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Mobile Position Related Services with Personalization

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Mobile Position Related Services with Personalization

Master Thesis in Computer Science
carried out at Telia Research AB in Luleå, Sweden
by

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1 Abstract

Many people have adopted the mobile phone in the last years. The mobile industry is now going to add the possibility to use data communication on the move. Many new technologies for this purpose will reach the market within a five year perspective. Example of technologies is GPRS, WAP, Bluetooth and MPS. Mobile data communication will make it possible to access the Internet from a mobile device. The last years a lot of PDAs has penetrated the market and the numbers of users are growing exponentially. All these industries are very hot today and they are merging to a mixed market with many different devices and services. This new market will probably be even hotter than any of these markets are today.
When positioning technologies becomes widely available a new big market, location based services, is created. It is therefore important to quickly offer the market good services based on location. Today people nearly drown in all information that they get. Therefore services have to be adapted to the user and only provide the user with information he is interested in. Services have to be personalized and it will be an important factor for gaining shares in a market getting more and more global. If these factors are taken into consideration we will have a good starting point to build new valuable mobile services from.

2 Preface

This thesis was made at Telia Research AB in Luleå, department Information Services, from April 1999 to August 1999.

Telia Research believes that the market for mobile services will explode in the near future and that is the reason for this master thesis. The goal was to examine the mobile market and find new ideas and solutions for mobile services. To make the thesis work possible to finish in time the work was limited to services based on positioning and personalization.

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Roland Kero and Peter Rosell
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3 Abbreviations

ANSI	American National Standards Institute
AMPS	Advanced Mobile Phone Service
bps	bits per second
CDMA	Code Division Multiple Access
CDPD	Cellular Digital Packet Data
D-AMPS	Digital-Advanced Mobile Phone Service
DGPS	Differential GPS
EDGE	Enhanced Data rates for GSM Evolution
ETSI	European Telecommunications Standards Institute
FPLMTS	Future Public Land Mobile Telephone System
G3	The third generation
GLONASS	Global Navigation Satellite System (Russian)
GPRS	General Packet Radio Service
GPS	Global Positioning Service (American)
GSM	Global System for Mobile-Communications
HPC	Handheld Personal Computer
HSCSD	High Speed Circuit Switched Data
HTML	Hypertext Markup Language
IMT	International Mobile Telecommunications
IP	Internet Protocol
IPv6	IP version 6
ITU	International Telecommunication Union
LAN	Local Area Network
MIG	Mobile Information Guide
MPC	Mobile Positioning Center
MPS	Mobile Positioning Service
OS	Operating System
PAMR	Public Access Mobile Radio
PCS	Personal Communication System
PDA	Personal Digital Assistant
PIM	Personal Information Manager
PMR	Private Mobile Radio
RAD	Rapid Application Development
SSL	Secure Sockets Layer
TDMA	Time Division Multiple Access
TIA	Telecommunications Industry Association
UMTS	Universal Mobile Telephone System
VAS	Value Added Services
VR	Virtual Reality
WAP	Wireless Application Protocol
WCDMA	Wideband Code Division Multiple Access
WML	Wireless Markup Language
XML	Extensible Markup Language

4 Contents

5 Introduction

This section describes the background of mobile data communication with location dependent services. It also covers the market of today and the trends in mobile computing. Motivations for why this thesis is done and what it will cover will also be described. Finally the limitations and assumptions of the thesis are declared.

5.1 Background

Many people have adopted the mobile phone in the last years. In Sweden the penetration of the population is about 51%. In Norway and Finland the penetration is 48% respective 58%. In Europe, USA and Asia-Pacific there are over 240 million cellular phones. The number of users have increased a lot during the last two years and different analysis companies assume that the number of worldwide subscribers will increase to about 1 000 millions in five years. The usage of the Internet has also grown rapidly in the last five years. According to Sifo, over 50% of the Swedish population surfed the Internet during May. [1] Many different services have popped up on the Internet in the last years. Some examples of services are banking, buying books and music, trading stocks and reading news. People also use Internet for communication e.g. using e-mail and instant messages. Today there are increasing demands for access to these services from mobile devices. Some services have been implemented with SMS, but these services are often only information services. The number of SMS messages sent through Telia's mobile network has, between Nov ´97 and Nov ´98, increased with 250%. [2]
A big problem with two-way communication in SMS based services is the user interface. The user has to send a command as a text message. The upcoming protocol WAP has been developed to make mobile data communication easier. WAP makes it possible, among other things, to surf the web on a mobile device.
The only technology available today, when doing wireless data communication, is circuit switched connections and the user has to pay for the connection time. In year 2000 GPRS, an extension of GSM network, will be available and provide packet switched communication. The bandwidth will increase up to 115 kbit/s and GPRS will also make it possible to charge for the amount of transferred data instead of time.
Today it requires an extra device to position a mobile computing device, e.g. a GPS-receiver. Therefore the market for mobile services with positioning has been small. The US Government has established a law, which says that it must be possible to locate all mobile communication devices with 125 meters accuracy. The law will take effect in October 1st 2001 and this will open up a new market for location dependent

services. [3] Many manufacturers are working on different solutions to make the positioning possible. These products will obviously not be used in the US only, but also in the rest of the world.

5.2 Reason and Task for the Thesis

There are many events and enabling technologies for mobile data communication that will emerge within a three years horizon. GPRS and WAP are two technologies that soon will reach the market and make the creation of wireless services much easier. The data communications for mobile devices are increasing and the number of mobile devices as well. Therefore this is an interesting market that will grow a lot in the near future. The focus is put on personalization and positioning, which are described below.

5.2.1 Personalization

We will take personalization into special consideration. This is done because the amount of information in the society of today increases every day. Due to the globalization and the increasing pace of changes in the society people feel stressed. People need support to sort out the relevant information and services. The increasing number of services makes it hard to provide access and a good user interface to all services. This is very true if the user has a limited user interface as on a mobile device, which is often quite small. To get around this problem, an individual access interface to the services can be used.

5.2.2 Positioning

A position is something very personal. Every person has a unique position at a specific time. This will make a person's position a superb attribute to use in personalization. The user gets the information that is relevant to his/her position. Nearly all information can be related to a special position and it can often be used as a filter. For example, if the user wants weather information he/she often wants to know the forecast at his/her location. Also traffic information, travel information and tourist guidance are location dependent. The position enables many other services, e.g. fleet management, tracking of persons and vehicles and even games.
Today one has to use a satellite based system or a sensor based system to get the position. Sensor based systems are often situated locally and cover small areas. The satellite-based systems cover the whole surface of the earth. The industry also works on solutions that are based on the mobile network's base stations and triangulation. In the near future it will be possible to make positioning of mobile devices easily. This will open up a new market called "Location Dependent Services".

5.2.3 Goal

The goal with this thesis is to find out which services that will be interesting for the market and when it is possible to release them due to enabling technologies. We will investigate the trends of wireless devices and networks. We will also look at social and market trends. A prototype or demonstrator of some services will be implemented during the thesis work.

5.3 Limitations and Assumptions

Some limitations had to be done in order to make this thesis possible to finish in time. To cover all future mobile services in a three year perspective would have been a huge project. Therefore the concentration is put on services that take advantage of positioning and personal adaptation. With positioning mainly the position of mobile devices are considered but positioning of stationary units is also discussed (e.g. routers in a network). The personal adaptation restriction is added to further limit the services of interest. This limitation is added because it helps to concentrate the work to the hottest mobile service areas in the near future.
We have assumed that all mobile communication devices will have positioning capability when the law in the USA takes effect October 1st 2001.

5.4 Problem description

It is hard to find services that people are interested in. To find services that will be released in three years is even harder. First we have the technical problems. We don't know what kind of devices will be available on the market and we do not know which devices peoples will use. Because the devices are mobile they have to be quite small. That will limit the size of the display and input. This is a known problem and there are many different solutions and some are better than others. We will not come up with any solutions to this problem, but we will have it in our minds while discussing services. We will also have to take into consideration which wireless networks that will be used. This is a bit easier because the networks are globally standarized and that information is public. Positioning a mobile devices today can mainly be done by using a satelite based system as GPS. Today the GPS receiver has to be connected externally to the device, but in the future devices will be positioned in an easier way.
The hardest problem is to find the good services, to know what services peoples are interested in. The market for wireless data communication

are small today, but we believe it will grow in the near future. Today not many wireless data services and a lot of services can be developed. Therefore we have limited our services to be location dependent. We have to take the society trends into consideration and imagine how people's lifes are in three years. Three years doesn't sound long in society trends, but in this domain three years is quite a long time. New technologies are coming all the time and in wireless data communication many enabling technologies will be released within three years.

6 Thesis work

6.1 Mobile Devices

The purpose of this section is to cover the variety of mobile computing devices of today, and also what devices that will exist in the foreseeable future. The intention is to make this listing as complete as possible and to cover the worldwide market.[1]
There are several different ways of categorizing mobile devices, and the categories that are most commonly used by vendors are also used in this paper. A mobile device can be in one or many of these categories.

6.1.1 Mobile Phones (classical voice phones)

Common for these devices are a very limited display and that they are mainly made for voice calls and short text messages, SMS. They can also often transfer data over the GSM network, but only as modems for other devices (like notebooks etc.). Ericsson SH 888, Motorola v3688 and Nokia 8810 are three examples of mobile phones from some of the largest manufacturers. A very likely development is that Smart Phones (see below) will replace mobile phones step by step in 1999-2000. This simply because mobile phones will become smart phones. A wide range of mobile phones is available now on the market.

6.1.2 Mobile Smart Phones

These devices have much in common with the mobile phones. The main difference is that the smart phone is constructed for data communication as well as voice. A protocol standard that most probably will be used is WAP [4] (Wireless Application Protocol) and an operating system that is supported by big manufacturers is EPOC [5], developed by Symbian. Important to notice is that ordinary mobile phones can transfer data but not handle it, while smart phones also have data processing capabilities built in. For instance can a smart phone have browser capability and handle e-mail. The display size can vary from the size in a mobile phone to the size in a PDA. The input devices can vary but the most common ones are numeric keypad and touch screen input. Ericsson R380, Motorola i1000plus and Nokia 7110 are examples of smart phones. Smart phones are supported by all big mobile phone

[1] If the reader knows about any mobile hardware of importance with technical features that is not included in this document, please contact the authors.

manufacturers and will probably get a big market share in 2000. They will start showing up on the market Q2-Q3 1999.

6.1.3 Browser Phones/Multimedia Phones

The browser phone has no keyboard. Instead the whole device is a touch sensitive display (e.g. 159 x 239 pixels). The display is big compared to mobile phones. It is not the same thing as a PDA because it can always be used as a common mobile phone. Features such as video cameras and external speakers are sometimes built into a browser phone. Alcatel One Touch COM and Spectronic TS2000 are examples of browser phones. Browser phones are available now on the market and new models will be available in 1999.

6.1.4 Communicators

A communicator is a combination of an advanced mobile phone and a palmtop. The displays on existing devices are monochrome, and a keyboard is the common input device in the communicator. Nokia 9110 and Philips Synergy are examples of communicators. The future for the communicators is hard to predict. There is a risk that these devices will lose market shares when communication capability is added to all mobile devices. Communicators are available now on the market.

6.1.5 PDAs

Casio E-100

The Personal Digital Assistant, PDA, is very popular today. It has a big touch sensitive display (often color) for a pen or fingers, and a couple of buttons. The size of the display is normally 240 x 320 pixels. The processor is stronger than in the browser phones and it has normally no built in communication device. The two most commonly used operating systems in PDAs are Palm OS from 3Com and Windows CE from Microsoft. Casio E100, Compaq Aero, HP Jornada and Palm Pilot are examples of PDAs. The market for this category is growing fast and it will probably grow even faster when mobile communication capability is added (there is no information from the manufacturers about when that will happen). A wide range of PDAs is available now on the market.

6.1.6 Handheld PCs/Palmtops

Handheld PCs are notebooks in miniature. They have a QWERTY keyboard and a color display (typically 640x240 pixels) that is sometimes touch sensitive. They are fairly fast with clock speeds over 100MHz and 32MB RAM or more. The two most common operating systems on handheld PCs are Windows CE from Microsoft and EPOC from Symbian. Ericsson MC218, HP Jornada and NEC Mobile PRO are examples of handheld PCs. The future for these devices is hard to tell. There is a risk that this category gets pinned between the PDAs that gets stronger and stronger and the Sub Notebooks that gets smaller fast. A wide range of handheld PCs is available now on the market.

6.1.7 Sub Notebooks

Slightly bigger than handheld PCs but these are real PCs with Intel Pentium II processors, lots of RAM memory and big hard drives, i.e. ordinary notebook computers but very small and light (around 1 kg). The operating systems can be any of the ones run on stationary PCs, i.e. Windows 95/98/NT from Microsoft, Linux etc. Fujitsu LifeBook, Mitsubishi Amity (notebook version) and Toshiba Libretto are examples of sub notebooks. There seems to be a future for this kind of devices where more computing power and a full-grown PC is needed. A wide range of sub notebooks is available now on the market.

6.1.8 Tablets

Take a notebook, remove the keyboard and make the display touch sensitive for pen and/or finger and you have a tablet. It’s basically a big touch screen computer with the same performance, hardware and operating systems as a sub notebook. Fujitsu Stylistic, Mitsubishi Amity (tablet version) and Telxon PTC are examples of tablets. It is hard to say anything about the future for tablets but big manufacturers put effort on developing them. There are a variety of tablets available now on the market.

6.1.9 Auto PCs

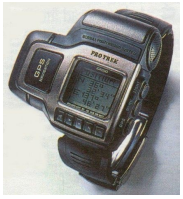
Auto PCs are, as the name indicates, mobile devices for automobiles. The weight and size are not as critical here as for other mobile devices. The appearance and usage scenarios in the car can vary much but there are three key concepts for Auto PCs today, safe communication, safe information and safe navigation. Windows CE from Microsoft plays a central role on the Auto PC market. Delphi Automotive Systems, Swedish Mecel, Intel and Visteon are examples of manufacturers of Auto PCs. It is very likely that the Auto PC market will grow because many of the dominant car manufacturers stands behind it. There are

computing, communication and navigation solutions available on the market today and new, more advanced and refined products are to be expected continuously.

6.1.10 Wearable Computers

This is a rather diffuse category while a wearable computer can look in so many ways and is built for totally different purposes. Common for these devices is that the user is wearing them instead of carrying them. It can be computers that are built into clothes and computers hanging in the belt together with a VR-helmet. IBM, Xybernaut and MIT Media Lab are examples of companies and Universities that do research on wearable computers. Xybernaut is the only company that is found to have a wearable computer product on the market right now.

6.1.11 Other Devices



The categories above do not cover all mobile devices of existence. Wrist computers, electronic books, mobile gaming devices, navigation devices and pagers are some examples of other mobile devices. Some of them could possibly be commercial booms in the future.One innovative example is Casio’s PRO TREK, a wristwatch with built in GPS.

6.2 Wireless networks

6.2.1 Wireless networks today

The major wireless networks of today are GSM, D-AMPS and CDMAOne. These second-generation wireless networks are digital and can be used to mobile data communication as modems. The bandwidths for these networks are very low, between 9.6 kbit/s and 19.2 kbit/s and they are also circuit switched. The network vendors are therefore working on increasing the bandwidth to make it possible to provide better data communication services. To meet the market's demands of higher bandwidth, there are technologies that use the old networks but provide higher bandwidth. For the GSM network there are three different technologies, HSCSD, GPRS and EDGE. TDMA technology together with CDPD can be used in D-AMPS networks to retrieve higher bandwidth and D-AMPS+ will increase the bandwidth to 144 kbit/s. The CDMAOne networks will use CDMA Phase 2. Some of these technologies will provide up to 384 kbit/s. [6] To get even higher bandwidth new technologies using the CDMA technology will be used in the third generation of wireless networks. See chapter 6.2.2 for the third generation's networks.

GSM

GSM is mainly used for voice in cellular phones. GSM, which stands for Global System for Mobile Communications, is a digital cellular radio network operating in more than 200 countries worldwide. It provides almost complete coverage in western Europe, and growing coverage in the Americas, Asia and elsewhere. Of special interest is the capability of the GSM network to be used for data computing. Most people think of voice calls when they think of cellular phones. But because GSM is digital, you can connect your GSM-enabled phone to your laptop computer and send or receive e-mail, faxes, browse the Internet, securely access your company's LAN/intranet, and use other digital data features including Short Messaging Service. [7] The GSM networks will soon be upgraded with HSCSD or GPRS and EDGE. That will provide faster connections for data communication and GPRS and EDGE will also provide packet switched communication.
Bandwidth: 9.6 kbit/s
Release: available today

HSCSD (High Speed Circuit Switched Data)

HSCSD is aimed at satisfying the need for higher speed services, by enabling users to aggregate timeslots. The HSCSD is, as GSM, circuit switched and not packet switched as GPRS. Some network operators have announced a release of HSCSD on their nets during 1999. Now it seems that they wait for GPRS. It might be hard to gain profit from HSCSD because it is circuit-switched.
Bandwidth: up to 64 kbit/s.
Release: Expectations are that the first commercial HSCSD services, for all operators that opt for HSCSD, will be launched during 1999. SingTel in Singapore announced in May of 1998 that they will use HSCSD technology, offering data rates of up to 38.4 kbit/s. No HSCSD capable net has been released yet.

GPRS (General Packet Radio Service)

The most important aspects of GPRS are that it allows data transmission speeds over 100 kbit/s, that it is packet based, and that it supports the world's leading Internet communications protocols, Internet Protocol (IP) and X. 25.
GPRS introduces packet data services to the GSM standard. Furthermore, GPRS allows for simultaneous voice and data communication, so the user can still receive incoming calls or make outgoing calls while in the midst of a data session. [8]
Bandwidth: up to 115 kbit/s (Telia will probably start at 30-40 kbit/s)
Release: first half of 2000

EDGE (Enhanced Data rates for GSM Evolution)

EDGE technology is designed to be introduced in existing GSM and D-AMPS digital wireless networks, to support multimedia services at bandwidths up to 384 kbps. One of the attractions of EDGE technology is that it requires minor changes to network hardware and software, and can be introduced into an existing network on the current frequency bands. EDGE uses the same TDMA (Time Division Multiple Access), frame structure, logic channel 200 kHz carrier bandwidth and spectrum mask as today's GSM networks. Existing cell plans can remain intact. EDGE can be introduced stepwise into the network, starting with high-capacity areas such as dense city areas, airports, etc. The added capacity is achieved by increasing the data capacity of a single GSM timeslot from today's 9.6 kbps to 48 kbps per timeslot, and even up to nearly 70 kbps per timeslot under good radio conditions. EDGE also allows up to eight timeslots to be aggregated, to allow a total bandwidth of more than 384 kbps. [9], [10]
Bandwidth: up to 384 kbit/s (under good conditions up to 560kbit/s)
Release: 2000-2001 according to Nokia.

D-AMPS (Digital-Advanced Mobile Phone Service)

D-AMPS, sometimes spelled DAMPS, is a digital version of AMPS, the original analog standard for cellular phone service in the United States. Both D-AMPS and AMPS are now used in many countries.
Cellular Digital Packet Data (CDPD) can today be used in the D-AMPS networks. CDPD provides packet switched communication and supports IP and will also support IPv6. Take up of CDPD has been slow so far, because it has not been widely available, but there are signs that it is picking up. CDPD offers a transfer rate of 19.2 kbit/s. [11]
Bandwidth: up to 19.2 kbit/s
Release: available today

D-AMPS+

The next stage for DAMPS will be DAMPS+ (IS-136+), which should be launched by 2000. It will offer maximum transmission speeds of 63kbit/s for circuit-switched and packet data. [11]
Bandwidth: 63 kbit/s
Release: 2000

cdmaOne

cdmaOne™ is a brand name, that describes a complete wireless system that incorporates the IS-95 CDMA air interface, the ANSI-41 network standard for switch interconnection and many other standards that make up a complete wireless system.
CDMA is a "spread spectrum" technology, which means that it spreads the information contained in a particular signal of interest over a much greater bandwidth than the original signal. To gracefully migrate cdmaOne to cdma2000 capabilities, offering advanced features to the market in a flexible and timely manner, implementation has been broken into evolutionary phases. The first phase capabilities have been defined in a standard known as 1XRTT. Scheduled for publication in the first quarter of 1999, 1XRTT introduces 144 kbps packet data in a mobile environment. [12], [13]
Bandwidth: 9.6 kbit/s or 14.4 kbit/s
Release: available today

6.2.2 The third generation (G3)

ITU, Intenational Telecommunication Union, has produced a global standard IMT-2000 that will provide higher bandwidth. Ericsson and Qualcomm have developed new networks based on the CDMA technology to get higher bandwidth. Ericsson's and Qualcomm's technologies are not equal. Ericsson calls their technology for W-CDMA and Qualcomm's is

called cdma2000. These technologies are not compatible with any of today existing ones. Ericsson and Qualcomm have agreed on supporting a single CDMA standard with three optional modes for the next generation of wireless communications. In Japan they will start using the third generation's network in 2001 and in Sweden it may be available in 2002-2003.

IMT-2000

IMT-2000 (International Mobile Telecommunications) is an ITU standard. Its name reflects both the spectrum that it applies to (approximately 2,000MHz, that is, 2GHz) and the anticipated year of availability. The 2GHz spectrum for the worldwide usage of IMT-2000 was identified by the 1992 World Administrative Radio Conference (WARC). IMT-2000 was formerly known as the Future Public Land Mobile Telephone System (FPLMTS). Due to different regional requirements, IMT-2000 will be a family of mobile systems in which inter-system roaming can be performed. [14]

UMTS

UMTS (Universal Mobile Telephone System) is a regional variation of IMT-2000. The European GSM community is driving it and it is backed by ETSI. It has slightly longer time scales than the ITU standard. The launch of UMTS services from the year 2002 will see the evolution of a new, "open" communications universe, with players from many sectors (including providers of information and entertainment services) coming together harmoniously to deliver new communications services, characterised by mobility and advanced multimedia capabilities.
The third generation will also have a new unified standard called UMTS (Universal Mobile Telecommunications System), which will be a combination of the current technologies along with new developments. [15]

W-CDMA

W-CDMA should not be confused with narrowband CDMA. Based on extensive research conducted between 1989 and 1997, W-CDMA is a completely new technology targeting true 3G requirements. W-CDMA is able to meet all the requirements outlined by the ITU, delivering high-speed data very efficiently, with high-quality sound and video services.
W-CDMA fully supports both packet- and circuit-switched communications such as Internet browsing and traditional landline telephone services respectively. From the start, W-CDMA has been designed for high-speed data services. Japan and Europe have agreed on a version of W-CDMA that is harmonized with cdma2000 on some details. [16]

Bandwidth: Internet-based packet-data offering up to 2 Mbps in stationary or office environments, and up to 384 kbps in wide area or mobile environments.
Release: 2001-2002 (2001 in Japan by NTT DoCoMo)

cdma2000

cdma2000 developed by Qualcomm is a name identifying the TIA standard for third generation technology that is an evolutionary outgrowth of cdmaOne offering operators who have deployed a second generation cdmaOne system a seamless migration path that economically supports upgrade to 3G features and services within existing spectrum allocations for both cellular and PCS operators. The network interface defined for cdma2000 supports the second-generation network aspect of all existing operators regardless of technology (cdmaOne, IS-136 TDMA, or GSM). This standard has been submitted by the TIA to the ITU as part of the IMT-2000 3G process. [14]

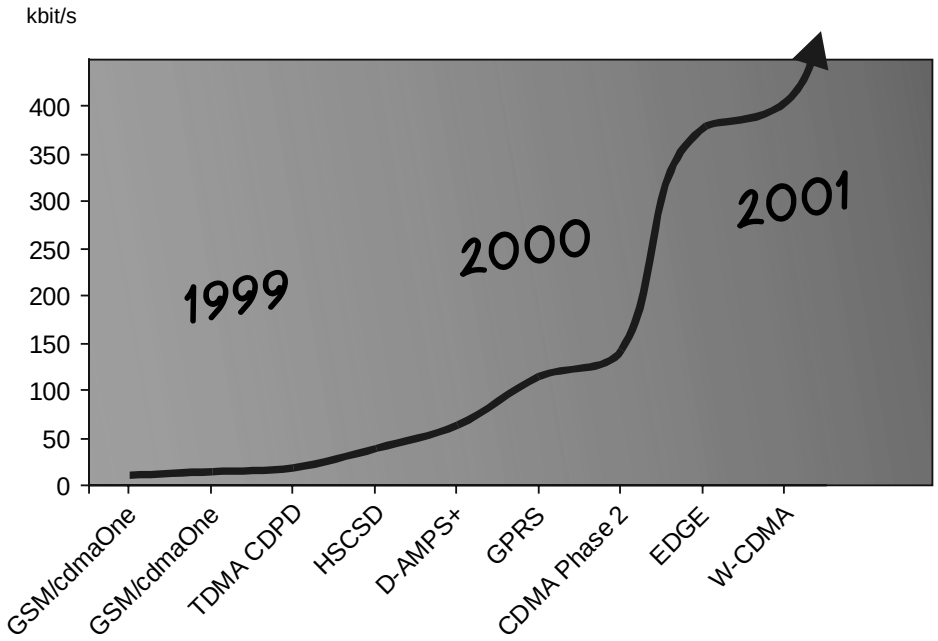


Diagram of the different wireless networks and when they a planed to be released. The graph also tells the bandwidth, in kbit/s, that the different systems provide.

6.3 Positioning

Positioning is one of the key enabling factors for mobile services. In this section we will examine the existing technologies for positioning a mobile device. There are two types of positioning technologies on the market today. Satellite positioningis the oldest, where the US Government is responsible for one system called Global Positioning System [17] (GPS) and the Russian government for the Global

Navigation Satellite System [18] (GLONASS). The second technology is positioning with the mobile network on the ground. Ericsson has a solution called Mobile Positioning Service [19] (MPS). These three positioning solutions are described below.

6.3.1 GPS

This is the most commonly used positioning service in the world. It is built on 24 satellites that cover the surface of the earth. The mobile device must have visual contact with the satellites to get the position; i.e. it does not work indoors. The inaccuracy of GPS is around 100 meters because of an error that is built into the system. The inaccuracy can be reduced to a few meters with Differential GPS (DGPS) which is based on units on the ground that complements the satellites.

6.3.2 GLONASS

GLONASS works in the same way as GPS but the Russian Government has not built in any error so the inaccuracy is around 15 meters. There is an uncertainty if the Russian Government will continue maintaining GLONASS.

6.3.3 MPS

This is quite a new technology for positioning. Ericsson is using the base stations in a cellular network to position a mobile phone. With this system all cellular phones in a MPS enabled network can be positioned. The inaccuracy can be around 1000 meter today but an improved solution, which will reduce the inaccuracy to less than 125 meters, will be released around 2001. The system works at all locations where a MPS enabled cellular network exists.

6.4 Other Enabling Technologies

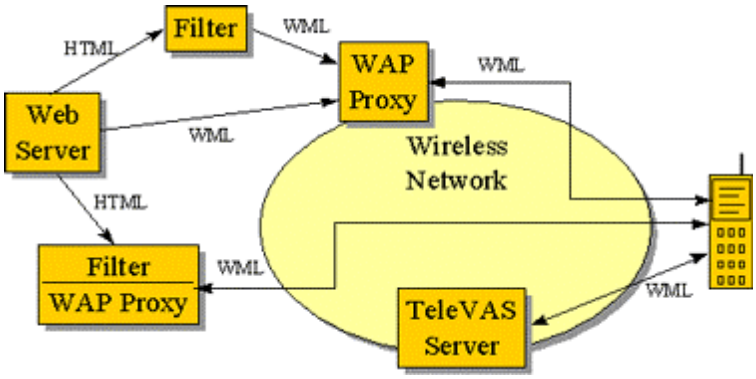
6.4.1 Bluetooth

Bluetooth is a short-range radio communication system. It ranges from 10 cm up to 100 meters. First generation Bluetooth radios will use tiny radio-frequency transmitters, no larger than 2.5 cm by 1.7 cm, which can run on a watch battery for months. Considerations about power consumption are always important for battery-powered mobile devices, and Bluetooth's low power modes are planned to meet those requirements with less than 0.1 W active power. And since Bluetooth is designed for both computing and

communications applications, it is designed to support high quality simultaneous voice and data, with robust data transfer rates of up to 721 Kbps. [20]
Bluetooth-enabled devices will be more expensive than their wired counterparts. Intel admits that, initially, Bluetooth hardware will add an extra $20-30 to the cost of manufacturing a device.
”As volumes increase, we can see a cost reduction to less than $10 [per device] in a year,” said Simon Ellis, Intel’s data communications marketing manager in Santa Clara, Calif.
Bandwidth: asynchrony, up to 721kbit/s
Release: late 1999 according to Ericsson (Compaq Aero, Intel talks about early 2000)

6.4.2 WAP (Wireless Application Protocol)

The Wireless Application Protocol is the de-facto world standard for wireless information and telephony services on digital mobile phones and other wireless terminals. Handset manufacturers representing over 75% of the world market across all technologies have committed to shipping WAP-enabled devices. The WAP Forum has published a global wireless protocol specification based on existing Internet standards such as XML and IP for all wireless networks. The protocol will be independent of wireless network standards and open to everybody. It will also be extensible over time to new networks and transports. WAP v1.0 was released in April 1998 and 30 June 1999 were version 1.1 of the WAP specification released. [4]



WAP Infrastructure Overview

WML: Wireless Markup Language - A tag-based display language providing navigational support, data input, hyperlinks, text and image presentation, and forms. It is a browsing language similar to Internet html, Hypertext Markup Language.
TeleVAS: Telephony Value Added Services
WML is one of the major features of WAP. It allows a WAP enabled device to use a microbrowser to display html-pages.

6.4.3 EPOC

EPOC is Symbian's advanced real-time, multithreading operating system designed to be equally at home in a Communicator or Smartphone. The highly optimized, multi-tasking, 32-bit operating system written in C++ includes a suite of fully featured PIM, Personal Information Manager, productivity and communications applications. EPOC Release 5 supports Java and can also be programmed using a language named OPL, which is a BASIC-like RAD language. Support is built into the platform for rich text, wide characters, colour graphics, sound and embedding objects. Its modular design separates the operating system and middleware from the user interface, enabling licensees to produce devices with their own user interface and applications.
Ericsson, Nokia, Motorola, Panasonic and Psion own Symbian. Psion has developed the old 16 bits version of EPOC and are now together with the other companies providing this 32 bits version. Psion and Ericsson are already using EPOC in their products. [21], [22]

6.4.4 WinCE

WinCE is Microsoft's operating system for mobile devices. It can also be used in embedded system and be built into cars. WinCE is a multi-tasking, 32-bit

operating system with support for Internet communication via LAN or dial-up. WinCE is independent of programming language and can for example be programmed in C++, Visual Basic and Java. Microsoft does not make any hardware for the operating system. Instead many other vendors, e.g. Compaq, Casio, HP, Philips and Everex, licenses WinCE for their products. [23]

6.4.5 PalmOS

PalmOS is the operating system that Palm Computing, owned by 3Com, is using on their Palm Pilots. Until now Palm has used PalmOS only on their system and no other vendors has been able to use it. IBM is discussing with Palm about porting PalmOS to Intel's StrongARM processor. Palm OS can be programmed in C++ and Java. Palm Pilots are the most commonly used palm-sized devices today.

6.4.6 JavaOS

JavaOS is an efficient and highly reliable embedded operating system for companies creating Java™ technology-enabled consumer information products, such as screenphones, set-top boxes and automotive and industrial devices. JavaOS for Consumers 3.0 software includes the integration of the latest Java technology with a real-time microkernel, providing "Write Once, Run Anywhere" capabilities with predictable response time and the ability to coordinate functions without any lapse in operations. JavaOS runs PersonalJava™ functionality and compatibility, which include e.g. IP communication and SSL. The current target platforms for JavaOS are x86, PowerPC 823, microSPARC^{TM} Iiep and ARM SA1100. [24]

6.5 Trends

The world is changing rapidly. Therefore it is very important to know what trends will influence the companies business in the future. If the trends are well-known, then it is much easier to make decisions about the future services or products. Below is a discussion about the strongest trends that will affect the mobile market tomorrow. Three different points of view are used to illustrate the trends: individual, technology and society. [25], [26]

6.5.1 Individual

More and more focus is put on individuals. Instead of trying to find groups of customers for a specific product or service, the companies try to provide personalized solutions. The customers also have higher IT maturity now when the Internet has been around for some years and an

increasing number of the population gets connected. This means that it is meaningful for companies to use the Internet as an information/communication channel to the customer. One problem is that the customers also become less loyal and therefor change service provider more easily. Immaterial assets, such as knowledge and experience, are becoming more important than material assets. The new information era with very good communications also makes it much easier to build up personal connections with people and the border between work and private life gets diffuser. The accessibility of people is very high, thanks to the explosive growth in the mobile market.

6.5.2 Technology

The technical development is very intense which has resulted in an abundance of information and very good communication capabilities. Almost everything is connected or is about to get connected. First were the computers connected and soon everything from coffee machines and dishwashers to cars and toilets will get connected. Together with that, personalized services are built into products and vice versa. That way the products and services will become more and more intelligent, and will with that, adjust to the user's lifestyle and needs. The position of these products and services will be accessible to mobile users and the accessibility will be better through higher bandwidth and more stable connections to both stationary and mobile devices. In addition to that, mobile devices will be positioned with higher and higher accuracy.

6.5.3 Society

We have transformed from a local to a global society and that has caused diffuser borders between societies and cultures. Lots of market areas get deregulated (e.g. the telecom industry) which result in lower prizes and more choices for the customers. It has also become easier to establish companies. The conditions for making business are changing rapidly, which demands real time control. The rules and solutions of yesterday do not work today. There are new, easier and more efficient ways of making business today thanks to the information technology and for many companies the stock market value is, in some sense, more important than the profit.

6.6 Services

6.6.1 Scenarios

The three scenarios described below are based on every day situations where location dependent mobile services with personalization can add value and make life easier. Most of the services used in the scenarios are described in detail in the following section (see 6.6.2), but services without benefits from positioning and personalization are not described (e.g. electronic payment, digital keys, AMP and remote control). They are included to help illustrating the benefits of using the mobile device in every day life. An intelligent assistant is also included in the scenarios but the functionality will not be described. See [27] for more information about intelligent agents.

Shopping

AMP [28] (Agent Based Market place) is really useful for Alice while she easily finds the cheapest shop in town for the perambulator model she wants. The shop happens to be *G-Knapp*. They have the model in stock and since Alice has the rest of the day off she decides to have a look at it. But she doesn't recognize the address so she checks it up and finds that it is an alley connected to the main street. Then she doesn't need any additional help with the navigation. She opens the carport and drives out their new car. The carport automatically closes behind her.
The best parking space today is the city malls parking house because it is so hot that the car would turn to an oven if left outdoor. She grants the payment for one hour in the parking house, making sure she gets reminded when the time is up, and then heads for *G-Knapp*. -Oh my goodness, it's hot today, Alice sigh to herself. She is sweaty when she enters *G-Knapp* and the air-conditioned shop is a welcome release from the heat. She looks around and concludes that it's a nice place. A shop assistant turns up and asks if she needs help. –Yes thanks, I would like to see the pro2000 perambulator, Alice says. The assistant shows Alice where it is and from the first look Alice knows that this is what she has been looking for. Alice doesn't need much time to make up her mind. She bargain with the assistant so she gets free delivery, pays for the perambulator and leaves the shop. She places out a public footprint so she and her friends get info about G-Knapp because it is a really nice shop.
When she get out on the street her PDA tells her that Bob is only 200 meters away on the main street. She contacts him and they decide to drink a cup of coffee together on a café in the neighborhood. It must be six months since she talked with Bob so this was a pleasant surprise. When they are at the café, Alice gets reminded by her PDA that it's only

ten minutes left on her parking ticket, and she extends the time with 15 more minutes so she can talk with Bob without stress. Bob has found a new feature on his mobile subscription to Telia and is eager to demonstrate it to Alice. It helps him to catch the bus or train right on time, even if it is late.
On the way home Alice go to the supermarket to buy some food. The digital purchase list is of great help because it automatically adds standard products that the family is short of. The PDA updates Alice with the latest news about areas of interest to Alice by voice in the car on the way home. The carport identifies her and opens up automatically when she gets close to the house. The kids meet her when she opens the door. –We knew you were coming because we tracked you from the supermarket, the kids shout in unison. It's good to be home again, Alice thinks for herself with a smile.

The Tourist

The Edström family, consisting of Stina, Johan and their son Emil, are travelling by car from Jönköping to the Landvetter airport. They are going to Crete on vacation after a period of hard work. When they have passed Borås, they get informed that their plane is at least 30 minutes late and that the new time for checking in their luggage is 18:30. Stina is always hungry so she wants to stop and eat at a restaurant on the roadside, now when they have some extra time. Stina looks at the map and finds out that they will pass the Bollegården restaurant in 15 minutes. That sounds like a nice restaurant but it is unfortunately closed. She finds another restaurant in the neighborhood and they decide to go there instead. Stina orders minute steak with wedged potatoes to her and Johan and a child's portion of meatballs with mashed potatoes to Emil. The price for everything is 170 SKr, including drinks.
They get to the restaurant, eat a superb dinner and then they continue to Landvetter. When they arrive at the airport, they leave the car at the long time parking, and take the bus to the international terminal. They check in their luggage and go to gate 23 and wait. Emil is playing computer games while Johan and Stina read the newspaper. They don't have to wait long before they hear "Good evening ladies and gentlemen and welcome onboard flight 624 with destination Crete". They go onboard the plane and Emil wants to have the seat by the window so Stina gives in, because that will hopefully give a more peaceful trip. Emil continues to play with his video game.
Johan checks the weather report before they land at the Iraklion airport and it is 29°C in Chania and the weather forecast says sunny the whole week. Johan shows it to Stina. -Look how wonderful, he says. –Mmmm…, Stina says.
They sit in the transfer bus that takes them to their hotel. A guide informs them about important things to think of, but it is noisy and

almost impossible to hear what he says. Therefore Johan sits and read for himself and gets a personal guidance instead. The bus drives by an old ruin from the antiquity and Johan thinks that it would be interesting to visit it some day. They arrive at the hotel 03:00 and lock up the door. –Oh, it is nice and cool, exactly as I want it, Stina says when she enters the room. –It will be so good to sleep some hours now. They tuck themselves into bed and fall asleep immediately.
A couple of days later Johan has persuaded Stina to come along to the ruin that he got information about in the transfer bus. They rent a car and soon they are on the way to the ruin. Johan takes a detour to get to the countryside and see the nature at Crete. During the trip they get information about the places they pass and their history. When they arrive at the ruin, Emil thinks it is time for icecream and Stina agrees on that. Johan buys icecream and they sit down in the shade and eat. Now they are prepared for the ruin. They walk to the ruin and listen to a guidance about its' history. They also get pictures and a couple of short movies about what it probably looked like in the ancient times in greece. Johan gets information about the building techniques probably used while building the palace because he is interested in construction. They meet another couple from Sweden while they are at the ruin, Sandra and Peter, and they start to talk with them. When they are about to leave, they decide to go out and eat together in the evening. Peter knows about a restaurant that his friend Roland, that has been to Crete earlier, recommended to him. It is a nice gourmet restaurant. That sounds exciting to Stina and Johan, so they decide to meet at the restaurant at 19:30.
On the way back to the hotel, Stina gets a message that the freezer has broken down at home. –Oh, it just has to happen while we are away, Stina groans. She calls a service firm for freezers and they say that they can fix it immediately or in the worst case replace it if needed. That sounds fair to Stina and she accepts the offer. She pays the firm and sends a temporary key to them. When they finally get back to the hotel, they decide to take a cooling dip in the pool. It is 25°C in the water.

Kids

It is lunch break and Erik is just about to have lunch in the school restaurant when he gets a message on his PDA. The message is from his teacher that tells him that the lesson after lunch is cancelled. What pages to read as homework is also attached. –That is great, Erik shouts, it was the last lesson for today and that means that we have the rest of the day off! -I go to the town for a while, he says. Erik put on his inlines and leaves for the town. Suddenly the PDA beeps again and he pushes a button to get the message as voice. It tells him that some friends are only a few hundreds meters away. -That is fun, Erik think, I call Johan and check if they want to come and eat at McDonalds with me. He puts on

his wireless headset and makes the call. They decide to meet at McDonalds in 5 minutes. Erik rolls in a few minutes later and he orders a BigMac & Co. The payment is handled through the PDA and he sits down at a table and wait for his friends. Johan and the rest of the friends jump in and sit down with their burgers at the table. They talk for a while and Bengt tells that he has found a new scenario to MAG on the net. They decide to try the new scenario out immediately and Erik sends a message to some other friends, telling them that they will meet and play in the grove in 15 minutes. Of course he take advantage of the free messaging service from McDonalds, even if that means some advertisements to his friends.
They all connect to the game server when they come to the grove and adjust the scenario so it fits the environment. A few more friends show up and everyone go to their starting points. Now it is time for some serious fun.
Erik puts on his headset on the way home and listen to the news that he is interested in, e.g. if his favorite soccer team won today. He locks up the door and walk in when he comes home. His mother is not at home but he gets a message from her as soon as he enters the house, -Hi sweetheart, there is food in the refrigerator, heat it up in the microwave. He eats the food while watching TV. He uses the PDA to turn the TV on and switch channels.

6.6.2 Service Descriptions

A wide range of services is used in the three scenarios above (see 6.6.1). These and additional services are described in detail in this section. Information about required client hardware, required network speed/functionality and when it is technically possible to release the service are also provided for each service when applicable.
The services below are described as isolated parts but the best benefits are gained when they are combined together and the user always sees services mixed with each other. Let us consider navigation and the Mobile Information Guide for example. These two services can be provided separately but they become much more powerful when used together. That way the user gets information about roadwork, traffic jams and moose warnings together with the navigation information. To make the combinations even more powerful, and complex, three, four or five services can be combined together and provide very sophisticated functionality to the end user. It is very important to have this in mind when reading these isolated service descriptions.
All services are dependent on the possibility to position mobile devices with “good” accuracy. The positioning technology can either be partly implemented in the client hardware or completely in the network (GPS vs. MPS). Personal adaptation is also a key word for all services in this

list. This means that each service has to provide functionality to adapt to the users personal interests and current situation.
Some of the biggest actors on the mobile market have published their visions about future wireless services and we have taken impression from them. [2], [29]. Services that are intended for end users are described first and services for other purposes are described in the end of this section.

Emergency Calls

Imagine the scenario when the emergency central gets a call from somebody that is involved in an accident. It is not hard to realize how much the information about the caller's position is worth for the rescue workers. And if it is possible to distribute that position to some navigation system in rescue cars and helicopters, then the benefit is even higher. This can be accomplished when positioning is added to cellular phones and other wireless communication devices. This service is tested at the Swedish emergency center on research basis. The customer for this service is the emergency centers controlled by the government, but everybody that have an accident are, of course, positively affected by this service.

Service Calls

This service is based on an ordinary mobile voice call to a service center, e.g. a support center, but with positioning and personalization added. This provides extra value to the service provider when knowing the context and the position of the customer. Ordinary mobile phones connected to existing wireless networks can be used without increasing the bandwidth. Positioning capabilities of the mobile device has to be added before it is possible to introduce this kind of services. The release date depends on when positioning of mobile devices is possible. This is a typical service for adding value to the customer, but also helps call centers to personalize the service. This can be accomplished when positioning is added to cellular phones and other wireless communication devices.

Mobile Information Guide

This is a service for providing information based on the user's position and personal interests. The basic idea is to show the users position on a map and then add information objects, which are of interest to the user, on the map. The information objects can be linked to additional information that is shown for example when the user clicks on the object or comes close to it. One example of this concept are the MIG [30], [31]

(Mobile Information Guide). The MIG is a project at Telia Research that was carried out in 1998. The result is a working prototype of the MIG concept. A screenshot of the user interface is shown below.

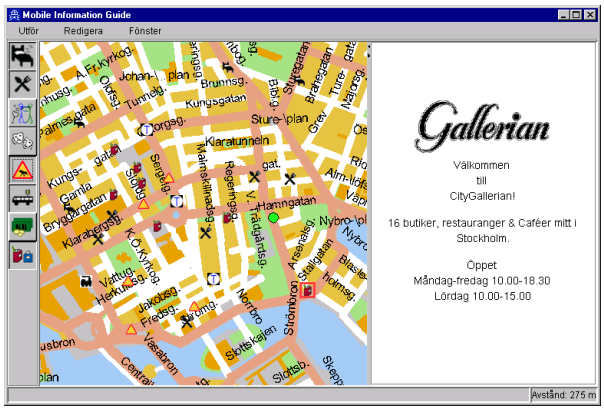


Figure 1 Screenshot of MIG

The MIG is one way of providing yellow pages functionality (and more) in a smart way to mobile devices. This is a service type that will emerge on the market soon. Location based yellow pages, for stationary Internet users, exist on the market today (e.g. Telia Infomedia), and location information is already implemented in the databases. So this type of service is not new but the work that has to be done is to provide the yellow pages to the mobile device in an appropriate way. This type of service have great potential to reach a mass market because of its simplicity and the possibility to combine a variety of services in one "easy-to-use" user interface. It can be released as soon as communication capability and positioning is added to palm computers. The existing GSM network can be used but faster networks are of course preferable.

Navigation/Vehicle Guidance

Vehicle guidance is a service that has great growing potential. A variety of first generation navigation services are already available on the market and more advanced and refined products are to be expected continuously. The basic idea with vehicle guidance is to help the driver to get from one place to another as fast, comfortable and safe as possible. The navigation system should be able to update the route dynamically and give the driving instructions by voice. The systems that exist today are static, very expensive and built into new cars. The navigation help would become much cheaper, dynamic and could be installed in any vehicle, if the functionality were moved into the network and ordinary mobile

devices with communication and positioning capability were used, e.g. PDAs. The navigation service could then reach a mass market.

Traffic Information Service

A traffic information service can be very useful for everybody on the road, professional and private drivers, as well as for supervising purposes. The basic feature in this service is information selection through positioning. Parameters such as roadwork, accidents, traffic jams etc. are examples of information that is provided. The navigation service can take great advantage of this service.
Another way to provide traffic information to drivers is to put up traffic cameras on the roadsides and provide the mobile devices with video streams from the closest camera available. That way the drivers can see exactly what the traffic looks like ahead. Higher network speed than GSM is required before video streaming is meaningful but if the video is replaced with snapshots the existing networks can be used. This type of service can be accomplished when positioning is added to cellular phones and other wireless communication devices.

Fleet Management

This is a huge area for new location dependent services. Every company that needs to control a fleet of mobile units gains advantages from the positioning possibility. Fleet management services are important for, among other, taxi, police, rescue services, hauliers (heavy traffic), delivery services, rental cars and service companies. First basic versions of fleet management systems can be released as soon as positioning capability is added to mobile devices.

Tracking Services

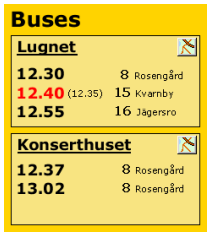
The possibility to locate mobile devices makes a variety of tracking services possible. Tracing of stolen vehicles, asset tracking (e.g. money transportation, sensitive goods, dangerous goods), person tracking (e.g. children tracking, location of elderly or disabled) and emergency services (e.g. assault alarm, car breakdown/road assistance) are some example of areas with benefits from position based safety.
Another example is tracking the pet. There are solutions available today for finding a pet that has run away but the problem is that these systems are fairly expensive and the working range is very limited. Therefor would wide area positioning possibilities enable more efficient and cheaper solutions for tracking the pet. One example is to integrate a GSM device in the pet's necklace and then use GSM positioning (e.g. Ericsson's MPS) to locate it.
The possibility to locate mobile devices is also enabling surveillance services. The government can use it to keep close watch over people that

need it. One example is criminals that are not in jail but still need to be watched.
This service could be released as soon as mobile devices can be positioned. The existing wireless networks are good enough for this type of service.

Bank & Shopping on the move

Instead of paying with money or credit card in shops, on the bus, in the movies etc. the user effect payments via the mobile terminal that has a connection with the cash register. The identification is easily done through the mobile device. Banking business done while on the move includes all services that is possible to do via tele or data banking. Examples of such services are checking the balance, transferring money and pay bills. The user can subscribe to a service that gives information to the mobile terminal when a special event occurs; e.g. the X stock has gone down below £15. The possibility to buy and sell stocks from the mobile terminal should also be provided. This stock selling/buying service is highly dependent on a real time handling as changes might occur rather quickly. This service can be released very soon. Enabling technologies for this type of service are WAP and Bluetooth. If a standard for mobile electronic payment is set, this service could reach a mass market very fast.

Public Transportation



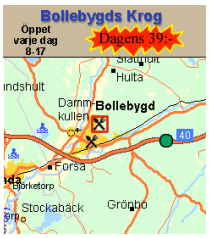
Mobility and positioning would increase the usability and effectiveness of electronic timetables. You can carry it everywhere you go and the positioning functionality will always give you fresh information about the right area of interest. One example is to travel by train, using a mobile electronic timetable system. The latest timetable for the local area is continuously downloaded to the mobile device. Delays on trains with reasons for the delay is also sent to the mobile device. This type of service could be released as soon as positioning of mobile devices is possible. All trains/busses must also be positioned. This is a service for the mass market.

Location Dependent News

One obvious mobile service is to provide personalized news and recreation information to the mobile device, i.e. the same information as TV and radio. If the mobile user's position is taken into account, the news can be even more personalized. This type of service

can be released as soon as positioning of mobile devices is possible, and would reach a mass market as fast as the penetration of mobile devices increase.

Advertisements

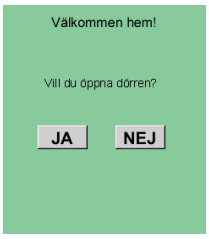


When adding the advertisement receiver's position as a factor for choosing target groups for advertisements, the personalization of the advertisements increases substantially, and with that an increase of the value for the receiver. An obvious example is the situation when a consumer is walking by a shop that has a special offer. This offer is sent to the consumer's mobile device. In addition a filter with "areas of interest" can be added to make sure that the consumer is interested of the object that is for sale.

Location based charging

Positioning information can help the service provider to decide if the customer is at home or at work. This is valuable if the charging depend on where the customer is located, e.g. if the customer is in the home zone or in the business zone.
Another service idea is for companies, such as Restaurants and supermarkets, to give away messaging service for free inside the restaurant or supermarket. This to make more people to visit them and also send advertisement together with each message sent for free. This type of service can be released as soon as positioning of mobile devices is possible.

Security Services



Security services will play an important role in the future where integration of different security functions is a design target. Examples of user services are access security (login, password), key function (lock unlock doors etc.) and identification. This type of service can be released as soon as positioning of mobile devices is possible and secure identification is provided through mobile devices.

GSM Dispatch (PMR) Phones [32]

GSM phones can now provide the same functionality as Private Mobile Radio (PMR) and Public Access Mobile Radio (PAMR) systems. And when positioning is added to the GSM, it gets much better than PMR/PAMR. The positioning will for example improve the safety on a

workplace when a worker easily can be found if an accident occurs. This type of service can be released as soon as positioning of mobile devices is possible and the market is companies with needs for PMR/PAMR systems today.

Infrastructure Planning

Assume that the government can keep track of all vehicles. Also assume that that they can watch their movements in a city for example. Then it is easy to realize what big benefits can be achieved for the technicians responsible for the infrastructure in the city to plan the traffic flows and eliminate the bottlenecks. This type of service can be released as soon as positioning of mobile devices is possible.

Location based IN services

Intelligent networks can also take advantage of positioning capability. One example is to use the location as a parameter when routing data. If both routers and clients would provide positioning information, then smarter routing can be done.
There are some significant benefits for the wireless network when positioning capability is added. Assistance for hand-over and improved traffic measurements are examples of areas with benefits from positioning capability. This type of service can be released as soon as positioning of mobile devices are possible.

6.7 Demonstrator

It is much easier to make people understand and see the benefits of concepts and ideas if they have the possibility to experience it in some way. We have therefore built both a demonstrator and a prototype to visualize our ideas. Both of them are built to run on the Windows CE™ operating system from Microsoft.
The demonstrator is basically a slide-show viewer with three series of slides that are direct visualizations of the scenarios described in section 6.6.1, *Shopping*, *The Tourist* and *Kids*. For information about the design of the demonstrator see Appendix B, for a manual see Appendix C and for manuscripts and the screen shots see Appendix A.

7 Discussion

Many people have adopted the mobile phone in the last years. The mobile industry is now going to add the possibility to use data communication on the move. Many new technologies for this purpose will reach the market within a five-year perspective. There are many manufacturers of mobile devices and a lot of different kinds of devices, therefore this market will probably be very confusing for the end customers. Some trends can still be made out and it seems like the PDAs and the mobile phones (soon smart phones) are leading the race. They do have massive support from the big manufacturers and these devices are the ones that sell best. We will very likely see PDAs and mobile smart phones in the same device soon and these will be hard to compete with when the desire is mobile communication and information services. Ericsson R380 is one example of a phone and a PDA in the same device and Qualcomm pdQ is another. It's important to remember the more uncommon devices, such as wearable computers and wrist computers.

The wireless networks will soon, within a year, be able to provide the same bandwidth as today's wired modems, which is about 40 kbit/s. They will also be packet-switched which will make them cheaper to use for an end-user, if the payment depends on the amount of transferred data instead of time. These networks will start the boom of mobile data communication services. The bandwidth will probably increase from 40 kbit/s up to 100 kbit/s and then the common standard based on WCDMA and cdma2000 will reach the market. WCDMA and cdma2000 will provide a bandwidth of 384 kbit/s and that makes it possible to provide good multimedia services, e g videoconference and other video services. The third generation's networks will later reach a bandwidth of up to 2Mbit/s in local areas. All network providers will not get licenses to use the third generation's spectrum. The providers that don't receive any licenses will probably use the EDGE technology, which can handle a bandwidth up to 384kbit/s.

Positioning is already possible using a satellite based system. The satellite solutions are preferable if very good accuracy is important but the MPS solution has two advantages compared to the satellite based systems. The first is that mobile devices can be positioned anywhere where the cellular network is working, i.e. no visual contact is needed. The second advantage is that old mobile devices can be positioned with this system as well, while the functionality is built into the network (old cellular phones also works on the improved solution that will be released 2001). Special receiver hardware needs to be built into mobile devices to enable satellite positioning.

There are also two interesting enabling technologies that will reach the market in late 1999. The first is WAP enabled mobile phones. WAP enabled phones are a good way to get devices that can display

information without any external device. It provides a standardized platform that within a couple of years will exist in almost every mobile phone. The second is Bluetooth. It replaces the wires between the different devices with short-range communication. This will make it possible to use a number of devices in a personal network, e.g. a PDA and a mobile phone.

With these technologies it is possible to release lots of services. New services that require new devices are always hard to get out on the market, this because the initial costs are high. Therefore services that are aimed for a market that is financially strong should be released first. When the mobile phones where released they aimed the business market. We think that this is a good way, but we must take into consideration that people today change mobile phone quite often and therefore WAP enabled devices will soon reach the market. Therefore services based on WAP can reach a mass-market quickly. Before GPRS arrives the services have to use the wireless connection efficiently because of the circuit switch nature of GSM. When GPRS arrives people can be always online. This will make it possible to introduce pushed services like e-mail notifications and Instant messenger clients.

It may be hard to reach a mass market with location based services before the MPS systems arrive. That's because the mobile phone manufactures seems to not include a GPS into their mobile phones. For example both Ericsson and Nokia develop MPS systems and they rather sell these systems than add a GPS into the mobile phone.

Important to notice is that the services described in this master thesis are only isolated basic services. When combining two or more services much more powerful services can be created. For example an Instant messenger client can be a combination of a fleet management service and a tracking service with the possibility to receive and send direct messages. Many location-based services don't require better accuracy than the 125 meter that the MPS will provide, but if the inaccuracy decrease to about 10-15 meter or less the services can be much more powerful.

One important trend today is personalization. Services should be adjusted to the person's needs and not the group's. The services should be adjusted to quickly give the user the information or help that the services are intended to. This trend is very important to take in consideration when creating new services.

8 Conclusions

Because location dependent services require new devices, services aimed for a financially strong market should be release first. The WAP platform will soon get a large market penetration due to people change mobile phone often. WAP enabled devices will therefore be excellent for many basic services. For more advanced services PDAs will be used. GPRS and MPS will make it possible to introduce pushed location based services like location based Instant messenger clients to a mass market. MPS provides an accuracy of 125 meter and that is enough for many location-based services. Personalization should be taken into consideration when creating new services. They should be adjusted to the person's needs and not the group's, to quickly give the user the information or help that the services are intended to.
Services based on the MIG concept will also become a large market. It provides a good platform on which customized services easily can be built. Services aimed for a mass market have to use WAP enabled devices because new devices always have problems reaching a large market. The Location-based Instant messenger is a very good and easy service aimed for a mass market that easily can be implemented with WAP as soon as GPRS and MPS arrives. To be able to provide good services it is very important to establish partnerships with other companies e.g. information providers.

9 Further work

This thesis work covers the technical area in mobile data communication. Trends and services are also included. One big task left to do is a solid market analysis for each service. This is a very important part before any services are “productified”.
Telias Business Units should also be contacted to establish a dialog about which services they are interested in. It is also important to contact information providers to get the hands on valuable information before any competitor gets it. Other companies that work with mobile services and/or technologies should also be contacted for cooperation.
The mobile data communication industry changes very fast and it is therefore very important to watch the market for new technologies and services.

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Manuscript – Tourist

In this scenario we will follow the Edström family, consisting of Stina, Johan and their son Emil, on their trip to Crete for vacation. The story starts in the car between Jönköping and Landvetter airport. Let's get started!

Slide: T1	**Delay:** 30s.	**Click:** Whole screen.

When they have passed Borås, they get informed that their plane is at least 30 minutes late and that the new time for checking in their luggage is 18:30.
Technology: An agent that continously check the departure time for the plane on their ticket. A short note about the change of time is showed by a display-agent, with the possibility to click for more information.

Slide: T2	**Delay:** 30s.	**Click:** unmarked food icon.

Stina is always hungry so she wants to stop and eat at a restaurant on the roadside, now when they have some extra time. Stina look at the map and finds out that they will pass the Bollegården restaurant in 15 minutes. That sounds like a nice restaurant but it is unfortunately closed.
Technology: Mobile Information Guide. A map with information icons from areas of interest to Stina.

Slide: T2_2	**Delay:** 30s.	**Click:** Marked food icon.

She finds another restaurant in the neighborhood and they decide to go there instead.
Technology: Mobile Information Guide. A map with information icons from areas of interest to Stina.

Slide: T3	**Delay:** 30s.	**Click:** Order Button

Stina orders minute steak with wedged potatoes to her and Johan and a child's portion of meatballs with mashed potatoes to Emil. The price for everything is 170 SKr, including drinks.
Technology: Mobile electronic commerce. The order is sent directly to the restaurant.

Slide: T4	**Delay:** 30s.	**Click:** Yes Button

They get to the restaurant and eat a superb dinner. The payment is taken care of digitally.
Technology: Mobil electronic commerce. The identity needed for the digital payment is provided through the mobile device.

Slide: T5	**Delay:** 30s.	**Click:** Yes Button

Then they leave for the airport. They park their car on the long time parking space. The payment is as usual done digitally. The proposal from the agent to leave the car for 14 days is based on the dates on the tickets.
Technology: An agent gives the proposal to leave the car for 14 days . The identity needed for the digital payment is provided through the mobile device.

Slide: T6	**Delay:** 30s.	**Click:** Whole screen.

They take the bus to the international terminal and, while on the bus, the assistant gives them valuable information about the flight.
Technology: The helper shows info about the flight automatically. The information is selected based on the users position and the data from the ticket.

Slide: T7	**Delay:** 30s.	**Click:** Whole screen.

They check in their luggage and the assistant informs them so everything is done correctly. The assistant stores the information in case it should be needed later.
Technology: They get the information about checking in through Bluetooth or GSM. The identity of the persons are proved through the mobile device and the tickets are stored digitally and can be found in SAS' database.

Slide: T7_2	**Delay:** 30s.	**Click:** Whole screen.

They go to gate 23. The tickets are stored digitally and are provided by the assistant at the gate. They enter the gate and sit down and wait.

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Technology: They get the information about the flight through Bluetooth or GSM. The identity of the persons are proved through the mobile device and the tickets are stored digitally and can be found in SAS' database.

Slide: T8	**Delay:** 30s.	**Click:** Whole screen.

Emil plays computer games and Johan and Stina reads the newspaper while they wait at the gate.
Technology: The game could be any existing one to a computer. It could also be network based.

Slide: T9	**Delay:** 30s.	**Click:** Whole screen.

The flight takes about five hours and Johan checks the weather report for Crete before they land. It looks pretty good, 29 degrees and sunny.
Technology: An information channel, e.g. via GSM, that is adjusted to Johan's position and his personal interests.

Slide: T10	**Delay:** 30s.	**Click:** Whole screen.

They sit in the transfer bus that takes them to their hotel. A guide informs them about important things to think of, but it is noisy and almost impossible to hear what he says. Therefore Johan sits and read for himself and gets a personal guidance instead
Technology: The guidance are based on position and personal interests. The information is retreived dynamically from Internet via GSM.

Slide: T11	**Delay:** 30s.	**Click:** Whole screen.

The bus drives by an old ruin from the antiquity and Johan thinks that it would be interesting to visit it some day. Therefore he puts out a virtual footprint on the spot so they can find their way back there later.
Technology: The virtual footprint is a bookmark that is based on a position. The footprint can be personal or be shared within a group of users.

Slide: T12	**Delay:** 30s.	**Click:** Yes Button

They arrive at the hotel 03:00 am. They unlock the door with the key provided to the mobile device.
Technology: A digital key that communicate via bluetooth. The key is restricted to this room for a limited time.

Slide: T13	**Delay:** 30s.	**Click:** Whole screen.

It is nice and cool when they enter the hotel room because they adjusted it earlier digitally through the mobile device. They can of course adjust the temperature whenever they want. They tuck themselves into bed and fall asleep immediately.
Technology: The communication with the different units in the hotel room is done via bluetooth. The interfaces between the units are based on Java's JINI.

Slide: T14	**Delay:** 30s.	**Click:** Whole screen.

A couple of days later Johan has persuaded Stina to come along to the ruin that he got information about in the transfer bus. The assistant helps them to find a place to rent a car for a fair price.
Technology: AMP (Agent based Market Place). Searching in a net-based database for products and services. The search can be done with many details. A thin client is used on the mobile device.

Slide: T15	**Delay:** 30s.	**Click:** Order Button

They choose a suitable car model and get it delivered to the hotel.
Technology: Mobile electronic commerce. The payment and ordering is done through GSM and the Internet, of course with cryptography that provides high enough security.

Slide: T16	**Delay:** 30s.	**Click:** Whole screen.

Johan takes a detour to get to the countryside and see the nature at Crete. During the trip they get information about the places they pass and their history**.**
Technology: Guidance based on position and personal interests. The information is fetched dynamically over the net via GSM.

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Slide: T18	**Delay:** 30s.	**Click:** Yes Button

They walk up to the ruins and listen to a guided tour.
Technology: The assistant has found a guided tour based on the position information. The payment and ordering is done through GSM and the Internet, of course with cryptography that provides high enough security.

Slide: T19	**Delay:** 30s.	**Click:** Whole screen.

They also get pictures and a couple of short movies about what it probably looked like in the ancient times in greece. Johan gets information about the building techniques probably used while building the palace because he is interested in construction.
Technology: Local guidance. Communication through bluetooth to gain higher bandwidth which is required for high quality multimedia.

Slide: T20	**Delay:** 30s.	**Click:** Whole screen.

Incoming message from Peter.
They meet another couple from Sweden while they are at the ruin, Sandra and Peter, and they start to talk with them. When they are about to leave, they decide to go out and eat together in the evening. Peter knows about a restaurant that his friend Roland, that has been to Crete earlier, recommended to him. It is a nice gourmet restaurant. That sounds exciting to Stina and Johan, so they decide to meet at the restaurant at 19:30. Johan gets Peters virtual footprint for the restaurant so it shouldn't be any problem to find the way there.
Technology: a footprint, i.e. a position based bookmark, that is sent via bluetooth or GSM.

Slide: T21	**Delay:** 30s.	**Click:** Whole screen.

Johan checks the restaurant's information page and it seems like a good choice.
Technology: Ordinary mobile surfing. Both a position and a web page are included in the footprint.

Slide: T22	**Delay:** 30s.	**Click:** Contact… Button

On the way back to the hotel, Stina gets a message that the freezer has broked down at home. She calls a service firm for freezers and they say that they can fix it immediately or in the worst case replace it if needed. That sounds fair to Stina and she accepts the offer.
Technology: A sensor in the freezer senses that it doesn't work properly and sends a warning message to Stina. This message is sent via GSM and IP. The assistant suggests a service firm that they have positive experiences with earlier.

Slide: T23	**Delay:** 30s.	**Click:** Whole screen.

She pays the firm and sends a temporary key to them.
Technology: Mobile electronic commerce. The payment and ordering is done through GSM and the Internet, of course with cryptography that provides high enough security. The digital key is sent via GSM, of corse also encrypted. The key is limited in time and also limited to the doors needed to be opened.

Slide: T24	**Delay:** 30s.	**Click:** Whole screen.

When they finally get back to the hotel, they decide to take a cooling dip in the pool. It is 25°C in the water.
Technology: The communication with the different units at the hotel is done via bluetooth. The interfaces between the different units are based on Java's JINI.

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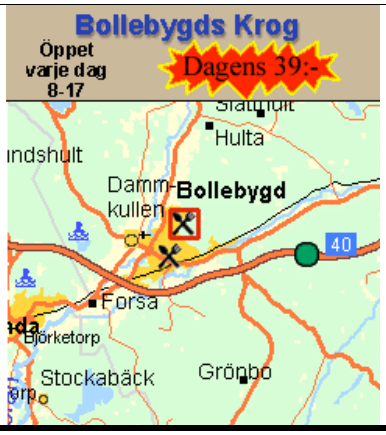
T1

T2



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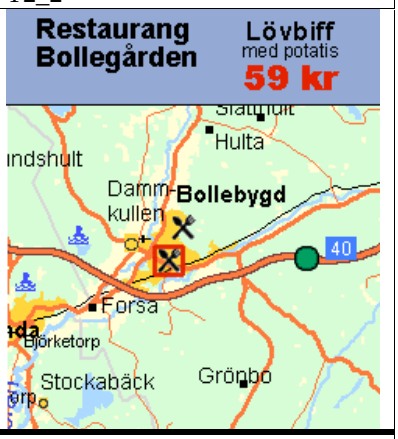
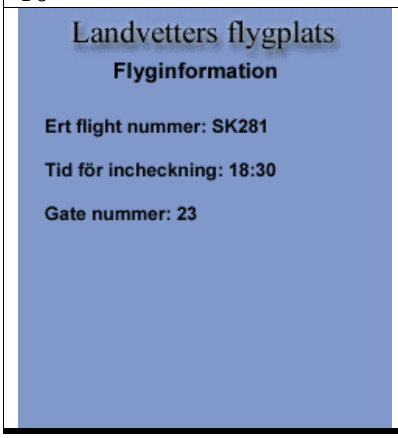


T3

T4

T5

T6



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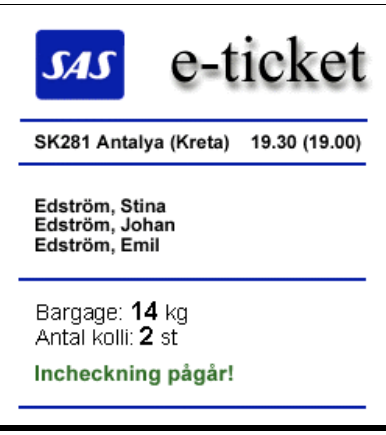

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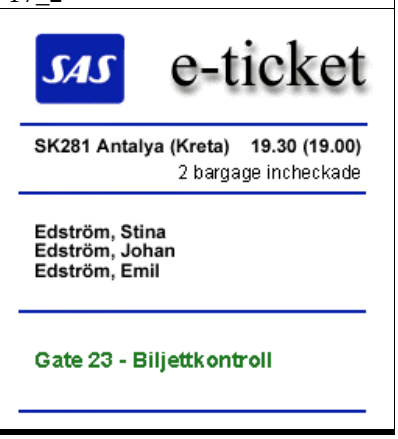

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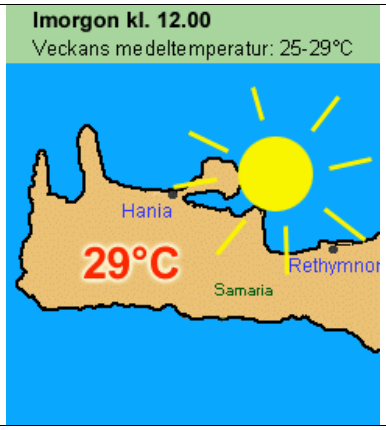
T8

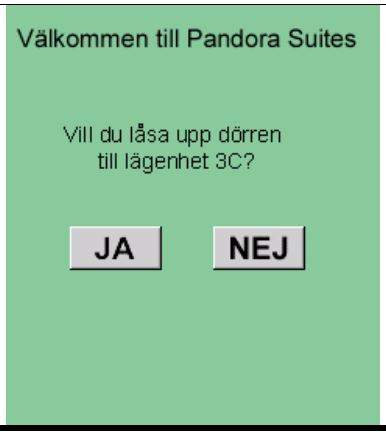
T9



T10

T11

T12



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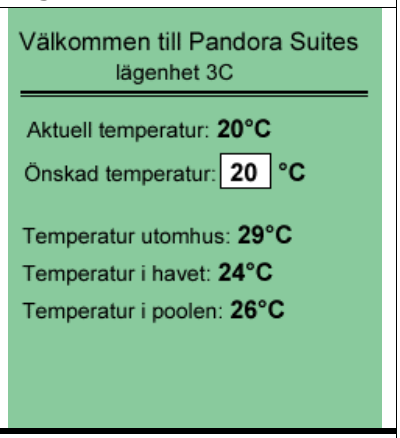
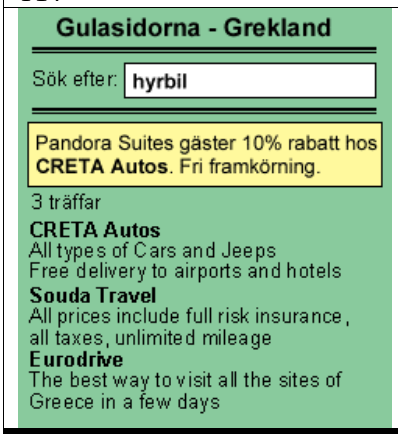


T14



T15

T16

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T18

The palace of Zakros

The palace of Zakros stands 45km to the east of the town of Sitia, in a sheltered bay on the eastern coast of Crete, oriented politically and commercially towards the major civilisations of the Middle East.

Multimedial guiding **10 SEK**.

Buy?

JA NEJ

T19

The palace of Zakros

It was brought to light by the great Greek archaeologist N.Platon at 1961. Like the other Cretan palaces, the palace of Zakros, was first built in about 1900 B.C. The present ruins seen by the visitor belong to the second building phase, in about 1600 BC. The long term excavations have yielded over 10,000 objects, many of them considered unique.

T20

Inkommande Fotavtryck
Du har tagit emot ett fotavtryck från Peter Rosell. Det avser ***Chania Seafood Restaurant***

Fortsätt Guidad Tur
Det finns fortfarande ca 30 minuter kvar av den multimediala guidningen. Fortsätt?

Temperaturinformation
Temperatur i luften: **29°C**
Temperatur i havet: **24°C**
Temperatur i hotellpolen: **26°C**

T21

CACTUS
Cafe - Restaurant - Bar

We are waiting for you to come and enjoy the best meal ever in our restaurant, which is located on the cleanest beach in all Crete, and where, together with the delights of good food, you can also enjoy the delights of water sports in the beautiful Mediterranean sea.

- Menu
- Book table

Agia Marina, Hania, Crete
Tel.: +3 0821 68372
N. &J. TZIFAKIS

T22

Alarm!

Frysen har gått sönder. Kompressorn är trasig.

Aktuell temperatur i frysen: **-15°C**

Kontakta Electrolux Service

Sök annan servicefirma

T23

Nyckelhantering

Sänder tidsbegränsad nyckel till Hans Eriksson på Electrolux Service.

Tidsbegränsning: **1** dag

T24

Status - Frysbox
Electrolux är nu på plats och undersöker frysboxen. Meddelande om reparation eller utbyte kommer inom 30 minuter. Kontakta?

Inkommande Fotavtryck
Du har tagit emot ett fotavtryck från Peter Rosell. Det avser ***Chania Seafood Restaurant***

Temperaturinformation
Temperatur i luften: **29°C**
Temperatur i havet: **24°C**
Temperatur i hotellpolen: **26°C**

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Manuscript – Perambulator

In this scenario we will follow Alice on an ordinary day. She has a day off from work and has decided to go to the town and buy a perambulator. Let's go!

Slide: B0	**Delay:** -	**Click:** Search Button

Alice start looking in AMP, the Agent based Market Place, for a perambulator. She specifies the type of perambulator she wants and click on search.
Technology: AMP. Search in network-based database for products and services. The search can be based on detailed descriptions. A thin client is used on the mobile device.

Slide: B1	**Delay:** -	**Click:** On G-Knapp

As you can see here, Alice gets three hits and after she has investigated these she concludes that G-Knapp seems to have the best offer for her so she chooses that.
Technology: see B0

Slide: B2	**Delay:** 7s.	**Click:** Whole Screen

Information about G-Knapp and a map that shows where the shop is located shows up on the display. The assistant asks Alice if she needs navigation help but she finds the way by herself.
Technology: Mobile Information Guide. A map and a information icon that are fetched from the net dynamically via GSM or Bluetooth if she has that technology at home.

Slide: B3	**Delay:** -	**Click:** Yes button

When she jump in the car in the garage, the assistant asks if she want the car port opened. Alice answers yes.
Technology: The cart port is controlled via Bluetooth and Java's JINI.

Slide: B4	**Delay:** 5s.	**Click:** Whole screen.

The car port closes automatically behind her.
Technology: An agent senses that Alice leaves with the car and closes the car port.

Slide: B5	**Delay:** 5s.	**Click:** Whole screen.

When Alice comes close to the town she gets advice from the assistant to park in a parking house instead of outdoor because it is so hot today. The assistant also propose a parking house in the neighborhood with free parking spaces.
Technology: The assistant assumes that Alice wants to park close to G-Knapp and look up a parking house with free spaces. Communication via GSM. The local government provides information about free parking spaces. The agent gets information about the weather from the local weather stations.

Slide: B6	**Delay:** 5s.	**Click:** Whole screen.

She gets information about the price and the payment options for the parking house when she has parked.
Technology: Identification needed for the payment is done through the mobile device. Encrypted communication via GSM.

Slide: B7	**Delay:** -	**Click:** Yes button

She is sweaty when she enters *G-Knapp* and the air-conditioned shop is a welcome release from the heat. She looks around and concludes that it's a nice place. A shop assistant turns up and asks if she needs help. Alice asks about the perambulator she wants. The assistant shows Alice where it is and from the first look Alice knows that this is what she has been looking for. Alice doesn't need much time to make up her mind. She bargain with the assistant so she gets free delivery, pays for the perambulator and leaves the shop. She places out a public footprint so she and her friends get info about G-Knapp because it is a really nice shop.
Technology: Mobile electronic commerce. Identification needed for the payment is done through the mobile device. Encrypted communication via GSM. The virtual footprint works as a bookmark that has a position. The footprint can be personal or be shared among a group of people and is stored in the network.

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Slide: B8	**Delay:** -	**Click:** On Bob-link

When Alice is on her way out from the shop, the assistant tells her that Bob is in the neighborhood. Allice surf to Bob's contact page.
Technology: Alice has a list of her friends where Bob is included. The assistant check the position of the members in the list and notice Alice when one or more of them gets close enough.

Slide: B9	**Delay:** -	**Click:** On Voice link

Alice can here choose between different ways to get in contact with Bob, e.g. voice, instant message or e-mail. She chooses voice and they decide to have a cup of coffée together at a café in the neighborhood.
Technology: Bob has a personal contact page where people can contact him in different ways. The information is stored in the net.

Slide: B10	**Delay:** -	**Click:** Yes button

They sit down on the café and order coffee. The payment is done easily through the mobile device. Alice accepts the payment.
Technology: Mobile electronic commerce. Identification needed for the payment is done through the mobile device. Encrypted communication via GSM.

Slide: B11	**Delay:** 10s.	**Click:** Whole Screen.

Bob has found a new feature on his mobile subscription to Telia and is eager to demonstrate it to Alice. It helps him to catch the bus or train right on time, even if it is late.
Technology: The busses (or trains) are positioned and the time when they arrive at a specific bus stop is calculeted based on this position and the route they drive. The time schedule is then based on these times. It is also possible to watch a specific bus.

Slide: B12	**Delay:** 7s.	**Click:** Whole Screen.

On the way home Alice go to the supermarket to buy some food. The digital purchase list is of great help because it automatically adds standard products that the family is short of. It also keeps control that she doesn't miss anything on the list and give price info. The payment is done digitally.
Technology: A digital purchase list where price info is added via Bluetooth when she enters the supermarket. Information about lower prices on products of interest to Alice are also shown in her mobile device.

Slide: B13	**Delay:** -	**Click:** On news link

On the way home, the assistant asks Alice what she wants to listen at and also propose a list of things that Alice usually wants to listen at. Alice chooses to listen to the news.
Technology: The assistant knows that Alice usually listens to music or the radio on her way home from town. It knows her taste in music and also what radio stations she listens to most frequently and propose this to her. The user interface is voice because she is driving.

Slide: B14	**Delay:** -	**Click:** Yes Button

Exactly as when she left, the assistant asks Alice if she want to open the car port and she answers yes.
Technology: The assistant knows that she is on her way home and also her position. Communication via Bluetooth or GSM.

Slide: B15	**Delay:** -	**Click:** Yes Button

The same applies to the door. She only has to verify that she wants to open the door.
Technology: Digital key. High level encryption and communication via Bluetooth.

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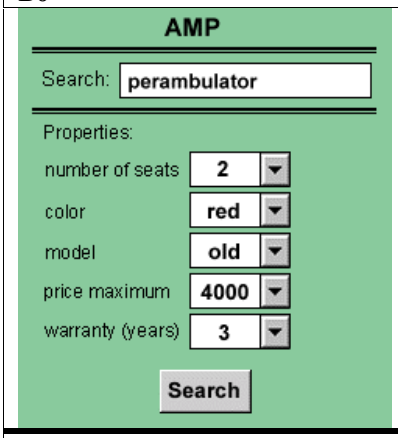
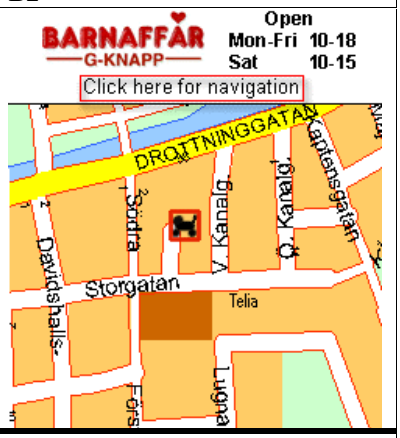
B0



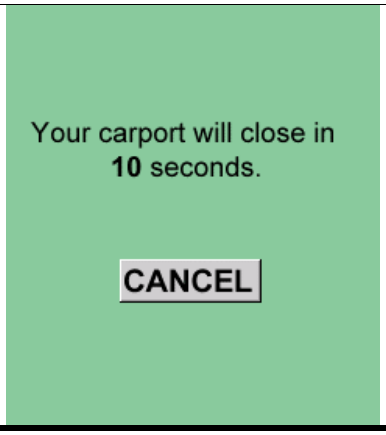
B1

B2



B3

B4



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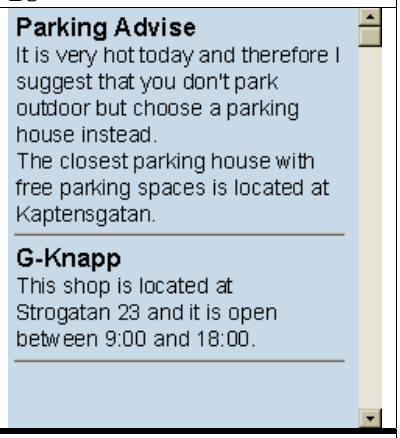
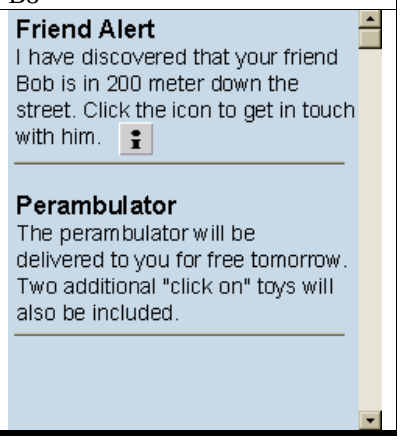


B6

B7

B8



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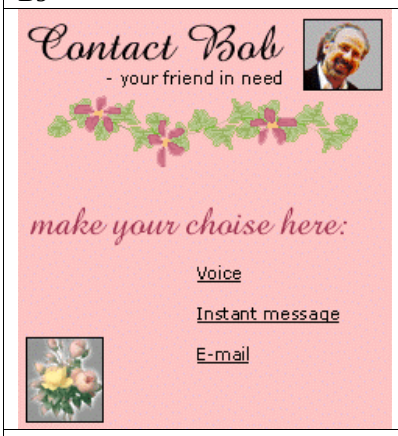
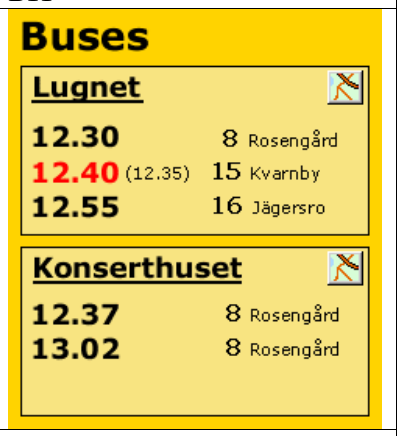
B9



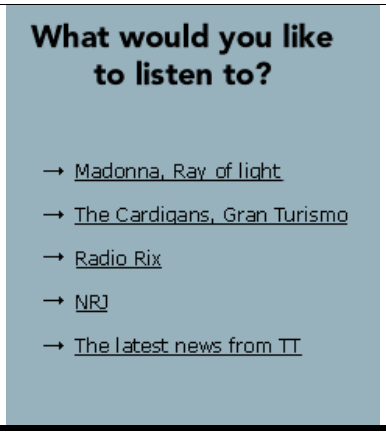
B10

B11

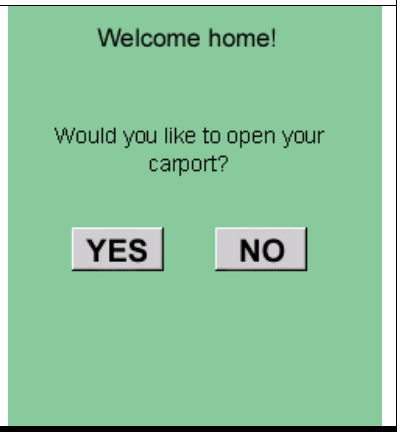


B12

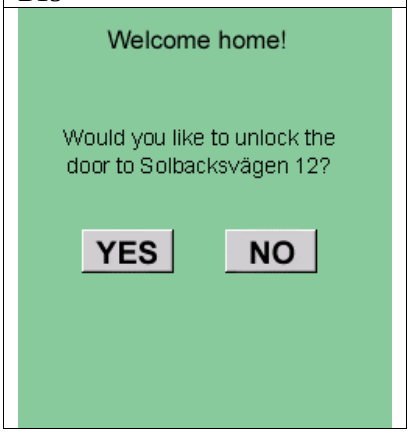
B13



B14



B15



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Manuscript – Kids

In this scenario we will follow erik during a normal day. Erik study at senior high school. Let's go!

Slide: U1	**Delay:** 7s.	**Click:** Whole screen

It is lunch break and Erik is just about to have lunch in the school restaurant when he gets a message on his mobile device. The message is from his teacher that tells him that the lesson after lunch is cancelled. The pages to read as homework are also attached. Erik put on his inlines and leaves for the town.
Technology: The teacher can send messages to everybody in the class and the assistant shows it immediately on the mobile device because it is important. The communication is done via GSM.

Slide: U2	**Delay:** -	**Click:** Friend Icon

Suddenly the mobile device beeps again and he pushes a button to get the message as voice. It tells him that some friends are only a few hundreds meters away.
Technology: Erik has a list of his friends. An agent checks their position and tells Erik when one or more of them are in the neighborhood. The positioning is done via GSM or GPS and the communication via GSM. The map and information icons are fetched dynamically from servers connected to the net.

Slide: U3	**Delay:** -	**Click:** Voice link

He puts on his wireless headset and makes the call. They decide to meet at McDonalds in 5 minutes.
Technology: The headset communicates via bluetooth with the mobile device that calls via GSM.

Slide: U4	**Delay:** -	**Click:** Yes Button

Erik rolls in a few minutes later and he orders a Big Mac & Co. The payment is handled through the mobile device and he sits down at a table and wait for his friends. Johan and the rest of the friends jump in and sit down with their burgers at the table. They talk for a while and Bengt tells that he has found a new scenario to MAG on the net. They decide to try the new scenario out immediately.
Technology: Mobile electronic commerce. The identity needed for the payment is done through the mobile device. Communication via GSM or Bluetooth to McDonalds that in turn check with the bank if there is any money on the account.

Slide: U5	**Delay:** -	**Click:** Send Button

Erik sends a message to some other friends, telling them that they will meet and play in the grove in 15 minutes. Of course he take advantage of the free messaging service from McDonalds, even if that means some advertisements to his friends.
Technology: Eric connects via Bluetooth to the messaging service at McDonalds and sends a message to his friends.

Slide: U6	**Delay:** -	**Click:** Whole Screen

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Slide: U7	**Delay:** 7s.	**Click:** Whole Screen.

Erik puts on his headset on the way home and listen to the news that he is interested in, e.g. if his favorite soccer team won today.
Technology: An assistant knows that Eric usually listens to music or the radio on his way home. Th assistant also knows his taste in music and what news he is interested in. A voice interface is preferrable while in motion.

Slide: U8	**Delay:** -	**Click:** Yes Button

He locks up the door with the mobile device and walks in.
Technology: Digital key. Good encryption and communication via Bluetooth.

Slide: U9	**Delay:** 7s.	**Click:** Whole Screen

His mother is not at home but he gets a message from her as soon as he enters the house, -Hi sweetheart, there is food in the refrigerator, heat it up in the microwave.

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Technology: Position based bookmark. The assistant informs about the message when Eric gets cose enough to the bookmark. Communication via Bluetooth or GSM depending on coverage.

Slide: U10	**Delay:** -	**Click:** Whole Screen

He uses the mobile device to turn the TV on and switch channels.
Technology: The mobile device communicates with the TV via Bluetooth. The TV-guide for the channels available is fetched from the net.

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U1

U2

U3

U4

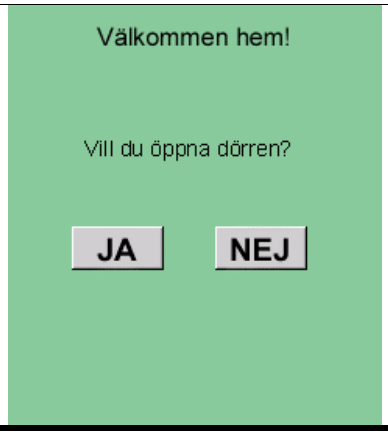
U5

U6

- Classified -

U7

U8



U9

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U10

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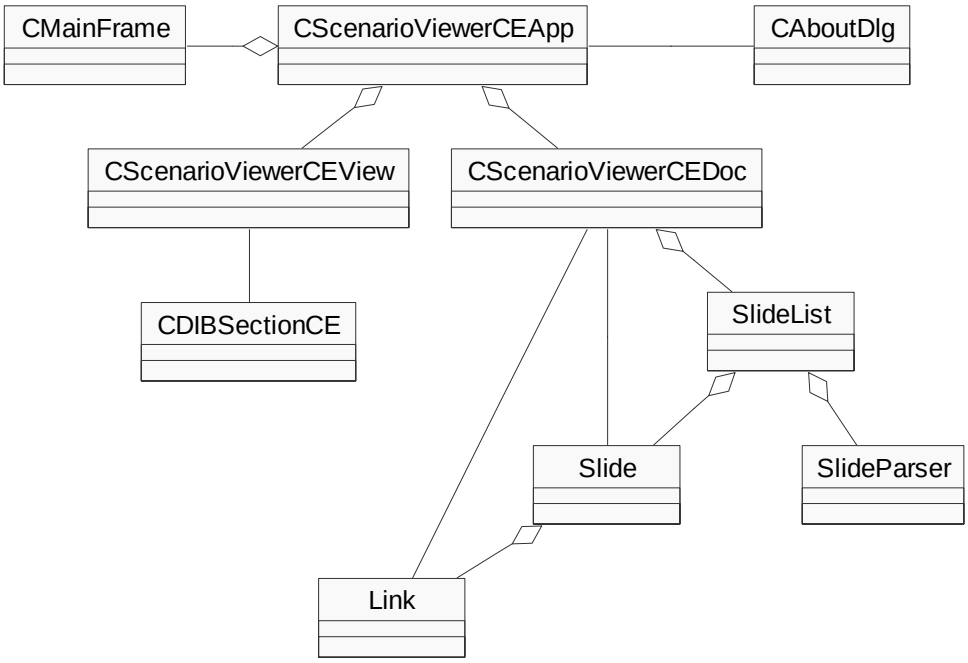
Design of the Scenario Viewer for WinCE

The Scenario Viewer is going to be developed in Visual C++ with an extension for Windows CE. To get a quick base application to start with, the application wizard will be used. The programming model that the wizard uses is the Document-View model. The wizard will create some classes that will handle the events and call the events methods. When you develop applications with Visual C++ there will be some macros included in the code. It is these macros that combine the events with methods.

Class diagram



Class description

CAboutDlg

This is the about dialog box that tells some short information about the program.

CDIBSectionCE

Handles the bitmap images. It loads them from file and paints them on a device context.

CMainFrame

The application's main window containing the menu, toolbar and the view.

CScenarioViewerCEApp

The main application that starts the program and creates the main window, the document and the view. Wizard generated.

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CScenarioViewerCEDoc

The document containing the abstraction of the application. It contains the slide list. Wizard generated and then extended.

CScenarioViewerCEView

The view that shows the images and gets the input from the user. Wizard generated and then extended.

Link

A link in a slide's list of links to other slides.

Slide

A slide containing information about which image to show or which program to run. It also has a list of links to other slides.

SlideList

A container class, containing a list of slides.

SlideParser

A parser that parses a slide show file and creates a S*lideList*.

Slide show file specification

```
<SlideListFile> ::= <SlideList>

<SlideList> ::= <Slide> | <Slide> <SlideList>

<Slide> ::= <SlideDef> | <SlideDef> <Links>

<Links> ::= <AreaLink> | <DelayLink> | <AreaLink> <Links> |
<DelayLink> <Links>

<SlideDef> ::= <SlideID> <Separator> <SlideName> <Separator>
<SlideType> <Separator> <FileName> <NewLine>

<SlideID> ::= “slide”

<Separator> ::= “,”

<SlideName> ::= <String>
An arbitrary name of the slide

<SlideType> ::= 1 | 2
1 is for image slide and 2 is for a program slide

<FileName> ::= <String>
The name of the image file for the slide

<NewLine> ::= “\n”

<String> ::= a normal text string NOT starting or ending with a space
and NOT containing any comma
```

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<AreaLink> ::= <AreaLinkID> <Separator> <Left> <Separator> <Top> <Separator> <Width> <Separator> <Height> <Separator> <LinkSlideName>

<AreaLinkID> ::= “area”

<Left> ::= an Integer
Defines the left side of the clickable area in the image. Starting from left with 0 and increase to the right. Unit: pixels.

<Top> ::= an Integer
Defines the top side of the clickable area in the image. Starting from top with 0 and increase downwards. Unit: pixels.

<Width> ::= an Integer
Defines the width of the clickable area in the image. Unit: pixels.

<Height> ::= an Integer
Defines the height of the clickable area in the image. Unit: pixels.

<LinkSlideName> ::= <String>
Contains the name of the slide that the link area points to.

<DelayLink> ::= <DelayLinkID> <Separator> <DelayTime> <Separator> <LinkSlideName>

<DelayLinkID> ::= “delay”

<DelayTime> ::= an Integer
Defines the delay time before changing to linked slide. Unit: seconds.

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Scenario Viewer v 1.0

for Windows CE

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Scenario Viewer

With this viewer you can run a precomposed slide show. It handles linked areas in a slide and delay links between the different slides. The slide show should be composed in the Slide Show Editor. Notice that the slide show file have to have the extension **.sld**.

System Requirements

A PDA running Windows CE 2.01 or higher

Tutorial

This tutorial explains how to run a scenario.

1 Copy all image files (.bmp) to a directory under My Documents on your PDA.
2 Copy the .sld file to the same directory.
3 Start the ScenarioViewerCE application from the start menu.
4 Choose **Open** from the **File** menu.
5 Select your slide show file and click the **OK** button.
6 Now the scenario starts. Click on the slide's linked areas to proceed to the next slide or wait for the delayed link if any.

Comments

If you want to restart the scenario choose **Restart** from the **File** menu.

Installation

1 Run SVSetup.exe
2 Follow the instructions.

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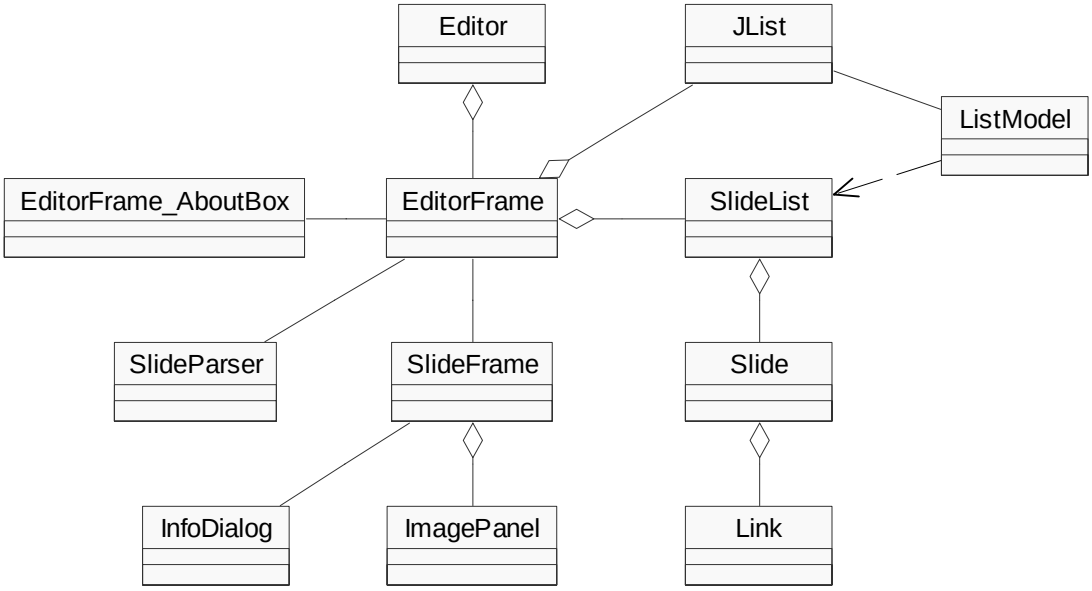
Design of the Slide Show Editor

The Slide Show Editor is a tool that helps you to create slide show files. It will be developed in Java 2 and is using its Swing features.

Class diagram



Class description

Editor

This is the main application class that starts the application and creates the *EditorFrame*.

EditorFrame

The *EditorFrame* is the main frame of the application. It contains the menu, toolbar and a list of all slides.

EditorFrame_AboutBox

The about dialog that contains some information about the application.

ImagePanel

A panel that shows a bitmap image (.bmp). It also provides a feature to draw a rectangle on the image with the mouse.

InfoDialog

A dialog that tells the user a short message.

Link

A link in a slide's list of links to other slides.

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Slide

A slide containing information about which image to show or which program to run. It also has a list of links to other slides.

SlideFrame

The frame in which the user can change the properties for a slide.

SlideList

A container class, containing a list of slides.

SlideParser

A parser that parses a slide show file and creates a S*lideList*.

Slide show file specification

```
<SlideListFile> ::= <SlideList>

<SlideList> ::= <Slide> | <Slide> <SlideList>

<Slide> ::= <SlideDef> | <SlideDef> <Links>

<Links> ::= <AreaLink> | <DelayLink> | <AreaLink> <Links> |
<DelayLink> <Links>

<SlideDef> ::= <SlideID> <Separator> <SlideName> <Separator>
<SlideType> <Separator> <FileName> <NewLine>

<SlideID> ::= “slide”

<Separator> ::= “,”

<SlideName> ::= <String>
An arbitrary name of the slide

<SlideType> ::= 1 | 2
1 is for image slide and 2 is for a program slide

<FileName> ::= <String>
The name of the image file for the slide

<NewLine> ::= “\n”

<String> ::= a normal text string NOT starting or ending with a space
and NOT containing any comma

<AreaLink> ::= <AreaLinkID> <Separator> <Left> <Separator> <Top>
<Separator> <Width> <Separator> <Height> <Separator> <LinkSlideName>

<AreaLinkID> ::= “area”

<Left> ::= an Integer
Defines the left side of the clickable area in the image. Starting
from left with 0 and increase to the right. Unit: pixels.
```

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<Top> ::= an Integer
Defines the top side of the clickable area in the image. Starting from top with 0 and increase downwards. Unit: pixels.

<Width> ::= an Integer
Defines the width of the clickable area in the image. Unit: pixels.

<Height> ::= an Integer
Defines the height of the clickable area in the image. Unit: pixels.

<LinkSlideName> ::= <String>
Contains the name of the slide that the link area points to.

<DelayLink> ::= <DelayLinkID> <Separator> <DelayTime> <Separator> <LinkSlideName>

<DelayLinkID> ::= “delay”

<DelayTime> ::= an Integer
Defines the delay time before changing to linked slide. Unit: seconds.

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Slide Show Editor v1.0

for Java

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Slide Show Editor

With this editor you can compose a slide show for a specific viewer running on a palm-sized PDA with Windows CE. It creates a file containing the relationships between the different slide. It is possible to create linked areas in a slide and it is also possible to set a delay between the different slides.

System requirements

Java™ 2 Runtime Environment

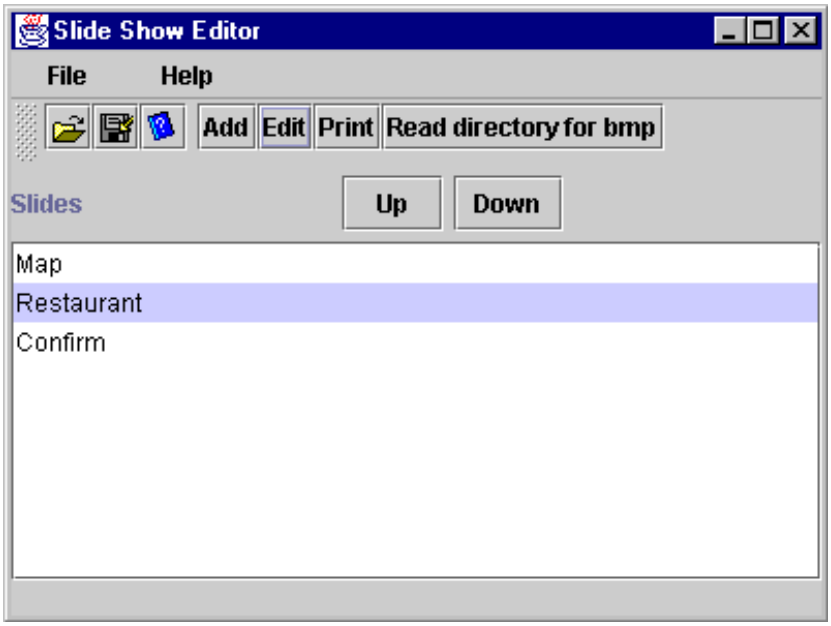
Tutorial

This tutorial explains how to create a simple slide for a palm-sized PDA running Windows CE.

7 Draw the images you want to use as slides. The images must have a height of 270 pixels and a width of 240 pixels. **Notice** that they have to be saved as uncompressed bmp with a maximum of 256 colors or 8 bits color. This because Windows CE can not handle any larger images.

8 Place all your images in one directory.

9 Then start the Slide Show Editor. To do that double click on the **editor.jar** file. The Slide Show Editor's main window shows up. Se picture 1.



Picture 1. The main window of the Slide Show Editor.

10 Use the **read directory for bmp** function to get all images to slides. Browse to the directory where your images are and select one of them and click **Open**.

11 All slides are now listed in the main window. You can use the **Up** and **Down** buttons to move the selected slide in the list. Notice that the order doesn't mean anything to the slide order in the final slide show.

12 Select the first slide and press the **Edit** button. Now a new window opens. See picture 2.

13 You can now change the name of the slide to a better name. When you read a directory for bmps the slide's name is the same as the filename. **Notice**, if you change the filename you have to press **Enter** to load the image file.

14 To make a delayed link to another slide you have to enter a number in the delay field. It is the delay between two slides in seconds and has to be an integer. You also have to select the slide you want to link to in the drop down box to the right of the delay field. Notice that it is not necessary to have a delayed link.

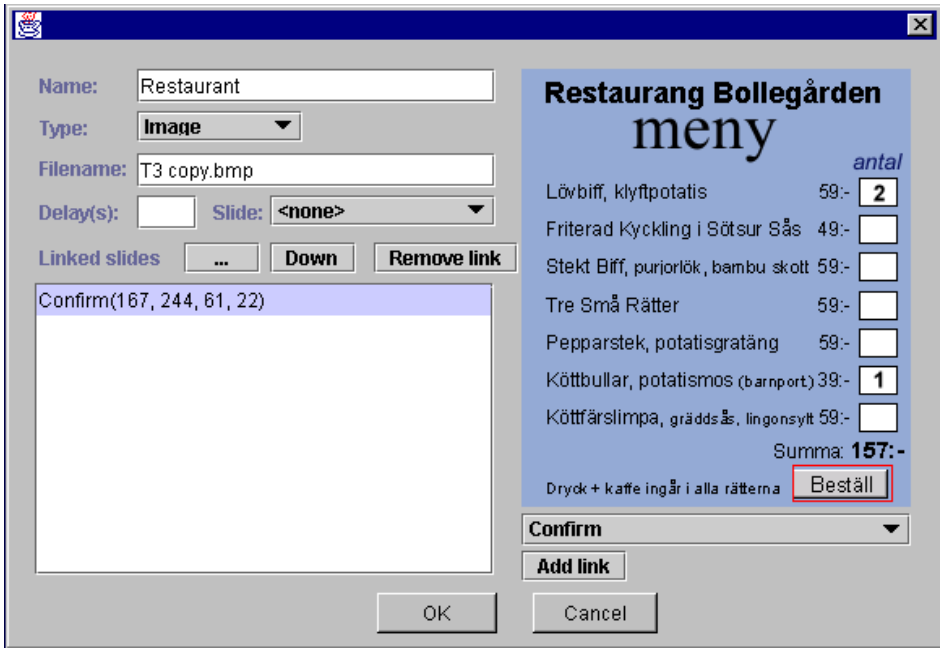
15 To make a linked area to another slide you draw a rectangle on the image. When you have a red rectangle that covers the area you want to link, you have to select a slide in the drop down box below the image. Finally click on the **Add link** button. The link now appears in the linked slides

list. It is possible to add multiples links in the same slide. It is also possible to have areas that cover each other. The links areas are checked from top and to bottom in the list, which means that the first slide's link will be followed if it covers the same area as the second link. To change the links order you have to select a link and use the **Up** and **Down** buttons. Notice that it is not necessary to have a link area.

16 When all fields are completed click **OK**.

17 One slide is finished and you have to select the next slide, click the **Edit** button and restart at 7.

18 When all slides are linked you have to save your slide show. Click the **Save** button,  . The file must be saved in the same directory as the image files and must have the extension **.sld**. Click the **Save** button and you are finished with your slide show.



Picture 2. The window for editing a slides properties.

Comments

It is possible to add new slides to a slide show after the image files have been read from a directory. Click the add button in the main window and enter the slides properties.

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Appendix F

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Appendix G

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Appendix H

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