UPTEC STS05 004
Examensarbete 20 p
Mars 2005

Mobile Text Telephony and Voice, Text and Video over the Internet

Development and analysis of new ways to communicate for deaf and hard of hearing

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Abstract

Mobile Text Telephony and Voice, Text and Video over the Internet

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This master's thesis deals with two new ways of communication for deaf and hard of hearing: Mobile text telephony (MTX) and Voice, text and video over the Internet (MMX). The purpose with MTX in this thesis is to develop the user interface. This is done in close relation to test users and by employing an iterative approach which includes user analysis, user interface development, usability test and suggestions for changes. The user interface is developed with J2ME and the usability tests include one thinking aloud test and one test, which is video recorded, where quantitative measures are taken.

MMX allows users to communicate with voice, text and video via computers connected to the Internet. This means that deaf users can communicate in their first language – sign language – thanks to the video feature. The purpose with MMX in this thesis is to evaluate users' experiences. In order to do this a web questionnaire in sign language is constructed. 13 respondents of 21 answered the questionnaire and the main conclusions show that the users are positive towards using MMX even if improvements can be made. A majority claim to prefer MMX over traditional textphones.

Finally, a question concerning whether or not the new ways to communicate will be used in the future is discussed. The conclusion from this discussion states that MMX probably will be used mostly by deaf, while hard of hearing will adopt MTX to a greater extent.

Handledare: Marcelo Tapia
Ämnesgranskare: Anders Jansson
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ISSN: 1650-8319, UPTEC STS05 004
Tryckt av: Ångströmlaboratoriet, Uppsala

Sammanfattning

Denna rapport handlar om två nya sätt att kommunicera för döva och hörselskadade: *Mobil texttelefoni* (MTX) och *Tal, text och video över Internet* (MMX). Syftet med examensarbetet vad gäller MTX, är att utveckla ett program för mobil texttelefoni som användaren kör på sin mobiltelefon. Utvecklingen sker i nära samarbete med testanvändare och tillvägagångssättet är iterativt med stegen användaranalys, programmering, användbarhetstest samt förslag till förändringar.

Med MMX kan användarna kommunicera med tal, text och video via Internetanslutna datorer. Detta innebär att döva användare kan kommunicera på sitt förstaspråk – teckenspråk – tack vare videofunktionen. Syftet i denna rapport vad gäller MMX, är att utvärdera användares erfarenheter. Detta görs med hjälp av en webbenkät på teckenspråk. 13 respondenter av 21 besvarade enkäten och de viktigaste slutsatserna visar att användarna är positiva till att använda MMX men att förbättringar kan göras. En majoritet föredrar MMX framför traditionella texttelefoner.

Slutligen diskuteras frågan om de nya sätten för kommunikation kommer att användas i framtiden. Slutsatsen från denna diskussion är att MMX antagligen kommer att användas mest av döva, medan hörselskadade i större utsträckning kommer att använda MTX.

Preface

This report is the result of the master's degree project that I have carried out at the company Envilogg in Uppsala. The department of Information Technology, division for Human-Computer Interaction, at Uppsala University has been the supervising department. The degree project was carried out in the period of September 2004 – February 2005. Envilogg was acquired by the company Netwise in the autumn of 2004 and Envilogg was integrated at Netwise's office in Kista in the beginning of 2005. The degree project marks the end of my studies to achieve a Master of Science in Sociotechnical Systems Engineering.

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1 Introduction

This master's thesis deals with two new services for telecommunication between people: **Voice, text and video telephony via the Internet** and **Mobile text telephony**. The services have been developed by the company Envilogg Datateknik AB in Uppsala, the place at which this thesis work has been carried out. The technology for this kind of telecommunication is quite new which means that in order to reach a useful service, from a user's point of view, it has to be evaluated and improved as the work goes along. This is where this master's thesis comes into the picture.

1.1 Two new communication services

Deaf and hard of hearing have been able to telecommunicate via textphones for about 25 years. A textphone is either a physical artefact or a computer, equipped with a particular program. The textphone (or computer) is used for writing text between two users. If a textphone user wants to contact someone who does not have access to a textphone, the call can be made through a relay service. This service consists of people translating the written text into speech, and vice versa.

People who are deaf since birth or who became deaf in a relatively early age has sign language as first language and written Swedish as second. Sign language is a visual and gestual-based language that does not have much in common with written or spoken Swedish; it is a language of its own with a particular vocabulary and grammar. This means that when communicating using textphones, deaf have to use their second language – written Swedish. Envilogg has developed a service for communication with voice, text and video over the Internet. The service is called **MMX,** which is an abbreviation for **M**ulti**M**edia e**X**change. MMX allows its users to communicate with voice, text and video, which mean that deaf users are able to use sign language. The reason that MMX is called a *service* and not a *product* is that it is not a physical artefact, but a computer program that is installed on quite an ordinary computer. A web camera is also needed, in order to use the video feature, as well as an Internet connection. The main purpose of MMX is to provide deaf with the possibility to communicate in sign language.

Mobile telephony has been a success story since the development of the GSM network. What has been especially interesting is the use of SMS – a service that was not at all indented to reach such a widespread use among mobile telephone users. SMS made it possible for deaf and hard of hearing to "be mobile" too. Although SMS is a nice feature it has certain restrictions. One of those is that the communication is asynchronous, which means that the text message does not arrive instantly, but minutes, hours or days later. Sometimes the message never reaches its destination. Another restriction concerns the amount of text that can be written in each message – 160 characters at a maximum. The second of the two new communication services that Envilogg has developed, is **M**obile **T**e**X**t telephony, abbreviated **MTX**. With MTX, communication works in about the same way as it does with ordinary textphones. Unlike the case for SMS, the communication is synchronous, which means that the moment after the message is sent, it reaches its destination. This is due to the fact that a communication channel is opened when a call is connected. A big difference between MTX and traditional textphones is the way in which the user is to write text. The keyboard of the mobile phone normally does not resemble the keyboard of the traditional textphone or that of a computer. Instead each button on the mobile phone

often has three characters, and to choose between these the user either presses the button a certain number of times (i.e. one, two or three), or uses the T9 feature (see the wordlist in section 1.6). There are some requirements that must be fulfilled by the mobile telephone in order to be compatible with MTX; Firstly, the phone has to be Java enabled, which means that Java program can be downloaded and run on it. Second, it has to be compatible with GPRS, which is the communication protocol that MTX uses. Finally the phone has to have enough memory. Today, a lot of mobile phones have these features.

The development of MMX and MTX might sound a bit contradictory, since the purpose with MMX mainly is to apply deaf with the opportunity to communicate in sign language, while the purpose with MTX is to provide a better way for mobile text communication. How does this focus on both video and text communication coincide? When it comes to mobile communication, in order to communicate through video, a connection to the 3G network[1] is needed. This is not necessary when communicating only with text. Mobile text telephony can partly be seen as a complement for mobile video telephony. Another reason to develop MTX is that someone who has become deaf or hard hearing as an adult does normally not have sign language as first language. For those people MTX can be useful. Finally there is also the fact that not everyone who wants to contact someone with sign language as first language knows sign language himself and vice versa.

Envilogg is involved in projects where MMX and MTX will be tried-out by test users. The thesis work takes place within the frames of these projects. The MMX project includes 40 deaf users who will be prescribed MMX by their county councils[2]. This is a pilot project since it is the first time deaf will be prescribed MMX as a communication aid. Deaf are traditionally prescribed textphones. MMX is already in use in some organizations, but then only the text and voice features are implemented. The MTX project is on an earlier stage than that of MMX – no users have tried mobile text telephony before the current project. Arbetsmarknadsverket[3] is involved in the project and five of their handling officers will participate as test users. MMX and MTX are highly connected, since MTX is based on MMX and would not work without it[4]. Envilogg has been working about three years now on developing and improving MMX, while MTX is a new concept, from 2004, added to the original service.

1.2 Problem description

In order to develop a system that the users will like and want to use, it is necessary to focus on them throughout the design process. Questions concerning how to design a system that matches the users' needs and demands are within the scope of this thesis. The development of MMX has reached further than that of MTX, which means that the two projects are in different stages. As mentioned above, MMX has been in use for some time already, while MTX will be developed and tested by users for the first time in the autumn of 2004. This master's thesis work will be directly involved in the development of MTX, while the work with MMX will have an evaluative character.

[1] Network for fast mobile connections that allows for more data to be transferred than with the GSM network.
[2] Deaf and hard of hearing who cannot use ordinary or amplified voice telephones, are entitled to textphones. The county councils ("landsting") are responsible for prescribing communication aids.
[3] The Swedish National Labour Market Administration.
[4] Technical details will be discussed in later chapters.

The scope of the work with MTX is to develop and test the MTX program from a user perspective. This will be done by designing and evaluating the user interface in close contact with the test users. An example of something that will need to be discussed is what text (e.g. headlines) to print out on the screen of the mobile phone. The screen is very small, at least when compared to that of an ordinary computer, which suggests that it is particularly important that the text is really meaningful. Apart from design issues, there are other interesting matters to discuss. One such issue is if certain mobile telephones are more suitable than others to be used for text conversations. Different mobile phones are designed in different ways, which means that the ways buttons are placed, menus navigated and text written differs. Perhaps a certain phone is more suitable for the use of MTX than others? This remains to be investigated.

The MMX related work will take an evaluative character. An investigation will be made in order to find out how the users experience the service and from this conclusions will be drawn about how to improve it. The part of the thesis work concerned with MMX is much smaller than that concerning MTX, due to the fact that only an evaluation will be carried out.

A last question about the new communication services is whether or not deaf and hard of hearing are going to use them in the future. What does the demand for the services look like? The fact that the technology now exists does not necessarily implicate that users will adopt the services. Within the scope of this question, the aim is not only the test users in the projects, but also possible future users.

1.3 Purpose of the thesis

The discussion above leads to the purpose of this master's thesis, which is to:

- Develop and evaluate mobile text telephony (MTX) from a user perspective.
- Investigate if certain mobile phones are more suitable for the use of MTX than others.
- Evaluate users' experiences from voice, text and video over the Internet (MMX).
- Analyse whether deaf and hard of hearing in general are going to use the new communication services in the future.

1.4 Thesis delimitation

It is possible that people with no hearing impairment could be interested in the new communication services. However, this will not be dealt with here. The focus in this master's thesis is on users who are deaf or hard of hearing, since the test users in the projects as well as the intended future users are deaf or hard of hearing.

The first part of the purpose specifies that MTX will be developed and evaluated from a user perspective. The development here will be focused on the user interface, other people at Envilogg will be dealing with communication related development, i.e. to make it possible to phone with MTX.

When it comes to part two of the purpose above, an investigation to see if certain mobile phones are more suitable for the use of MTX than others, focus will be upon the features that are relevant for MTX. Things like how to turn on and off the phones will be included since that is a necessary operation for the use of MTX too, but things like playing games or using a possible calendar feature will not be dealt with. At the start of the thesis work, Envilogg had already decided upon four different mobile phones to test, why the evaluation will be limited to these.

1.5 Disposition

In this first chapter an introduction to the new communication services is given, as well as a problem description and a specification of the thesis's purpose. In chapter two the theoretical framework is specified and relevant theories and methods are discussed. The theory chapter is based on the discipline of human-computer interaction and especially on theories and methods concerning the usability of a system. In chapter three mobile text telephony and voice, text and video over the Internet are discussed in more detail. Both the technology behind the services as well as the context surrounding them are discussed. In chapter four the methods used for going from questions to answers are described. This is followed by a chapter devoted to the work with MTX and a chapter to that of MMX. After this a chapter dealing with the question of whether or not the new services will be used in the future follow. In the next chapter the major conclusions are drawn, followed by a chapter containing some critiques to the way the thesis work was carried out as well as some recommendations for the future.

1.6 Wordlist

GPRS	General/GSM Packet Radio Service, a standard that specifies how to transfer data in GSM networks.
HCI	Human-Computer Interaction.
HRF	Hörselskadades Riksförbund (The Swedish Association of Hard of Hearing People).
HTML	HyperText Markup Language, format for web pages.
HTTP	HyperText Transfer Protocol, a protocol that specifies how to transfer data.
IP	Internet Protocol, the communication protocol that is used on the Internet.
ISO	International organization for Standardization.
J2ME	Java 2 platform Micro Edition, a special edition of the Java platform intended to be used when constructing programs for small devices like mobile phones.
MIDlet	Mobile Information Device application, Java application that is downloaded to a mobile phone.
MMX	MultiMedia eXchange.
MTX	Mobile TeXt telephony.
OTA	Over The Air, standard used to transfer MIDlets to mobile phones.
PSTN	Public Switched Telephone Network, the ordinary network for landline calls.
SIP	Session Initiation Protocol, a protocol (or framework) that specifies how to initiate a conversation between two users.
SDR	Sveriges Dövas Riksförbund (Swedish National Association of the Deaf).
SMS	Short Message Service, technology to send short text messages between mobile phones.
T9	Text on 9 keys, a way to type text on mobile phones. The user strikes each button once and a program compares the word to a dictionary and gives suggestions on probable words.

2 Theoretical framework

In this chapter theories about human-computer interaction, usability and technological development that are relevant for the thesis work, are introduced and discussed.

2.1 Human-computer interaction

In the beginning of computers, only skilful technicians with thorough knowledge about computers could use them. However, the development of computers has led to that a wide spectrum of people today uses them. Still, skilful technicians use computers but also ordinary people with almost no knowledge of computers. This is why the way in which users interact with computers has to be intuitive and clear, which on the other hand does *not* mean that the systems should be adapted to all computer users worldwide, but to that specific group of users for whom a specific system is intended. Users should not have to understand how the computer works for being able to use it. In the same way as the driver of a car does not have to know in detail how the mechanics of steering is transmitted from the steering wheel to the wheels, does the computer user not need to know what happens inside the computer. However, it is of great importance that the driver understands what the effects will be if he turns the wheel, and the same goes for the computer user. The area in which issues like these are dealt with is called *human-computer interaction* (HCI). An older term that dates from the 1970s, is *man-machine interface* (MMI). (Preece, Rogers, Sharp, Benyon, Holland, Carey, 1994)

There is no widely accepted definition of HCI, but suggestions have been made. One of those is the definition made by ACM SIGCHI Curriculum Development Group, that can be found in Preece et al. (1994):

> *Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them.*
> (Preece et al., 1994, p. 7)

Gulliksen & Göransson (2002) believe this to be one of the most accepted definitions of HCI and also think that this definition points out the fact that HCI covers a wide area, including system development, social conditions of technology and effects on society. Gulliksen & Göransson (2002) claim that HCI treats different areas of applications, e.g. mobile telephones, handheld computers or more subtle products where it might even be hard to know that the application is computer-based.

The fundament of all HCI research and design is that the persons who use a computer system should come in first place. Focus should be on the users – their needs, competence and wishes should be the take-off when a system is to be designed and implemented. Users should not have to adapt to the system, but the system to users. (Preece et al., 1994)

2.2 Usability

Usability is a key concept within HCI and deals with questions such as how to make systems that are easy and simple to use. Systems that are badly designed can be very annoying to use. The term *system* includes not only hardware and software, but also the surroundings that use or get affected by use of the system. (Preece et al., 1994)

Ketola (2002) says that a product does not become usable by chance, but by conscious work with usability. Dumas & Redish (1999) agree on this and also point out that usability cannot be added in the end of the development of a system, but must be built in from the beginning, something that is done by involving users throughout the whole process, by specifying quantitative usability goals, by letting usability and users' needs drive design and by testing the product's usability.

When trying to reach for a definition of usability, it is striking how many different suggestions that show up. Nielsen (1993), Dumas & Redish (1999), Preece et al. (1994) and ISO (1998) all have their own definitions. However, even if the different definitions all have dissimilarities, they also have similarities. The clearest similarity is that usability is something measurable. Gulliksen & Göransson (2002) also claim that there is a certain understanding about what usability actually is. They choose ISO's definition of usability for several reasons. One is that they find that definition to include aspects essential to users that normally is not included when usability is discussed. Another reason is that an ISO standard yields a certain amount of attention and acceptance, simply by being an ISO standard. An important aspect on usability, which both Gulliksen & Göransson (2002) and Nielsen (1993) point out, is that usability is not a one-dimensional concept. Whether a product is usable or not depends not only on the product itself, but also on the context in which it is used and on the users who use it. Usability has to be studied in its context, which the ISO definition implies. (Gulliksen & Göransson, 2002)

2.2.1 ISO 9241-11

This section discusses ISO's definition of usability as well as ISO's own description of how to measure usability. The original source has been used, namely *ISO 9241-11, 1998, Ergonomic requirements for office work with visual display terminals (VDTs) – Part 11: Guidance on usability*.

ISO defines usability like this:

> *Extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.*

ISO also defines the terms *effectiveness, efficiency, satisfaction* and *context of use* separately.

> *Effectiveness:*
> *Accuracy and completeness with which users achieve specified goals.*
>
> *Efficiency:*
> *Resources expended in relation to the accuracy and completeness with which users achieve goals.*
>
> *Satisfaction:*
> *Freedom from discomfort, and positive attitudes towards the use of the product.*

Context of use:
Users, tasks, equipment (hardware, software and materials), and the physical and social environment in which a product is used.

ISO claims that this definition is meant to be used for office work with visual display terminals, but also say that it can be used for other situations where a user is interacting with a product to achieve goals.

2.2.2 Usability goals

According to ISO 9241-11 usability goals are something of high importance. Already in the introduction to the standard it is mentioned that the users' performance and satisfaction should be measured in order to see whether or not the usability goals have been fulfilled. In order to be able to measure usability, it is necessary to first identify goals with the usability and to split up effectiveness, efficiency, satisfaction and the context of use, into smaller, measurable components. ISO 9241-11 points out that it is necessary to specify at least one measure respectively for the effectiveness, efficiency and satisfaction. There is no rule telling how the measures should be chosen or combined, since that depends on what weights the different components have been prescribed in each specific context. For example, if the product is only to be used occasionally by the users, it might be suitable to give the component learnability (i.e. how easy it is to learn how to use the product) a high weight.

What can a usability goal look like? ISO 9241-11 gives some proposals on this. They mean that there are both broader goals, such as to "produce a letter", and narrower ones, such as to "perform search and replace". The goals can be coupled to the terms effectiveness, efficiency and satisfaction. To demonstrate how a goal can be specified, an example is given in ISO 9241-11: "…the criterion for the efficiency of installation has been specified as completion of the installation task within 10 min." (ISO 9241-11, 1998, p. 16) The goal here is thus that the user should be able to install the product within 10 minutes. If it takes more than 10 minutes then the goal has not been reached and improvements should be made.

2.2.3 Usability and mobile telephones

It is difficult to find studies directly related to the usability of mobile phones. When reading Klockar et al. (2003) this seems logical since, according to them, few studies about the usability of mobile phones have been published, in spite of mobile phones today being one of the most common consumer products. However, Klockar et al. (2003) themselves have performed a usability study concerning mobile phones. They have studied the usability of Nokia and Siemens mobile phones with the purpose to examine how difficult it was for users to use some common and uncommon features. The users used their own phones during the test. Nine users participated, all of whom had owned their phone at least two months. Each user performed 26 different tasks that the test leaders specified. During the test session the phone was video recorded in order to count the number of times the user pressed the buttons of the phone. In order to ease the counting, the sound of the buttons was switched on. The counting was done after the test, by studying the video. This number was then compared to the minimal number of times it is necessary to press the buttons in order to perform the specified task. The result was in short that it was difficult to find and use uncommon features. Klockar et al. (2003) came to the conclusion that mobile phones can be made much more usable by

more careful design and by paying more attention to menu navigation. They did not find any difference between the Nokia and Siemens phones, regarding the usability.

2.3 Examining usability

There are several methods for examining the usability of a product. Most of them fall in one of two categories – methods that involve users and methods that do not. Nielsen & Mack (1994) call these methods empirical and informal respectively. Nielsen & Mack (1994) suggest that a combination of different kinds of methods is preferable, since they complement each other. Informal methods find certain types of usability problems that empirical do not, and vice versa. Dumas & Redish (1999) advocate usability tests, which are a form of empirical method, but say that informal tests can be used as a complement. Methods for examining usability by using empirical methods are discussed below, followed by a section about heuristic evaluation, which is an informal method.

2.3.1 Usability tests

The main purpose for performing a usability test is to improve the usability of a product. According to Dumas & Redish (1999) the following five items characterize every usability test:

1. *The primary goal with a usability test is to improve a product's usability*
   For each test there are also more specific goals. For example, a test goal might be to investigate how easy it is for the users to navigate in the menu system.

2. *The test participants represent real users*
   The participants who attend the test must be part of the group of users who will use the final product.

3. *The test participants perform real tasks*
   It is necessary to find out how the users will use the product in their daily work, which in turn implicates that an understanding of their work and what they do must be accumulated. The test tasks that the users perform should relate to the goals with the usability tests, as well as to other things that need to be examined.

4. *Observe and document what the test participants do and say*
   Normally one participant at a time works with the product. A usability test consists of tasks that the user is to try to accomplish, as well as a questionnaire that the user should fill out.

5. *Analyse the information, diagnose the problems and recommend how to solve them*
   It is important to analyse the test results and to document the usability problems that have been discovered. Recommendations to how to solve the problems should also be given.

(Dumas & Redish, 1999, p. 22)

It is relevant to perform usability tests in all stages of a product's development. At an early prototype evaluation there are normally fewer test participants and fewer tasks. It is also normal not to take quantitative measures at an early stage. Usability tests are used iteratively during product development. (Dumas & Redish, 1999)

To perform a usability test where users are to be observed, some usability experts recommend the use of a usability lab with one-way mirror and software for logging keystrokes. Dumas & Redish (1999) on the other hand advocate methods that can be used if there are difficulties to get access to such a lab, or if there are financial restrictions. How many test participants is it necessary to recruit? It is not enough with a single one, but with two or three it is possible to reach some general conclusions. Further on, at least some factors should be measured quantitatively, e.g. how many participants who had a certain problem. What measures to take depends on the test goals as well as the stage in the development process. Dumas & Redish (1999) emphasize that usability tests can be performed on different kinds of products and not only on computers. They themselves have performed usability tests on, among other things, video recorders, cordless telephones, answering machines and software. It is not necessary to make a lot of adaptations to a test according to what type of product that is to be tested. (Dumas & Redish, 1999)

As mentioned in the section concerning usability goals, section 2.2.2, it is recommended to measure effectiveness, efficiency and satisfaction in order to examine the usability. Effectiveness and efficiency are preferably examined by objective measures, e.g. by measuring the time it takes users to accomplish some predefined tasks. If it is impossible to gather objective measures, subjective measures based on the users' opinions can be used as an indication. Satisfaction is measured subjectively, e.g. by letting users mark on a scale how satisfied they are with the product. However, satisfaction can also be measured objectively by noting the users' spontaneous comments about the product. (ISO 9241-11, 1998)

Thinking aloud

Nielsen (1993) thinks that the so-called *thinking aloud* method might be the single one most valuable method for examining usability in a product. In a thinking aloud test the test participant uses the product while continuously telling what he is thinking. This way the test leaders can get an idea of how the user understands the product and by that come to conclusions about usability problems. A drawback of the thinking aloud method is that it does not support quantitative measures very well. Its strength is instead the qualitative data that can be retrieved from quite a few test participants. Although a lot of relevant information can be found by noticing the users' comments, it is also important to observe what the users do when working with the product, since this might not be obvious only from the users' comments. Another thing to consider when conducting a thinking aloud test is that it feels unnatural for most people to continuously tell what they are thinking. This may affect the test result as well as make it more difficult to conduct the test. The test leader will often have to remind the participant by asking "What are you thinking right now?" or "What do you think that message means?". Except from asking such questions the test leader should speak as little as possible and should not help the participant to perform the tasks. When performing a thinking aloud test about three to five test participants are recommended. (Nielsen, 1993)

Active intervention

Dumas & Redish (1999) argue that the most common way to conduct usability tests is to let the user work alone with the product, without any intervention from the test leader. The reason for this is that later on the user will use the product alone, or at least not in the presence of a test leader. However, sometimes it can be useful to perform another kind of test, e.g. with a method that is called *active intervention*. With active intervention the test leader more actively observes the user and asks questions, for example what the test participant expects will happen or why he did a certain thing. By conducting a test like this, Dumas & Redish (1999) mean that the test leaders can get an understanding of how the user understands the product. Active intervention is particularly useful for evaluating early design ideas, since it works very well on prototypes. On the other hand, it does not work well if the goal is to measure time, for example the time it takes a user to perform certain tasks. If an active intervention test has been decided upon, it is important to plan it carefully and to make sure that the questions to be asked are relevant and not leading. (Dumas & Redish, 1999)

Video recording

Video logging can be used as a help when performing a usability test. One idea is to use two cameras at the same time where one is focused on the user and one on the computer screen. This way both the user's interaction with the system and his body language can be monitored. It is not necessary to use expensive video equipment, but ordinary home-movie cameras can be used. It is important to plan the observation in advance and to decide what kind of data to look for. After having finished a recording it is time to analyse it, something that can either be task-based or performance-based. In the first case attempts to determine how the users tackle the specified test tasks are made, whereas in the second clearly defined performance measures are identified. Examples of common measures are frequency of correct task completion, task timing and frequency of user errors. An important thing to consider with a performance-based analysis is to make sure that the measures are obtained in the same way throughout every test, since there otherwise will be reliability problems[5]. (Preece et al., 1994)

Pilot test

No usability test should be performed if it has not been preceded by a pilot test during which the test method is tried on a couple of pilot test participants, often two or three persons are enough. (Nielsen, 1993) The reason to why a pilot test should be conducted is to debug the usability test in order to find and solve test problems before the real test. (Nielsen, 1993, Dumas & Redish, 1999) Typical problems that are discovered during a pilot test, are that the participants do not understand the task instructions or that they misinterpret them. (Nielsen, 1993) It often shows that the test tasks are more difficult than thought, which means that either the test will take more time, or the tasks have to be changed. Another reason for conducting a pilot test is to let the persons conducting the real test practice. (Dumas & Redish, 1999)

2.3.2 Questionnaires

Lots of aspects of usability can be studied by simply asking the users. This is particularly true when it comes to users' subjective satisfaction, which can be hard to measure objectively. However, it is important not to take all user opinions for truths.

[5] The test has to be repeatable by other evaluators.

Data showing what users actually do should have priority over what users say they do. 24 of 25 users of a mobile phone system answered via a questionnaire that the instructions on how to use the system were satisfactory. When the users later were asked to use the system, only about 50 % could use it satisfactory. The users thought they had understood the instructions, although they had not. (Nielsen, 1993)

When wanting to reach a larger group of users, questionnaires can be a good tool. Unlike interviews, questionnaires are quick and can be analysed more thoroughly afterwards, e.g. by calculating percentages or by looking for correlations. The first thing to do, once having decided to create a questionnaire, is to analyse what kind of information that should be collected. This could be measurable feedback related to certain features, or the users' impression of the system (Dix, Finlay, Abowd, Beale, 1998). A good idea is to keep the questionnaire as short as possible, since this maximizes the chances of getting a lot of answers. (Nielsen, 1993)

There are some different kinds of questions that can be posed in a questionnaire:

- General: Questions which purpose is to get information about the user's background and to position him in the user population group. Typical questions are related to age, sex and occupation. There can also be questions that concern the user's earlier computer experience.
- Open-ended: Questions without predefined answering options – the user must himself write an answer. These kinds of questions are usable for collecting subjective information, but hard to analyse. A special case is when the user is encouraged to write down actual values, like how many commands he has been using. However, open-ended questions are the first ones that the user chooses to skip, which means risking not to receive an answer at all. (Dix, Finlay, Abowd, Beale, 2004)
- Scalar: Statements to which the user respond according to a predefined scale. An example is the statement "It is easy to recover from mistakes" to which the user will have to choose from a 5 graded scale where 1 means "do not agree at all" and 5 means "totally agree". Other types of scales can also be used, but the 3 graded scale where 1 means "do not agree at all", 2 means "neutral" and 3 means "totally agree" can give more "neutral" answers since the user might not have very strong feelings against either "disagree" or "agree". A scale with lots of options can on the other hand be difficult to interpret in a consistent manner. The users will probably interpret the options differently – one user might put 2 when he absolutely does not agree, while another might put 2 when he agrees a little. This is why a 5 or 7 graded scale is preferable.
- Multi-choice: The user is asked to choose between some predefined responses to a question. If suitable, the number of responses the user should give can be specified.
- Ranked: The user is asked to rank certain items in order of preference.

(Dix et al., 1998)

For the questionnaire to be easy to understand, only a few different kinds of questions should be mixed. In addition the scales should be designed in the same manner throughout the questionnaire. (Nielsen, 1993)

2.3.3 Heuristic evaluation

Heuristic evaluation is an informal method, i.e. that does not involve users, developed by Nielsen and Molich for finding usability problems in a user interface. (Dix et al., 1998) According to the method, three to five evaluators examine the interface and judge how well it comply with recognised usability principles, the so-called heuristics. During an evaluation session the evaluator goes through the interface and examines the different dialogue elements and compares them with a list of usability principles. Nielsen (1993) has developed a list of usability heuristics that can be used, but other principles that the evaluator knows of can also be applied. It is possible to develop heuristics specific to a certain type of products, as a complement to the general heuristics. The evaluators work independently during an evaluation session. Afterwards each evaluator's result is used to put together a list of usability problems, with references to the relevant heuristics for each problem that has been discovered. The reason for having several evaluators is that it is hard for a single evaluator to find all usability problems in an interface. It is not an impossibility using one single evaluator but tests show that only about 35 % of the usability problems are found then. The evaluators decide for themselves how many times to go through the interface, but Nielsen (1993) recommends at least two, where the first is devoted to getting the overall picture – what is the main purpose with the system, what ways of interaction are there. In the second review the evaluation is performed. It will often be quite easy to find solutions to the discovered usability problems since they have been specified with reference to established usability principles. (Nielsen, 1994) Three of Nielsen's ten heuristics are listed here. All ten heuristics can be found in annexe 1.

Heuristic	**Description**
1. Visibility of system status:	The system should always keep the user informed of what is going on, through appropriate feedback within reasonable time.
2. Match between system and the real world:	The system should speak the user's language with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in natural and logical order.
3. User control and freedom:	Users often choose system functions by mistake and will need a clearly marked 'emergency exit' to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.

(Nielsen's homepage)

2.4 Principles and guidelines

Principles and guidelines concerning the design of a system's user interface can help system designers to make sound decisions. There are a lot of different principles and guidelines that originate from different sources such as journals, house style guides and general handbooks. (Preece et al., 1994)

What are principles and guidelines? According to Dumas & Redish (1999), while a principle more constitutes a design goal, a guideline describes how to reach that goal. Apart from principles and guidelines it might be necessary to create guidelines that are suitable for the specific product under development, something that Dumas & Redish (1999) call rules. To illustrate what they mean they give an example with the development of a remote control, where a guideline is to "Let the users leave menus in a consistent manner". A rule corresponding to this guideline can then be to always have the users press the same button when leaving menus. Preece et al. (1994) seem to agree on the need to locally adapt principles into rules. Dumas & Redish (1999) point out that by understanding and employing principles when developing a product, usability is built into it. This is better than to wait for a usability test to show weaknesses in the system, which the designer could have discovered a lot earlier. Nielsen's heuristics can be used as design principles, although they more have the character of rules of thumbs than of real principles, according to Nielsen himself (Nielsen's homepage).

It is not always clear exactly what is meant by a principle, a guideline or a rule, since there seem to be no clear definition of this. Different authors seem to give these words somewhat different explanations. However, as long as it is clear how and what they are used for, this should not have to cause any problems. A final important note comes from Preece et al. (1999) when they claim that what is really important to realize about guidelines, is that they are no cookbook in how to design a user interface, but only a guidance.

2.4.1 Guidelines specific for mobile telephones

It has been difficult to find principles and guidelines specifically intended for the design of mobile system user interfaces. There does not seem to be very much done within this area. However, Dix (Dix' homepage) has some examples of principles that are important to have in mind when designing user interfaces for mobile telephones. These principles are important for the design of other systems too, but due to the unreliable character of wireless nets, mobility creates special problems and opportunities, according to Dix. Two of these factors are *feedback* and *feedthrough*. Feedback is related to how fast the user sees the effects of his actions, while feedthrough is related to how fast users see the effects of another user's actions. (Dix' homepage) Ketola (2002) also discusses feedback and feedthrough and claims that feedback often can be analysed and improved as part of the product development. Feedthrough on the other hand can never be fully analysed or improved as part of product design, since it is dependent on the bandwidth and the network latency. (Ketola, 2002)

Klockar et al. (2003) claim that it is important to consider the small size of the screen when designing for mobile phones. They refer to an article by Paap & Cooke that say that it is of great matter to choose words with high care. According to Klockar et al. (2003), Paap & Cooke claim for example that a headline of a menu must include all items underneath it as well as exclude all items found elsewhere in the menu system. One consideration that a designer should do is to let users participate in the design of the menu system by choosing words and organizing the menus. (Klockar et al., 2003)

2.5 Iterative development

The idea with iterative development is to gradually improve the product. When starting the development process it is not possible to know everything about demands on and problems with the product. This is found out by iterating. From the beginning there is only limited knowledge, but little by little more knowledge is accumulated. (Gulliksen & Göransson, 2002) Dix et al. (1998) agree with this and explain that parts of the design should be constructed and tested on users in order to find out what is working satisfactory and what is not. After this the system should be modified and then tested again. Step by step the final system is built.

2.5.1 Elements in an iteration

The four elements in an iteration are analysis, design, evaluation and feedback. In the first step the users are analysed as well as their work tasks and the context in which they will use the product. In the design step proposals for what the interface should look like are made. This step involves making prototypes. The third step, evaluation, involves measuring user performance and comparing test results with usability goals. In the final step suggestions for how to improve the product are made. (Gulliksen & Göransson, 2002)

2.5.2 Prototypes

A prototype is an artefact that simulates or animates some of the features of a future system. For being able to test certain applications a simulation of what an application leads to might be needed. A certain feature, that has not yet been fully built, might need to be visualized for the user. (Dumas & Redish, 1999)

Dumas & Redish (1999) claim that tests with users can be made either on final systems or on systems that do not yet have all features implemented, i.e. prototypes. They suggest that usability tests with prototypes give the system designers a chance to change things before it is too late. Prototype evaluation makes it possible to:

1. Early incorporate user attitudes in the design.
2. Investigate several different design concepts, before settling for one.
3. Evaluate more iterations of a design.
4. Make the user interface clearer and less fuzzy, which makes it easier for everyone involved in the project to discuss it.

Dumas & Redish (1999) also point out that some designers prefer to develop the whole user interface and make it as similar to the final interface as possible, before letting users try it out. However, this is not a good idea, partly because it will be a waste of time, but also because the possibility of having the users try out only parts of the system is lost. (Dumas & Redish, (1999)

2.6 Technological development from a social constructivistic point of view

This section discusses technological development, just like the other sections in this theory chapter do in one way or another. However, this section is quite special, since it does not have a technical perspective but a social. The discussion takes off in Summerton's article "Stora tekniska system, en introduktion till forskningsfältet" (1998). In the article she talks about the development of technology. She points out that in order to understand the processes that shape and reshape the growth, development and use of technology in society, it is necessary to include historical studies as well as studies in social science. She talks about a systems perspective on technology and means that all technology consist of a number of smaller components that are tightly or loosely connected. For these components to work together as a whole they have to be coordinated. In order to study modern technology it is not enough to look at individual artefacts, but the artefacts have to be seen as parts of complex systems. Summerton mentions the telephone as an example of an artefact. The telephone can either be considered an individual artefact – "a little box on our kitchen walls, bedside tables or work desks" (Summerton, 1998, p. 22, my translation). If the telephone on the other hand is considered a *system*, then the little box is "…just a part of an enormously wide ramified system that also consists of millions of cables, numerous switchboards and telephone poles, lots of national and transnational companies…" (Summerton, 1998, p. 22, my translation). Technical systems do not consist only of the technical components, but of actors and organizations that operate, develop or use the system, as well as of institutions and institutional regulations that provide a framework to the system. During the 1980th three research directions concerning the look on technology as systems were developed. These three new concepts had their root within social science. One of the new directions were the social constructivistic approach developed by the sociologists Bijker and Pinch. They called their theory *SCOT – Social Construction of Technological Systems*. (Summerton, 1998)

2.6.1 SCOT – Social Construction of Technological Systems

According to the SCOT theory technological artefacts do not develop linearly but by groups of people interpreting and using them in different ways. When developing the theory Bijker and Pinch use a case study of the bicycle's development in the late 19th century. They study how different groups of people contributed to today's appearance of the bicycle. Bijker and Pinch use the conception *relevant social groups*, by which they mean institutions and organizations, but also unorganised groups of people who "…share the same set of meanings, attached to a specific artefact" (Bijker & Pinch, 1987, p. 30). The consumer and user groups are obvious relevant social groups. Less obvious groups can also be relevant, for instance the so called "anti cyclists" that Bijker and Pinch identify in their case study. The "anti cyclists" were a group of people who were opponents to the bicycle. This group had different methods of showing their dislike – from derisive cries to more destructive ways. A certain social group can have relevant social subgroups. An example of this is the group cyclists that are further divided into female cyclists and male cyclists. Female cyclists were not supposed to ride a bicycle in the beginning of the bicycle's development. Eventually though, adaptations to women, with respect to them wearing skirts, were made. An example of an adaptation was the high-wheeled bicycle which back wheel were moved a bit to the side, in order

to let women stand with both legs on the same side of the front wheel. However, this adaptation was soon abandoned.

Different relevant social groups see different problems with an artefact during its development. As for the bicycle, some groups focused more on safety aspects while others were interested in speed. Different solutions to the problems were presented by different groups, which were shown by the amount of different kinds of bicycles that came and went. Not only technological solutions were proposed, but also judicial or moral ones – for instance trying to change people's attitudes so that women could wear trousers. Eventually, by negotiations between the groups, a solution was found – consensus was reached and it was decided what the bicycle should look like. Such a *closure* in the debate is reached when the relevant social groups regard the problems as solved. This does not necessarily mean that the problems have been solved in the common sense of the word[6]. Bijker and Pinch claim that the process of "inventing" the bicycle took 19 years (1879-1898). (Bijker & Pinch, 1987)

[6] Technical problems might still be the same, even when consensus has been reached (my note).

3 New ways to communicate – technology and context

This chapter starts with a short description of the company Envilogg Datateknik AB. After that the wider user group, consisting of deaf and hard of hearing in general, is described, followed by a short description of traditional text telephones. This is followed by a description of MMX and MTX in technical and functional terms. The test user groups are described and a comparison between the new communication services and other ways to communicate is made.

3.1 Envilogg

Envilogg Datateknik AB was founded in 1988 by three persons who had been colleagues at Uppsala university when they all studied engineering physics. Envilogg's focus is on CTI – Computer Telephony Integration. Envilogg develops technology for call and contact centres, web support for telephony and text and video relay services. A perhaps well-known installation is Eniro's directory enquiries[7] (118118). Since January 2005 Envilogg is integrated in the company Netwise AB.

3.2 Deaf and hard of hearing

Being deaf means to not hear. A person who has been deaf since birth or an early age has sign language as first language. Sign language is a visual language that deaf use in direct communication, when hearing instead use spoken Swedish. (SDR's homepage [1]) In the same way as hearing children develop their voice and their language by imitating their parents and other people in their surrounding, do deaf children learn sign language. Deaf children crow with their hands, at the same age as hearing children crow with their voices (Miles, 1998). Sign language has developed in the same way as spoken languages, which among other things means that it is not international - there are even dialectal differences within a country. (SDR's homepage [2]) Sign language is a different language than Swedish with its own grammar and structure – it is not a translation of Swedish. This means that there are a lot of people who are skilled in sign language but significantly less skilled in written Swedish. (Waller, 2004) There are about 8-10 000 deaf who have sign language as first language. (Tema Modersmål's homepage)

People who are hard of hearing or who have become deaf as an adult do normally not have sign language as first language. They communicate through speech but often with the support of aids or interpreters. (HRF's homepage [1]) There are about 1 million people in Sweden who have a hearing impairment, some have a small impairment and others a more serious. About 15 000 have such a hearing impairment that they cannot use a voice phone[8] – they use textphones and relay services instead. (HRF's homepage [2])

[7] "Nummerupplysning".
[8] A voice phone is an ordinary telephone.

3.3 Text telephony

A textphone has traditionally been a physical artefact that looks a bit like a typewriter (see figure 1 below). As mentioned in the introduction, today computers can also be used as textphones, if they are equipped with appropriate software. A textphone, either a computer-based or not, is used for writing text either directly between two users, or via a relay service. The reason for having a relay service is to make it possible for someone without a textphone to reach someone who does, and vice versa. At the relay service operators are working with translating the hearing person's spoken language into text and the deaf or hard of hearing person's text into speech. The operator translates word for word what is being said and written, in a neutral voice (Handbok för texttelefoni ord för ord, Eniro). To reach the relay service a special telephone number is dialled[9]. No charge is taken to use the relay service. The company Eniro runs the service, commissioned by Post- och Telestyrelsen (PTS)[10], with Envilogg as technology supplier. The technology behind text telephony often only allow for one user at a time to write text, which means that the users have to take turns in writing. To ease the communication special symbols are used. An example of this is the asterisk, "*", that a user types when finished writing. That way the other user will know when to start typing. When one user wants to hang up the call, he types "KL SL" which means "Klart Slut"[11] and then waits for the other user to write the same before hanging up. (Handbok för texttelefoni ord för ord, Eniro)

Figure 1 – Textphone

[9] 90 165 from a voice phone and 90 160 from a textphone. (Handbok för texttelefoni. Ord för ord, Eniro)
[10] The National Post and Telecom Agency.
[11] "Over and out".

3.4 Marvin MMX

The following information about MMX has been gathered by trying it out and by talking to people at Envilogg, where nothing else is mentioned.

Marvin MMX[12] is Envilogg's multimedia platform for voice, text and video (see figure 2 below). It allows its users to communicate with voice, text and video. MMX is based on the client/server architecture, where the clients are quite ordinary computers[13] equipped with a web camera and an Internet connection. The server, which is a J2EE Application Server (Java Enterprise), is either placed at Envilogg or at the organization that uses MMX. An MMX user can call and receive calls not only from other MMX users, but also from users of other SIP videophones and from textphone users. Calls from an MMX user to a textphone user is transmitted via Internet to a modem pool that connects the call to PSTN. The other types of calls are transmitted via SIP over the Internet. A web client is available for anyone who does not have any of the phones specified above but who wishes to contact an MMX user. The web client is downloaded for free from the Internet.

MMX is intended for organizations such as companies and public authorities. One kind of customer is the county councils in Sweden. They are responsible for prescribing communication aids to disabled within the council. As mentioned in the introduction to this report, the county council of Örebro participates in a pilot project which took-off in the autumn of 2004. MMX is already in use at Specialskolemyndigheten[14] and Arbetsmarknadsverket. However, neither Specialskolemyndigheten nor Arbetsmarknadsverket use the video feature at this time. The reason for this is that the video feature had not yet been satisfactory developed, when MMX was installed at those organizations. Specialskolemyndigheten and Arbetsmarknadsverket have taken somewhat different stands concerning the video issue; while Specialskolemyndigheten is currently testing the video feature with the purpose of using it in the future, Arbetsmarknadsverket is involved in the pilot project with mobile text telephony.

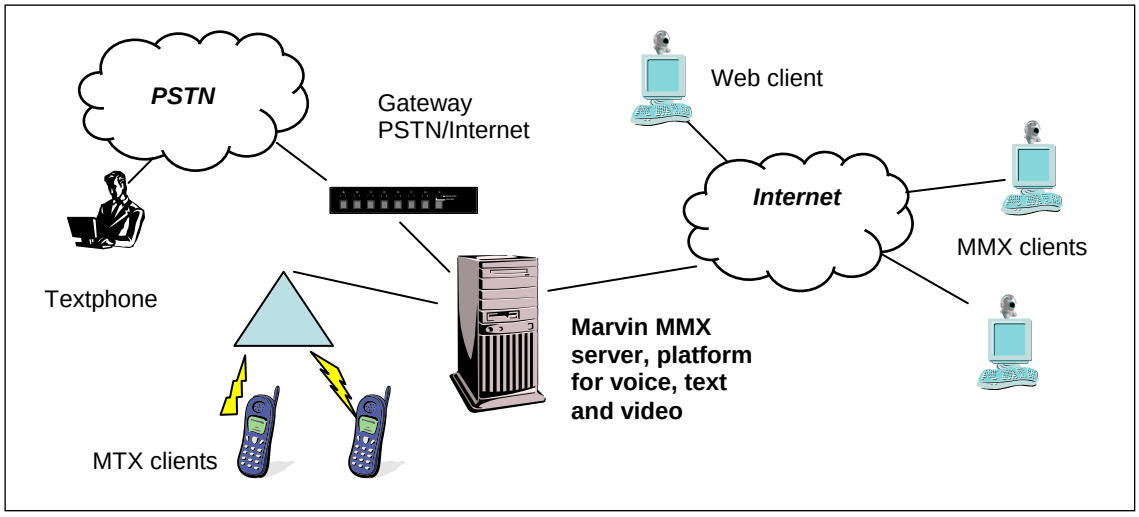

Figure 2 - Schematic picture of MMX

[12] In this report Marvin MMX is usually called only MMX.
[13] Windows 2000 professional or XP. Minimal resolution for graphics: 1024x728.
[14] The National Agency for Special Schools for the Deaf and Hard of Hearing.

3.4.1 How to use MMX

As already mentioned, the MMX user can make calls to other MMX users, textphone users or users of other SIP videophones. The user can also receive calls from these kinds of phones as well as from a web client. The web client is intended to be used by friends, relatives and other persons who want to get in touch with an MMX user. Text calls and video calls can be made from the web client, if there is a web camera installed on the computer to which the web client is downloaded. So far calls cannot be made from an MMX user to a web client user. When making a video call, two windows appear on the computer screen; One bigger in which the person on the other end of the line is seen and one smaller in which oneself is seen. The smaller window lets the user verify how the person at the other end of the line sees him. This way he can make sure that he signs within the frames of the web camera. However, if the user wants he can close the small window. When a call comes in a visual indication on the screen notifies the user. If a perception equipment[15] is connected to the computer this will be activated in order to get the user's attention. Figure 3 shows the MMX client's user interface.

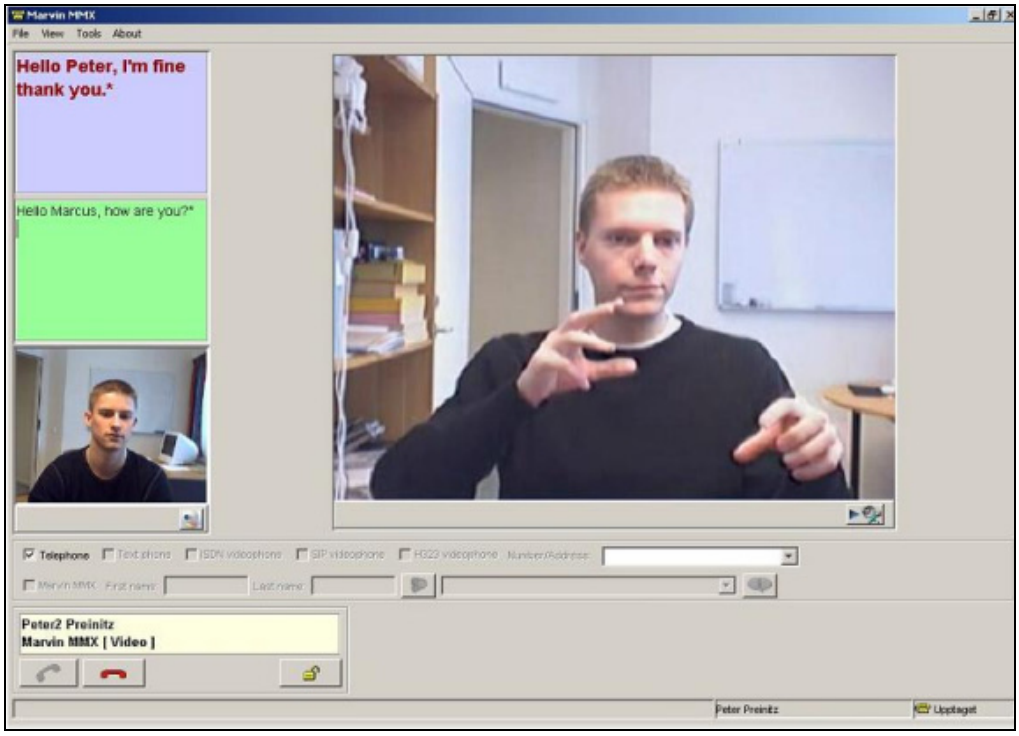

Figure 3 - MMX client

3.4.2 Test users

21 deaf[16] living in the county council of Örebro have been prescribed computers with MMX installed, to use at home. The computers are equipped with the appropriate software, a web camera and an Internet connection. Apart from using MMX and surfing the web, the computers have been locked which means that users cannot do anything else with them. The users themselves pay for the Internet connection. When deciding to whom MMX should be prescribed, the county council used the following approach: Inhabitants of the council who earlier had been prescribed a traditional textphone received a letter telling about MMX and asking them to reply whether or not they were

[15] E.g. vibrator or external lamp.
[16] 21 users had had MMX installed at the time for this thesis. The intention is to install it to 40 users.

interested in trying it out. Those who replied that they were interested, were later on called to a meeting where more information about MMX was given. After that, they had to answer again whether or not they were still interested. Everyone but one answered that they still wanted to try MMX and all of those were then prescribed MMX. (Stigsdotter, 2004) The test users were to keep their ordinary textphones when testing MMX.

3.4.3 Comparison between MMX and other ways for communication

The main advantage of MMX is that people who are deaf since childhood can communicate in their first language. Text and voice can be used as a complement, for example if a user wants to communicate with a textphone user. There exist some other products for this kind of total conversation, i.e. voice, text and video communication. First of all, there is another service for total conversation that has been developed by the company Omnitor in Sweden. It is called Allan eC and looks quite alike MMX. The main difference between Allan eC and MMX is that there also is a web client for MMX, something that Allan eC does not have. Apart from Allan eC and MMX there are physical videophones, which look like ordinary telephones but with a built-in screen and video camera. The company Visiontech makes such videophones. There does not exist any kind of web client to use with physical videophones and it is not possible to use them for writing text.

3.5 Marvin MTX

The following information about MTX has been gathered by reading internal project documents as well as by talking to people at Envilogg, where nothing else is mentioned.

MTX is a new module to MMX. The purpose of MTX is to handle text communication between mobile phones, text phones, MMX clients and web clients (see figure 2). MTX consists of the MMX server to which a new application is added and software for mobile phones. The software is programmed with Java 2 Micro Edition (J2ME), which is a Java edition specifically designed to be used with mobile phones, handheld computers and other small devices with limited screen size, processor power and memory (Carlsson & Setterlund, 2002). A J2ME application is called a MIDlet. In order to install the MIDlet on the mobile phone it is downloaded from a web page via OTA. MTX uses the communication protocol GPRS, which means that the user only pays for the amount of data that he sends and receives. A message with 160 characters would cost about 0.009 SEK[17].

3.5.1 How to use MTX

In order to make things clear it should be stated here that it was not defined how to use MTX when the thesis work began. This was something that was gradually developed. Today MTX can be used for receiving calls from other mobile textphones, from ordinary textphones and from MMX web clients. It is possible to make calls to other mobile textphones, ordinary textphones and MMX clients. The procedure in which to answer an incoming call is a bit special: The user should first reject the call and then start the MTX program. Eventually an announcement will be made telling the user that

[17] 1 character = 1 byte. Each data packet has an overhead of 58 byte. A normal price on sending data seems to be 20 SEK per MB, according to some phone operators' homepages. Since both the sender and the receiver have to pay this makes 2*(160+58)*(20 /10^6) = 0.00872.

an incoming call has been made and demanding if he wants to answer or not. In order to accept the call the user should press the “ok” button. The reason for this procedure is that once having started the MTX program on the phone, the program is polling to check if there is anything to download from the server. Once the call has been received, a conversation window is opened in the mobile phone. In this window the user sees what has been written so far in the conversation. In order to write new text, the user has to press a certain button that opens a new window in which new text can be written and sent. The text is being transmitted via HTTP, which is a communication protocol that secures that all data packets reach their destination. If there are problems with the transmission that prevent a packet from arriving to the destination, it is sent again.

3.5.2 Test users

Five handling officers at Arbetsmarknadsverket (AMV) in Uppsala are going to participate in the pilot project. They will use MTX at work during a try-out period of six months. After that it will be decided whether or not they will go on using mobile text telephony. Out of the five test users one is deaf, three hard of hearing and one hearing. There are different departments at AMV in Uppsala. ”Arbetsförmedlingen för döva”[18] is responsible for a nationwide coverage of deaf and deafblind, when it comes to work-related matters. ”Arbetsförmedlingen för hörselskadade”[19] is responsible for the hard of hearing in eight councils in Sweden. (AMV’s homepage) Due to these large catchment areas the officers travel a lot and during theses trips they sometimes need to get in touch with each other, something that until now has been done by SMS messages. This, together with the fact that AMV already used MMX were the reasons for them to decide to try MTX.

3.5.3 Comparison between MTX and other ways for mobile communication

What alternatives for mobile communication are there today for deaf and hard of hearing? As mentioned in the introduction SMS rapidly became popular, although it meant deaf communicated in their second language (PTS’ homepage). However, when compared to no mobile communication at all it is natural that the service grew quickly. As mentioned earlier SMS is an asynchronous way to communicate, at the same time as it is quite a lot more expensive than to send data over GPRS. As a comparison, an SMS message costs around 1 SEK. To send the same amount of text with MTX that can be sent as a maximum with SMS, costs about 0.009 SEK. However, this differs slightly depending on the telephone operator.

Mobile video telephony has not been a possibility for very long - only since the construction of the 3G network. According to Sveriges Dövas Riksförbund about 95 percent of all young deaf in Sweden use 3G mobiles to communicate. In a statement from June 2004, SDR says on their homepage: “Being able to read emotions, to speak to one’s family in one’s common language – obvious facts for hearing, until today an utopia for deaf” (SDR’s homepage [3], my translation). A fact that contributes to the widespread use of 3G among the deaf is that the operator 3 allows its customers to make free video calls within the 3 network.

[18] “Employment agency for deaf”.
[19] “Employment agency for hard of hearing”.

3.5.4 The mobile telephones in the project

When starting the thesis work Envilogg had already decided upon what models to test. There are four different telephones; Sony Ericsson P900, Palm Tungsten W, Nokia 6600 and Nokia 3510i. The physical design of the telephone is of course fixed, which means that things like the size of the screen and the location of the buttons cannot be changed. This is why it is interesting to investigate if certain kinds of phones are better to use for MTX than others. Both the Sony Ericsson and the Palm are equipped with a pointing device that together with the buttons is used to control the phone. When pushing the pointing device softly against the touch sensitive screen, a command is given. It does not seem possible to use MTX on the Sony Ericsson with the ordinary buttons[20]. The two Nokias are controlled only with the buttons.

The way in which to write text differs between the phones. As for the Sony Ericsson, there are two different ways to choose between, both of which involve the pointing device. The first possibility is to use a virtual keyboard on the screen. This way the pointing device is used for clicking on the letters, one click per letter. The second way is to write letters directly on the screen. It is predefined exactly how the letters should be written and it takes some training to be able to write correctly. Writing text with the Palm can also be done by writing on the screen with the pointing device. Another possibility is to use the qwerty keyboard[21]. Although the keyboard is quite small, especially when compared to a normal full-size one, it seems possible to use it effectively for writing text. However, different users probably think differently concerning the size and use of the keyboard. When writing text with the Nokias the ordinary buttons are used, either with or without the T9 feature. The screens' sizes differ quite a lot. The Palm has the largest screen, followed by the Sony Ericsson. On third place comes the Nokia 6600 and finally the Nokia 3510i[22].

[20] According to the user's guide more advanced features is best performed with the phone's door open. When the door is open the buttons face in the wrong direction. It seems impossible to open downloaded programs with the door closed and due to this MTX can only be used with the door open. However, this has not been checked with Sony Ericsson.
[21] Standard design of computer keyboards (at least in Sweden).
[22] The Sony Ericsson screen has 208x320 pixels, the Palm 320x320, the Nokia 6600 176x208 and the Nokia 3510i 96x65 pixels.

4 Method

This chapter describes the methods that will be used for trying to walk the road from questions to answers. According to the purpose of the thesis work, MTX will be developed and evaluated from a user perspective, whereas for MMX an investigation of the users' experiences will be made. Methods for developing MTX can obviously not be applied to the evaluative work of MMX. To make things clear, this chapter first covers methods that will be used for MTX, followed by methods for MMX. Finally methods concerning the last part of the purpose, to "analyse whether deaf and hard of hearing in general are going to use the new communication services in the future", are discussed. A literature study was performed as an overall introduction to the thesis work, why this is described below, detached from a certain part of the purpose.

4.1 Literature study

In order to decide what methods to use in the thesis work a literature study was performed during the first weeks of the thesis work. The theory chapter is the result of that study and this method chapter is the result of trying to employ the theories to the special circumstances of the thesis work. From a general knowledge of human-computer interaction more specific knowledge was built up. This was mainly done by first studying other thesis reports and dissertations within the same area, including their corresponding lists of references. It became clear that some sources are very widely used, why these were further consulted. Gulliksen & Göransson (2002) have a reference list to sources within the human-computer area that they recommend. This list was also consulted. As for the analysis of whether or not people will use the new communication services, relevant literature from the university courses in history of science was restudied.

4.2 MTX

4.2.1 Iterative development

The development and evaluation of MTX will be conducted in an iterative manner. The reason that this iterative method for development and evaluation is chosen is that it is difficult, if not impossible, to make only correct assumptions about what the user interface should look like in advance. The first step in an iteration is to analyse the users and the context. After that design proposals are made. Some programming had already been done when the work on the thesis started, so the work will take off from there. The first iteration therefore continues by deciding what changes to make from the program that had already been done, as well as what new features to add. The next step will be to perform an evaluation of the system with the users – some sort of usability test. Finally, the results from the test will be analysed. Three iterations will be made, where quantitative measures will be taken in iteration two and three.

4.2.2 User interface development with J2ME

The development of the MTX client's user interface will be done with IBM's IDE[23] Websphere Studio device developer and with J2ME. There is an emulator to use with Websphere that simulates how the program will look on a mobile phone. This means that it is possible to check the program on a mobile phone without actually having to

[23] Integrated Development Environment.

download it to a physical phone. The emulator phone's buttons can be pressed just like on a real phone, which makes it possible to move around in the menu hierarchy and execute commands. The development of the user interface will follow accepted design principles, namely Nielsen's heuristics (or rules of thumb). When it comes to the concepts of feedback and feedthrough, these cannot be used in the user interface development, at least not in the beginning, since the actual communication does not work at that time. When starting developing, the user interface will only be a shell with no underlying functionality. Apart from the help of design rules, the user interface will be designed based on the results of usability tests.

4.2.3 Specifying usability goals

Goals with the usability of MTX will be defined according to ISO's definition of usability. The reason for choosing to use usability as a central theme is that it concerns how to make systems that are easy and simple to use. If a system is badly designed it will be very annoying to use and in the prolongation perhaps no one will use it. Once having decided to focus on usability, the next decision was to choose whose definition to use. It fell on ISO's, due to its focus on the context of use and its further definitions of effectiveness, efficiency and satisfaction.

Usability goals will be specified for the effectiveness, efficiency and satisfaction with MTX. The usability tests will then show whether or not the goals have been met. If they have not been met, changes have to be made. Test two and three will be carried out in the same way and the same measures will be taken. This way the results can be compared and improvements verified. Both the MTX program's and the phone's usability will be investigated. Therefore, the five test users will be encouraged to change phones with each other with an interval of about two weeks. This way all users will probably have tried at least two different phones until usability test two and the remaining two until usability test three. In order to reach as reliable results as possible, usability tests will be held with every combination of user and phone. A potential problem can be spotted here concerning how to interpret the test results. Since the MTX program will be changed between test two and three, how will it be possible to know if changes in the test results are caused by interface improvements or by the user now trying a different phone? If the results show on a higher usability it can be caused by a more usable interface or by a more usable phone. Perhaps a better approach would be to test all phones with each user, both at test two and three. However, due to a time limit it would not be possible to go through with this. It would take too long to wait for each user to try each phone before conducting test two. Also, the test itself would be quite extensive if the user was to test four phones. For these reasons, two phones per user will be tested at test two and three. By being aware of the possible problems to distinct phone usability problems from program usability problems, the approach should work satisfactory.

4.2.4 Usability tests

The five test users of MTX will be involved in the evaluative work by participating in usability tests. In order to get to know how the users understand the interface and to investigate the usability, three usability tests will be made, i.e. one per iteration. There is no possibility to use a usability lab for the tests, but according to Dumas & Redish (1999) that is not necessary. Even with financial restrictions as well as limited equipment a usability test can be very useful.

The methods that have been chosen for the usability tests are thinking aloud, active intervention and observation. The first test will be a thinking aloud test, an active intervention test or a combination of both. This cannot be decided before discussing it with the users. Just as Keijer (2004) points out, deaf and hard of hearing may not have such a good spoken language and may not be able to fully tell what is on their mind. Therefore it is important to discuss which test method or combination of methods to use, with the users before starting the test. If the thinking aloud method is decided not to work, the active intervention approach with more direct questions will be used.

The tests will be conducted with one user at a time. The user's actions and commentaries will be recorded as he performs certain predefined test tasks. During test two and three some quantitative measures will be taken and during that part of the tests no questions will be asked since that would affect the measurements.

The intention is to make a pilot test before every test. The most important reasons for this are to control that the test tasks are viable with the given instructions and the questions understandable. Another reason is to practice on conducting a usability test. Some claim that the pilot test participants should represent the real test participants, while others claim that colleagues or friends can participate. In the MTX case friends will participate.

After a usability test it is time to collect the results and to analyse what changes to make. Preece has said something wise about this: ”Observing can change what is being observed”. (Preece et al., 1994, p. 638) It is important to interpret the results and not rush along and change everything immediately. The fact that in a test someone is watching the user can change the performance or actions. Besides, only one user's claim cannot rule the development, but it is the overall picture that is interesting.

4.2.5 Heuristic evaluation

According to section 2.3.3 in the theory chapter three to five persons should conduct a heuristic evaluation, in order to find as many usability problems as possible. Yet one evaluator should be better than none, why a heuristic evaluation of MTX will be performed. Due to the low number of users, only five, this kind of expert evaluation seem a good idea. The heuristic evaluation will be made during a couple of hours with basis in Nielsen's ten heuristics.

4.2.6 Questionnaire

A questionnaire will be distributed to the MTX users. They will be asked to fill it in during the period in which they use the phones and to complete one questionnaire per phone. Since there are four different phones, the goal is to have all users to fill in four questionnaires. According to the theory chapter, questionnaires can be a good tool when wanting to reach a larger group of users. Five users can probably not be considered such a group, but the advantages of a questionnaire in this case are still plenty. The ISO term satisfaction will be investigated with the questionnaire by including relevant questions for this. Another reason for the questionnaire is that the users will be encouraged to think concretely about what they think of MTX.

4.3 MMX

After having done a lot of thinking about how to do the evaluation of the users' experiences of MMX, the decision was made to create a questionnaire. There are several reasons for this decision. First of all the users live in Örebro län which makes it harder, but of course not impossible, to meet for a usability test or an interview. Secondly there are 21 users and in order to gather information from all of them a questionnaire seems convenient. If usability tests were to be conducted, some kind of selection of users would have to be made. Thirdly, since the users are deaf and has sign language as first language a sign language interpreter would be needed due to the fact that for me, who is a beginner in sign language, it is quite difficult to read off what someone else signs. All in all a questionnaire seems the best. The creation of the questionnaire will be based on ISO's definition of the user satisfaction, which is a part of the definition of usability. No usability goals will be specified since that would be to make a detour from the purpose. Usability goals are applied when a system is being developed, something that will not be done for MMX within the frames of the thesis work.

4.4 Discussion on the basis of SCOT

Part four of the purpose is to analyse whether deaf and hard of hearing in general are going to use the new communication services in the future. This will be done theoretically with the base in the SCOT theory, which has been discussed in section 2.7. An alternative to this theoretical discussion would be to go out and ask other deaf and hard of hearing, apart from the test users, whether or not they would be interested in using the new services. One idea was to visit a deaf school and after a demonstration of MTX investigate the students' interest in using it, perhaps via a questionnaire. However, it is possible that the students or the other people who would be consulted could get interested in the new services and would want to know when they could start using them. In order not to make expectations grow and then not be able to respond to them the idea was dropped, after consultation with the Envilogg supervisor of the thesis.

5 MTX

This chapter covers all work that is done concerning mobile text telephony, i.e. part one and two of this thesis's purpose. In the first section of this chapter, usability goals are specified for mobile text telephony. After that the iterative work with MTX is described, something that takes up a big part of this chapter. This is followed by a section covering the heuristic evaluation. A section about the questionnaire concludes this chapter.

5.1 Specifying usability goals

In this section the usability goals with mobile text telephony are presented. When conducting a usability test, both quantitative and qualitative measures can be taken. When measuring the effectiveness and the efficiency of a product it is often better to take quantitative measures (see section 2.3.1), partly due to the fact that users do not always do what they say they do. Therefore it is better to observe and document their performance. In order for quantitative measures to be useful, it is necessary to have something to compare them against. Otherwise it will be difficult to interpret the test results. Therefore, some goals with MTX have been defined, to which the test results will be compared. According to the theory chapter, it is better if goals with the usability have been identified in the beginning of a project, but in lack of this it is better to define them later then never. An example of a usability goal is: ”The user should have to make at the most 5 keystrokes in order to make a phone call.” When defining usability goals some creativity is needed in order to reach ideas about what they might look like. The goals should be relevant to the context in which MTX are to be used. According to ISO 9241-11 the goals can be coupled to the effectiveness, efficiency and satisfaction of the product, something that have been used when defining the goals for MTX.

Effectiveness is defined by ISO as the ”Accuracy and completeness with which users achieve specified goals”. The goal for the effectiveness of MTX has been set to ”approximately 100 % of the tasks completed by each user”[24]. An example of a task is to make a call to a textphone. The usability goal can seem a little bit too high, but due to the character of the tasks available in MTX it was decided a relevant goal. So far, there are only basic features in MTX, such as to make/receive calls and leave messages. The users are not to perform e.g. setting adjustments. However, due to possible network problems the goal has been set to *approximately* 100 % of the test tasks completed by each user. This means that if a user is not able to perform a certain task, it should have to do with uncontrollable network problems and not with the MTX program. The MTX program should be designed in such a way that the users can perform every task.

Efficiency is defined by ISO as the ”Resources expended in relation to the accuracy and completeness with which users achieve goals”. It is not intuitive how to define usability goals for the efficiency of MTX. One idea is to specify the amount of time it should take at a maximum for performing different tasks, while another is to specify the maximum number of keystrokes to be used for different tasks. Klockar et al. (2003) preferred to count the number of keystrokes the users pressed instead of measuring time. The reason for this was that there is a big difference in how fast users strike the keys, according to Klockar et al. (2003) However, they did never define any usability goals with the mobile phones in their investigation, why a strict adoption of their method could be misleading.

[24] All usability goals are summarized in a table later in this section.

According to both Dix (Dix' homepage) and Ketola (2002), feedback (how fast the user sees the effects of his actions) and feedthrough (how fast the user sees the effects of another user's actions) are especially important to consider when designing mobile systems. Therefore, it has been found relevant to define a usability goal that specifies the amount of time it should take at a maximum for the users to perform certain tasks. The goal differs somewhat depending on task. However, Klockar's et al. (2003) procedure of measuring the number of keystrokes has also been found useful. Therefore there are two usability goals for the efficiency of MTX, where the second is set to the minimum number of keystrokes necessary for performing a certain task, plus three. The reason for the "plus three" is that it can be quite easy to strike the wrong button by mistake and in order to recover from that some more keystrokes are necessary.

Satisfaction is defined by ISO as "Freedom from discomfort, and positive attitudes towards the use of the product". Out of the three terms effectiveness, efficiency and satisfaction, it is the last one that is best suited for subjective investigation, i.e. to be based on users' opinions. Perhaps the best way to know how satisfied the users are with a product is to ask them, and therefore it was decided to add that question to the questionnaire that will be distributed to the users at the same time as the mobile telephones. On a five graded scale, the goal is to receive at least a four on the inviation to "Indicate on the scale how much you like using MTX", where 1 means *do not like MTX* and 5 means *like MTX* " (more about the questionnaire in section 5.4).

According to the purpose of the thesis an investigation as to which telephone is preferable to use with MTX should be made. This can partly be answered by the users on a direct question. Therefore a question concerning which telephone the users prefer will be placed in the questionnaire. The users will answer whether or not they prefer the current telephone over the ones they have already tried. It is not relevant or possible to define a usability goal for this area, since the purpose is not to develop a usable telephone, but only to examine already existing ones.

The usability goals are summarized in table 1, as well as a declaration of how to measure if the goals have been reached or not. See section 5.2.2 for a specification of tasks and corresponding maximum times.

	Effectiveness	**Efficiency**	**Satisfaction**
Goal	Approximately 100 % of the tasks completed by each user.	Amount of time it may take at a maximum for the users to perform certain tasks.	On a scale from 1 to 5, where 1 is ”do not like MTX” and 5 is ”like MTX”, the goal is at least a 4.
Measure	Share of the tasks completed by the users.	Time to complete a certain task.	The users will indicate on a scale in a questionnaire how much they like MTX.
Goal		Minimum number of keystrokes in order to perform a certain task, plus three.	
Measure		Number of keystrokes to perform a certain task.	
Telephone preference measure			The users will answer in a questionnaire whether or not they prefer the current phone or someone that they have already tried.

Table 1 - Specification of usability goals

5.2 Iterative work

When planning the iterative work it was decided that three iterations should be made. The first iteration would consist of the steps user analysis, user interface development, usability test and finally proposals to user interface changes. The second and third would consist of the same steps apart from the first one that would not be investigated explicitly again. The reason for this was that there were only five test users participating in the project, why it was decided enough to analyse the users and the context in which they were to use MTX only in the first iteration. The second and third iteration would then consist of the remaining three steps; Development, usability tests and proposals to interface changes. Part two of the purpose, mobile phone investigation, was intended to be investigated with usability test two and three, in iteration two and three respectively. The intention was to first make each user use each of the four different mobile phones for about two weeks. Then, during usability test two and three, some quantitative measures would be taken and by comparing the measures a hint could be given as to which phone is the most usable for MTX. Also, this would show if the user interface had been changed to the better.

However, due to a time delay with the MTX project, the mobile telephones with the MTX program could not be handed over to the test users at the planned date. The reason for the delay had nothing to do with the thesis project, but were caused by the Envilogg staff’s other commitments. At this moment there were two choices; Either to proceed as planned but with a time delay of perhaps two months, or to make some changes to the plans. The second alternative was chosen, both due to the unplanned time delay, but also due to the belief that a result could be reached another way than according to the original plan. So, the plan was revised to include only two iterations instead of three.

This ruined the idea of comparing test results, since no quantitative measures could be taken during the test in the first iteration. Therefore it was decided to only check the test results with the predefined usability goals. If the goals were not reached, then the usability of MTX had to be improved. However, the goals have been seen as a guidance and not as an exact truth, meaning that if a goal was missed a little bit it did not necessarily have to implicate big interface changes. The time delay also implicated that each user would only have had tried one phone until test two, instead of the planned two. In spite of this it was believed that some kind of result could be drawn concerning which phone is preferable to use with MTX, even if it would have been better if all phones could have been tried. When developing the user interface, the intention was to follow Nielsen's heuristics, something that will not be explicitly described throughout the text below.

5.2.1 The first iteration

User analysis

The gathering of information about the MTX test users was completed mainly by talking both to people at Envilogg and to the users themselves. Some information was gathered from AMV's homepage. No specific interview guide was followed, but the questions asked were of the type "What work do they perform" and "Where do they perform it". The result of this informal user analysis has already been described in section 3.5.2, but will be repeated and slightly developed here, for clarification reasons. There are different groups at AMV in Uppsala. "Arbetsförmedlingen för döva" is responsible for a nationwide coverage of deaf and deafblind, when it comes to work-related matters. "Arbetsförmedlingen för hörselskadade" is responsible for the hard of hearing in eight councils in Sweden. The officers work with deaf or hard of hearing who are in their working ages (AMV's homepage). Due to the large catchment areas the officers travel a lot. During theses trips they need to get in touch with each other, something that until now has been done by SMS messages. The goal is to change these SMS messages into MTX conversations.

User interface development with J2ME

When entering the development phase, more about J2ME had to be learnt. This was mainly done by studying the code that already had been written, as well as by testing to implement and execute code. Programming with J2ME is very similar to ordinary Java programming, although it has some special features. One of those is the classes that can be used especially when making applications for mobile devices. Examples of such classes are the "TextBox" class, which allows the phone user to enter and edit text, and the "List" class that produces a list with choices between which the phone user may choose.

The first thing that was done when starting working with the user interface of the MTX client, was to design the main menu, which is the menu that is reached after having logged into MTX on the mobile phone. When the thesis work started, a suggestion for the main menu had already been made. According to this suggestion the user was to choose if he wanted to call a mobile textphone or the relay service. However, only the first choice of these two could in fact be connected. It is not yet possible to phone the relay service from an MTX client. On the other hand it is possible to phone either a "normal" textphone (i.e. not a mobile one) as well as an MMX client at AMV. It was decided to immediately make the user choose between these alternatives, once having

started MTX. Since the server cannot analyse phone numbers, the user have to make this explicit choice. Figure 4 shows the main menu in the Websphere emulator[25].

Figure 4 - Main menu of the MTX client

When choosing alternative one or two, to call a mobile textphone or a textphone, a new window opens (figure 5), in which the user is supposed to dial a number to a mobile textphone or a textphone respectively and then press “Ok”. If the user changes his mind and no longer wants to make the call, he presses “Back”.

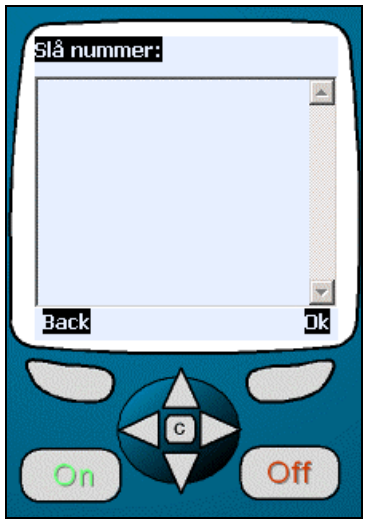

Figure 5 - Form to dial a number

Alternative three in the main menu is to call AMV textphone. AMV uses MMX as a text phone for the communication between officers and job seekers who are deaf or hard of hearing. Job seekers can make text calls to the officers from a web client. The mobile text phone can also be seen as a web client, although the application is run on a phone instead of on a web page. Therefore it seemed logical to follow the pattern from the web client, which looks like this:

[25] When running the emulator, an entire mobile phone is shown. In order to save space only the screen is shown here.

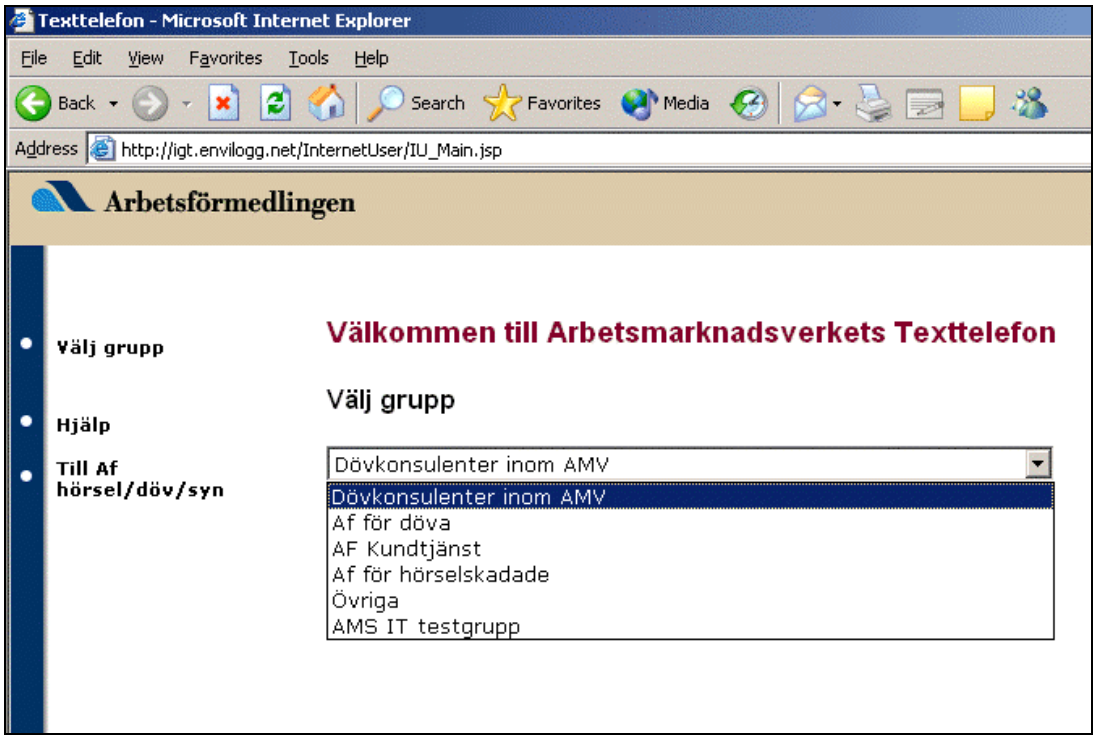

Figure 6 - The MMX web client

Now the decision had to be made as to how much of the information in figure 6 should be seen on the screen of the mobile phone. It was decided that only the really necessary information should be given space, since the screen would otherwise appear confusing due to too much text. Therefore, the window appearing after having chosen to call AMV is a window in which the user is to choose which group within AMV he wants to contact (figure 7).

Figure 7 - Menu where the user chooses which group to contact

The pattern of the AMV web client was still tried to be followed. There, when having chosen a group, a handling officer should be chosen, as well as whether to make a call or to leave a message. As can be seen to the left in figure 8 below, there is an alternative saying ”Contact group”. The user can make this choice if he does not know which officer to contact. He will then get connected to an operator.

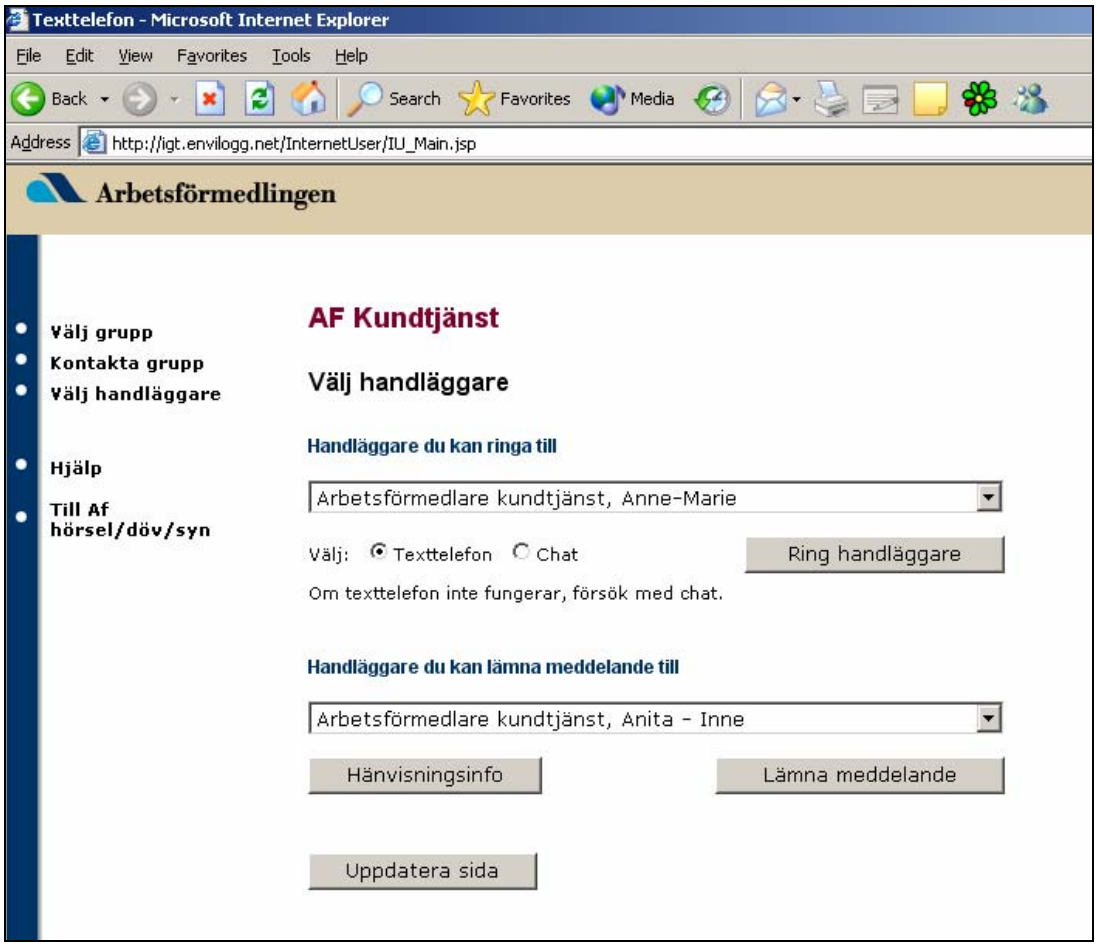

Figure 8 - MMX web client, choose handling officer and choose whether to make a call or leave a message

Since not all of this information can possibly be squeezed into the little screen of a mobile phone, the decision was made to first make the user choose if he wants to get in touch with a specific handling officer or an operator. If an operator is chosen, further alternatives are to either make a call or leave a message, as can be seen in figure 9 below.

Figure 9 - Choice to make once having chosen which group to contact

If the user decides to contact a specific officer, he will in the next step choose which one to call. The names of all officers in the chosen group are listed in the window (figure 10).

Figure 10 - Officer at a specific group

Once having chosen which officer to contact, a new menu is shown asking if the user wants to call, leave a message to or see direction information about the officer (figure 11).

Figure 11 - Available choices, once having decided which officer to contact

In order to better be able to test the user interface with the users, a window saying that a call has been established was made (figure 12). Then, when the users try to make a call, this window will turn up. This feature has no working functionality below, i.e. no call is made, since the reason is only to visualize what it might look like to the user.

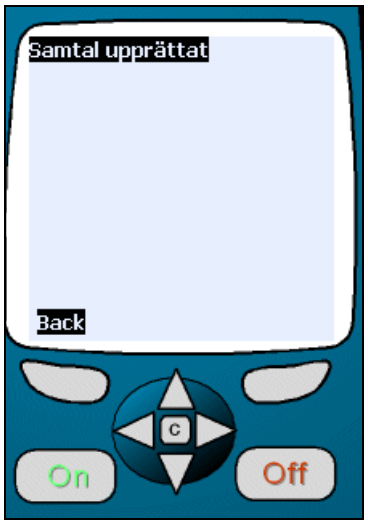

Figure 12 - Simulation of making a call

The first usability test

Why this test?

The goal with the first usability test was to get early feedback from the users on questions regarding the layout of the user interface and the way to navigate menus. There was not yet any working functionality, why it was not relevant to make any kind of quantitative measurement of the users' performance. The test was performed with one user at a time and only with the Sony Ericsson phone, which is controlled by a pointing device.

How?

Before beginning the test the user was given an explanation of the goal with the test – to collect their opinions at an early stage in order to use them in the continuing work. It was emphasized that the point really was not to test how well the users could operate the phone, but to test how well the MTX program itself worked while being operated by the users. The test was planned as a thinking aloud test, with an active intervention test prepared as a backup if the users did not feel comfortable with the thinking aloud variant. After having described how the thinking aloud test would work, and having given the users examples of how to think aloud, e.g. "This is really easy!" or "Oh, I was supposed to click there!", they agreed on trying to do it. Although it was a thinking aloud test, some questions had been specified as well as when to ask them. The difference between this method and an active intervention test might not seem that big, but in an active intervention test more questions would have been asked - it would have been more of an interview. Since this was the first time that the users ever spotted the MTX program, they first got a short introduction on how to navigate the menus. One alternative was to let the users start themselves without any introduction, but since this might have been a bit stressful for the users the idea was abandoned. Also, the aim was not to make the program easy to use especially for first-time users. After the introduction the user was supposed to operate the phone without help. Examples of the test tasks are given below. A complete list of the tasks given in the first test can be found in annexe 2.

One task that was given to the users was to "Call an officer at AF Döv". The purpose with this task was to see if the users understood how to go from the main menu, via the

necessary steps, to the point at which an officer at “AF Döv” had been called, i.e. when the window telling that the call had been established show. Another task was to “Write a message to the officer Anna Andersson at AF Kundtjänst”. The purpose with this task was partly to see how the users managed to navigate to the correct position in the menu system, partly to see how the users managed to write text with the phone.

An example of a question that was posed: “What do you think of the way in which the menu system is navigated?”. The target with this question was to get a picture of how the users’ understand the menus. One answer might have been that it is intuitive, another that it is inconsequent. Other questions were related to the choice of words in the MTX interface, e.g. “What do you think of the choice of words, e.g. “Call a mobile”, “Call a textphone” etc.?”. The question: “Do you have any spontaneous comments about what you see?” was supposed to be posed immediately after the test had started, but was erased. It did not feel right to ask that so soon, since it could create a stressful atmosphere, something which in the extension could have affected the rest of the test.

Results from the first usability test

After having performed the usability test with all five test users, the following conclusions could be drawn:

- The menu navigation worked well – it seemed intuitive for the users. However, it must be remembered that only the Ericsson phone was used. A special feature on this phone is that the pointing device can be used for clicking directly on the choices the users make, without having to click an “Ok” button afterwards. One user claimed that a lot of clicking had to be done in order to move back to the main menu, while another meant that this was quick.
- There were different opinions about using the pointing device. Some liked it and others not. A majority were however positive towards using it.
- When being in the position of making a call, the button to click should be labelled “Call” instead of “Ok”. That will make it more obvious what will happen when that button is pressed. The same goes for sending a message; The button should be labelled “Send” instead of “Ok”. When hanging up a call, the button to press should be labelled “Hang up”, instead of “Back”.
- It should not be possible to click on an “Ok” button if nothing happens. In some cases there are such possibilities.
- The main menu should say “Call mobile textphone” instead of just “Call mobile”. Several users got uncertain whether or not an ordinary mobile phone or a mobile textphone was meant.
- The users wondered how to turn off the MTX program. On the Ericsson phone this is done by clicking on “Af” on the top of the screen and then on “Exit” or “System Exit”. However, it needs to be made clearer.
- Some users had difficulties remembering that it is necessary to click on a special symbol to open the virtual keyboard on the Sony Ericsson.
- In order to close and inactivate the virtual keyboard, the button “Ok” must be pressed, even if the user has not written anything. The users spontaneously looked for another possibility to close the keyboard. *If* on the other hand they had written something, they got uncertain what would happen when pressing the button – “Was the message sent or not?”.

- Some users express a certain anxiety of losing the pointing device.

Comments on how the test was conducted

The first thing that happened was that the planned pilot test could not take place, due to problems with the transfer of the MTX program from the computer to the mobile phone. This was a small disappointment, but there was nothing to do but to go on with the tests as planned. Besides, Hals[26] and Keijer[27] had studied the test tasks and the questions and given their opinions on them. As a whole the test was carried out as planned. The impression of the thinking aloud method was that it worked well. The users told what they were thinking, some users spoke more than others. It was a good idea to mix with some questions, since more things were then discovered.

It is important to clearly explain how the test works and when it starts. In this case the users tested the program for a short while during the introduction before the actual test, why it in some cases was a bit difficult to decide if the test had started or not. This probably had to do with the inexperience of conducting a usability test. Further, all test tasks were performed, even if they did not come in the same order as planned. Sometimes the user went ahead and had performed a task without being asked. In those cases it was unnecessary to demand the user to perform that task again. Some of the questions in the plan were answered before being asked, meaning that they were not explicitly asked again. The users wanted to try to turn off the MTX program, a test task which had not been specified originally. This task had not been thought of in advance, but it seems natural that the users wanted to know how to turn it off.

One of the test users did not know in advance that the phone could not yet be used for real calls. The user found that a bit boring, something that might have affected the rest of the test. The other test users were aware of this. In order to optimize the chances of getting as much useful information as possible from a usability test, it is important to see to that all users have the same initial information. Another thing that might have had some effect on the test results was that some users were more interested than others to check out the program. Some wanted to click around a lot and investigate not only the MTX program but other features of the phone as well. The users also differed in how attentive they were to the tasks they were asked to perform. Some immediately tried to perform the task, while the task had to be re-asked to others. The only thing to say about this is that people are different and that no judgement about it is to be made. It is however important to be aware of it, in order to conduct the test and interpret the results in a good way.

[26] MTX project leader at Envilogg.
[27] Adj. professor in architecture at KTH, Stockholm. Keijer has been dealing a lot with architectural issues related to human-computer interaction.

Suggestions to user interface changes

It is never possible to meet every demand of every user, since sometimes users might proclaim things that are in contradiction to each other. All spontaneous comments do therefore not have to mean that something should be changed. Also, certain results from above have to do with the specific telephone used, in this case the Sony Ericsson, which means that it is not even possible to change everything that might be wanted. The results from above have been interpreted and the following suggestions for changes are made:

- "Send" instead of "Ok" when sending a message.
- "Call" instead of "Ok" to dial.
- "Hang up" instead of "Back" when ending a call.
- In the main menu: "Call mobile textphone" instead of "Call mobile".

About the virtual keyboard of the Ericsson phone:

- In order to remind the users of opening the virtual keyboard when they want to write text, a help text was considered as a suggestion. It could be something like "To write – open the virtual keyboard". This would however create problems for the other phones, since only one version of the program was made. Therefore, it was decided not to write any such help text. Also, all users succeed to open the keyboard after having done some thinking. It is believed that after some training this will be if not a reflex so at least something that is quickly thought of.
- The users got uncertain what would happen when pressing the "Ok" button in order to close the keyboard, as mentioned above. Had the text been sent or not? This problem will probably be of a lesser degree once the other "Ok" buttons have been replaced by "Send" and "Call" for sending messages and making calls respectively.

5.2.2 The second iteration

User interface development with J2ME

During the second iteration a problem with Websphere came up. After having failed to solve the problem a new IDE was downloaded, namely an evaluative version of Sun Studio[28]. This IDE also has a mobile phone emulator, even if the phone looks a bit different, as can be seen in the figures below. After having installed the new IDE the work could continue. The interface change suggestions from the first iteration were discussed with the MTX project leader at Envilogg and the following changes were decided upon:

[28] Sun Java Studio Mobility 6.

Figure 13 - Write a message

- ”Send” instead of “Ok” to send a message.

Figure 14 - Dial a number

- ”Call” instead of “Ok” to dial.

Figure 15 - Call connected

- “Hang up” instead of “Back” when ending a call. However, once the program is developed with all functionality, this simulation might be replaced with another window.

Figure 16 - Main menu

- In the main menu: ”Call mobile textphone” instead of ”Call mobile”.

After having done these changes the work continued with making the interface. Since the development was focused on the user interface and not on communicational matters, something that was done by other people at Envilogg, it was sometimes a little bit difficult to imagine how that part would influence the user interface. Therefore, the entire interface was not developed at this point. The way in which to conduct a text conversation was not regarded, but implemented by the communication team. However, other things were done. Something that had not been thought of earlier, was to avoid having the user remembering what choice he had made, when it comes to group and officer at AMV. Therefore it was decided to change the headings of the two menus that follow directly after having chosen which group and officer to contact within AMV (figures 17 and 18 respectively). Before making these changes the users were consulted

via e-mail. All five users did not answer but the ones who did were positive to the change. The following changes were made:

Figure 17 - Choosing which group to contact. New heading on the menu to the right.

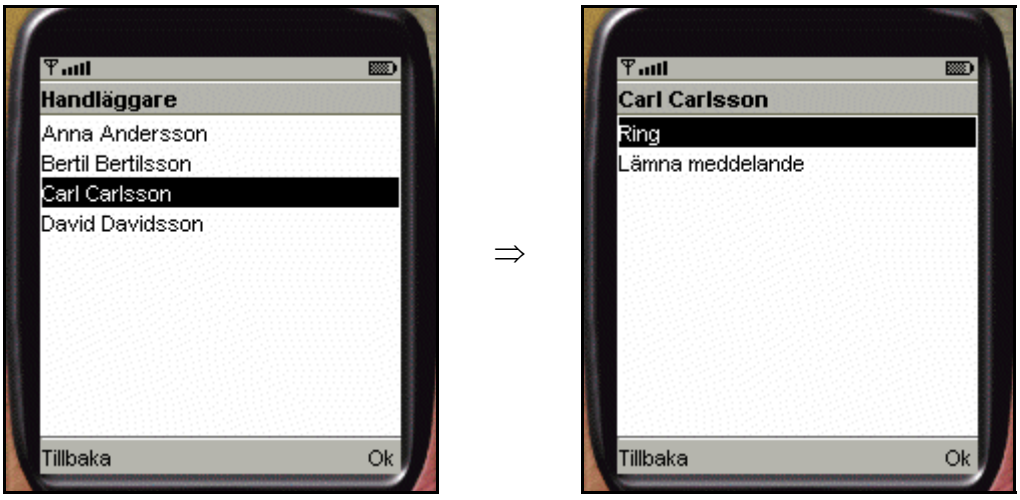

Figure 18 - Choosing which officer to contact. New heading on the menu to the right.

The second usability test

At the time for the second usability test the users had been able to use their phones during a couple of weeks. During this period it was discovered that the Nokia 3510i did not work very well with MTX, due to too low memory capacity. This was a surprise since according to the technical specifications of the phone it should have had enough memory. Also the Palm did not work well with MTX, since it took long time for it to process the user's commands. Therefore, it was decided that neither of these two phones should be further consulted for MTX, a decision that was made together with the thesis supervisor at Envilogg. Now it only rested two different kinds of phones; The Sony Ericsson and the Nokia 6600. The user who had the Nokia 6600 fell ill which meant that no test could be done. Therefore the test was done only with the Sony Ericsson. The test could at least be performed twice since two users had been equipped with a Sony Ericsson.

A short description on how to conduct a conversation with MTX will now follow (also see figure 19). Once a call has been established the window called “Samtal”[29] opens. In this window the user sees what he and the other person have written so far. In order to write new text, the user has to press the button “Skriv”[30] which takes him to a new window in which he can write text. Once finished writing, he should press the button “Sänd”[31]. At this point the text is sent to the other person and can also be seen in the conversation window. A user’s guide was constructed and handed over to the users together with the delivery of the phones. The guide contains more information regarding how to use the MTX program and can be found in annexe 6.

Figure 19 - Conversation window; Writing window; Conversation window

As mentioned in section 3.5.1, the procedure to answer a call is a bit special. The user should first reject the call and then start the MTX program. Eventually an announcement is made telling the user that an incoming call has been made and asking if he wants to answer or not. In order to accept the call the user should press the “Ok” button.

Why this test?

The goal with the second usability test was to take quantitative measures in order to check whether or not the usability goals were met. However, apart from looking for these specific measures, it was decided to be open also to discover other things that might not have been thought of in advance. Thus, the usability test was mainly performance-based (see section 2.3.1), but decided to be analysed with an open mind in order to possibly discover new things.

How?

In order to ease the succeeding analysis the test was video recorded. Before conducting the tests with the real users, a pilot test was made with the help of a friend. During this test the camera equipment was checked in order to learn how to use it and especially how to adjust it together with the tripod in order to get a clear picture of the phone’s screen and keys. Figure 20 below shows how the test was video recorded.

The test tasks were defined in advance and usability goals corresponding to the tasks decided. Only general goals had been defined so far (see section 5.1). Six test tasks were defined and are described in detail in annexe 3. The test tasks included to answer an incoming call, to call an officer at AMV and to call a textphone. It also included turning

[29] “Conversation”.
[30] “Write”.
[31] “Send”.

on and off the phone, to login to MTX and to leave a message. Apart from defining the tasks, the conversations were also decided upon in advance, with the purpose of keeping the conditions between each test as similar as possible. Thus it was decided what the user should write as well as what the other person should write. It was arranged with relevant persons in advance, so that they were to be aware of the incoming call. When it comes to the usability goals then, the keystroke usability goals had been set to the minimum number of keystrokes necessary, plus 3. Different tasks of course demand different number of keystrokes. The goal which defines the time it should take the user at a maximum to perform certain tasks also differ for different tasks. To call AMV and write the predefined conversation should take 2 minutes and 30 seconds. Important to note is that the goals were seen as a guidance and not as an exact truth. If one user took e.g. 15 seconds longer to perform a task it might not have to mean that the user interface had to be changed. The test was performed with one user at a time. In order to facilitate counting the keystrokes afterwards, the button sound was switched on, after having asked for the user's approval.

Figure 20 - The video recording at usability test 2

Results of the second usability test

After having conducted the tests it was time to analyse the results, by watching the video recordings as well as by consulting some notes that had been taken during the test sessions. The goals corresponding to the efficiency were more or less met. The users did not have to use more keystrokes than predefined in the goal. Occasionally a user chose the wrong alternative by mistake, e.g. to call instead of leaving a message. However, this was so rare that it must be considered a normal rate of user error, which does not necessarily have to do with the design. The time it took the users to complete the tasks did not equally well agree with that corresponding goal. However, the results did not show any extremely large deviation from the goals; the most significant difference was the time it took to leave a message – around 2 minutes instead of the predefined 1 minute. When leaving a message the user first chooses a group followed by an officer,

something which takes some seconds since the group and name lists have to be loaded from a database. This is probably the reason why the task to leave a message showed the largest relative difference from the goal. The other tasks also differed a bit from the predefined time. When studying the video it showed that the users need to think for a few seconds when moving from the "conversation" window to the "write" window, something that added to the total time. Sometimes they also start to write in the conversation window, something that is possible even if it is not possible to then send the text to the other person. Another thing that added to the time was the need to open and close the virtual keyboard when writing. As a whole the efficiency of MTX was pretty good.

When it comes to the effectiveness the goal was that each user should succeed with performing approximately 100 % of the tasks. This goal was not met, since there were tasks that the users could not perform. When one user tried to call a textphone, the call was connected but immediately unconnected, so the conversation did never start. The user tried a couple of times but no connection was established. However, another user succeeded with this task. The task to answer an incoming call caused some problems, since the users did not remember to first reject the call, start the MTX program and then wait for an incoming text call. Instead they answered the call on the first notice and then waited for the conversation window, forgetting to start the MTX program. The users managed to answer correctly the second or third time. The tasks to leave a message, to turn on and off the phone and to login to MTX were completed in a correct manner.

Apart from performing the test tasks the users described some problems they had been experiencing during the period in which they had used the phones. They chose to describe them at the test instead of in the questionnaire (see section 5.4), which is the reason why this is discussed here. The users gave examples on problems with feedback and feedthrough, even if they did not speak explicitly with these terms. When the users had tried to use MTX to phone colleagues' MMX clients, the colleagues in question had come to their offices demanding what was going in. It took too long time before something happened why they started wondering. At the test session the people with whom the test calls had been arranged were aware of the fact that it takes some time from answering a call to the moment when text comes. Another thing that came into light was that the timeout period of 2 minutes[32] was too short. Sometimes it took longer time to write a message which meant that the users were automatically logged out. The two test users, who had tried the Sony Ericsson phones, liked using the pointing device and were also content with the large screen.

Comments on how the test was conducted

The problem from the first test with deciding when the test had started was not a problem in the second. The users were asked to perform a specific task and the camera was only turned on at this point and turned off after the task was finished, why it was more obvious when the test was going on. Also here the test tasks were performed in a somewhat mixed order, due to the fact that sometimes the person that the user was supposed to call to was already busy with a call. When in a conversation and when leaving a message the users sometimes did not write exactly what had been decided in advance - they might add or replace some words. However, they did not write a lot more

[32] For safety reasons the user is automatically logged out of MTX when he has been inactive a certain time.

or a lot less than in the plan why this should not have had any significant affects on the test result. Even if it worked quite well to conduct the test alone, it would have been nice to have had an assistant. That way one person could be responsible for the camera and the other for conducting the test.

Suggestions to user interface changes

There are some things concerning the user interface that need to be discussed. First of all the way in which to switch between the “conversation” window and the “write” window might need some improvements. Three different ways for this can be seen. The first suggestion is to write some kind of help text to remind the user to open the “write” window when he wants to write. The second suggestion is to allow the user to write new text in the “conversation” window. This might be more difficult to implement technically or might demand more of the phone, which implicates that fewer phones would be compatible with MTX. The last suggestion is to investigate if it is possible to create the “conversation” window differently, so that it would not be possible for the user to write text there. The intention here is to show that this is an important issue to consider and not to immediately give a solution.

Another interface issue is the way in which to answer an incoming call. It seems difficult for the users to learn to first reject the call and then start the MTX program, something which might not be very surprising since normally the button for “yes” or “ok” is pressed when answering phone calls on a mobile telephone. Neither here is there a clear solution of what to do, but one suggestion is to investigate if it is possible to start the MTX program automatically when a call comes in. This way the user would not have to respond to the first notice but only to the second, which means that he will not have to reject the first call and start the program. Another suggestion is to write out a relevant text, e.g. “Incoming text call, reject the call and start MTX”, when the first notice comes.

One way to solve, or at least ease up a bit, the feedthrough problem that the users had become aware of when calling colleagues, could be to write out relevant text on the phones to which the MTX users call (in this case the colleagues’). This could be “Incoming text call, please wait”, in order for the colleagues to be a bit more patient.

The problem with establishing connections, especially to textphones, can probably not be solved by making user interface changes since it has to do with communication issues but is still important to remember. Also the fact that the two-minute time-out period is too short cannot be changed by adjusting the interface, but should still be considered revising.

5.3 Heuristic evaluation

Before handing over the phones to the users in order for them to try them out during a six months’ period, a heuristic evaluation was made. Based on the result of the evaluation suggestions for changes were then presented to the other people in the MTX development team. Some of the changes were implemented before handing over the phones. The evaluation took about three hours and was made with the base in Nielsen’s heuristics (see section 2.3.3). The discovered usability problems are listed below, with reference to the corresponding heuristic in italics, as well as suggestions for changes.

When choosing to “call AMV” in the main menu, the system fetches the group names from a database. The same happens when the system fetches the officers’ names. During this time it is not obvious what happens, no feedback is given from the system. A possible solution might be to write a message to the user, telling him to wait. *(Visibility of system status)*

Swedish words should be used instead of English - “Back” and “Exit” should be in Swedish. This had been missed when developing the user interface. When ending a call a message in English shows, saying “Status: End call”. A suggestion is to change this to “Call ended” in Swedish. When starting the MTX program on the mobile, the user should click on the program’s name, which at this point sill had the name that a programmer had given it at an earlier stage. That name did not tell what it actually was, from the user’s point of view, why it was suggested to simply change it to “MTX”. The feature of showing direction information about an officer had not yet been implemented at this point, why it should not be possible for the user to try to make that choice. It should therefore be removed. (*Match between system and the real world)*

In order to go back to the main menu when having entered “Call AMV”, the name and group lists have to be loaded from a database, something that takes some time, as mentioned already. It would be a good idea to let the users choose to go directly back to the main menu, without having to pass those steps. *(User control and freedom)*

Once a call has been connected, a window for conversation is opened. In that window the user sees what he and the other person have written so far. In order to write more text, he has to press the button “Send”, to open a window in which he can write. To send the text to the other user, another button called “Send” should be pressed. The fact that these two buttons are labelled with same name can probably be a bit confusing, why it is suggested that the first button, to open the window in which to write, is labelled “Write”. Another thing concerning the conversation window is that the text is not deleted after a call, if the user does not logout of MTX. The suggestion here is to delete the text even if the user has not logged out, in case he makes or receives another call immediately. When fetching the group and name lists the button “Ok” is shown. When clicking there the fetching is cancelled, why the button should be labelled “Cancel” instead. However, this might be specific for the P900 which in that case implicates that not much can be done. *(Consistency and standards)*

When having a conversation there is no indicator that tells the user what he himself has written and what that other person has written. A suggestion is to show this with the help of some kind of arrows that point in different directions depending on who has written what. *(Recognition rather than recall)*

5.4 Questionnaire

When specifying the usability goals of MTX (section 5.1) it was decided to measure the ISO term satisfaction subjectively with the help of a questionnaire. The purpose of the questionnaire was also to “force” the users into thinking concretely about what they think of MTX, as well as to investigate which telephone the users prefer for MTX. However, due to the time delay this last issue could not be examined since the users only had had time to try one phone.

5.4.1 How the questionnaire was made

The questionnaire was decided to mainly consist of scalar questions and questions with predefined answers to choose from, but also of some open-ended ones. The open-ended questions were mainly placed at the end of the questionnaire, in order to maximize the chance of getting the users to answer all of the questions. The usability goal concerning the users' satisfaction with MTX had been specified to a 4, where 1 means "do not like MTX" and 5 means "like MTX". After completion the questionnaire was pilot tested by letting a friend read it through to see if the questions were understandable. Some formulation changes were made as a result. The complete questionnaire can be found in annexe 4. The questionnaire was distributed to the users at the delivery of the phones and the users were asked to fill it in after having used the phone a couple of weeks. According to the original plan the users should fill in one questionnaire per phone they use but because of the time delay they had only used one phone when collecting the questionnaires again.

5.4.2 Results

First of all it should be said that two of the users could not fill in the questionnaire since their phones did not work well enough with MTX. Therefore the results should be interpreted with this in mind. The usability goal for the satisfaction with MTX had been defined to a four when requesting the users to tell how much they like or do not like MTX. The users put three on this request, which thus means that the goal with the users' satisfaction had not been met. With the results from usability test two in mind, this was not very surprising. Usability test two showed that the goals with the effectiveness were not met, since the users could not perform all the tasks. As an example the users were logged out when writing a message, due to the time-out period. Hopefully by improving things like this the users will be more satisfied with MTX in the future.

One of the purposes with the questionnaire was to "force" the users into thinking about MTX. There were mostly scalar questions and questions with predefined answers, but also some where the users were encouraged to write down their own thoughts. However, they seem to have chosen to instead take the opportunity to talk about MTX during usability test 2, which might be the reason to why they have not written down so much in the questionnaire. They have mostly answered the scalar questions and from these answers it shows that the users neither find it hard nor easy to operate MTX, e.g. to make and answer calls and to conduct a conversation. They claim that they would prefer using MTX in the future instead of SMS, at least if it is improved.

6 MMX

This chapter is devoted to the evaluation of users' experiences of voice, text and video over the Internet (MMX) – part three of this thesis's purpose.

Once having decided that a questionnaire was a good way to examine the users' experiences of MMX, the next question was to decide how to create and distribute it. At first a questionnaire on paper, which the users should fill in by hand, was considered, as well as sending it as an attached file by e-mail which they should fill in on the computer. Both these alternatives were skipped due to the fact that the users' have written Swedish as second language. It is already difficult to create questionnaires that the respondents all interpret in the same way, and in the same way as the one who created it, if both respondents and creator have the same first language. It is even more difficult when both parts do not have that. All in all it was decided that the best thing to do was to create a web questionnaire with the questions in sign language and predefined answers for the users to choose from. This way the users would not have to write a lot of text. Of course it would have been better if the users were to answer in sign language, but due to two reasons this was decided not to be done: First of all, for a beginner in sign language it is more difficult to understand what someone else signs than to sign for oneself. A sign language interpreter would be needed. Secondly, it would acquire a lot more technical work by the users to have them answer in sign language since some sort of video recording device would have to be used by them. Since Envilogg has delivered all MMX computers to the users, it is known exactly which web browser and media player that are available. Due to this the web questionnaire could be optimized for those programs. The users were to answer anonymously since it was important to encourage them to answer truthfully. Perhaps a user who would find MMX very difficult to use would not want to say that if he could not answer anonymously.

6.1 How the questionnaire was made

The questionnaire included some different kinds of questions, where most of them were directly related to the ISO definition of satisfaction. Apart from questions related to MMX, there were also questions about the user's age and previous computer experience. One hypothesis was that younger users and users who had used computers often before would use MMX more when compared to older users or users with little previous computer experience. However, this hypothesis was not the main goal with the questionnaire. The goal was to investigate the users' experiences of MMX, something that was done by asking questions where the user directly should answer what he thinks of MMX, as well as asking questions like "How often do you use MMX?". One part of the questionnaire consisted of questions of the type "Do you find it hard or easy to use MMX?", where the end of the question was changed to include how hard or difficult the users find it to answer a call, to make a call, to sign in the web camera and to see on the screen what the other person is signing. The users were to answer these questions by putting a mark on a 5 graded scale, where the alternative most to the left meant "hard" and the alternative most to the right meant "easy". The text version of the questionnaire can be found in annexe 4.

The questionnaire was recorded at home in the living room, after having done some furniture rearrangements. A normal digital camera was switched to video mode and put on a camera tripod. A lamp on 1000 Watt was borrowed from Läromedelscentralen at Uppsala University in order to make the room light enough. The questions and answer

alternatives were then recorded one by one. It would of course have been better to record in a real studio, but due to financial restrictions that idea was quickly dropped. The quality of the video recordings was good enough since there were no problems in seeing what was signed. A friend with thorough knowledge in sign language went through the recordings and gave suggestions for improvements. Help was also fetched from the digital version of the Swedish dictionary for sign language. This procedure of making the video recordings took more time than imagined, but after a couple of weeks it was finished. One reason that it took a lot of time was that the procedure of how to do a web questionnaire in sign language had to be made up as the work went along. It has not been possible to get some hints from other questionnaires in sign language, since no ones have been found. It does not seem to be a conventional way to make questionnaires; probably most of them are text-based.

After having recorded all questions and answers, an HTML file was made in order to put the questionnaire on the Internet. It was specified in this file that the first video on the web page should start automatically when the users get there, while for the others the users must press the play button. Information about the questionnaire was put in the first video. The questions and answers were given both in written Swedish and in sign language, as can be seen in figure 21 below. At the end of the questionnaire a button labelled "Send"[33] was placed, on which the users were supposed to click once having finished the questionnaire. When clicking, the user's answers were sent to a server in Uppsala, in which the answers were stored as a text file. The address to the web page containing the questionnaire was sent to the users by e-mail, in the case this was known and in second hand by normal mail. The questionnaire was distributed to 21 users. Before deciding to investigate users' experiences of MMX about 40 users were expected. But only those who had had MMX installed could receive the questionnaire and due to some installation problems only 21 users could use MMX at the moment of the distribution. After two weeks a reminder to answer the questionnaire was sent-out.

[33] "Skicka."

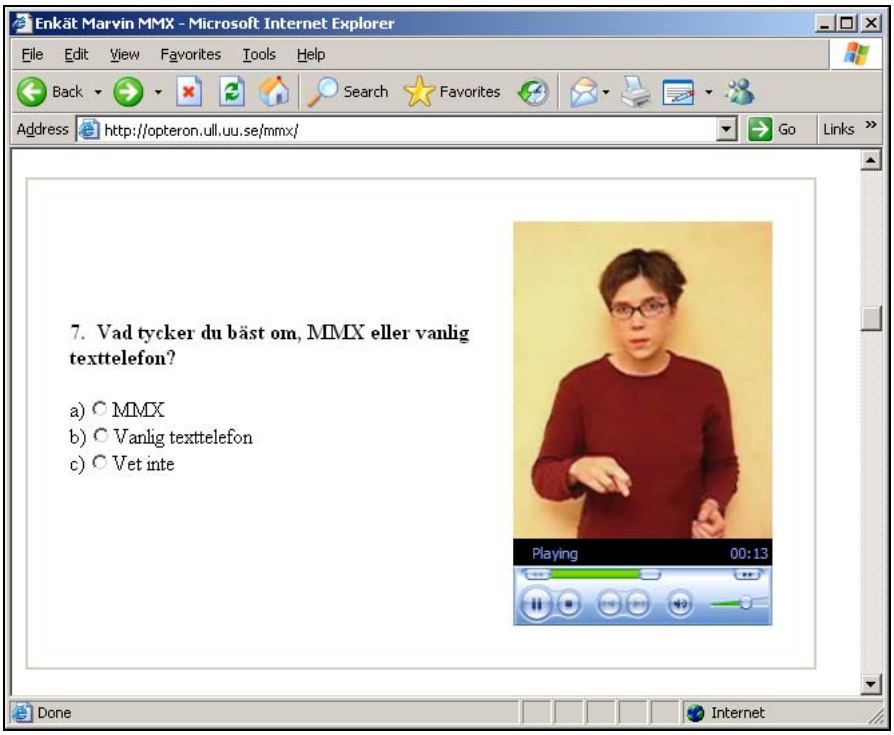

Figure 21 - MMX web questionnaire

6.2 Results

13 users of 21 responded to the questionnaire, which gives an answer frequency of 62 % . It is not possible to know who answered and who did not, since they answered anonymously. This means that it was not possible to investigate why the others did not answer, even if it would be interesting to know. Due to the relatively low number of users no statistical analysis was done afterwards. Even if all 21 users would have answered it is not sure that such an analysis would have been relevant.

After having compiled the answers and studied them, the following results show:

- 8 of 13 claim that they like MMX more than ordinary textphones. 3 prefer ordinary textphones and 2 say that they do not know.
- 5 of 13 say that they use MMX more than ordinary textphones. 5 say that they use textphones more and 3 do not know.
- 8 of 13 claim that they have often used computers before.
- 8 of 13 find it easy to use MMX. They have put their mark as high as possible on the scale.
- 4 of 13 put their mark in the middle concerning how easy/hard they find it to sign in the web camera. 3 of 13 chose the second hardest alternative.
- 8 of 13 put their mark in the middle concerning how easy/hard they find it to see on the screen what the other person is signing.
- 9 of 12 (one blank) claim that they would use MMX more often if it was improved.
- 6 of 13 answered that their friends and relatives did not use the web client. 4 say that it has happened but rarely. 3 say that their friends and relatives use the web client several times a week.
- 9 of 13 have used MMX to contact an ordinary textphone.

- 9 of 13 have *not* used MMX to contact an Allan eC or a Visiontech user.
- The users were asked to write down suggestions as to how MMX might be improved. Two users would like to have the video feature improved, in order to make it smoother and less jittery. Another wish that come from two other users is to make it easier for textphone users to call MMX users. Today they have to call via the MMX server and then choose which MMX user to contact. It would be better if they could call directly to the MMX user.
- The users had the chance to write anything they wanted in the last question. Several users wrote that it was a bit hard to try MMX a lot since their friends were not involved in the project and therefore did not have MMX.

An interesting thing to notice is that there seem to be no correlation between the users' ages or earlier computer experiences and how often they use MMX. Further, it shows clearly that the users are positive towards using MMX, although improvements can be made. The users seem to prefer to use MMX, even if they do not really do that in a corresponding level. The reason to this might be that there is a certain threshold to pass in order to use MMX more and more, together with the fact that friends might still call the MMX user's textphone. This is something that could be investigated further. A majority claim that MMX is easy to use, something which is good news. However, a majority find it a bit hard, or in between easy and hard, to sign in the web camera as well as to see on the screen what the other person is signing. This could have to do both with the quality of the video and with the fact that the users perhaps are not used to signing in a web camera as well as not used to watching the person they are talking with on the computer screen. Concerning the different features of the MMX client, it shows that a majority has contacted an ordinary textphone but not an Allan eC or a Visiontech videophone. The reasons for this are probably that a lot more people use textphones than videophones. When it comes to the web client it seems that more can be done in order to make more people use it. It was a bit surprising to notice that only 3 of 13 claim that their friends and relatives use the web client several times a week. More information might have to be given about the web client and how to use it. However, the friends and relatives probably need some time to get accustomed to this new way of calling. It should also be noted that not everyone has a computer, a fact that probably also affect the use of the web client.

It would be interesting to know what the users thought of the questionnaire. Have they met a questionnaire in sign language before? Was the quality of the video good enough? How did they find the sign language used in the questionnaire, was it too slow or too quick? There was no time to examine these questions within the frames of this thesis, but it would be very interesting to see the results of such a study.

7 Future use of the new communication services

This chapter is devoted to the last part of this thesis's purpose – to "Analyse whether deaf and hard of hearing in general are going to use the new communication services in the future".

Today the necessary technology for developing new ways to communicate exists. Yet, this does not guarantee that a wider group of users will actually adopt them. What has to be fulfilled in order to make people in general, not only the test users in the study, to really use the services? Summerton (1998) points out that focus cannot only be on the technology in order to understand the processes that shape and reshape the growth, development and use of technology in society (section 2.6). She emphasizes that to look at individual artefacts when studying modern technology is not enough. The artefacts instead have to be seen as parts of complex systems. Therefore, an attempt to answer the question "Are deaf and hard of hearing in general going to use the new communication services in the future?" falls within the frames of such a systems perspective. As mentioned in the theory chapter, the SCOT theory was one of three research directions within the area that developed during the 1980th. The SCOT theory is used below for trying to reach an answer to the question above. According to that theory different relevant social groups exist when a technology is being developed and adopted (or not adopted). As for mobile text telephony and voice, text and video over the Internet, the following relevant social groups can be identified: *Prescribers*, *users*, *organizations* and *friends and family*.

7.1 Prescribers

As Summerton (1998) points out in the theory chapter, institutions surround modern technology. In the MTX and MMX cases these are among others the county councils in Sweden, which are responsible for prescribing communication aids to the inhabitants who are in need of it. In Sweden there are 20 county councils who each have the right and obligation to decide what kind of communication aids the inhabitants should receive.

Today the different county councils in Sweden do not use the same policies when it comes to prescribing computers as aids to disabled. In some county councils the inhabitants are prescribed the appropriate software, but have to buy the computer themselves, whereas in others the computer is also prescribed as an aid. When the county council of Örebro prescribes MMX in the test project to inhabitants, the computers have been locked before delivery, so that the users can only use the MMX program[34]. Other county councils might follow in Örebro's foot steps and prescribe computers that can only be used with certain programs. Another possibility is that they will prescribe software and modems (for network connectivity) to persons who already have a computer. Earlier the county council of Örebro prescribed unlocked computers with specific software as textphones to deaf, but due to incorrect use they now lock the computers. The council had to perform a lot of service work on the computers since the users sometimes erased files and got virus. (Stigsdotter, 2004)

The prescribers might also play an important part when it comes to mobile text telephony. If they decide to prescribe MTX, more people will use it. But it is not clear

[34] A web browser can also be used.

how likely it is that the county councils will prescribe mobile phones as communication aids, since it is not a necessity to have a mobile phone. After all, it is still possible to send SMS messages for deaf and hard of hearing. Perhaps a compromise could be to prescribe only the MTX program, to users who buy their own phone.

7.2 Users

It is clear that deaf prefer signing to communicating in written Swedish. No scientific investigation has been made in order to come to this conclusion, but it is an obvious fact since sign language is their first language. When growing up as deaf, it is sign language that is learnt from birth. Deaf children learn signs by imitating other people who sign, in the same way as hearing children learn words by imitating others (for more on the deaf and sign language, see section 3.2). Today it is possible to communicate in sign language via videophones. There exist other videophones than MMX, but with MMX there is the advantage of having a downloadable web client that friends and relatives can use.

With the new 3G network for fast mobile connections it is also possible to communicate in sign language via mobile phones. This feature is quite new since the 3G network has not been a reality for very long. It is not even fully developed yet. In spite of this, according to Hjälpmedelsinstitutet's magazine "Allt om hjälpmedel" (7 November 2004) a third of the deaf individuals in Sweden use 3G phones. SDR estimates that 95 % of all young deaf in Sweden use 3G phones to communicate in sign language. So, does this not mean that the future for mobile text telephony, MTX, look very dark? Deaf want to communicate in sign language and not in written Swedish. Two factors are important here. The first one regards the status of the 3G network. Videophones work well in some places in the country but not at all in others. This means that users cannot trust that their phone will get connected to the 3G network when they e.g. go on a train. Even if this problem also exists for GSM users, it is of a lesser degree. The point here is that MTX perhaps could be seen as a complement to mobile video telephony, for deaf users. In the first place they would try to make video calls, but when the connectivity to the 3G network would be bad, MTX could be the alternative. The second factor to consider is users who do not have sign language as first language, but who still have difficulties to conduct a voice call. This includes people who are hard of hearing or who have become deaf as adults. MTX could be an alternative for them. However, it does not only depend on whether or not this group *want* to use MTX, but it is also a question of how to distribute it, something which is coupled to the idea above of having the county councils prescribe the software.

7.3 Organizations

"3G means the door to the world for us" says SDR (SDR's homepage [3], my translation). SDR takes a stand in the debate concerning radiation from 3G radio towers. The debate concerns in short whether or not there are dangerous radiation originating from the radio towers[35]. SDR says that there are political actors who want to stop the 3G

[35] It is neither possible nor relevant to describe this debate thoroughly here. Interested readers are directed to other sources. Information about radiation from systems for mobile phones can e.g. be found at Statens Strålskyddsinstitut's homepage,
http://www.ssi.se/ickejoniserande_stralning/mobiltele/stralning_mobil.pdf (2004-12-10)

expansion due to environmental reasons, an opinion to which SDR disagree. SDR claims that they too can feel a certain anxiety concerning radiation, but this anxiety is of minor importance when compared to the freedom that comes with the 3G phones. SDR thus claims that "3G means the door to the world for us" and continues by "We are not prepared to let the world close that door again" (ibid). Speaking in terms of the SCOT theory, it is not an exaggeration to say that a consensus has been reached within the deaf society, saying that the technology that makes videophones a possibility is the future.

HRF is very positive towards mobile text telephony. A press release from PTS came 2005-01-17 telling that PTS will start a project during the summer of 2005 with 60 deaf or hard of hearing who will try mobile text telephony[36]. HRF calls this is a "revolutionary project" and a "breakthrough for deaf and hard of hearing" (HRF's homepage [3] & [4]).

7.4 Friends and relatives

As mentioned a couple of times now, there is a web client to use for friends and relatives to MMX users[37]. The web client is free of charge, why it could be imagined quite popular to use. However, this means that a change of act is required from this user group. From earlier having used e.g. the relay service they can now communicate with the MMX users directly. It does though demand a computer with Internet connection, something which a lot of people have today but not everybody. If MTX continues to grow a web client with which calls can be made to MTX will probably be demanded from this user group, something which in that case will lead to a wider use of MTX.

7.5 Results of the discussion

People who are deaf since an early age and therefore use sign language to communicate seem to prefer to use video telephony, since with other alternatives they have to use their second language. It is probably quite near the truth to claim that a closure has been reached within this group of people, saying that video telephony is the technology for the future. For hard of hearing and deaf who do not use sign language as first language, video telephony does not seem to be as important. For them on the other hand mobile text telephony seems a useful service. However, the expansion of the new communication services also depends on the county councils in their roles as prescribers. Will they look upon the new services as communication aids or not? For MMX things are a bit clearer, since one council already has started prescribing it. It will be interesting to see if several other councils will do the same. Apparently no clear answer can be given as to whether or not people will use the new communications services in the future. However, based on the discussion above a guess is that MMX will be continuously used at home by deaf and that hard of hearing will use mobile text telephony.

[36] Envilogg will participate in the project as technological supplier.
[37] Or anyone else who wishes to contact an MMX user this way.

8 Conclusions

In this chapter the most important conclusions are drawn and connected to the purpose of the thesis. The first part of the purpose was to “Develop and evaluate mobile text telephony (MTX) from a user perspective”, something that has been done by using an iterative approach together with ISO’s definition of usability. Two iterations were made. The first one consisted of a user analysis, development of the user interface, usability test and suggestions for changes. The thinking aloud method was used in the test in order to get a picture of how the users understood the MTX interface. At this point the communication features had not yet been implemented, why the phone could not be used for making calls. The results of the test showed that the way in which to navigate the menu system was quite intuitive and consequent, but some words should be changed to more meaningful ones, e.g. “Send” instead of “Ok” when sending a message. In iteration two the interface development continued by first making some of the changes that had been suggested in iteration one and then by changing the headings of two menus so that the users would not have to recall information. Usability test two consisted of a session where the users were video recorded in order to afterwards analyse whether or not the usability goals had been met. The usability goals had been defined in advance in close relation to ISO’s definition of usability. The results of test two was that the goals with the efficiency were more or less met, but that the goal with the effectiveness was not. Suggestions for improvements were specified. An example of such a suggestion was to allow the user to write directly in the “conversation” window instead of having to switch to the “write” window. Other suggestions were related to problems when answering incoming calls as well as problems with slow feedthrough.

A questionnaire was also distributed in order to get a closer look of how the users regarded MTX. A result from this questionnaire was that the users seem to prefer using MTX instead of SMS in the future. Part two of the purpose was to investigate if certain phones are more suitable for the use of MTX. The conclusions that can be drawn is that yes, there are certain phones that are better to use for MTX than others. Four models were tried out, of which the Nokia 3510i was discovered not to work well with MTX. The reason for this was that it had too low memory capacity, although it should have had enough according to the technical specifications. The Palm did not work well either, since it was too slow to implement the commands given by the user. Therefore only the Sony Ericsson and the Nokia 6600 lasted. It seems that the most secure way of examining if a phone works well with a special application, like MTX, is to try it out. Although the Nokia 3510i and the Palm should have been compatible, they were not.

A questionnaire was distributed to the MMX users in order to evaluate their experiences of using the service of total conversation, i.e. voice, text and video over the Internet. The questionnaire was recorded in sign language since that is the users’ first language. 62 % of the users responded and a majority of those were positive to using MMX. A majority also claimed to prefer using MMX in front of a textphone, although when answering which they used the most they did not answer MMX in a corresponding level. The reason for this might be that it takes some time to adjust to the new way of communicating in combination with that friends still might call to the MMX user’s textphone. In general MMX was found easy to use, but to sign in the web camera and to read off what the other person signs was more difficult. Concerning the web client, it was a bit surprising to find out that the frequency of use was quite low. Perhaps more

information could be given to friends and relatives about the web client, but also here it might have to do with the threshold of using a new way of communication.

The last part of the purpose was to analyse whether deaf and hard of hearing in general are going to use the new communication services in the future. An analysis with basis in the SCOT theory has been done, but it did not result in a clear “yes they will use them” or “no they will not use them”, something that however had not been thought in advance either. There does not seem to exist a consensus about the new communication services in terms of who will use them and who will pay for them. One reason for this is that they are quite new why there has not been enough time to decide who is responsible for what. One idea is that more county councils will prescribe the services to its inhabitants and another that users will have to get them on their own. It does not seem an impossibility that more councils will prescribe MMX but not MTX, since mobile communication is not a necessity. However, even if no overall closure has been reached yet, it seems clearer what the organizations and users think. As to deaf users and SDR, video communication is the future and especially mobile video communication, while hard of hearing and HRF on the other hand seem to look positively at mobile text telephony.

9 Discussion

9.1 Performance of the thesis work

When starting the thesis project, some plans specifying how to carry out the work were created. The plan has been followed as far as possible. However, due to reasons beyond the control of the thesis project, the delivery date for the mobile phones to the users was postponed. As a consequence only two iterations were made instead of the planned three. Another consequence was that the users only tested one phone each, which made it harder to answer to part two of the purpose. However, since two of the four phones were not practically compatible with MTX there were only two left.

Something that was within the control of the thesis project, but still was not carried out very well, was the user analysis. In the theory description of iterative work, the first step involves making an analysis of the users, their work tasks as well as the context in which the product is to be used. This step could have been carried out in a more exhaustive way. ISO defines the term context of use in a way that seems to be quite closely related to the way in which it is described in the theory for iterative development. The reason for this somewhat poor connection in the thesis probably has something to do with the eagerness to start working with the user interface. However, it is impossible to know what the results would have been *if* a more thorough user analysis had been made.

It was difficult to keep quiet when conducting the usability tests, something that might have had an affect on the test results. When the users tried to perform the test tasks they sometimes got stuck and asked for help, which they sometimes got a little bit too soon. It would probably have been better to let them try a bit more before helping them.

If the MMX questionnaire was to be reconstructed, some more questions of the type “How easy or difficult is it to use MMX?” would be added. On these questions the users were to put a mark on a 5 graded scale, which meant that a comparison between each user’s own answers showed if he found something to be more difficult than other things. However, there were already five such questions in the questionnaire but, as said, a few more could have been added.

9.2 Recommendations for the future

The concepts of feedback and feedthrough have been found important, therefore a recommendation to give is to perform usability tests with two users at the same time. That way the feedthrough can easily be investigated. A recommendation concerning the future development of MTX is to put some force into improving the way of answering a call. Today the user should reject the call, start the MTX program and then answer it. This seems like an unnatural way to act, since the test users answered the call automatically on the first notice and forgot to start the MTX program. However, after some training they learnt how to answer. In the future when some users might want to answer a voice call the “normal” way but MTX calls by first rejecting them, there will probably be problems why it is a recommendation to try to figure out a better way to give notice about an incoming text call.

Since the MTX program looks a bit different on different phones, a matter which is dependent on the phones, it might be a good idea to try to optimize the program for certain phones and to recommend those phones to the users.

When making questionnaires it is recommended to do it in the respondents' first language. It increases the chances that everyone interprets the questions in the same way. It was a bit surprising that no other questionnaire in sign language could be found, not even information about it was found. One reason could be that it takes a lot more time to make a questionnaire in sign language, even if the knowledge in that language is thorough. Therefore it is important to make sure to take that time before deciding to go on with the questionnaire, in order to make it good enough.

Finally, some recommendations for future research will be proposed. As mentioned earlier, lots of deaf communicate in sign language via mobile video communication, something that is free of charge within the operator 3's network. If some day a charge will be taken for this, something that does not seem extremely unbelievable since 3 is a commercial company, how will the users act? Will mobile text telephony be an alternative? Another interesting issue is if mobile text telephony could be a complement to mobile video communication today. In places where the 3G coverage is low, perhaps mobile text telephony could be used?

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ANNEXES

ANNEXE 1 - Nielsen's heuristics

Heuristic	Description
1. Visibility of system status:	The system should always keep the user informed of what is going on, through appropriate feedback within reasonable time.
2. Match between system and the real world:	The system should speak the user's language with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.
3. User control and freedom:	Users often choose system functions by mistake and will need a clearly marked 'emergency exit' to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.
4. Consistency and standards:	Users should not have to wonder whether different words, situations or actions mean the same thing. Follow platform conventions.
5. Error prevention:	Even better than good error messages is a careful design which prevents a problem from occurring in the first place.
6. Recognition rather than recall:	Make objects, actions and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for users should be visible or easily retrievable whenever appropriate.
7. Flexibility and efficiency of use:	Accelerators – unseen by the novice user – may often speed up the interaction for the expert user such that the system can cater to both in inexperienced and experienced users. Allow users to tailor frequent actions.
8. Aesthetic and minimalist design:	Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.
9.Help users recognize, diagnose and recover from errors:	Error messages should be expressed in plain language (no code), precisely indicate the problem, and constructively suggest a solution.
10. Help and documentation:	Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focus on the user's task, list concrete steps to be carried out, and not be too large.

(Nielsen's homepage)

ANNEXE 2 – Plan for usability test 1

Fråga 1: Har du någon spontan kommentar angående det du ser?
Uppgift 1: Gå till menyn Ringa Mobil
Uppgift 2: Slå ett nummer till en mobiltelefon
Uppgift 3: Gå tillbaka till Huvudmenyn
Uppgift 4: Ring en handläggare på AF Döv
Uppgift 5: Gå tillbaka till Huvudmenyn
Fråga 2: Vad tycker du om sättet att förflytta sig mellan olika menyer?
Fråga 3: Vad tycker du om utseendet?
Fråga 4: Vad tycker du om valet av ord? T.ex. ”ringa mobil”, ”ringa förmedling”, ”Ok”, ”Back”.
Uppgift 6: Skriv ett meddelande till handläggaren Anna Andersson på AF kundtjänst
Uppgift 7: Ring David Davidsson på Af för hörselskadade
Uppgift 8: Ring en texttelefon
Fråga 5: Vad tycker du om att använda ”pekpinnen”?
Fråga 6: Hur känns det rent estetiskt? Tilltalande, fult…
Fråga 7: Har du några övriga kommentarer utöver det vi redan gått igenom? Vad som helst, alla kommentarer är av intresse.

ANNEXE 3 – Plan for usability test 2 (with usability goals for each test task)

Uppgift 1: Sätt på telefonen och logga in. Mål: 15 s.
Uppgift 2: Svara på inkommande samtal, vänta på att text kommer. Mål: 2 min.
Karin: “Hej det är Karin här.”
Användare: “Hej detta är NAMN. Jag testar MTX.”
Karin: “Det går bra det här.”
Användare: “Ja det gör det. Hej då.” Lägger på.
Uppgift 3: Ring AMV. Mål: 2 min 30 s.
AMV: “Hej det är NAMN här.”
Användare: “Hej detta är NAMN”
AMV: “Det går bra det här.”
Användare: “Ja det gör det. Hej då.” Lägger på.
Uppgift 4: Ring texttelefon. (Användaren får ett nummer att ringa till) Mål: 2 min 30 s.
Person vid texttelefon: “Hej det är NAMN här.”
Användare: “Hej detta är NAMN”
Person vid texttelefon: “Det går bra det här.” Lägger på.
Uppgift 5: Lämna meddelande till någon annan testanvändare. Mål: 1 min.
Användare: “Hej detta är NAMN, jag testar MTX. Hej då.
Uppgift 6: Stäng av telefonen. Mål: 15 s.

ANNEXE 4 – MTX questionnaire

“Försök att använda MTX på olika ställen, inte bara på kontoret. Försök att använda den då du tidigare skulle ha skickat SMS, exempelvis på tåget eller vid arbete på annan ort. Försök också att prova alla olika funktioner: Ringa annan mobil texttelefon, ringa texttelefon, ringa AMV texttelefon samt lämna meddelande. Fyll i enkäten nedan för varje telefon du provar. Svara så uppriktigt som möjligt. Om du till exempel tycker att det är besvärligt att använda MTX så skriv det! Poängen med denna undersökning är att försöka utveckla MTX till det bättre.”

1. Vilken telefon gäller denna enkät?

Ericsson ☐
Nokia 3510 (blå, orange kant) ☐
Nokia 6600 (vit-grå/svart) ☐
Palm ☐

För varje fråga: Ringa in den siffra du tycker passar bäst, där 1 är besvärligt och 5 är enkelt. Om du vill får du gärna skriva en extra kommentar.
2. Hur upplever du det att:
a) Ringa ett samtal?

Besvärligt 1 2 3 4 5 Enkelt

Kommentar:_____
_____
_____

b) Besvara ett samtal?

Besvärligt 1 2 3 4 5 Enkelt

Kommentar:_____
_____
_____

c) Skriva och läsa text i konversationsläget?

Besvärligt 1 2 3 4 5 Enkelt

Kommentar:_____
_____
_____

d) Hantera telefonen? (Sätta på/stänga av, starta MTX-programmet etc.)

Besvärligt 1 2 3 4 5 Enkelt

Kommentar:_____
_____
_____

Markera ett eller flera alternativ

3. Var har du använt telefonen? Hur bra eller dåligt har det fungerat på dessa platser? Kryssa för platser och ringa in på skalan hur dåligt/bra det har fungerat där. 1 är dåligt och 5 är bra.

Plats		Dåligt				Bra
På arbetet	☐	1	2	3	4	5
Vid arbete på annan ort	☐	1	2	3	4	5
Hemma	☐	1	2	3	4	5
På stan	☐	1	2	3	4	5
På tåget	☐	1	2	3	4	5
Annan plats	☐	1	2	3	4	5

4 a) Ange på skalan hur mycket du gillar MTX, där 1 är ”gillar inte MTX” och 5 är ”gillar MTX”.

Gillar inte MTX 1 2 3 4 5 Gillar MTX

b) Är det något särskilt som gör att du gillar/inte gillar MTX?

_____
_____
_____
_____

5 a) Har du upplevt någon skillnad mellan att ringa en annan mobil texttelefon, en texttelefon och AMV texttelefon?

Ja ☐
Nej ☐
Vet ej ☐

b) Om ja, vad består skillnaden av?

_____
_____
_____
_____
_____

6 a) Har det någon gång uppstått problem som gjort att du inte har kunnat använda MTX?

Ja ☐
Nej ☐
Vet ej ☐

b) Om ja, försök att förklara vad som hänt vid dessa tillfällen.

_____
_____
_____
_____

7 a) Om du har provat MTX på någon annan telefon redan, vilken telefon föredrar du i så fall? (Hoppa över frågan om du provar din första telefon)

Den jag har just nu ☐
Jag föredrar en annan ☐
Vet ej ☐

b) Om du föredrar en annan, vilken tycker du bäst om av de du provat hittills?

Ericsson ☐
Nokia 3510 (blå, orange kant) ☐
Nokia 6600 (vit-grå/svart) ☐
Palm ☐

c) Varför föredrar du den?

_____
_____
_____
_____

8 a) Har du använt dig någonting av SMS tidigare?

Ja, dagligen ☐
Ja, flera gånger i veckan ☐
Ja, några gånger i månaden ☐
Ja, någon enstaka gång ☐
Nej, aldrig ☐

b) Vilket skulle du helst använda av SMS och MTX i framtiden, förutsatt att den person du vill kontakta också skulle ha MTX?

SMS ☐
MTX ☐
Båda ☐
Vet ej ☐

9. Eventuella övriga kommentarer:
_____
_____
_____
_____

ANNEXE 5 – MMX questionnaire
"Hej och välkommen hit! Jag heter Karin och är student i Uppsala. Jag gör mitt examensarbete på Envilogg. Jag har gått teckenspråkskurs 2 veckor i Leksand, sommaren 2004. Vi på Envilogg vill göra Marvin MMX bättre. Vi vill veta vad du tycker om MMX. Det är bra och viktigt att du svarar på frågorna. Frågorna och svarsalternativen finns på teckenspråk och i text. Klicka på play-knappen för att starta videoinspelningarna. Kryssa för ditt svar, bara ett svar per fråga. När du har svarat på alla frågor klickar du på SKICKA. Du behöver inte tala om ditt namn. Tack för att du svarar!"

1. Hur länge har du använt MMX?

a) Ungefär 1 vecka
b) Ungefär 2 veckor
c) 3-4 veckor
d) Över 4 veckor

2. Hur ofta startar du MMX?

a) Min MMX är alltid på
b) Jag startar MMX när jag kommer hem
c) Jag startar MMX ibland
d) Annat

3. Hur ofta använder du MMX?

a) Varje dag
b) Några gånger i veckan
c) Ungefär en gång i veckan
d) Mindre än en gång i veckan

4. När använder du MMX?

a) Dagen
b) Kvällen
c) Natten
d) Vet inte

5. Använder dina vänner eller anhöriga hemsidan sprida.envilogg.net?

a) Ja, varje dag
b) Ja, flera gånger i veckan
c) Ja, men sällan
d) Nej

6. Har du använt dator förut, innan MMX?

a) Ja, jag har ofta använt dator
b) Ja, men lite
c) Nej, jag har inte använt dator förut

7. Vad tycker du bäst om, MMX eller vanlig texttelefon?

a) MMX
b) Vanlig texttelefon
c) Vet inte

8. Vilken telefon använder du mest, MMX eller vanlig texttelefon?

a) MMX mest
b) Vanlig texttelefon mest
c) Vet ej

9. Har du använt din MMX för att kontakta Allan EC eller Visiontech?

a) Ja
b) Nej
c) Vet inte

10. Har du använt din MMX för att kontakta vanlig texttelefon, inte MMX?
a) Ja
b) Nej
c) Vet inte

Respondenten markerar på en 5-stegsskala för fråga 11 a-e.

11 a) Tycker du det är svårt eller lätt att använda MMX?

11 b) Tycker du det är svårt eller lätt att svara när någon ringer dig?

11 c) Tycker du det är svårt eller lätt att ringa någon?

11 d) Tycker du det är svårt eller lätt att teckna i kameran?

11 e) Tycker du det är svårt eller lätt att avläsa teckenspråk på datorn?

Respondenten skriver ett svar i en textruta.

12. Hur kan vi göra MMX bättre tycker du?

13. Om MMX blir bättre, skulle du då använda den mer?
a) Ja
b) Nej
c) Vet inte

14. Hur gammal är du?
a) 15 år eller yngre
b) 16-25 år
c) 26-35 år
d) 36-45 år
e) 46-55 år
f) 56-65 år
g) 65 år eller äldre

Respondenten skriver i en textruta.

15. Vill du skriva mer? Varsågod!

ANNEXE 6 – User's guide to mobile text telephony

Innehåll

1 Detta dokument

Detta dokument beskriver hur MTX-klienten används. För att visa hur menyer och inmatningslägen ser ut visas bilder på en generisk mobiltelefon. Detta betyder att bilderna är exempel på hur det kan se ut på en mobiltelefon. Exakt hur det ser ut på riktigt kan variera något från telefon till telefon. För att göra dokumentet mer överskådligt kommer endast displayen att visas, enligt nedan.

Generisk mobiltelefon

Endast displayen kommer visas i resten av dokumentet

2 Översikt

2.1 Starta MTX-programmet

Sätt på telefonen. Välj sedan **”MTX”** i telefonens meny (hur denna meny ser ut beror på vilken telefon du har). Du får nu upp ett meddelande som talar om att **”MTX färdig att använda, tryck ok”**. Tryck på **”Ok”**. Om en kort stund får du svara på en fråga om du vill ansluta till Internet. Tryck då ”**Anslut”** eller **”Ok”** (olika på olika telefoner). Du loggas nu in och kommer direkt till huvudmenyn i MTX-programmet.

Bild 1 Start

2.2 Menymanövrering i MTX-programmet

För att stega sig igenom en meny används telefonens pilknappar. Pil ned används för att flytta markören nedåt i en meny och pil upp för att flytta den uppåt. På två av telefonerna, Ericsson och Palm, använder du dig av ett litet pekdon istället för telefonens pilknappar. Du trycker lätt på skärmen med pekdonet på det du vill markera.

För att välja ett visst alternativ i en meny trycker du på knappen för **”Ok”** på telefonen. Var den knappen sitter är olika på olika telefoner. Det står inte **”Ok”** på själva knappen, utan det är det som syns i mobiltelefonens fönster.

För att backa från en meny används knappen **”Tillbaka”**. Har du exempelvis valt att ringa en mobiltelefon men kommer på att det i själva verket var en texttelefon du ville ringa, använder du dig av **”Tillbaka”**-knappen.

2.3 Huvudmeny

Det finns tre möjligheter för att utföra ett utgående samtal. Antingen ringer du en annan mobil texttelefon, en texttelefon eller AMV texttelefon (handläggarplatsen). Dessa tre val finns att välja mellan i huvudmenyn.

Menyval 1: Ringa mobil texttelefon
Menyval 2: Ringa texttelefon
Menyval 3: Ringa AMV texttelefon (handläggarplatsen)

Knappval 1: Stäng av MTX
Knappval 2: Ok

Bild 2 Huvudmeny

Om du väljer:

- **”Ringa mobil texttelefon”** kommer du till menyn ”**Ringa mobil texttelefon”** där du får knappa in ett telefonnummer till en mobil texttelefon.
- **”Ringa texttelefon”** kommer du till menyn ”**Ringa texttelefon”** där du får knappa in ett telefonnummer till en texttelefon.
- **”Ringa AMV texttelefon”** kommer du till menyn ”**Välj grupp”** där du får välja mellan att ringa eller lämna meddelande till Dövkonsulenter inom AMV, AF för döva, AF Kundtjänst, AF för hörselskadade, Övriga eller AMS IT testgrupp.

2.4 Stänga av MTX-programmet

Du stänger av MTX-programmet genom att trycka **“Stäng av MTX”**.

2.5 Automatisk utloggning

Om du inte har gjort något menyval eller skrivit någon text under två minuter kommer du automatiskt att loggas ut ur MTX.

3 Kommunikation

3.1 Samtal

När du ringer eller svarar på ett samtal kommer du in i konversationsläget. Det består av två olika fönster. I det första läser du vad som hittills har skrivits, både vad du själv och vad den andra personen har skrivit. Det andra fönstret går du till när du vill skriva ny text.

Bild 3 Konversationsläge. Det första fönstret (till vänster ovan) visar vad som sagts hittills (ingenting än så länge för detta samtal). För att skriva text trycker du **”Skriv”** och kommer då till fönster två (till höger). Där skriver du din text och trycker **”Sänd”**.

Bild 4 Konversationsläge. När du skrivit din text och tryckt sänd skickas texten till mottagaren, samt visas i ditt konversationsfönster (till höger).

När du vill lägga på samtalet trycker du på **"Lägg på"**. Du får då en bekräftelse på att samtalet avslutats. Därefter trycker du **"Ok"** för att komma till huvudmenyn, eller **"Stäng av MTX"** om du vill stänga av programmet.

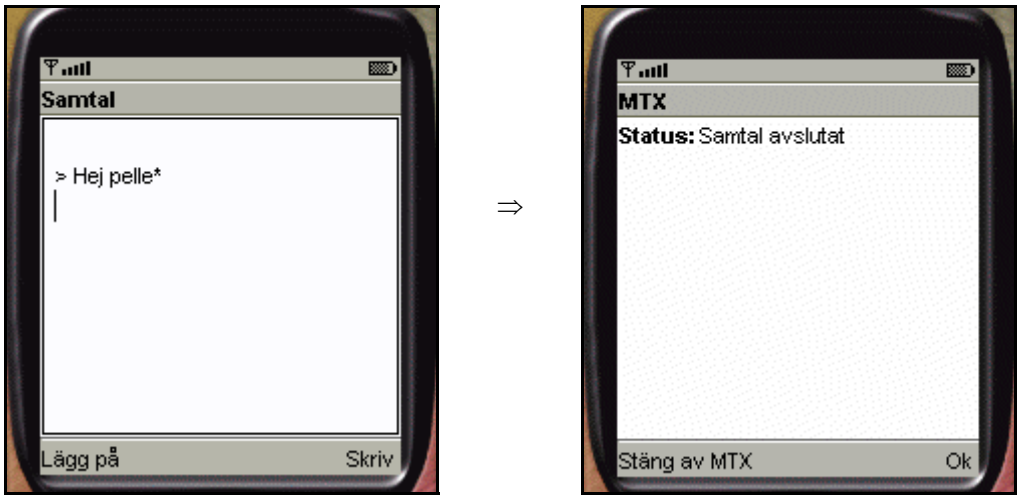

Bild 5 Konversationsläge - Lägga på samtal.

3.2 Svara på samtal

Du svarar på ett samtal på olika sätt beroende på om du redan har MTX-programmet igång eller inte.

- Om du *inte* har MTX-programmet igång när du får ett inkommande samtal gör du på detta sätt:

  1. Svara inte på samtalet. Avvisa det genom att trycka **"Avvisa"**, **"Avbryt"** eller **"Skicka upptaget"** (beror på telefon).
  2. Starta MTX-programmet (se avsnitt 2.1).
  3. Vänta på inkommande samtal. När det ringer blir du tillfrågad om du vill svara. Tryck **"Ok"**. Nu startas konversationsläget.

- Om du redan har MTX-programmet igång när det ringer svarar du genom att trycka **"Ok"**.

3.3 Huvudmenyval 1: Ringa mobil texttelefon

Om du i huvudmenyn väljer ”**Ringa mobil texttelefon”** (genom att markera det alternativet och trycka **”Ok”**) kommer du till en meny med samma namn. Här markerar du valet ”**Slå nummer”** och trycker på **”Ok”**.

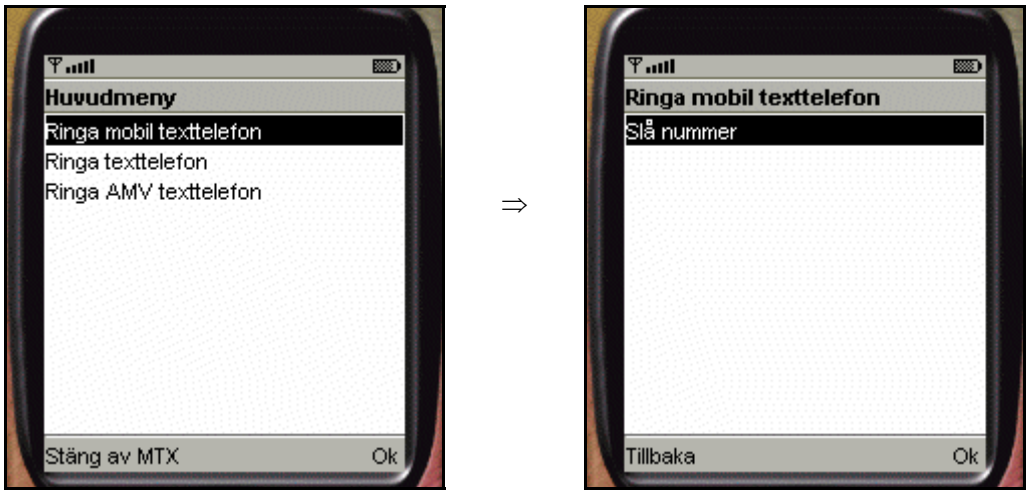

Bild 6 Ringa mobil texttelefon

3.3.1 Ringa mobil texttelefon→ Slå nummer

Telefonnumret matas in för hand, via telefonens knappsats. Ångrar du dig och inte vill ringa det inmatade numret trycker du **”Tillbaka**”. Skriver du fel siffra använder du dig av telefonens raderingsmöjlighet för att backa en siffra. För att ringa det inmatade numret trycker du på **”Ring”**.

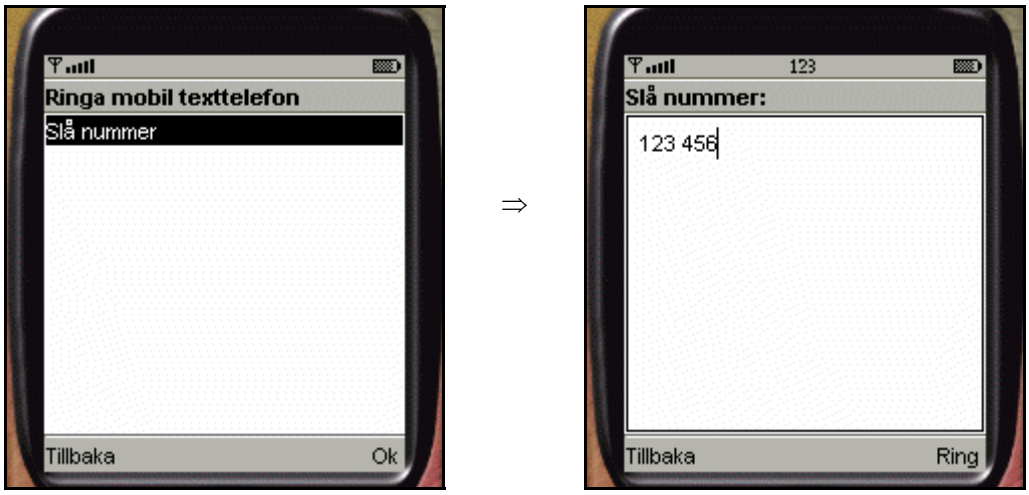

Bild 7 Slå nummer till en mobil texttelefon

När du trycker på **”Ring”** talar ett meddelande om att samtalet håller på att kopplas. Om personen du ringt är anträffbar startas konversationen.

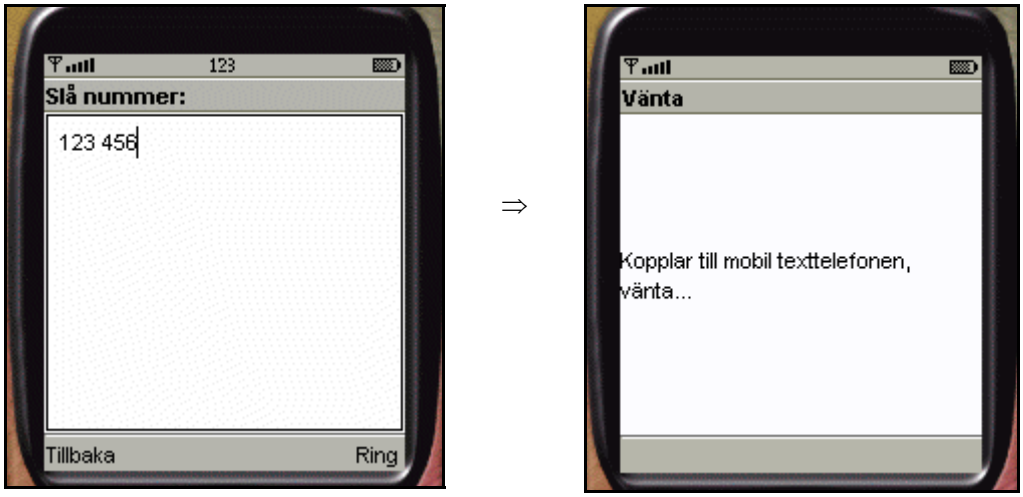

Bild 8 Ringer upp - väntameddelande

3.4 Huvudmenyval 2: Ringa texttelefon

Om du i huvudmenyn väljer ”**Ringa texttelefon”** kommer du till menyn som heter ”**Ringa texttelefon”**. Här markerar du valet ”**Slå nummer”** och trycker på ok.

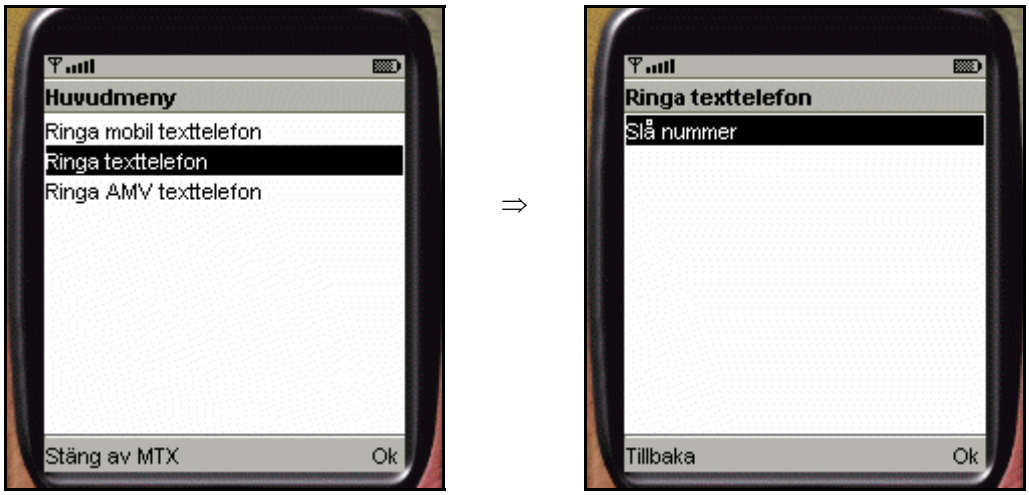

Bild 9 Ringa texttelefon

3.4.1 Ringa texttelefon → Slå nummer

Här får du mata in telefonnumret för hand, via telefonens knappsats. Skriver du fel siffra använder du dig av telefonens raderingsmöjlighet för att backa en siffra. För att ringa det inmatade numret trycker du på **”Ring”**.

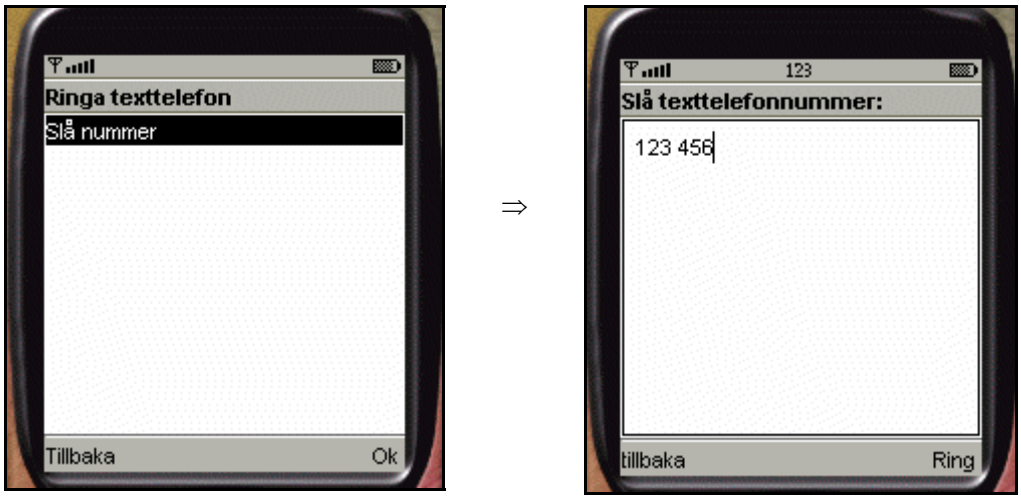

Bild 10 Slå nummer till en texttelefon

När du trycker på **”Ring”** visas ett meddelande som talar om att samtalet håller på att kopplas. Om personen du ringt är anträffbar startas konversationen.

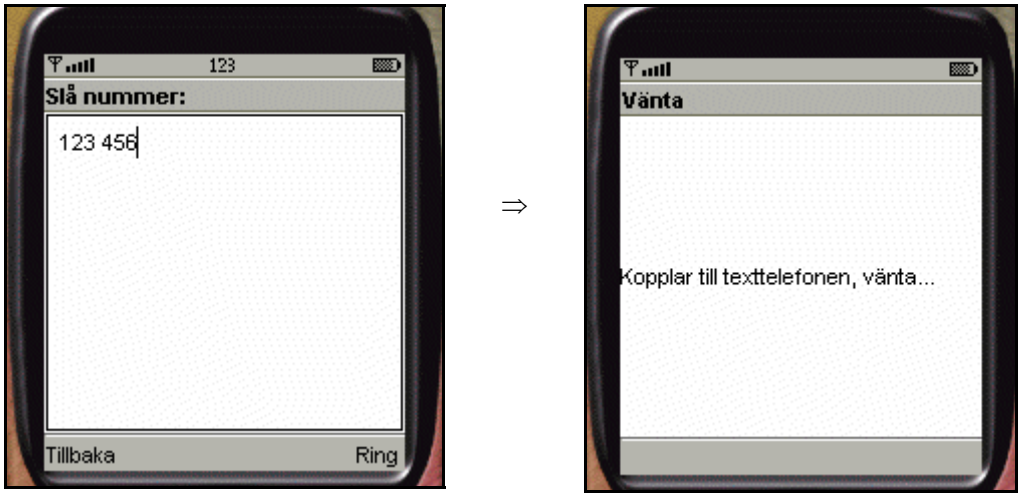

Bild 11 Ringer upp - väntameddelande

3.5 Huvudmenyval 3: Ringa AMV texttelefon

När du i huvudmenyn väljer **”Ringa AMV texttelefon”** laddas namnen på de olika organisationerna (grupperna) in i telefonen. Detta tar några sekunder. Under tiden syns ett väntameddelande. Sedan hamnar du i menyn **”Välj grupp”**. I denna meny finns det sex olika val. Varje val motsvarar en grupp inom AMV. När den grupp du önskar kontakta är markerad trycker du **”Ok”**.

Menyval 1: Dövkonsulenter inom AMV
Menyval 2: AF för döva
Menyval 3: AF Kundtjänst
Menyval 4: AF för hörselskadade
Menyval 5: Övriga
Menyval 6: AMS IT testgrupp

Bild 12 AMV texttelefon - Väntameddelande

Bild 13 Väntameddelande - Välj grupp

3.5.1 Välj grupp

I denna meny markerar du den grupp du vill kontakta och trycker på ”**Ok**”. När du gjort detta kommer du vidare till en meny vars rubrik är baserad på vilken grupp som valdes. Om du till exempel valde **”AF Kundtjänst”** kommer rubriken att vara **”AF Kundtjänst”**. I denna meny kan du välja att kontakta en handläggare direkt, ringa gruppen du valt eller lämna meddelande till gruppen du valt. När du markerat önskat alternativ trycker du **”Ok”**.

Menyval 1: Välj handläggare
Menyval 2: Ring grupp
Menyval 3: Lämna meddelande till grupp

Bild 14 Välj grupp

3.5.2 Välj handläggare

För att kontakta en handläggare direkt markerar du alternativet **”Välj handläggare”** och trycker på **”Ok”.** Du får vänta några sekunder på att namnen laddas in. Under tiden syns ett väntameddelande. Sedan kommer du till menyn ”Handläggare” som visar handläggarna inom vald grupp.

Menyval 1: Anna Andersson
Menyval 2: Bertil Bertilsson
Menyval 3: Carl Carlsson
Menyval 4: David Davidsson
(exempel)

Bild 15 Handläggare

När du markerat vilken handläggare du vill kontakta trycker du på **”Ok”.** Du kommer då till en meny där du får välja att ringa eller att lämna meddelande till handläggaren.

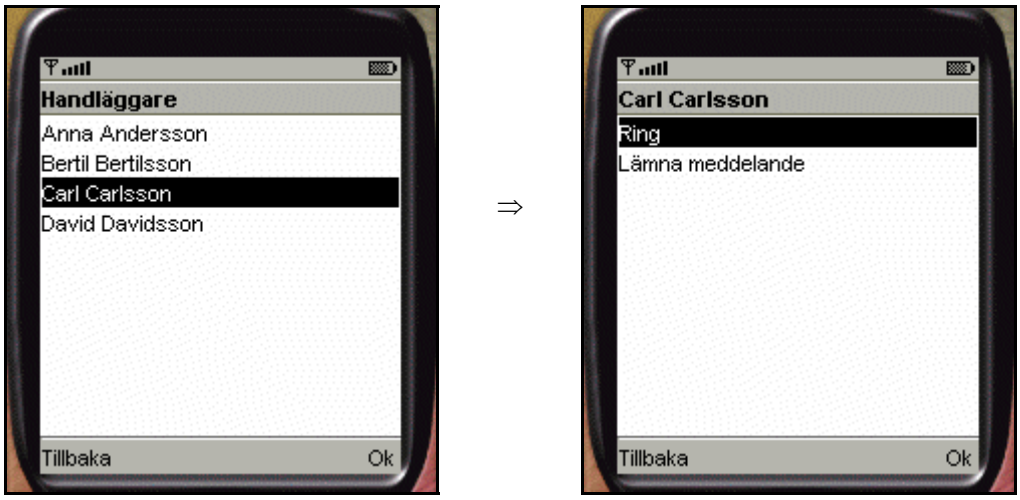

Bild 16 Välj handläggare

3.5.2.1 *Ring handläggare*

Genom att markera **”Ring”** och trycka på **”Ok”** rings handläggaren upp. Ett meddelande visas som talar om att samtalet håller på att kopplas. Om handläggaren du ringt är anträffbar startas konversationen.

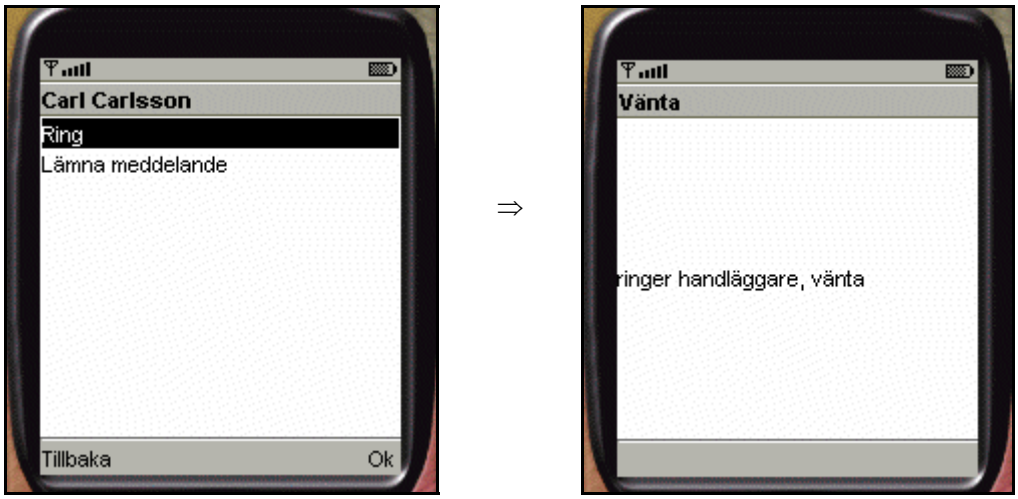

Bild 17 Ring handläggare

3.5.2.2 *Lämna meddelande till handläggare*

Om du markerar **“Lämna meddelande”** kommer du till ett fönster där du får skriva in ett meddelande. När du skrivit klart trycker du på **“Sänd”**. Ett meddelande talar om att ditt meddelande håller på att skickas iväg.

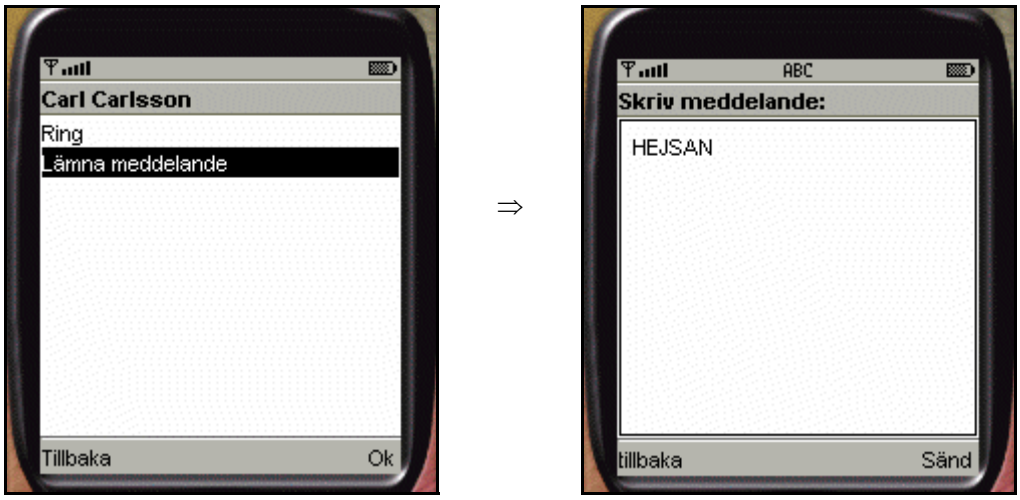

Bild 18 Lämna meddelande till handläggare

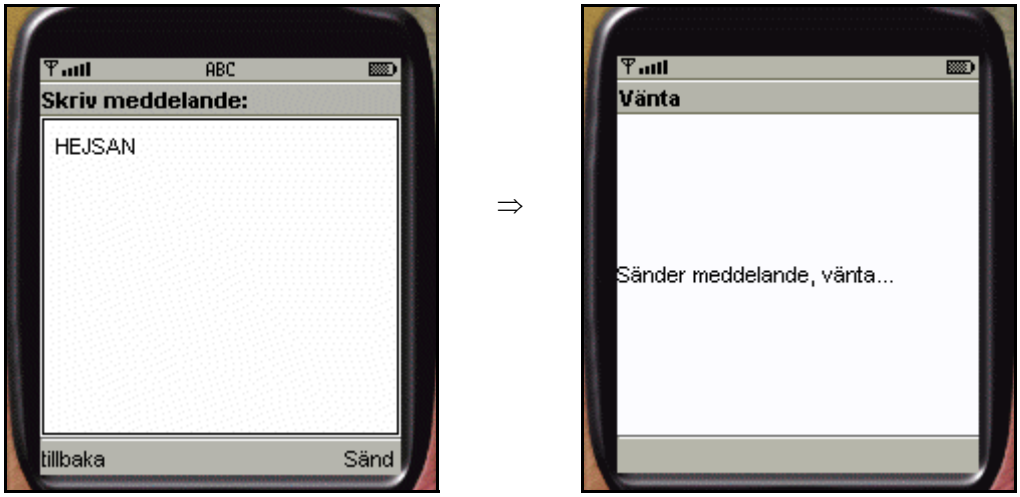

Bild 19 Skickar meddelande till handläggare

3.5.3 Ring grupp

Om du inte vet vilken person du ska prata med kan du ringa AF Kundtjänst. Markera då ”**Ring grupp**” och tryck på **”Ok”**. Ett meddelande visas som talar om att samtalet håller på att kopplas. Om någon på AF Kundtjänst är anträffbar startas konversationen.

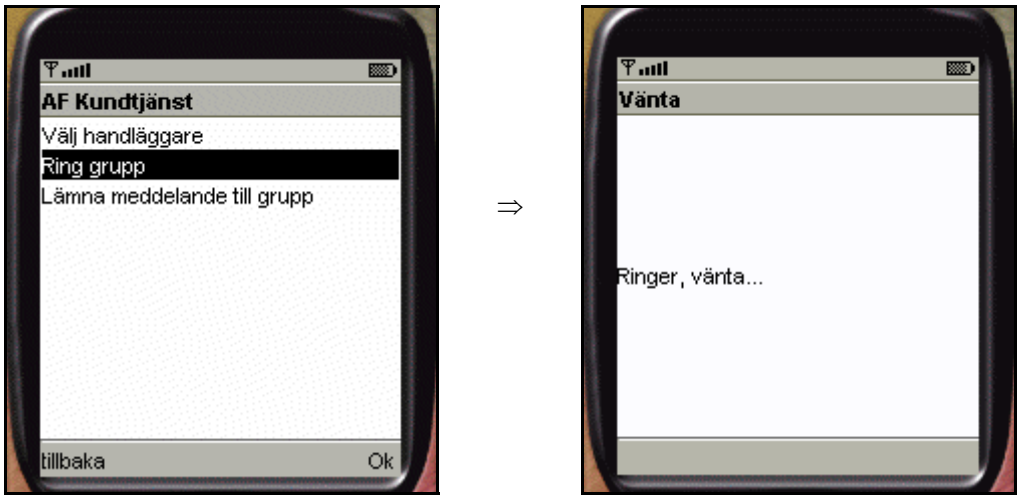

Bild 20 Ring grupp

3.5.4 Lämna meddelande till grupp

Om du valt AF Kundtjänst som grupp, kan du lämna meddelande till dem. När du markerar **"Lämna meddelande till grupp"** kommer du till ett fönster där du får skriva in ett meddelande. När du skrivit klart trycker du på **"Sänd"**. Ditt meddelande skickas då till AF Kundtjänst. Ett meddelande talar om att meddelandet håller på att skickas iväg.

Bild 21 Lämna meddelande till grupp

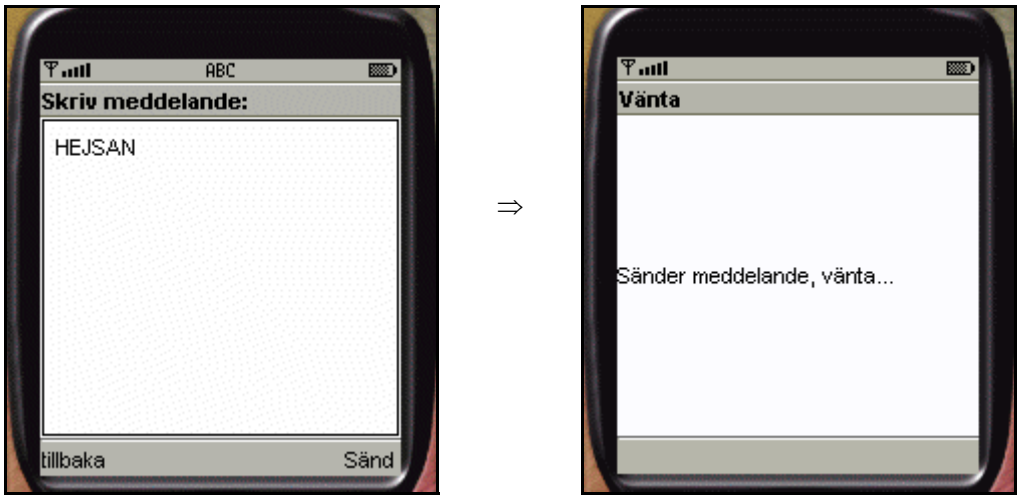

Bild 22 Lämna meddelande till grupp