Attention all mobile users!

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Abstract

The ongoing convergence between the telecommunications industry and the information technology industry leads to new products and services for the end-user. Products based on Wireless Application Protocol (WAP[1]) technology bring the world of Internet into our pockets, where the services provided may be wireless and accessed from anywhere. There are high expectations to these new services provided by products like the next generation of mobile phones, Personal Digital Assistants (PDAs), handheld computers and so on. The leading telecom industries expect services like banking transactions and mobile electronic commerce (e-commerce) to be widely used by the adopters. Based on our empirical research, we claim that system developers of such mobile services who do not realize that there is a major fundamental difference between stationary computing services and mobile computing services will see the whole concept of mobile e-commerce challenged. Designing services and applications to be used with mobile devices requires a new way of thinking. In this article we elucidate one aspect we believe to be important, namely attention. We have observed that existing mobile devices demand too much attention from the user, actually more attention than the user is willing to give.

Keywords: Contextual communications, Mobility, E-commerce, handheld devices, WAP

BRT Keywords:

Introduction to mobile e-commerce

Personal Communications

Mobile phones and services form one of the world's fastest growing commercial areas within the service sector. The suppliers of associated services and end devices have experienced record turnover and tremendous growth in terms of the number of connected users. Convenience and mobility are the client requirements to be solved by mobile phone-related offers. In the past the only services offered by mobile telecommunication devices have been signals that simulate text (Morse code, teletypewriter, and telex), pictures (telephotography) or speech. In the beginning of wireless telecommunication there was only one communication device available for a whole institution. For instance, to the whole community on a transatlantic ship there was only one radio available. As

[1] The WAP Forum has drafted a global wireless protocol specification for all wireless networks and will contribute it to appropriate industry and standards bodies (Martin, Hjelm and King 1998).

technology matured it was possible to design devices small enough to be installed in vehicles like cars. These devices were
called mobile phones. The present size of a mobile phone can be compared to a box of matches. While the size has decreased, the functionality of the device has increased remarkably. The mobile phone is also called *a personal communication device*, because its functionality involves much more than only speech. Thanks to the small size that makes the phone fit in a pocket, and to the low prize that makes it affordable even for school kids, mobile phones have become very popular and personal devices. About 50 per cent of the population in Scandinavia own a personal communication device like a mobile phone or a pager (Norsk Gallup 1998). Estimations show that mobile telephone services have a potential of 80 per cent market penetration, whereas telephone services based on fixed networks have a potential of only 60 per cent (Grimstveit and Myhre, 1995). Therefore we can call the mobile phone a true personal communication device.

The GSM system in Europe is based upon digital transmission which has made it possible to introduce new services such as *Short Message Service* (SMS) and computer connectivity. The next generation of personal communications is about to be launched into the marked. Products based on SIM Application ToolKit[2] or WAP technology make it possible to download and run applications to the SIM (Subscriber Identity Module) card of a mobile phone. In this way it is possible to access the Internet via the mobile phone. It is predicted that many new services will evolve, and expectations to mobile e-commerce are especially high (Erlandson and Ocklind 1998). This new technology based on WAP or SIM Application ToolKit, makes it possible for a service provider to design i.e. e-commerce services or banking services that the user may access and use via a mobile terminal, for instance a mobile phone, PDA or other personal communication devices.

E-commerce

Electronic commerce is becoming more important every day. Because digital communication is becoming commonplace, electronic business is growing rapidly in today's world. Respected market research institute experts predict a dramatically increase in the number of online transactions over the next few years. This is due to the constantly growing numbers of Internet users. A WTO (World Trade Organization) report predicts that e-commerce will reach a turnover of $300 billion by the year 2001 (WTO 1998). Figure 1 shows that predictions vary widely regarding the adoption of e-commerce, but most institutes agree that e-commerce will grow in significance over the next few years. The explanation for the great variations in the predictions may be due to the different definitions for e-commerce employed by the different market research institutes (Andersen 1999).

It is important to notice that e-commerce is a lot more than only buying books from a virtual bookstore on the net. Existing sales companies are now faced with the task of adopting to the new sales channels based on e-commerce. All kind of articles as well as services and information are becoming available for potential customers who may pay electronically. Banking transactions and financial transfers are expected to be important fields of e-commerce. The methods of doing business electronically have existed for the

[2] The SIM Application Toolkit (ETSI 1999) provides mechanisms which allows applications, existing in the SIM, to interact and operate with any mobile equipment which supports the specific mechanism(s) required by the application.

last 20 years through EDIFACT (Electronic Data Interchange for Administration Commerce and Transport) between business partners, through airline reservation and payment systems. What is new is the diffusion and adoption of Internet technologies (Storrøsten 1998). The openness of Internet represents a far greater accessibility for all types of users, and a far greater flexibility in the type of applications and services. New technologies like Digital-Television, mobile phones, web-telephones etc. provide new interfaces for the users.

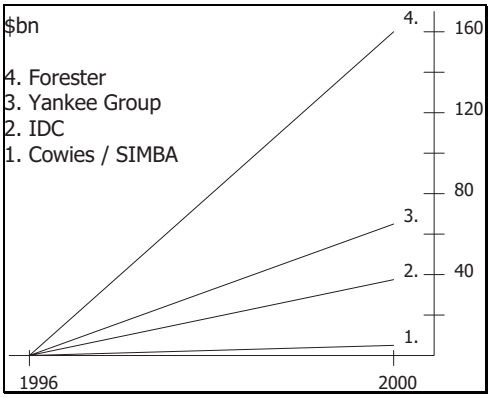

Figure 1: Estimated growth in e-commerce

Wherever there is money there will always be crooks. Therefore security is of paramount importance in e-commerce. Many models describe secure ways of doing e-commerce, but so far we have not yet seen a widely accepted model for the mass market. Secure Electronic Transfer - SET, on the one hand seems to be the most successful model. At the same time we observe that SET is not being widely accepted. The criticism of SET aims at the complexity and difficulty of the model (Telecom Revy 1999), but another reason may well be that the concept hardly has been promoted. The SET solution provides a secure transfer over the Internet, but it also prevents unprofessional actors from taking part in the game (Soelberg, 1996). There are some significant barriers to e-commerce both national and international, such as 1) technology and infrastructure issues, 2) required organizational changes, 3) the market and the regulatory and legal environment (Storrøsten 1998). The focus of this article, however, is not on these barriers, but rather on barriers that decrease the usability of mobile devices.

Actuality for mobile devices

Even though the SET standard makes it possible to make secure transactions over the Internet, Internet shopping has not yet become a success, neither for the customer nor the service provider, with only a few exceptions. Not only is the SET standard difficult to use; many users also seem to blame the PC. Donald Norman claims that the PC is too complex and too difficult to use (Norman 1998) and many other scholars agree that because of this complexity the PC is more of a glue to e-commerce than it is a glide (Maartman-Moe 1999). If you have a terminal without startup time, which is always available, you will have a device that is more fit to e-commerce than a PC. So where do we find such a terminal?

One solution may be the mobile phone, which enjoys a market penetration of about half the population in Scandinavia. The new wireless technology makes it possible to use mobile personal communications as a medium for e-commerce.

Not only does the technical quality like no boot time and less complexity (compared to a PC) make the mobile phone more suitable for e-commerce, emphasis on

the importance of being able to act spontaneously should also be considered. If a user wants to buy a service or a product, a decisionmaking takes place, either to go to the store or use his computer to perform the desired transaction. Let us say our potential customer wants to buy two tickets to the opera, and he wants to use the electronic service provided by a ticket bureau. If a buying decision is logic, rational and well considered, one can wait until one gets home or reaches the office where a computer is accessable. There is no spontaneity in this situation. The decision to buy opera tickets, however, may not be very rational and well considered, but rather an impulsive thought. The famous Norwegian philosopher Arne Næss, argues in his latest book that our emotional feelings seem to be underestimated when talking about decision making (Næss, 1998). Næss argues that many of our decisions are not very logical or rational, but more often a result of a spontaneous reaction where our feelings play an important role. Let us go back to our opera-loving friend. With the new technology he/she can, while driving past the Opera building (or any other building for that matter), act spontaneously, order and pay for as many opera tickets as he/she wants using his/her mobile phone. Once again, mobile devices are excellent tools utilizing such services. However, he/she may perceive the service to be very time consuming and he/she does not have the opportunity to pay as much attention as his mobile device demands. Or worse, he/she thinks this electronic service is a brilliant idea, but thanks to the complexity, difficulty and non-robustness of the service, he/she does not use it. Furthermore he/she may not trust the service. If these postulates are true, our Opera-loving friend is just like the users of personal communications we have studied in our field studies (Koht-Tøfte and Olsen 1998). If the users react in this manner, are there any good reasons for system developers or service providers to build expensive services for mobile e-commerce?

Now we will introduce what we see as the problem area in e-commerce, followed by a description of our field studies.

The problem area of attention

So far in this article, we have argued that personal communications like mobile phones or other handheld devices are very well fit to be a medium for e-commerce. So if mobile communication technology is such an excellent medium for e-commerce, what is the problem? Here we will introduce the main focus of this article – the problem area in mobile e-commerce.

As our field studies will show, we have experienced that users of personal communications have several problems that decrease the usability of the services provided. We claim that the problems regarding usability of these services exist because the services have been developed with a stationary user in mind. This needs some explanation: When an application like for instance a web-browser for a mobile device is developed, we have seen no signs indicating that the development philosophy is any different compared to the development of a browser for a stationary computer (Koht-Tøfte and Olsen 1998). This indicates that the developer expects the browser on a handheld device to be used in a similar way to a browser on a desktop computer. When working on a desktop computer, the user normally is capable of using both hands on the keyboard, the screen is the focal point of the users eyes and the environment is normally stable regarding lighting, power and location. As our field studies explain, this is not the case for a handheld device. Of course the developer knows about the technical constraints of a handheld device, but we argue that the development process focusing on

these constraints is not sufficient to make usable services, applications or devices. Four often-debated constraints that characterize handheld devices are:

- Display size – limited screen size and resolution
- Limited input characteristics – limited keyboard size and small buttons
- Limited computational resources – limited CPU and memory, often limited by power constraints
- Narrowband network connectivity – limited bandwidth and high latency

Even if the developer is aware of these constraints, we claim that the philosophy still is still in a stationary mode. If the philosophy had been in a non-stationary (mobile) mode, the system should pay attention to the use context. Through our empirical work with handheld devices, we have experienced that because of the use context neither the device nor the service was used like intended by the developer. This often makes the mobile services useless to the user.

The focus on attention

Many articles discussing e-commerce focus on trust (Storrøsten 1998). Our focus on attention is a bit more difficult to explain compared to trust. Everybody can understand that the user must trust his or her service especially when doing e-commerce, but why focus on attention? As we explain in the next section, our experience is that the users of mobile devices argue that a mobile device is *demanding too much attention*, or in other words, the device *requires too much involvement from the user*. We believe this is a paradox, because the argument for using mobile devices is exactly the possibility for the user to use the mobile device in different dynamically changing contexts.

To summarize our problem area: we claim that applications or services for mobile devices must be developed in such a manner that the user do not have to pay too much attention to the mobile device while using the application or service.

Before going into our design approach, focusing on attention, our field studies are presented. The field studies are included to illustrate the usability engineering work that has been conducted, and the findings that are pointing towards our design approach.

Field studies

The two field studies, which this article is grounded on, were conducted at a large-scale international industrial company - and consumer goods purchasing. The field studies that have been conducted used the Contextual Inquiry method (Beyer and Holtzblatt 1998). Contextual Inquiry builds upon ethnographic traditions (Hammersly, M. and Atkinson, P. 1983), allowing the researcher observe the objects in their own environment. Since the operations in question are conducted in varying contexts, it was necessary to employ a method that enabled the capturing of contextual information. In addition, unstructured interviews have been used to elicit further information regarding some of the issues found using the contextual inquiry method.

The use of mobile devices, applications and services by field engineers

This first case study focus on how handheld computers and mobile phones are used by field engineers. We studied a company in Norway where a larger division replaced old

manual routines based on paperwork with handheld computers and GSM technology. Our main focus was to investigate how the use context decreased the usability of the mobile device or the service. A typical task for a field engineer is to install a communication line, like ISDN, in a building. This may include studying wiring maps for the location, installing the wires, and testing the connection. It may also include training of the customer, and troubleshooting. The field engineers are equipped with a GSM cellular phone connected to their PDA. Various number of times a day, they call their headquarter and download information about new missions. Usually they do this sitting in their vehicle with the PDA placed on their lap or in the passenger seat. This information is stored in a sheet in a WWW page, and the field engineers use a web browser at the PDA to access the information. To avoid inconsistency problems between the main database and the replicated one at the PDA, the mobile worker receives an SMS message if some information they already have downloaded is updated. During a mission, they use the PDA to take notes. When a mission is completed, they upload the information from the PDA to the main database at the headquarter. By doing this, the mission is declared as *closed*. The engineers upload information for closing jobs at different times: some prefer to upload the information immediately after the job is completed, others wait until they have lunch, or they may prefer to do it when they get home.

In many daily situations we observed that the users preferred not to use their mobile devices, or they thought it was too difficult to use in the given context. We have divided the situations that decreased the usability of handheld device into two categories: *physical constraints* and *mental constraints.*

The *physical constraints* made the PDA difficult to use because of the physical environment surrounding the user. Many of the observed users tried to use their PDA when they were working at the top of a telephone pole. Because they needed their hands to both climb and performing their primary cabling work, they were not able to pay the device the required attention; two hands at the keyboard and at least on eye focusing on the screen. In other situations the users tried to use their PDA when sitting under a desk, doing cable work at the telephone lines. When holding wires and pliers on one hand, and measuring equipment in the other hand, they were very much disabled to press the *PageUp / PageDown* keys required for reading the wiring map at the screen of their PDA. Because the PDA required two hands for pressing *PageUp,* which is actually done by pressing the *Alt-key* and the *Arrow-key* simultaneously, the users were not able to do so. Other situations that disposed the mobile device direct sunlight, or the lack of light in a dark room, decreased the usability of the device.

The *mental constraints* made the PDA difficult to use because the users had to concentrate about other tasks demanding attention. Quite often the users tried to look up an address while driving their car. Before they were equipped with handheld devices, they had papers containing all required information. Now, all the required information may be accessed through their PDA. Because of the contrast and size of the screen, it is harder to read the information on the screen compared to white papers. Once again, the mobile device require more attention than the users are able to pay. This quite often lead to hazardous situations in the traffic. Another less dangerous example, is when the users were doing cable work inside a wiring center containing several hundred, maybe thousand cables. The worker had to concentrate not making fault connection. Because the mobile device as now described demand too much attention from its user, they quite often preferred pen and paper when doing complicated cable work.

We experienced that the mobile systems we observed were designed in such a

matter, which made them useless because of these constraints. This resulted in workarounds and augmenting work by the users, as described by Gasser (Gasser 1986). Because pen and paper are less attention demanding than the PDA's we observed, the users first wrote their data on a piece of paper, for later typing the same data in on their handheld device. Another example is when the users simply delayed the use of their device, just because the current use context made the device useless. Due to those observations, we concluded that the mobile devices were demanding too much attention from the users, resulting in low usability. Our conclusion of this case study is that if services for mobile devices are too attention demanding, and they often are, they will not be used as intended.

Consumer goods purchasing

The second field study was conducted at various warehouses in Oslo.

The study has investigated a number of customer's ways and methods of handling payment transactions. The transactions are done with coins and notes, payment cards, checks and others means. The focus of this research has been to shed light into the existing payment methods, and investigate the question of attention.

In total 90 transactions has been observed and analyzed. All the transactions between purchaser and sales person are logged and analyzed with respect to:

- Timing – how long time the transaction was, and when in the purchase process it was executed
- Handling of receipt – when how the purchaser and the sales person handled the receipt
- Access to card, notes and coins before and after the transaction has been completed
- Breakdowns in the payment process, such as pin code failure, missing wallet etc.
- Other services at the point of sales, such as withdrawal of cash, the collection of bonus point etc.

The field study informed us about the importance of user attention in different contexts of use. We observed that the payment cards required minimum attention from the users. The access to the payment card varied across the customers, from shirt pocket access, trouser pocket access, wallet access and bag access. The user attention on the task at hand, which is purchasing goods, was more readily given than attention to the payment solution itself. If the commerce solutions are too attention demanding, customers simply do not use the payment solutions.

A new design approach

We claim that mobile e-commerce has more in common with the use of mobile devices and the use of payment cards than with stationary e-commerce services. We argue that the success of payment cards and mobile communication devices may be attributed to the limited attention that the cards and devices require from the user. When you engage in a transaction at your local store, the attention is on the goods to be purchased, and not on the payment card.

Integration into the existing telephone device will increase the complexity of the device. With additional functions such as calendar, SMS in addition to the main function of a telephone - voice over distance - the man machine interface will be more complex.

There are various ways of dealing with this, such as utilizing agents in the phone, using larger screens, better menu structures etc. These alternatives are yet to be explored and tested.

Wireless coverage at the place of purchase is a condition that has to be met. In the case of a component-based device to be introduced, it is possible to achieve local connectivity to the point of sale, and not necessarily go through the wider area cellular system. The payment transaction mechanism should always work, and battery capacity is a concern. If the service is integrated into the cellular phone, it will be draw battery from the main device, whereas if it is a separate component, the battery management can be designed for long time operations.

Our design approach is driven by the fact that attention in a mobile use context is crucial for the success of new mobile e-commerce services. The design approach is based on:

- A component based solution
- Harmonizing in the big picture

A component based design

Any new mobile e-commerce solution involves the following parts:

- A wireless device, e.g. a mobile phone
- An application, e.g. a browser
- A service, e.g. an online ticket ordering service

The user will get in contact with these three elements, the device, the application and the service for new mobile e-commerce solutions.

To minimize the attention needed from the user to the device, the application and the service, we suggest a component based approach in designing new e-commerce solutions. There is an inherent danger in designing new solutions based solely on existing technology. By integrating new services into one existing device, it is indeed possible to end up with a device that looks like the now famous Swiss army knife. Such solutions do require more attention to operate than the user may give.

The component-based solution consists of a set of basic components. These basic components could be classified into two types, which are:

- Effectors
- Sensors

The effector term is used as a generic term for the component that is giving output to the user. The sensor term is used as a generic term for components that is receiving input from the user.

The classification is done according to the human senses, and not according to the network or services. Note that this classification is not restricting for human users only. The user of the component-based services may also be non-human, like cars passing through toll road systems.

For each user, there is a "terminal agent". The "terminal agent" is the name of the program and the corresponding data that has the responsibility in the system for the assemblage and configuration of the different basic components that the user may use, and for the communication to the corresponding network(s). The information that the "terminal agent" holds is related to the basic components in use. The question if the physical transmission medium is of wireline or wireless type is transparent to the component-based solution, e.g. it may be wireline or wireless such as for example

BlueTooth (Haartsen 1998).

With the component based solution, it will be possible to design mobile e-commerce solutions that are minimizing the attention needed by the user for using the device, the application or the service. An example of a new e-commerce component may be a small credit card sized device that is connected wirelessly in an ad-hoc network fashion to a WAP enabled mobile phone.

Harmonizing in the big picture

Mobile e-commerce solutions are not used isolated. Early adopters of mobile e-commerce solutions also use other commerce solutions, both stationary net based and traditional paper based services. It is crucial to keep in mind the different platforms that the users are in contact with, and to harmonize the different new approaches to minimize attention needed for the user.

The focal point in designing new mobile e-commerce solutions should start with the user in focus. When the user is in focus, as opposed to technology only, it is seen that the user uses different types of commerce solutions. When new services are harmonized with the existing services in use, this will require shorter learning time and less attention is needed from the user.

An example illustrates this point. When a user is doing banking on the Internet with a certain bank, using payment terminals with a certain card type - any new e-commerce solution will need to evolve from the existing solutions with respect to interaction modality, feedback system etc.

Summary

The rapidly evolving technologies, standards and infrastructures for mobile information and communication solutions are providing new opportunities to develop mobile e-commerce solutions. In this article, we have discussed mobile e-commerce, presented field studies, and a new design approach based on the view that user attention should be minimized. We argue that mobile e-commerce has more in common with the use of mobile devices and the use of payment cards than with stationary e-commerce services. We argue that the success of payment cards and mobile communication devices may be attributed to the limited attention that the cards and devices require from the user.

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