User Expectations for Simple Mobile Ubiquitous Computing Environments

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Abstract

In mobile ubiquitous computing environments, users will be able to interact with different devices, providing them with many services. The technological heterogeneity of these environments is expected to increase overall system complexity. Flexibility and adaptability thus become key requirements. The goal of the IST-Simplicity project is to design, develop and evaluate an architectural framework supporting easy customization of terminals, services and networks in a consistent manner. In this paper, we present results from focus groups that have provided valuable user feedback on the concepts, user scenarios and business models developed during the project.

1. Introduction

In mobile ubiquitous computing environments, users will be able to interact with different devices, providing them with many services. The technological heterogeneity of these environments is expected to increase overall system complexity. Flexibility and adaptability thus become key requirements. The goal of the IST-Simplicity [1] project is to design, develop and evaluate an architectural framework supporting easy customization of terminals, services and networks in a consistent manner. In this paper, we present focus group results that have provided us with valuable user feedback on the concepts, user scenarios and business models. The key concept proposed by the project is a universal multi-application Simplicity Device (SD). The SD provides a simple and uniform mechanism for customizing services and devices. By describing user scenarios, use cases and business models based on this concept, the project partners defined system requirements and identified major actors in the value chain. A user-centered approach was then initiated by setting up focus groups. The aim of these groups was to understand how users deal with current Information and Communication Technologies and to discover how they perceive the SD, its services and functionalities. In the second section of this paper, we briefly present related work before describing the methodology used to set up and run the focus groups. The third section describes the results of the focus groups. We conclude with recommendations for the development of devices, services, functionalities and business models for mobile ubiquitous computing environments.

2. Related Work

The last decade has seen a number of business models for mobile commerce based to web-based services, mobile office scenarios and mobile electronic payment. Most of them have been unsuccessful, particularly in Europe. In the consumer market the only services that have succeeded have been

simple ones (e.g. ring tones and screensaver downloads). A commonly accepted explanation is that the services offered to users are too complex and lack usability. A number of research projects in industry and academia have addressed these problems through the development of context aware [2, 3, 4], personalized [5] or location based [6, 7] mobile services and interfaces [8]. These services take account of information such as user preferences, device capabilities, sensor data, service attributes and network parameters [9] using the information to determine the user's context (e.g. the user is attending a meeting). Rules or policies can then be used to decide how to adapt the service to user needs [10, 11]. At the same time, the rapid development of mobile storage technologies has meant that more and more people are storing large quantities of personal data in their mobile phones, PDAs, MP3 players and USB sticks. A number of research proposals have looked at ways of making this data more accessible. A key idea, proposed by Intel's Ubiquity Personal Server [12, 13] and Realm Systems, Mobile Personal Server [14] is that of a personal server where users can store their personal data and programs.

3. Running the Focus Groups

3.1 Methodology

Qualitative research is the first step in an iterative, user-centered process. The focus group methodology used within the Simplicity project aimed to support and improve the development and implementation of the Simplicity system. A further objective was to develop hypotheses for future research by analyzing users' needs and feedback on technologies, services and business models. We tried to better understand how target groups would react to Simplicity services. We also expected to obtain suggestions for service deployment (e.g. of distribution, promotion and pricing). Additional objectives included:
- Analyzing users' feelings and responses when they came into contact with Simplicity services. The goal was to gain a better understanding of responses from specific target groups than might have been possible using alternative quantitative tools (such as a questionnaire);

- Obtaining suggestions and ideas for service deployment including issues of distribution, promotion and pricing.
The focus groups were particularly useful in suggesting how to explain Simplicity to the end-user. Based on these issues, we planned the following interview schedule to guide focus group discussions:
- Analyze experiences and perceptions, identify needs associated with different technologies (services, equipment, wireless telecommunication technologies);
- Gauge initial responses to the Simplicity concept and Simplicity services and gauge initial reactions to 3 scenarios for using the Simplicity Card proposed by the project;
- Identify other actors in the value chain and obtain suggestions for pricing strategy.

3.2 Profile of the Participants

We defined mobile workers as the target group of our study. Our selection criteria targeted people who:
- Use mobile phones and computers daily as part of their normal working routine;
- Travel for work purposes (excluding short journeys e.g. for daily meetings) at least twice a month.

We then grouped candidates based on their age, profession and technical knowledge. Six focus groups were thus set up, as detailed in the table below:

	Mature adult groups (aged over 35 years old)				
FG No	Technology expertise	Work branch	Male	Female	Total
FG 1	Intermediate	Business	4	3	7
FG 2	Expert	Business	3	5	8
FG 3	Intermediate	Professional	4	3	7
FG 4	Expert	Professional	4	5	9
	Total		15	16	31
	Young adult groups (aged between 25-35 years old)				
FG No	Technology expertise	Work branch	Male	Female	Total
FG 5	Expert	Mixed	4	4	8
FG 6	Intermediate	Mixed	3	4	7
	Total		7	8	15
	Total		22	24	46

Table 1. Profile of the participants

We first conducted a pilot focus group session to assess the planned interview schedule. All focus

groups sessions were filmed. In total, 46 people were interviewed. We recruited focus group participants by word of mouth to avoid the perception of the focus group as an event organized to promote a particular product.

3.3 Material

Given that prototype development is still in progress, it was not possible to test how users would react to real devices. It was therefore decided to implement a "concept test", capturing participants' initial reactions to the Simplicity vision. Preparation of the concept test began by defining the "basic idea" underlying Simplicity: the "image", characteristics and "personality" of the service we wanted to test. We went on to provide information about specific Simplicity services, identifying their main characteristics and components and their potential users. In short, we reconstructed the meaning and significance of Simplicity as seen by the people who had developed the system (i.e. the project consortium members). The aim was not only to create a concept test but also a structure for concept development. This would allow the improvement of individual components and characteristics of the service and the identification of those best adapted to the needs of specific target groups. A series of short films were commissioned to ensure that the "Simplicity concept" was easily understood. Each film was approximately 3 minutes long. The films served to clearly communicate service characteristics and components. Group discussion did not focus exclusively on the films.

The general structure was as follows: The first section of the discussion was approximately 40 minutes long. During this part of the discussion, participants spontaneously described their needs regarding wireless technologies, mobile working, mobile devices and so forth. Simplicity was not mentioned. The short films were shown during the second part of the discussion. Participants began by talking about their initial impressions of Simplicity, before going on to give their views on specific features. This part of the discussion lasted roughly 80 minutes. The short films featured one of the more than 20 user scenarios produced by the project partners. The chosen scenario was the "mobile worker scenario". This scenario explored all the components and characteristics proposed by Simplicity but featured only one user, a mobile worker. The idea was to focus on one clearly defined user, fully investigating the services this type of user might require. This meant that the films gave only a partial view of Simplicity's potential, presenting services relevant to one class of user.

3.4 Concept Evaluation

As mentioned previously, we used focus groups to investigate needs and interests of potential users on a number of different issues in the field of mobile computing. At the beginning of each session, participants were told how focus groups are run and how the results would be used. We then investigated their experience and general opinions with respect to IT technologies (mobile phones, computers, PDAs, etc.). This allowed us to obtain an overview of their needs. At this point we introduced the core concept of our project: a personal mobile device providing access to personal data, profiles and preferences. We also explained a second concept, namely proactive adaptation of services and applications based on the user preferences stored on the personal device. It is often complicated to explain this kind of sophisticated idea to users, and often it is not sure how much they have understood. To circumvent this difficulty, we presented the main concepts of the project in a set of scenarios illustrated with short films [15]. In the first scenario, we showed how the personal device could be used in an office environment.

Fig. 1. Scenario "Office case"

"Office case" scenario: an employee of a company finds a free workstation and logs in via her personal device. Once logged in with a specific profile, users can automatically access the data and services associated with the profile (fig. 1a). The video shows how the personal device connects to the workstation (fig. 1b) and how the services in the environment are used (fig. 1c). We introduced the idea of a personal assistant that can help users in different situations and which can perform operations such as automatic form filling (fig. 1d). In the second scenario, we showed how the personal device could be used for location-based services and in mobile office environments.
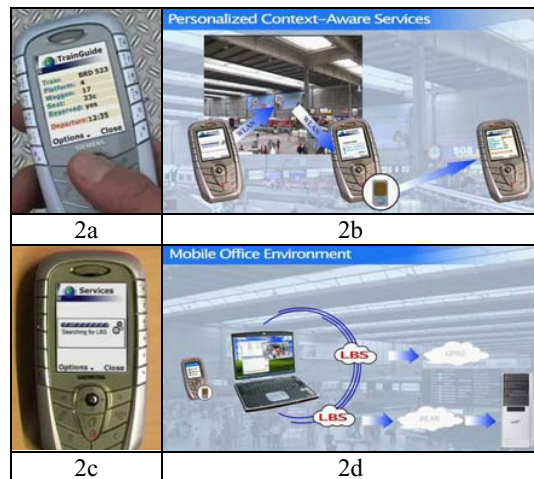

| 2a | 2b |
| 2c | 2d |

Fig. 2. Scenario "Train case"

"Train" scenario: the user is at a railway station, where she accesses mobile location-based services (fig. 2a). Services are personalized to account of user data on the personal device and local context-aware services (fig. 2b). During the train ride, the user can access a mobile office environment provided by the train's own WLAN (fig. 2c). The environment provides a connection to the user's company network (fig. 2d). Having understood the scenarios described, the focus group discussed different concepts and possible business models.

4. Results

4.1 Participants' key demands on technology: Integration and Interaction

The first part of the discussion focused on how participants use technology, and the feelings they associate with its use. At this point, no reference was made to the Simplicity project. In general, participants felt "involved" with technology but expressed a number of different feelings, ranging from positive or even enthusiastic opinions through to the idea of technology as something excessive, and sometimes useless and invasive. Although all participants had a general awareness and knowledge of new technologies, not everyone actually used them. Certain participants were adept at using most types of technology. Others were aware how useful technologies could be, but only used them to perform basic tasks[1]. The most common need expressed by participants was to be able to integrate and interact with different technologies: almost all participants expressed this need. The ability to integrate different technologies is one of the principal needs that Simplicity seeks to address. Almost all participants indicated that some of their needs were not met when using technology. In most cases, the priorities expressed by participants related to the need to connect and interact. These were cross-cutting needs relevant to all tools in the new technological world (applications, connections, devices) regardless of context.

Specifically, participants from all target groups identified the following priority areas:

- Data: participants were fascinated by the idea of having their own data available to them wherever they went. This was a priority even for participants in the intermediate groups and for people who do not travel for work so often.

- Equipment and devices: Many participants wanted to reduce the amount of hardware they carried. Some interviewees were put off by the idea of having to use such a complicated system. They displayed a conservative attitude and were less visionary than other participants; some even dreamed about technologies that did not require a device of any sort, which could be accessed by typing a code or swiping a card.

- Networks: Some interviewees felt that connecting to networks was too difficult. They found such

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[1] This later group tended to rely on experts for technical or specialist operations. This was particularly the case for mature adults with non-technical backgrounds.

difficulties stressful, particularly in new environments or when on the move.

- Software systems: Many interviewees considered software systems to be unstable and unreliable. These systems were felt to waste time and energy.

ISSUES*	QUOTE	FOCUS GROUP
Data integration	*"I'd love to have my hard disk with me wherever I go, like a sort of "mega USB" or to have all my files stored on a virtual hard disk that you can access regardless of the type of computer you're using or the devices you might have attached."*	FG 3, Female
Network connection	*"When I'm trying to connect to the network and I'm not in the office or at home, something always goes wrong. If I can't connect first time, I just leave it, and sometimes even after several attempts I still get nothing."*	FG 4, Male
Interaction and compatibility	*"Trying to synchronize my emails with my palmtop always makes me really angry."*	F5, Male
	"We're always hearing about how cutting edge these systems are, and then you find that they aren't compatible with each other even when it comes to the simplest things!"	F6, Female

Table 2. Needs associated with technology

The participants' desire for services that are easy to use is not met by current technology. Rather, it represents a problem. Many participants independently expressed the need for innovative services similar to those offered in the Simplicity scenarios. The majority felt that such services would be useful. But they also felt they would be *"…too complicated to use"*. A number of participants equated technology with complexity. They were skeptical about the idea of integrating many different tools in a single package. Interviewees gave examples of ways they expected the technology to be unreliable, inadequate and hard to use. They were unconvinced that hardware and other tools could ever be intrinsically reliable. Even more tellingly, they expressed the belief that any growth in a system's complexity (considered as any increase in its power or capabilities) would increase unreliability. As a result, participants expected to experience more technical difficulties than before.

4.2 Simplicity Concept

4.2.1 General reaction

In general, most participants reacted positively to the Simplicity concept, especially the promise of easy accessibility and "comfort". The name "Simplicity" encouraged these expectations. Almost all participants were enthusiastic about the possibility of accessing their own data, wherever they might be. Interviewees were impressed by the fact that Simplicity responded to the demand for centralized data. They were particularly keen to avoid sending, copying and duplicating documents and files, and to eliminate complex and boring procedures to save documents.

4.2.2 Simplicity Device and Simplicity Card

The most popular idea amongst participants was the possibility of using the "Simplicity Card" (containing user profile and personal data) in conjunction with a mobile phone. This tallied with participants' needs: the mobile was seen as a simple and universal solution. Indeed, the first reaction to the Simplicity Card was that it was the "obvious" solution and not particularly innovative. But precisely for this reason, participants perceived the card as something well tested and reliable. Most participants saw it as "Personal ID", a kind of appendix, an extension of themselves. In general, even though the card was considered as a personal ID, security issues were not of particular concern. Participants were not particularly afraid of losing the device or concerned about loss of privacy. Most participants placed a lot of trust in telephone operators and in "trust organizations" such as banks and credit card companies, who they viewed as fully capable of guaranteeing and managing user privacy. Participants were confident that security measures (such as blocking or reactivating the card) would be adequate to protect them in the event of loss or theft.

4.2.3 Location based services

In general, location based services were less popular that other Simplicity services. In particular they were much less popular than universal log-on and centralized data services. Many location based services struck participants as "excessive". They were worried that they might contribute to what is

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already a "surplus of information". Some saw such services as invasive or useless. In many cases, they were not interested enough to consider buying or using the services. Many were afraid that technological infrastructure, automatic updates and information verification options might be unreliable or insecure. Many did not see this kind of service as genuinely responding to their needs. Some (mostly women) found the service too "automatic and invasive" and complained it would prevent them from exploring the full range of possible options and combinations. Participants found other types of location-based services to be more useful; especially those geared towards people who spend a lot of time waiting around, or who need information on specific products. Participants also suggested a number of new services related to traffic and parking information, public transportation, plane schedules, access to communities and P2P services.

4.3 User clusters

Using the data collected from the focus groups, we were able to identify 3 principal "user clusters":

4.3.1. "Trendsetters"

Approximately 35% of participants, this group contained the highest number of "innovators". It was these users who had the most expertise in technology, who used it most extensively and who were most up to date with new products and services. Trendsetters were adept navigators of the Web. People in this group tended to be the first to introduce and promote innovative technologies to their friends, colleagues and family members. They owned and tried out new devices, tools, and applications. Often, they had experienced a sense of frustration in using technology and in making different technologies work together. In general, this group responded enthusiastically to Simplicity. Group members found that Simplicity provided a real solution to their need for integration and interaction.

4.3.2. "Savvy"

About 30% of participants, this group was the "smartest" group of participants. Mostly composed

of women and young people, group members loved to play and experiment with technology. They used mobile phones frequently and were always quick to try out new services, such as MMS, surfing the Internet, etc. People in this group particularly liked technologies that combined usefulness with aesthetic appeal. This group had the highest percentage of ownership of I-Books, I-Pods and digital cameras. Outside their working environment, they were the most frequent users of mobile technologies. They perceived technology as something "clean, brilliant, radiant, clear, and simple". These perceptions were even more marked in women. Female participants particularly liked wireless technologies, partly for their convenience, but above all because "they get rid of that knot of dusty cables!". The response of this group to Simplicity was positive. The device interested participants. They associated it with ease of use and as a support during their daily interactions with technology. But members of the group also suggested that a tangible, aesthetically-pleasing device would have made Simplicity more appealing. For some, the idea of Simplicity as something intangible evoked a sense of deprivation, and a loss of "ownership". The fear that it would not be possible for users to have their data "physically" with them produced negative reactions. Interviewees in this group tended to "fetishize" not only their data but also the equipment they used, most notably their PC or laptop. Some people preferred to always use their own computer. Concerning location-based services; some users (in particular women) considered that a user profile would never be enough to identify the services best suited to their needs. They also thought that to accurately define the profile, it would be necessary to continually update their personal data and that this would be an unmanageable task.

4.3.3. "Fussy"

Roughly 35% of participants, members of this group were predominantly men. People in this group were the most selective and demanding of all participants. They perceived themselves to be "competent and knowledgeable" users of new technologies, about which they knew much, even if they did not consider themselves as fans of particular tools or services or as promoters of innovative

devices. They appeared to be rational users: usefulness and capabilities were cited as the most important characteristics for any type of technology. But they were puzzled by technologies that did not seem to match their needs. They wanted to feel that they were familiar with the technology they were using and were extremely interested in usability, accessibility and the cost of various services. They indicated that these factors would be critical in making an eventual purchase. The reaction of this group to Simplicity was generally quite positive, though most participants considered that the service should be customized to include more interesting functions and services. They thought that some services (particularly location based services) could be improved and made more useful. In many cases, they questioned the true usefulness of the service, expressing doubt that it would be possible to provide adequate coverage. Within the "Fussy group" we identified a sub-group of uninterested, highly critical participants. We called this the "Droopy" group. The most common sentiment in this group was total indifference to Simplicity, which was not perceived as an innovative service. Several participants believed the service was already available on the market.

ISSUES*	QUOTE	FOCUS GROUP
Simplicity: initial impact	*"I wouldn't have to go through the usual ten million procedures like sending myself documents by e-mail, sending stuff to the office and then saving it onto the USB device."*	FG 1, Male
Information overload	*"Services like this should only be activated when you explicitly request them, otherwise you're bombarded…"*	FG2, Male
Intangibility	*"I'd prefer to carry my data with me, to have it on me physically, I want to be able to see it."*	FG3, Female
	"It gives me the idea that in the end, I don't really know where my data actually is. Is it virtual? Is it on my PC but also scattered about?"	FG6, Male
Profile	*"If it was supposed to update itself automatically on the basis of choices I made, it would be constantly changing. For instance, I change the background image on my desktop every day."*	FG2, Female

Business models	*"I don't mind paying a supplement on the train ticket, paying a bit more than I'd normally pay to include the card. The important thing is that I don't have to make another additional payment, something that shows up on your bank statement and you've no idea what it is."*	FG5, Male

Table 3. Reactions associated with Simplicity concept

5. Recommendations for concept development

On the basis of the needs expressed and the feedback provided by participants, we have defined a series of requirements and recommendations to improve the "Simplicity Concept" and customize it for various categories of users. Below, we identify three broad themes that emerged from the focus groups. These points represent not only an important input to the technical implementation process, but also ideas for the communication, dissemination and exploitation of Simplicity.

5.1 Sense of presence

Certain service characteristics evoke a sense of presence, the sensation of being in a familiar, tangible, comforting environment. For many users, this perception played a key role in making the service appealing as well as adding to their sense that it was fully developed and dedicated to serving users. Sounds and images played a fundamental role in evoking a sense of presence. One service that users particularly appreciated was the possibility of accessing their own "desktop" every time they used the Simplicity device. Users appreciated the possibility of choosing their own icons, sounds and screen savers - rather than having them automatically generated from their user profile. This facility evoked a strong sense of presence and familiarity.

5.2 Collaboration, community and teamwork

A second theme that emerged from the focus groups was the need to improve the community dimension in Simplicity. In many instances, Sim-

plicity was perceived as an individualized service, little suited to supporting teams and communities. A number of participants requested that Simplicity should explicitly provide a way for users to log into their own intranet, providing facilities for file sharing, chat and peering. Participants felt that desktops used by mobile workers (users moving from one location to the other, accessing their files via the Simplicity service) could act as a physical space, which the "Simplicity Community" could use. For example, users could share information with other users, by leaving files on the desktop that they had been using. Sharing could be extended and expanded, making the computer a node in a community of "Simplicity peers". All this would help to make the service more tangible, reducing the sensation of intangibility that some participants had complained of.

5.3 Business models

The final area covered in this study relates to business models and prospects. Most participants did not perceive the Simplicity service to be particularly expensive, expecting to pay a supplement of 7-10% on top of the monthly wireless connection fee. This would be equivalent to €5 – 50 per month depending on the type of coverage selected. One point that emerged very clearly was the user requirement that billing, accounting and payment should be easy to use and understand. Independent of cost, participants indicated that they did not want to pay an additional bill to use the service. They wanted to pay a fee that would be included in their connection contract. In other words, the bill for Simplicity services would have to be included in their mobile phone bill or paid as part of their internet connection charge. Many participants seemed interested in some form of corporate registration: in this case, they would use the service mainly for work. Participants expected that corporate registration would allow users to obtain special discounted rates, as well as access to intranet services, websites, and user communities.

6. Conclusions

This paper presented focus groups set up to obtain user feedback on the concepts, user scenarios and business models developed during the Simplicity project. This methodology made it possible to identify 3 main user clusters ("trendsetters", "savvy" and "fussy"). Most participants reacted positively to the Simplicity concept, especially the promise of easy accessibility and "comfort". Participants expressed their need to interact with integrated technologies – so long as this integration did not lead to additional complexity - and to have their personal data available anywhere, anytime. They were also concerned with the usefulness, usability and reliability of services, applications and networks. Focus group participants clearly identified the mobile phone as the most appropriate Simplicity Device. Surprisingly, security and privacy issues were not of particular concern for most participants. The majority of participants tended to place a lot of trust in telephone operators as well as in "trust organizations" such as banks and credit card companies. However, they emphasized that security should be transparent and not interfere with their tasks.The focus groups identified a number of additional issues which should be taken into account in the final design of Simplicity. In particular participants perceived location-based services as creating information overload. There was also some concern about user profiles, which many users considered to be unmanageable and inefficient

7. Future Work

Qualitative research can form the basis of more extensive studies, identifying interesting issues for future research. In this study, the evaluation process began with research activities focused on specific target groups. Subsequent evaluation phases will use a mix of qualitative and quantitative methodology. The final phase will emphasize quantitative methodologies. Qualitative and quantitative studies are of course complementary; using both approaches at different stages of the evaluation process can provide more insight than either method can offer on its own.

8. Acknowledgements

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