and strengthen the social ties between the users.
As an illustration we will now introduce a portfolio of Location Based Community Services (LBCS) and subsequently discuss why LBCS are an enhancement over conventional LBS.

3. LBCS in the COSMOS Project

The **COSMOS** project investigates mobile communities with respect to various points of view such as economic aspects, aspects of community management, mobile community service architectures and interoperability and privacy in mobile environments. One of the testing communities is the young, lifestyle oriented community **jetzt.de** of the Süddeutsche Zeitung, München. The community has about 10000 Members all over Germany. The service spectrum was enhanced by several LBCS services developed in COSMOS and technically affine 150 users of this community were equipped by our partner O2 Germany with PocketPC based XDA smartphones and free air-time. Regular user meetings and surveys collect feedback from the users and allow to control and measure the success of the proposed services. Enhancing an existing community has turned out to be much more effective than trying to build up an own community which has turned out to be a difficult task in the course of the project.

Our **LBCS portfolio** contains the following services:

FriendFinder. This service allows localizing friends from the buddylist on a Map according to their privacy preferences (full location, part of the city, no location). Every user can independently configure his location privacy preferences for every user on his buddylist. For users not on the buddylist, the privacy value is "no location". The locations of friends are perceived as parts of their profiles which are part of the shared information space of the community.

Figure1: FriendFinder service on a map

Virtual PostIt. This service allows placing a message on a physical location. A user can configure the text of the message and the expiration date and can confine the set of recipients which is set to "all friends" by default. The messages on the various physical locations also contribute to the locally and socially distributed information space.

Figure2: Virtual Post It at the Techniche Universität München

Portable Message / FriendAlert A service that allows to inform other users about one's whereabouts if one enters their neighbourhood or additionally to carry a message which is delivered to all possible recipients when entering their neighbourhood. If no portable message is configured all of a user's friends are informed by default if he enters their neighbourhood.

Figure3: Friend Alert Service. A friend, who's on my buddylist is coming near me.

4. LBCS as an Enhancement of LBS

Conventional LBS are mostly Pull-based: Sending a request together with a location will result in the right information to be returned. In contrast to that LBCS have a strong focus on **proactiveness and Push-based Interaction.** As an example consider the Services from the jetzt.de LBCS portfolio: FriendAlert, Virtual Posit It and Portable messages are all proactive and use push based delivery for information that is not explicitly queried by the user and for location updates to the community location server (for privacy issues, a blacklist allows to block these information).

That means that the service generating components need to know the positions of all interacting members at any time. With the usage of classic LBS, which are PULL based, these services aren't possible: The service would only get the community member's position, if he explicitly reveals this position in the course of using a LBS. Only simple retrieval services providing snapshot location information like "Where are my friends right now?" are possible [Mob]. When his commercial service is triggered by a user by providing his location, the system retrieves the location information of the other user's available and presents it to the user. With this paradigm, no proactive services are possible.

In order to support more complex services like our FriendAlert service, the system has to react on the continuous members' location updates. As mentioned earlier, these services require the system to know all positions of all members at any time, which is a necessary prerequisite for proactive location based services like LBCS. One implementation of this idea is event based location updates. Whenever a member changes his position, his mobile device informs the community system about the new position.

5. Mobile Positioning Techniques and Location Updating Heuristics

One main issue are **positioning techniques** in existing mobile networks without any new components either in the mobile network or the mobile phones. This is especially important for mobile communities where users must be able to join spontaneously without having to seal separate contracts or buy new hardware. With the knowledge of the cell id, the surrounding cells and the corresponding signal strengths, a mobile device can calculate a quite good geographical position without any new enhancements of the mobile phone network components. In comparison to the methods like GPS, E-OTD (Enhanced Observed Time Difference) and TOA (Time of Arrival) where additional hardware is required in the mobile device or in the mobile network.

This **terminal based** positioning method uses all the information, that the mobile device can get from the mobile network to calculate a geographical position. Depending on the mobile device, the cell-id or the cell-id plus the neighbour cell with its' signal strength will be used. All the processing is done in the mobile device [Hille2001]. Even loyality / privacy aspects with respect to mobile network users' position transmission to third party service providers are no problem, because the mobile users own and control the information themselves .

Another issue will be the **position update heuristics**. Because of the requirement of knowing any member's position at any time in order to offer the mobile location based community services, the mobile devices have to proactively update the central system's information of their position. There are several update heuristics possible: manual update, time based update and timetable based update. Additionally a fourth heuristic method is now possible for the mobile devices. Due to the fact that the mobile devices "know" their positions, they are able to react to position changes. If a mobile device notices a position change, an event is triggered and the device updates its position on the central community system. Depending on the position technique (cell-id or cell-id plus neighbours as mentioned earlier) the mobile device reacts on cell change or position change. The position change accuracy is a user defined setting of the system. It depends on the position method's position technique exactness (GPS about 10m, terminal based about 150 m in rural territories) [SEP2002]. An average value of

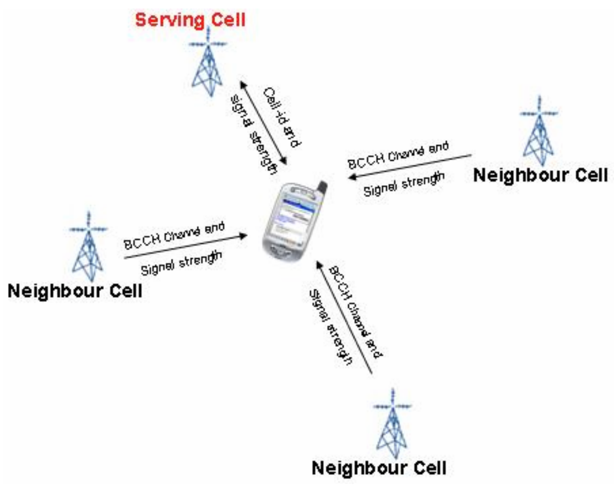

Figure 4: terminal based positioning with the usage of cell-id and neighbour cells

250-300 m is common. Of course other positioning techniques like GPS with other update settings like 50 m are as well accepted by the system. But the network data traffic on very small update settings is of course a problem which has to be considered.

6. Location Privacy

Another very important topic is the **privacy** of the member's position information. Many people may fear the misuse potential of a system which knows their position at all times. **Trust** in the community and **technical intervention arrangements** can contribute to decreasing this fear. It's important to offer the user **complete control** of his location information. We will shortly discuss how to provide mechanisms to execute this control and what each class of service demands in terms of privacy.

The main requirement is, one the one hand, to give a user the opportunity to adjust the distribution policy of his location information so **exact**, that he feels very save in terms of not giving his information to anyone he doesn't want to give it to, while on the other hand keeping the privacy system **simple, easy to handle and context sensitive**, so that an interaction with only those control facilities that are necessary for a particular situation and service will be necessary.

Earlier versions of our community support software relied on a very complex system for the configuration of a user's privacy with respect to profile elements. For each profile element, rules could be created or selected from a given set of default rules that would specify conditions under which this particular information could be accessed by services or directly by other users.

We found in our pilot tests that this method was too complicated for practical use and decided to substantially simplify the privacy settings.

Our **current system** allows to set location privacy as one of three alternatives ("exact", "part-of-city", "none") for each person in the buddylist and assumes "none" for users not on the buddylist. We presently investigate the feedback from the users through questionnaires and controlled feedback sessions.

The setting of these privacy levels on a **per-person level** is more appropriate than e.g. setting the privacy globally which would render the service useless. While a user may trust the community in that he is willing to use the LBCS in principle, he may mistrust single persons within the community.

Besides this per-person level of privacy control, the **overall design of the LBCS** must reflect the principle privacy issues of the specific community. E.g. in case of our example LBCS described above we have chosen to implement the FriendAlert service in such a way that a user is informed about the location changes of people that *have him on their buddylist* as an alternative to informing him of location changes of users *on his buddylist*. The former paradigm will give those users access to location information of other users that are trusted by these users and will not allow single users to supervise others with the help of a personal buddylist which does not reflect the trust that these people have in him. An alternative would be to allow only bidirectional buddylists.

Furthermore, as is trivially the case with all proactive services, the user must be given the opportunity to **turn off the service** if no further information is desired. We implemented this paradigm also on a per-person level by allowing to set a person on the blacklist which will block all proactive

information and all other communication directly or indirectly originating from this person or changes of this person's location data.
For further results on the user's reception of our privacy concept see [Brakel2004]

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