

# Mobile Support for Communities of Practice

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**Abstract:** New ways to support communities of practice are required. Our approach is to provide situated support for community members depending on their work environments. In this paper, we focus on mobile work situations. Based on a requirements analysis, we identify four clusters of mobile support functionality and evaluate state-of-the-art target mobile platforms. The back-end system is based on a groupware system enhanced to support mobile communities. We describe the functional design and implementation of three mobile prototypes. Finally, we report on some problems encountered during prototype development and evaluation.

## 1. Introduction

For the scope of this paper, we define communities of practice as “an informal aggregation of people who share work practices and common experiences” [8]. Communities are thus social areas where knowledge is created and exchanged. They are characterized by spontaneous participation and by common needs and problems. Examples are knowledge workers of a globally operating company who exchange ideas on product marketing or on market analysis. Other examples are customer communities who share experiences with a product or ask for or give advice on bugs and features.

Communities of practice can be computer-supported by company portals, news forums, recommender systems, email distribution lists, etc, but as of now specific mobile and situated support for communities of practice is still underdeveloped.



Figure 1: MILK integrated solution

In the MILK project, we aim to provide situated support for community members depending on their (work) environments — meeting in their offices, in public places, or while being on the move: desktop environment, social environment, and mobile access environment [2] (Fig. 1). This paper concentrates on mobile aspects of community support.

## **2. Communities of Practice: Requirements**

The ethnographic study during the first phase of MILK was the basis for the development of the three end-user environments and their back-end service. For mobile work situations, prospective users expected four main blocks of functionality:

- awareness in context: stay informed about what's new and important;
- search and browse: browse context related documents, based on keywords;
- access to documents: download documents to the supported mobile devices;
- person-to-person communication: stay in contact with other users and be aware about their communication features.

Our goal was to define an integrated and comprehensive system that provides users with a seamless work environment that addresses their needs in different situations. Naturally, users expect to share the same look-and-feel in all work environments independently of the underlying technology, though functionality may vary.

The technological challenges for mobile support were: restricted disk space and memory, low bandwidth, small displays with limited resolution and color capabilities. As our ambition was to make use of the latest mobile devices on the market and of state-of-the-art technology, we constantly had to deal with moving targets.

## **3. Approach**

We are an interdisciplinary team of sociologists, designers, system developers, and end-users who continuously exchange their work. In particular, end-users were involved from the very beginning of the project. Requirement assessment, functional and interface design, and system development were done following the seductive design approach, which integrates two design approaches, one from the industrial design and the other from the information systems design [1]. We reserved six months for system evaluation at our user organizations: an Italian consulting company with a high percentage of workers constantly on the move and a German multi-media software company which resides on two sites.

In order to make our system available to end-users in a limited time span, we decided to base our system on an existing and well-developed groupware tool, BSCW (Basic Support for Cooperative Work). This allowed us to concentrate on mobile and community aspects rather than on the provision of a groupware infrastructure. An additional advantage of integrating community support into an existing and wide-spread tool is that people need neither change the tool they are used to nor the database they use for their daily work.

## **4. Core groupware system: BSCW**

BSCW — Basic Support for Cooperative Work, [3, 4] — is a web-based groupware system based on the notion of a shared workspace, a joint storage facility that may contain objects such as documents, tables, graphics, spreadsheets, links to web pages etc. The members of a workspace cooperatively upload, edit or download documents and other objects.

Besides user and group management, the BSCW system maintains stored documents and applies access control mechanisms to shared workspaces. BSCW supports the concept of roles — workspace managers may define new roles and assign roles to group members. Version control, group calendars and discussion forums are other features that allow advanced group collaboration. Documents can be put under version control, thereby

enabling distributed co-authoring of work-in-progress while keeping track of previous versions as well as of the changes made by each author throughout.

The BSCW system keeps group members informed about one another's activities in the shared workspace by means of event alerting, catch-up functions and reports. BSCW proved a powerful and scalable groupware system in several thousand installations. BSCW servers run on all major operating systems such as Windows, Linux, Solaris, etc.

However, BSCW's user interface is ill-suited for access from mobile devices due to the large size of its HTML output generated and a graphical interface designed for standard browsers with full capabilities. Moreover, BSCW supports shared workspaces for closed workgroups, but lacks specific support for flexible and informal communities.

## **5. Community Support in MILK**

BSCW's notion of shared workspaces was extended by the new concept of BSCW communities. A community can be open or semi-open. Open communities are open for self-subscription. Subscription to a semi-open community requires prior consent by the community managers. In contrast to project workspaces where all members are treated equally, community members have restricted access rights by default — manipulating or deleting documents (and other data) of other members is not permitted. This helps protect the community's knowledge and takes into account the relative anonymity in a community.

Communities feed not only from BSCW's document store, but also from a recommender system interfaced to BSCW: Knowledge Pump (KP) [6] of Xerox Research Centre Europe. KP is a recommender engine that uses collaborative filtering to provide recommendations tailored to each user. Users may submit recommendations of URLs, local files, or text. A recommendation consists of a rating and a comment, along with the user's classification of the item into one or more communities of practice. Knowledge Pump calculates a personalized set of user recommendations for each community to which she belongs and sends individualized recommendations via various communication channels.

## **6. Mobile Platforms**

MILK supports mobile users by a wide range of tools including portable computing devices, mobile phones (Fig. 2) and even stationary devices (e.g. a fax machine at a client's office or in a public place). We group mobile technology into four device categories:

- Mobile Web – access using PDA/laptop via HTTP/HTML/XML over GSM, GPRS
- Smartphone – access using Java MIDP application over HTTP
- Mobile Phone – WAP access (WAP/WML over GSM, GPRS...)
- “Switch of media” – Gateways to external services (fax, SMS, printers...)

MobileWeb supports PDAs or Laptops with Internet access. For this device category, the MILK system provides a front-end to mobile Web browsers taking into account network restrictions and display capabilities of mobile devices.

Smartphones represent a combination of a mobile phone and a PDA. MILK provides Java MIDlets for installation on J2ME-enabled mobile devices. The MIDlets will use HTTP (and higher level protocols) to connect to MILK services and display information to users.

Mobile Phones are simple phones with basic services such as SMS (short message service) and WAP (wireless application protocol). Mobile phones using WAP browsers.

Switch of media in MILK means the switch from a mobile device to a stationary device outside the MILK system. This may be necessary when a mobile user requests to send a document to a nearby fax machine or to a printer, or when the user interacts with large screens in meeting rooms etc. For the latter, available technologies such as Infrared and Bluetooth are being evaluated.

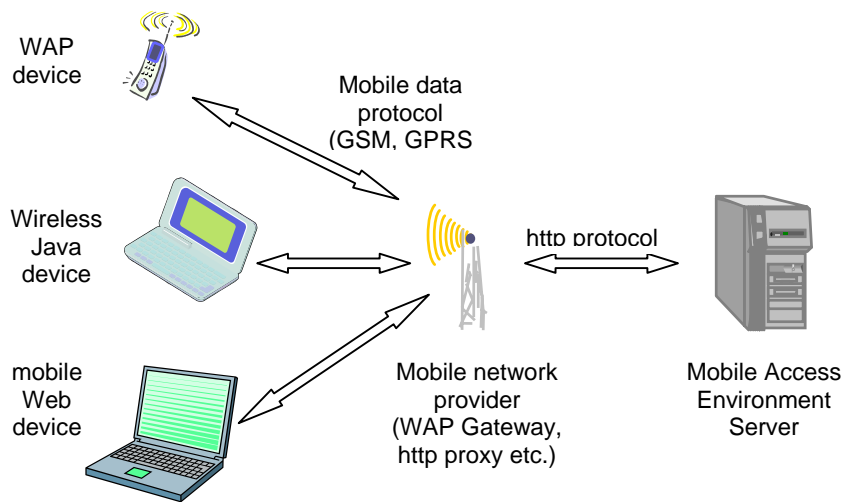


Figure 2: Data communication of mobile devices and server

## 7. Mobile Community Support

MILK's mobile access components give access to the MILK database from various viewpoints. At the user interface, a portal provides direct access to each view. The most recent and most important news are also directly shown in the MILK portal.

### 7.1 NewsBroker

In a mobile situation, the "What's new for me" aspect seems more important than the actual content of a document. Therefore, the NewsBroker is the primary view. It actively provides awareness about objects, people and their context and helps the user focus on important actions and information in the MILK system or whom to contact next. The NewsBroker pushes active notifications on MILK objects such as documents, links to the Web, appointments, discussion forums and annotations, tasks.

### 7.2 KnowledgeBrowser

While documents and their context play a crucial role in the desktop environment and — less so— in the social environment, in the mobile access environment, documents in their original form are of lesser importance.

#### 7.2.1 Documents on mobile devices

Mobile devices are typically constrained by their input and output capabilities (e.g. missing keyboard, small screen) as well as by their available memory. For this reason —and also because of network constraints— download and display (or editing) of documents is usually not possible. This especially holds for WAP devices and wireless Java devices. For those cases the system will provide valuable meta-information on documents and a short document abstract which may be displayed on the device.

Other mobile devices with more memory and better output capabilities (such as notebooks and PDAs) are able to download and display documents. However, display of documents may be restricted to a fixed set of document types (depending on the available applications for document editing). The system may provide methods for document conversion in order to enable mobile access to these documents (e.g. conversion from MS Word to HTML). This latter case especially applies to the mobile Web device category.

Documents, links and bookmarks may be annotated with informal textual messages. Annotations can be shared by user groups and structured as threaded discussions. For mobile devices however, typically only very short textual messages will be used.

### 7.2.2 Browsing the system database

The mobile environment will only provide very limited document upload and download functionality. The mobile input and output restrictions and the restrictions in bandwidth and connectivity also prevent heavily browsing the system database. Nevertheless, it must be possible to browser folders and projects from time to time. A very simple browser, the KnowledgeBrowser (Fig. 4), is provided. It allows users to navigate folders and check documents and, if necessary and feasible, download documents or their abstracts or redirect documents to other media, e.g. a nearby fax machine. The KnowledgeBrowser provides only very limited user interaction facilities with the system database.



Figure 3: KnowledgeBrowser on a PDA

### 7.3 Bookmarker

Bookmarks are the glue between the three MILK environments and also they are the combining element of the different viewpoints of the mobile environment. Bookmarks are annotated links to any object in MILK, including documents, folders, projects, Web sites, appointments, tasks and even people. From all views, objects can be marked and added to the Bookmarker. A bookmark may be enhanced by an informal text message; this is useful to add short memory aids like “I have to read this document” or “Do not forget to talk about the meeting with XYZ”. The Bookmarkers’ list is private to each user and cannot be shared. A user can keep a bookmark on a mobile device for a later visualization and processing in the social or the desktop environment. Annotated bookmarks made in one MILK environment will always be available in the other two environments as well.

### 7.4 PeopleFinder

The PeopleFinder (Fig. 4) handles information about people. It provides awareness about who is active in the system, who is important in a context or for a community, who is available and how people can be reached. The interface is focused on representations of human users by their names, icons or faces.

To facilitate direct communication between users, the PeopleFinder proposes a list of prioritized communication channels for reaching a person and gives addressing information. The PeopleFinder proposes communication channels depending on the availability profile and the reachability profile.



Figure 4: NewsBroker and PeopleFinder on a smartphone

Using the NewsBroker, PeopleFinder, KnowledgeBrower and Bookmarker components, we tried to match the functional clusters that the requirements analysis elicited.

## 8. Conclusions

In this paper we described how we addressed the goal of supporting communities of practice on the move. Starting from a requirements analysis, we identified four most important clusters of functionality in order to support mobile communities and designed an appropriate system architecture for the support of three mobile platforms. By now we have succeeded in implementing stable prototypes on various state-of-the-art mobile devices. Prototype evaluation in user organizations started at the time of writing this paper.

The decision not to start to develop a complex system from scratch, but to build upon an existing and well-developed groupware system proved wise, because we were able to concentrate on novel issues and on the demands of an ever-changing mobile base technology. Also, to involve end-user organizations from the very beginning was very helpful and reduced their reluctance to finally make use of our prototypes.

It should be noted, however, that communication and understanding between programmers, artists and end-users is not always easy. Many face-to-face meetings were necessary and after a short time it became apparent that a common glossary of terms was absolutely necessary to limit mis-understandings. We encountered a certain reluctance of users to deal with new technology or with demands to change the way they worked, supporting the observations of Bowers et al. [5]. This was in part due to users being under the pressure of their daily business which sometimes made it difficult to leave enough time for evaluation of research prototypes. Another reason is that devices still suffer from too small screens and limited document handling facilities. Often the user interface and interaction concepts are also different. Users can not simply map interaction techniques from a desktop interface to the mobile device. Thus the wide range of possibilities of

mobile devices are often not utilized [7]. To overcome this problem users must become aware that mobile devices require an initial investment in training before they can be fully integrated and applied for sophisticated cooperation process. On the organizational side it is important that the mobile solutions do not remain as islands, but that they are fully integrated into the organizational processes.

Technically, the full exploitation of the developed solutions was restricted from a rather slow moving dissemination of recent mobile technology. UMTS is not yet fully available and GPRS is only now covering the whole of Europe. Software development platforms for mobile support that we had to use proved partly buggy and incomplete and featured frequently changing releases. On the other hand, our system was to be introduced in a real-work setting with real users. In short: developing a system while the base technology is a moving target is time-consuming and sometimes frustrating, both for the developers and the users. Having to build stable prototypes on emerging mobile technology was a challenge and continues to be so. This includes the use of new mobile platform software libraries as they become available. The low performance on mobile phones is still not sufficient for more complex cooperative applications. As a consequence we plan to expand and improve the MobileWeb prototype on PDAs to be present on the very promising WLAN market.

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