Mobile Life: A Research Program for Mobile Services

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Abstract

The telecom and IT industry is now facing the challenge of a *second* IT-revolution, where the spread of mobile and ubiquitous services will have an even more profound effect on commercial and social life than the recent Internet revolution. Users will expect services that are unique and fully adapted for the mobile setting, which means that the roles of the operators will change, new business models will be required, and new methods for developing and marketing services have to be found. Most of all, we need technology and services that put people at core. The industry must prepare to design services for a sustainable web of work, leisure and ubiquitous technology we can call the *mobile life*. In this paper, we describe the main components of a research agenda for mobile services, which is carried out at the *Mobile Life Center* at Stockholm University. This research program takes a sustainable approach to research and development of mobile and ubiquitous services, by combining a strong theoretical foundation (*embodied interaction*), a well-defined methodology (*user-centered design*) and an important domain with large societal importance and commercial potential (*mobile life*). Eventually the center will create an experimental *mobile services ecosystem,* which will serve as an open arena where partners from academia and industry can develop our vision an abundant future marketplace for future mobile services.

Introduction

We are facing a *second* IT-revolution, caused by the spread of mobile and ubiquitous services, in combination with a broad consumer-oriented market pull. The first IT-revolution, the introduction and deployment of Internet and the World Wide Web during the 1990's, had a major impact on all parts of our society. This technology has now become intertwined with almost all societal, industrial and private activities.

Today everyday devices like phones, digital cameras and MP3-players already contain more processing power than a desktop computer did a few years ago. Soon, computer chips, sensors and displays will be so small and inexpensive that they can be integrated into virtually any product. The interconnectedness and ubiquity of this technology moves us towards the visions of *ubiquitous computing* and *mobile services,* where computation and digital communication will be

available in many new situations and become a natural part of everyday life. As information and communication technology moves from the desktop and out into the world, users will expect services that are unique and fully adapted for the mobile setting. This means that the roles of the operators will change, new business models will be required, and new methods for developing and marketing services will have to be found. Most of all, we need technology and services that will put people at core, and where mobile services find a natural place in an intricate web of work, family life, social activities, leisure and culture – the future *mobile life*.

As mobile, ubiquitous technology now becomes widespread, the design and evaluation of mobile services – i.e. information technology that can be accessed and used in virtually any setting – represents a vital area for every aspect of the IT- and telecom industry. It is now of strategic importance for the industry to engage in *service development* in order to secure a sustainable economic growth. First, services will be important for generating revenue by itself. Second, the introduction of new services will drive the technical development. The telecom industry, which is currently mostly oriented towards infrastructure, must understand these drivers in order to meet the demands of future consumers. Thus, in our vision the telecom industry will grow in the service sector and provide technologies based on strong commitment to consumers needs. The industry must be able to support rich and dynamic generation of services, and even include the users themselves as service providers.

In this paper we outline the research agenda of the newly started *Mobile Life* competence Centre at Stockholm University in Kista, Sweden. The center will have funding for up to 10 years from the Swedish Agency for Innovation Systems (VINNOVA). The Center's industrial partners include telecom infrastructure (Ericsson), handset manufacturers (Sony Ericsson), service providers (TeliaSonera), software (Microsoft Research), institutes (The Swedish Institute of Computer Science and the public sector (the Municipality of Stockholm). In its research, the Centre will address fundamental questions regarding mobile services, study the requirements that are unique for mobile situations, and explore the new interaction possibilities, infrastructures and business models of mobile technology. The Centre will also develop and evaluate novel new services in emerging domains, such as media, games and travels which may be taken up by Centre partners or commercialized in spin-off companies. In the following we will first give a brief background and motivation to the research area, and then outline the center's research program.

From mobile services to mobile life

The innovation of meaningful services with commercial potential does not follow automatically from the development of new technologies, and the uptake of mobile services has been slow in Europe. Despite extensive development of new infrastructure, in particular the 3G and upcoming 4G networks, the main use of mobile terminals continues to be voice communication and SMS. For instance, in Sweden, despite the introduction of many innovative services, the lack of a fully developed value network has led to companies losing enormous amounts of money on the mobile Internet in recent years (Sandström et al. 2006). In Japan, however, as well as other Asian countries like South Korea, the situation is different (Lindmark edt al. 2004). Mobile services are a natural part of everyday life and represent a large market. Many advanced services that are only in the prototype stage in the West have already been deployed. The risk is that when Europe finally catches up the initiative will still reside with Asian companies who will utilize their experience to continue to make profits in new markets.

However, European companies cannot simply copy other countries' success formulas. Research and development of new mobile services must take a different approach, more suited for European conditions of everyday life. We need to develop research on private consumer applications to establish a sustainable foundation for the next generation of applications and services based on upcoming technologies. In particular, development must be based on studies and analysis of actual mobile activities to achieve a better understanding of the specific opportunities of mobile services, and what makes such services successful. Mobile services are considerably more complex than stationary computing applications when it comes to context of use, which means that traditional methods for evaluation might not be suitable. Instead, studies and evaluations must be done in real-world settings rather than in lab environments.

In previous work we have explored a large variety of individual mobile services for different domains. We have looked at the potential of sharing digital music in various settings, such as between passing cars (Östergren and Juhlin 2006) or in everyday encounters (Håkansson et al. 2007). We have designed new ways of meaningful emotional expression in mobile messages, based on gestural and bodily input (Ståhl et al. 2005). We have developed and deployed games and narratives that take place in novel settings, such as on the road (Brunnberg and Juhlin 2006), in informal face-to-face meetings (Sanneblad and Holmquist 2004) or carefully staged milieus (Jonsson et al. 2006). We have explored new forms of everyday creativity, such as creating music in a duet with the city (Gaye and Holmquist 2006) or new forms of photography where the context is as important as the visual input (Håkansson et al. 2006). We have created location-based services that enable informal communication and information sharing (Rudström et al. 2004) or support specific work practices such as road maintenance (Esbjörnsson 2006).

Now is the time for researchers in this area to go from individual services and technology demonstrations to a more sustainable approach. We believe that future mobile and ubiquitous services will not be a unified set of systems that will replace the desktop computer. A range of solutions will co-exist: stationary services and mobile services, mobile services interacting with ubiquitous computing devices and smart artifacts of various kinds, and many other variations. We have to ensure that the whole landscape is well integrated with our lives, and meet users' expectations on services that are unique and fully adapted for the mobile setting. To do this, we must design services for a sustainable web of work, leisure and ubiquitous technology, that we can call the *mobile life*. We must also identify the domains where mobile services can have significant impact on peoples' lives, and where there is also a clear commercial potential. To do this, we must map out a design space that consists not just of individual prototypes, studies and evaluations, but cover the entire mobile services landscape.

The Mobile Life research program

The Mobile Life research program takes a sustainable approach to research and development of mobile and ubiquitous services, by combining a strong theoretical foundation (*embodied interaction*), a well-defined methodology (*user-centred design*) and an important domain with large societal importance and commercial potential (*mobile life*). On top of this theoretical and methodological foundation two kinds of tangible results will be built:

- A *mobile services ecosystem*, including a novel testbed where researchers and industry can meet in a neutral arena to experiment with future mobile services, and develop new standards, infrastructures, business models and interaction paradigms

- A range of innovative *mobile and ubiquitous services* as well as their supporting technology and platforms

The research in the centre is conducted in two major loops; see **Figure 1.** In the inner loop we produce concrete mobile and ubiquitous services in what we name *domain projects*. They are built from a thorough understanding of the specific domain selected, studies of real-life situations, and existing or invented technology. Once designed and implemented they are evaluated experimentally under real or realistic conditions against the research questions outlined for the specific mobile service. The concrete mobile services developed in the inner loop are research result in themselves, but they also serve as explorations of the whole domain, mapping out the territory before reaching the commercial market.

From the individual mobile services development we also gain deeper insights into what sorts of designs that work, what methods render good services, and how people's behavior interact with and change through the use of these services. We catch these higher-level insights in a set of *theme projects* in the outer research loop; see **Figure 1.** Theme projects include *theory projects* where we add to the growing theory formation in the field, in particular through generating mid-range theories about such design elements in the interface design that can be re-used for whole classes of systems; *method projects* that provide feedback on and invent new user-centered design methods; and *social science projects* that document and analyze people's behavior as it unfolds in naturalistic settings. Finally, an important activity that cuts through all activities is the *mobile services ecosystem projects,* which will construct an alternative mobile services universe, where novel ideas can be tried out with a large number of users.

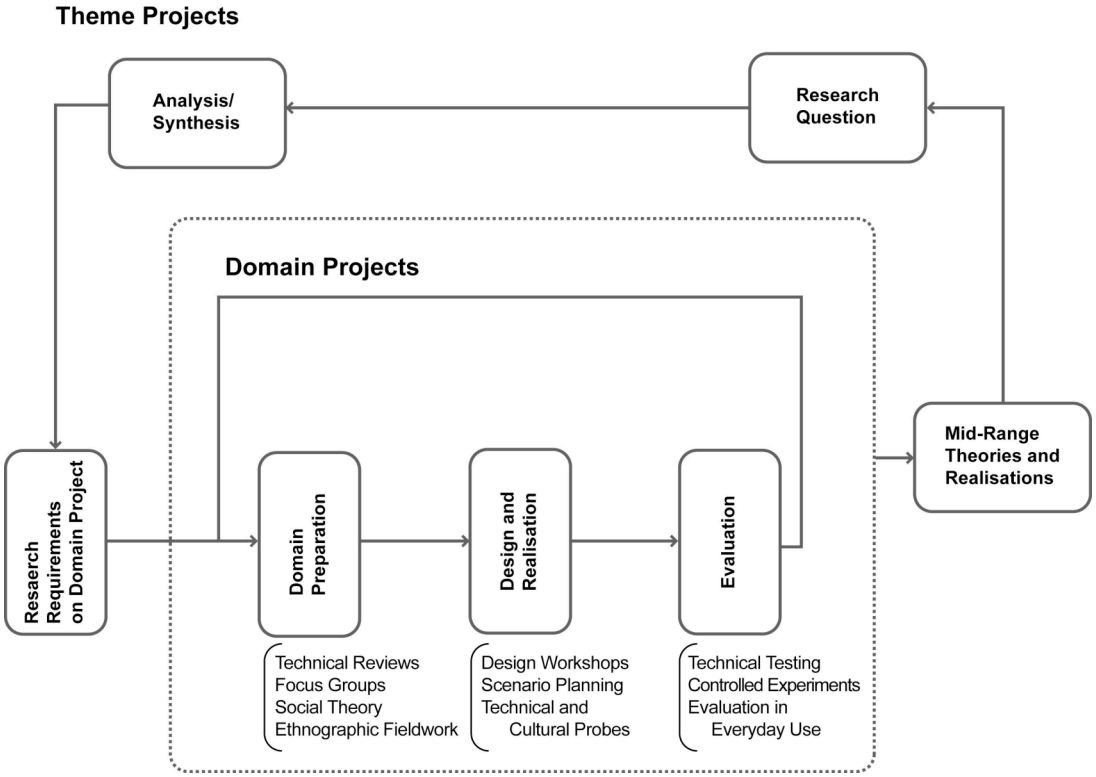

Figure 1: Research method

Theory: embodied computing

The Mobile Life research program is guided by a set of theoretically oriented positions on the interactions between humans, technology and society. Our starting point is the study and understanding of everyday practices – social practices as well as our interaction with the various tools we are surrounded by, and the way we make use of our body and cognition in our interaction with the world. Our theoretical foundation therefore has its roots in the ideas of *ubiquitous computing* and *embodied interaction*. In the late 1980's Mark Weiser introduced the notion of ubiquitous computing: computers that are seamlessly integrated with the task that they perform – much like writing, a mature and powerful technology that has become second nature to users (Weiser 1991). The term embodied interaction was coined by Paul Dourish (Dourish 2001) and is used to describe a phenomenology-inspired basis for design that builds on tangible interaction and social computing to provide computing which "…moves beyond traditional confines of the desk and attempts to incorporate itself more richly into our daily experience of the physical and social world". The idea comes out of our bodily and socially based knowledge of how to act in the world when there is no apparent "problem" to be solved. According to Dourish, humans focus the way in which we experience the world "as embodied actors interacting in the world, participating in it and acting through it, in the absorbed and unreflective manner of normal experience."

Drawing on the theory of embodied interaction, we state that:

- Computing occurs in specific settings, which are organized and dependent on collaboration between many people and physical objects.
- *Embodied computing* exploits our familiarity and facility with that everyday world – whether it is a world of social interaction or physical artifacts.
- Embodied computing is integrated with physical artifacts as a way to augment everyday objects in the world and provide for interaction through such objects.
- It recognizes that computers are design objects with an aesthetic.

By embodied computing we can also account for the ways in which bodily presence afford specific forms of interaction. This is a growing perspective in the field of tangible computing. We argue that:

- Embodied computing exploits our physical relationship to the world including our bodily presence in the interaction with computers

Our understanding of the ways in which social interaction occurs is informed by Lucy Suchman's studies of human-machine interaction (Suchman 1987), and could be understood as *situated interaction*. In situated interaction, norms and social rules always have to be fitted to a contingent situation. In such situations, people continuously negotiate and make use of these negotiations to establish agreements and interact successfully even though the situation is both complex and their interpretation of it is uncertain. Thus, it is essential that:

- Computing should support social mechanisms for organizations and enhance situated social interaction.

It follows from our understanding of the context of human-computer interaction that the design of technology should recognize that the context in which it will be used will vary significantly. Thus, technologies should not be designed with the intention to support a very specific and fixed way of interacting in everyday life. Drawing on Dourish's design principles, technologies are

more useful if users are in a situation to easily create meaning through their interaction with technology.

With the above discussion we have outlined a theoretical foundation for research, where human-computer interaction is embodied and situated in everyday settings. The theories and assumptions presented above are highly abstracted descriptions of human computer interaction, and can only work to frame the research. Our goal is to generate *mid-range theories of interaction*. Such theories are on the one hand design elements that have been proven to work and that other designers can pick up and base their designs on; and on the other hand empirically tested theories of how people in specific settings interact with technology and each other.

Method: user centered design

We aim to do justice to the full complexity of actual human lived experience, where people *actively* and *individually* construct meaningful experiences around technology. This requires us to work from a fundamentally *user-centered perspective*. This will frame our design approach, where we seek to involve users in the design process in a variety of ways.

Each mobile service is developed through a method that can be roughly divided into three phases: preparation, generation, and evaluation (c.f. **Figure 1**). In the preparation phase, we acquire knowledge about user activities and needs through methods such as ethnographic fieldwork or focus groups. It is valuable to understand people's behavior as purposeful actions and intentions in a natural context. This requires a familiarity with ordinary life, which surpass a formal representation of behaviors and in many cases even the users' own understanding of what they are doing and what they need. Mobile services can be used by anyone and anywhere, which means we will mainly study services that support aspects of human life not normally catered for in the mainstream design practice of human-computer interaction. Traditionally, human-computer interaction has focused on work-oriented tasks that are to be solved as efficiently as possible. We are instead inspired by areas such as entertainment computing, social interaction, personal media, and traveling. This might require new and unorthodox research methods, and a major issue for us will be to continuously refine and evaluate our research and service development methodology.

An important component in this process is how the analysis of current practice, such as social and ethnographic studies, can be used to form design hypothesis and inspire the service innovation process. There is a need for design methods that help structure a multitude of different sources of inspiration and fieldwork, and synthesize it into concrete requirements and concepts for mobile services. Such methods must support the design process of mobile services all the way from gathering information about the current practice, via brainstorming, early evaluation of ideas, to final evaluation of systems, and need to be different from those developed for traditional office environments or stationary work practices.

Transferring methods from the research laboratories into industrial practice give rise to additional requirements: they need to be cost-efficient, ethically defendable, easy to pick up and make use of, etc. For instance, researchers often work with ethnographic methods to elicit a better understanding of users, their practices, and how they interact with the world, each other, and the tools that surround them. But a proper ethnographic study takes too long time to be a feasible industrial production method. Similarly, research prototypes are often based on unreliable and untested technology, with high cost and limited infrastructure support. Industry, on the other hand, needs to be able to turn a prototype into a product within the very short time it takes to go

from concept to commercial launch. Therefore, an important challenge will be to develop new methods and adapt existing ones so that they meet the needs both of researchers and industry.

Use context: mobile life and its social properties

A mobile service is often a portable window to some remote content, for instance e-mail or web pages. Other mobile applications are still based on data that is primarily stored and/or created on the mobile device, such as portable music players and digital cameras. As networking becomes an integral part of mobile devices, we will see many more services that are based on always-on connectivity, where locally stored content and on-line activities mix.

This is just the start. The next step in this evolution is what we can call *truly mobile* services – services that exploit intrinsic properties of mobility, for instance access variability, ad-hoc meetings with other devices, context awareness, access to information dependent on geographical location, and positioning relative to other users or resources. An important part of our research will be aimed at exploring the new opportunities that arise from this.

Mobile services map to a complex and rich everyday mobile life, as it occurs "in the wild". It is embedded in the web of buildings, roads, people, nature, which is intertwined with an invisible wireless infrastructures and social practices. Mobile life occurs when people move between places where activities occur, such as the consultant who travels from one customer site to another or when student changes classrooms for each subject on the agenda. In addition, as travels and movement increases, mobile life tends to occur during journeys. These truly mobile services thrive on these passing opportunities for interaction between users and the relationships between users and the changing environment they pass through.

On a general level, these everyday situations share some properties. First, when people move about they have to attend to several things at the same time. For example, when people engage in face-to-face interaction in public settings they are also engaged in looking at where they are walking or driving. They read books or magazines, do window shopping, or arrange their clothes in conjunction with other activities such as talking on the mobile phone or interacting with a salesperson. On a very general level, the changing settings increase the need for mobile people to *divide their attention* between various activities.

Second, in mobile life, we constantly *shift social roles* as we move between one place and another. At breakfast in the home, we adopt family roles and responsibilities. At the office we adopt professional roles such as waiter, farmer, office worker or boss. At breaks, we may take on more relaxed and private social roles. Shopping makes us aware of our consumer rights and obligations. With friends we become entertainers, gossipers, and therapists. Traveling may turn us into tourists, sports into players and teammates, and so on. With colleagues we enter roles such as junior or senior; trusted or distrusted and co-located or far off. Every role means shifting responsibilities and allegiances vis-à-vis other people, and thus fundamentally affects how people behave and set priorities. Movement between different places make the shifts between roles more complex.

Third, the way we use our lived *space* to organize life also becomes visible in a more detailed level. We put things on the shelf near the exit door to remember to take them to another place. We pile papers in specific orders and place them at specific places on the desk to coordinate our work. We post messages at a selected location and direction to add to its meaning. In mobile life, the places were people are engaged are wider, and the use of location is different.

Fourth, when people increase their travel and movements they are more likely to *meet* each other. Meetings in mobile life range from sustained encounters with familiar persons to abundant but brief interaction with non-acquaintances. We can expect such meetings to take place in a variety of environments such workplace corridors, public spaces, or on the road. Establishing and managing such meetings requires various negotiations – who is allowed into the meeting and why, what information am I willing to share and with whom, are outsiders allowed to interrupt the meeting, etc.

Fifth, the *temporal* structure of social life becomes more and more important since a mobile person has to divide their attention to several activities; they attend to several roles and often engage in brief meetings. Thus, a mobile person pays attention to the timing of the activities as they occur.

Thus, in our research we will acknowledge the unique properties of the mobile life as it unfolds in the real world, and build service that harmonize with and build upon properties as those outlined above.

Towards a mobile services ecosystem

We believe it is essential to do justice to the users' role as customers of mobile services. We will study, and also do experimental research, on the organizational and economical landscape in which the service is placed. In our vision, their will be an abundant market for mobile services of various kinds to please different customers and different interests, which differ from the current situation where the value webs are dominated by large operators collaborating closely with equally large technology companies. From the user and consumer perspective, it is imperative that mobile services can be shared irrespective of mobile device, operator or which country the users happen to be in. Furthermore, the industry must support rich and dynamic generation of services, including services provided by the users themselves. In our research we specifically address the role of the future network operator and the necessary models to sustain and thrive on useful and meaningful services.

Our ambition is to approach the future mobile service market in the same innovative and experimental way as we approach other research domains: by experiments with alternate market spaces for mobile services and ubiquitous technology. The key goal is to understand how a mobile services *ecosystem* can be made to work. The term ecosystem is used because it puts the service in both users' contexts and in business systems. This alternative mobile services ecosystem will be explored through several activities, including a working environment in which both Centre partners and others (e.g. smaller companies) can enter their mobile services to be tested with these alternative business- and operator models.

It is critical for the industry to adapt to the new situation, but there are strong vested interests in the current system. Our experimental approach will provide tangible examples that can engender further forms of collaborations and realizations of eco systems as compared to more analytical approaches. The proposed testbed for mobile service eco system will focus more on organizational and methodological issues than technology. Thus, we will not provide a testbed that solves the problem by suggesting a different technical platform.

Below, we list a number of issues that have to be addressed through this experimental approach to marketplace research:

Alternative payment models. For innovative services, the prevailing models for payment are often inappropriate. There are also direct usability problems with many models for payment. For example, it is very difficult for the user of a service to know its requirements on access quality, or to estimate the price that a certain quality level is worth. However, he or she is perfectly able to judge the quality of a service and negotiate an adequate price for it. An experimental market place should allow us to experiment with a large range of payment models, including such where users pay only for services and the access costs are paid by service providers. Other examples of novel models including payment in kind, e.g. when users provide storage space or infrastructure for a service and get free access to the service in return.

Novel service infrastructures. The rapid development of service access technology and peer-to-peer technology has not yet been adequately reflected in device technology or market structure. However, such technologies can provide a potential solution to usability problems, in particular with mobile phones, where service access requires ubiquitous access to services through mobile technology. A future ecosystem will need to make use of novel service infrastructure technology and experiment with many different models for payment on top of these.

Rapid service creation. Development and deployment of mobile services is very time consuming. In the future, this time has to be decreased. Ultimately, users themselves should be able to develop and deploy certain types of services. Rapid service creation is an essential part of the future ecosystem. The experiences of using the design methods suggested, from pre-studies to evaluation, will be used as input to develop strategies for rapid service creation.

Novel and ethically acceptable approaches to digital rights. The rapid development of digital media has had a profound impact on the usage and distribution models for media resources such as film, music, and games. This has lead to a legal and ethical conflict between the media industry (and its 'pay-per-use' model) and the 'file-sharing community', which advocates that media resources should be freely available. None of these extremes will in the long run provide for a sustainable service ecosystem.

Disconnecting services from technology. The development of IP telephony is a very clear example of how services that previously were tied to particular technology infrastructures are becoming available in entirely new service and payment models that are not connected to a particular technology. Experiences show that people very quickly adapt to these when they provide an economically attractive alternative, even when the usability is questionable or the service quality inferior.

Trust, credibility and security. Unless users trust a particular service, the overall infrastructure or the payment model, they will not perform sensitive operations, such as buying and paying for goods. Some even advocate solutions where operators provide special networks to companies or groups of users where safety and service provisioning is ensured.

In summary, the mobile services ecosystem will provide a neutral pre-market arena for exploring alternate future environments for mobile services.

Conclusions

In this paper, we have outlined our approach to research on mobile services, as it will be carried out in the Mobile Life Center at Stockholm University. We draw on embodied computing and user-centered design to create services that exploit intrinsic properties of the mobile setting, which we call *truly mobile services.* In our experimental mobile services ecosystem, we will let

various actors deploy mobile services to users in order to explore questions on infrastructure, payment models, service creation and other issues. The results promise to be a quantum leap from previous research by us and other researchers, which for the most part has aimed at creating and evaluating individual mobile services in isolation from the larger context. By taking such a holistic approach to research on mobile services, researchers and industry can work together to explore the necessary technical, economical and social conditions for a future *mobile life.*

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