

Location-Awareness and Privacy in We-Centric Services

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Abstract. The latest developments in context-awareness, mobile terminals and the observation that people move around in dynamic personal social networks, rather than acting as member of groups, has led to a new category of services that we refer to as mobile we-centric services. This paper presents and positions this new concept and describes the role of location-awareness and privacy. We-centric services facilitate interaction itself (communication, information exchange, sharing context, cooperation), as well as supporting functions like finding each other, providing context like availability information for getting into contact and remembering the context in which social interaction took place. Location may play a role in each of those steps. Furthermore, mobile we-centric services have to enable to specify levels of privacy for each specific other party. This is required for more advanced control of who can see location details or who may contact you.

Introduction

Adding real world context, specifically location, to Computer-Supported Cooperative Work (CSCW) will enable a better quality of cooperation. Applications in CSCW have been extended beyond the desktop to different work settings and into the domain of mobile devices. Context and context-awareness becomes a central issue in the design and realisation of many systems and a crucial factor for their success (Schmidt et al. (2004)).

However, in context-awareness and ubiquitous computing community, often the focus has been about presenting context about objects close to the user and then presenting it to the user himself. However, humans are social beings and thus looking for other users and interested in *sharing* context, experiences and emotions with others. Erickson and Kellogg (2000) conclude that digital systems that support communication and collaboration over computer networks should make social information visible within the system, because in real life, people make countless decisions based on the activity of people around us. This observation explains the success of IM applications that made users aware of presence of other users. Nardi et al. (2000) found that users working late feel good when informed by IM systems that co-workers are online. This may lead us to think that similar emotions arise when people share location with each other.

In this paper we present how CSCW in a mobile setting, supported by smart mobile devices and enriched with location awareness, will lead to a new type of services, that we will refer to as mobile we-centric services.

We-centric services

We-centric services refer to applications that support dynamic and fluid sets of people in work as well as non-work contexts. People have always combined groups and roles, however we think that innovative personal, mobile communication means can enable people to do so in more effective, efficient and pleasant ways. One can, for example, use a PDA with communication functionalities, to communicate within different people, going from one context to another. We propose the following working definition of we-centric services:

We-centric services are context-aware services that facilitate the interaction between people in their dynamic personal social contexts

This definition illustrates the following important aspects of we-centric services:

Dynamic personal social contexts: The service does not focus on supporting static groups but it supports those people that refer to themselves as “we”, where ‘we’ is a dynamic, personal context-dependent notion. This concept has been presented and described by Ter Hofte and Mulder (2004).

Context-aware: The service is aware of people and their context in general and their location, social context, presence and activities in specific. Context is not only presented to the user himself but also forwarded to others to create social awareness.

Facilitate the interaction between people: Interaction between people includes communication and the exchange of information as well as context.

Furthermore, the we-centric service should also support human processes that *surround* the interaction (Nardi et al. 2000, Jones et al., 2004, Chalmers, 2004). We-centric services facilitate not only *interaction* (communication, information exchange, sharing context, cooperation) itself, but also supporting functions like *finding* each other, providing context like availability information for getting into *contact* and *remembering* the context in which social interaction took place.

Example: The following provocative example illustrates how we-centric services may have to deal with a privacy issue in a different way compared to other communication or CSCW services: Suppose that in you are in context A and you are busy with task A, so you switch your mobile phone off. But you are also an active member of a virtual community (context B), and someone from that community, who is a real trusted friend, needs you now (task B). Then your mobile phone rings (even when it's "off"). We-centric services are about new ways to control whether you are available for persons and being partially, not completely, in control. This quality has implications for trust, privacy and control of context, e.g. location, as well, as will be explored below.

Location to support and enrich the interaction

Because of the dynamic and mobile nature of the type of services we present here, we assume that location is relevant. There are many other context parameters that can be measured and it is a challenge to find out when and where location is relevant, why it is relevant and *if* location is relevant for proper service.

Location may be relevant for *all* four stages of an interaction experience, namely finding, contacting, interacting and remembering people (see previous section).

In the finding stage, location information may be used to decide who is relevant at this moment and whether people are around. This may be either people you know, or people you do not know.

In the contacting stage, location information may be used to decide whether it is appropriate to contact somebody, for example is he in the office or on the road?

In the interaction stage, in order to improve the experience, the interaction itself can be enriched with context, for example by showing the location of all members of a team on a map to act in an emergency or play a game.

In the remembering stage, the current location can be stored and coupled to other context information for later retrieval.

Sometimes location is relevant at each stage, sometimes only at specific stages. In some stages, detailed location is required, in other stages global location, e.g. stating whether you are inside or outside.

Trust, privacy and control in dynamic social contexts

When interacting with strangers, or people you recently met, using we-centric services poses restraints on privacy and trust. Sharing information is limited and sharing location is only done with people you trust since it reveals your current situation and this can be harmful.

Controlling what others see of you

In order to deal with privacy and trust issues when using we-centric services, privacy and trust mechanism are required to give the user control of what to share with whom. The Platform for Privacy Preferences project P3P (www.w3.org/P3P/) is designed to be integrated into browsers to let users easily manage relationships with multiple Web sites and identify what types of information they are willing to share with each. Technologies to support control of personal information in an open environment are also being developed in the Liberty Alliance project (www.projectliberty.org). Finally, Palen and Dourish (2003) present a conceptual privacy framework that allows describing the role of privacy in a mobile and pervasive world.

On the one hand, services that match people only work well when everybody is willing to share part of their profile and context. So creating the option to hide such information may seem like a danger for open we-centric services. On the other hand, apparently, users like to have such an option, so they can be anonymous at any time or they increase the amount of information or context that they want to reveal as well as the number of people they want to share it with slowly. The key is that they are in control at any time. *This leads to the requirement that it must be possible to share location in different detail to different persons.*

Trust levels and willingness to share location information

Social context is dynamic and people will meet and want to interact with many people, both unknowns and good fiends. It is interesting to see what people are willing to share based on the level of trust. We-centricness depends on how well

you feel connected to each other. This may create a level of trust and make you willing to share increasingly private information and context with each other.

We define two types of personal information to share:

Characteristics, which are static in nature, i.e. constant in time. This is descriptive information about yourself, often stored in a fixed profile. Examples are gender, birth date and your picture.

Context information, which is dynamic in nature, i.e. time dependent. This is information that describes the *current* situation. Such information contains measured or user entered state information and is often updated more than once throughout a day. Examples are location (exact or merely inside/outside), presence and mood.

In order to make the willingness to share location information measurable, we present a simple category of relations, while realizing that in case of more than two people in a social context different relations are affective. Table I shows the categories and an indication for the level of trust and the type of information that could be exchanged. This is based on current practice of what people share with strangers and, e.g. on dating sites and social network communities.

Table I. Willingness to share personal information based on trust

Level of trust	Sharing information about yourself
Very low	No name.
Low	Nickname. Part of profile, e.g. your general interests, but no picture of yourself. No location information.
Medium	Real name, e-mail address, Instant Messaging details. Full profile, picture of yourself, your contacts. Part of context, e.g. presence, mood. Non-precise location (inside or outside).
High	Phone number and address. Full context (exact location)
Very high	Passwords, pin codes. Location history.

This classification is very preliminary. Using this categorisation, a simple distinction in levels of trust in a social context could be defined. Based on that, an indication for the willingness to share location information can be estimated, ranging from showing no location up to allowing someone to see your location history. This table is a start to quantify privacy based on the quantification of trust. Another way of quantifying trust is looking at the history of interactions. Based on that, willingness to share location information can be determined.

Conclusions and further work

The latest developments in context-awareness, mobile terminals, positioning technologies and the observation that people move around in dynamic personal social networks, rather than acting as member of groups, has led to a new category of services that we refer to as mobile we-centric services. Location information shared between users may play an important and diverse role.

Adding location-awareness to mobile we-centric services leads to new research and implementation questions. Questions include: what is the role of location in the different stages before, during and after interacting? How to deal with privacy and trust when sharing your location with people you do not know? This paper gives some preliminary suggestions on how to solve these issues. For example, mobile we-centric services have to enable to specify levels of privacy for each specific other party. This is required for more advanced control of who can see location details or who may contact you. More research will be done to study the role of location and other context parameters in we-centric services. This will be done by implementing a real location-aware we-centric service in a real setting and evaluating the results.

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