INFORMATION TECHNOLOGY

News content for mobile terminals

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Contents

Foreword

This study was initiated by the Finnish Newspaper Association in co-operation with the IFRA Nordic Committee and funded by NATS. The work has been supported by a steering group headed by Mr. Raimo Mäkilä of Alexpress. The members of the group were Mr. Timo Elomaa of Nokia, Ms. Pirkko Haapakka of Turun Sanomat, Mr. Markku Kurki of Telehelp Oy, Ms. Kristiina Laurila of TEKES, Ms. Kristiina Markkula of the Finnish Newspaper Association, Mr. Harri Siren of Helsingin Sanomat, Mr. Mårten Stenius of ICL and Mr. Seppo Vanhatalo of Keski-Uusimaa. In addition to the steering group, Mr. Niklas Jonason of the Swedish Newspaper Association and Mr. Harald Loeffler of IFRA have commented on the manuscript of this study. Hannele Antikainen wrote Chapters 2 and 3, and Kaisa Kostianen wrote Chapter 4. Caj Södergård and Hannele Antikainen co-authored the other parts.

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The Authors

1. Introduction

Small-sized portable devices - mobile phones and personal digital assistants (PDA) and communicators -have a bright future, because people's lifestyles are getting more and more mobile. When people are moving, mobile phones let (or in some cases even force) them spend their time - both work and free time - efficiently. The development can be sensed particularly in the Nordic countries, where the mobile phone penetration is already high (50 per cent in Finland).

So far, most of the transmission in GSM networks is voice. Data communication account for only a few per cent of transmission volume. However, data communications is growing. Especially the growth of business applications on the Internet has necessitated the integration of PDAs, smart phones and even basic mobile phones into the data network infrastructure.

One reason for the slow development of data services is the slow transmission speed of the current GSM network (9.6 kbit/s). However, interest in data transmission services is growing, because operators are looking for new revenues now that the market for voice transmission is starting to saturate - at least in the Nordic countries. This interest has been further strengthened by the positive reception of SMS (Short Message Service) services in countries where the mobile phone penetration is high. The growing interest in data transmission encourages operators to offer new and more advanced services. On the other hand, many service and content providers - including newspaper publishers - are looking for new ways to reach also mobile people.

The success of new services depends on the content and also on the possibilities of the platform. In the near future new technologies will increase the transmission speed of the GSM network. This will lead to a more versatile use of mobile terminals. In the future GSM networks will have services which today we have in fixed-line data applications, including the Internet, e-mail, remote corporate LAN access and even video. In these services the mobile GSM device will be the terminal, as opposed to the current set-up, where GSM phones are used to connect laptop computers to Internet services.

The technological development makes the delivery of news content to mobile terminals more attractive, even if the main delivery channel for news will be paper for a long time to come.

Compared to newspaper publishing, the position of a publisher is more complicated in the mobile news business. The newspaper publisher traditionally fulfils the role of content provider. However, the operator, who is usually also the service provider, is in direct contact with the user. This strengthens the position of the operator and weakens the position of the publishers.

Besides publishers, there are other content providers looking at the possibilities of mobile terminals as a medium to reach potential users. Possible examples of the content are:

• retail outlets with purchase orders
• government information
• traffic agent with traffic plans
• stock market information
• sports results
• weather forecasts
• traffic forecasts

Chapter 2 of this study describes emerging wireless transmission technologies that will enable significantly faster as well as Internet-based data delivery to mobile phones and terminals within the next few years. The parallel development of mobile terminals - mobile phones, communicators and personal digital assistants - is described in Chapter 3. Delivering mobile news requires the newspaper to set up a production technology, which is covered in Chapter 4. Even if mobile news is a very new phenomenon, some newspapers have already gained experience in this field. These pioneering efforts are described in Chapter 5. The study concludes with recommendations for newspapers as to how they should take mobile news delivery into consideration when planning their production processes.

2. Emerging wireless transmission technologies

This chapter explains the most significant wireless transmission technologies which will be introduced during the next few years. Although the transmission speeds of mobile networks are increasing, transmission speeds of fixed networks will continue to grow at an even faster rate.

As soon as 1999, it will be possible to transmit data in GSM networks at a speed of up to 57.6 kbit/s. This will be made possible by a new method of encoding data and by combining up to four GSM channels. The idea is the same as in ISDN, where it is possible use several channels in the transmission. Around the year 2000, packet-based data transmission will be added to GSM networks, allowing higher speeds and band-on-demand. In the year 2002 a new generation of mobile telecommunications is expected to enter the market. It will allow transmission speeds up to 2 Mbit/s. The increase in transmission speeds of mobile networks as well as packet-based data transmission will make it possible to offer new types of data transmission services, including multimedia in mobile networks.

In spite of the rapid development, it should be noted that radio frequencies are a limited natural resource and the race to higher frequencies introduces problems. At frequencies over 1 GHz, the water in the atmosphere damps the radio waves. The result is that the mobile connection may not work properly when it is raining. Also when using high frequencies, the connection may be poor if the user is moving at speed.

It should also be noted that one 2 Mbit/s connection takes the capacity of over 100 GSM connections. There are doubts as to whether it will ever be possible to offer high-speed wireless data to a large number of users. Another question is: who will be willing to pay for it? One application is certainly multimedia transmission. Although telecommunication prices have gradually been falling, the mobile 2 Mbit/s connection will always be more expensive than the corresponding wired network.

2.1 High Speed Circuit Switched Data , HSCSD

The data transmission speed in GSM networks is gradually improving. Some operators, e.g. Sonera in Finland, have already invested in HSCSD (High Speed Circuit Switched Data), which increases the bit rate of one time slot from the present 9.6 kbit/s to 14.4 kbit/s. This is one of the new possibilities of a new type of channel coding, called GSM Phase 2. However, current GSM phones need at least a software update or, more likely, they have to be changed. HSCSD is an international standard, approved by ETSI in 1997.

HSCSD – which uses Time Division Multiple Access (TDMA) – gives the possibility to combine four time-slots, giving a maximum speed of 57.6 kbit/s. The service can be asymmetrical, giving three time-slots for the downlink direction (43.2 kbit/s) and one for the uplink direction (14.4 kbit/s). This is useful in Internet services, where most of the traffic

goes from the server to the terminal. If data compression is used, the transmission speed can be increased to as high as 200 kbit/s. This may be interesting for transmitting images. Fast transmission speeds can be utilised in downloading and uploading e-mail messages, in document transfer and in real-time applications demanding a constant bit rate and transmission delay. The maximum transmission speed of HSCSD is comparable to the speed of ISDN (one ISDN B-channel) and the fastest PSTN modems (Public Switched Telephone Network). For operators, HSCSD technology is a transitional step towards GPRS (General Packet Radio Service).

In Finland, telecom operators will introduce HSCSD services in spring 1999. Mobile terminals supporting several time-slots are expected to reach the market in 1998-1999 from several vendors. For example, Nokia Communicator 9110 supporting HSCSD will reach the market in autumn 1998. For the user, HSCSD will mean faster connections with the added benefit of not having to learn a new technology.

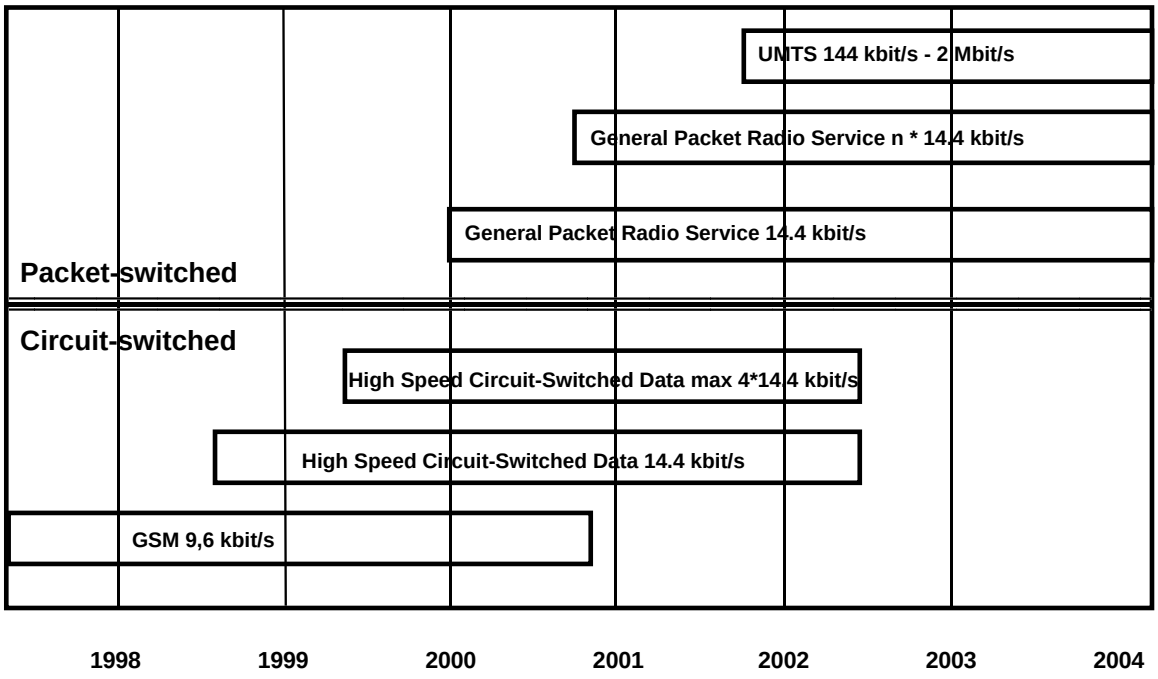

Fig. 1. The evolution of mobile communication. The first step is the High Speed Circuit Switched Data, which increases the transmission speed of the GSM network form 9.6 kbit/s to 14.4 kbit/s. Using four time-slots, the maximum speed can be 57.6 kbit/s. General Packet Radio Service adds the possibility to use packet-switched services, which means that radio sources are used only when data is transmitted. The third generation mobile network, UMTS, allows wide-band data transmission (based on Byte, May 1998, page 17).

2.2 General Packet Radio Service, GPRS

GRPS (General Packet Radio Service) is a future technology which will bring packet-switched data connectivity to GSM. This in turn will offer direct access to TCP/IP networks, the Internet among others. The first GPRS services will be launched in the year 2000. According to Nokia's estimate, mass market penetration will occur around 2002-2003. All major player, including Nokia and Ericsson, are bringing their GPRS (as well as HSCSD) technologies to the market.

GPRS, like HSCSD, is based on existing circuit-switched networks, but GPRS adds packet switching to the existing circuit switching. Packet switching is typically used in Internet applications over Local Area Networks (LANs) and Wide Area Networks (WANs). Unlike conventional circuit-switched connections, GPRS uses radio resources only when data is sent or received. In circuit-switched systems the line is occupied regardless of whether there data is being transmitted or not – for example, when the user has loaded an Internet page and starts to read it the line is busy. In a packet switched system the line can be utilised by other users. The benefit for the user is that he can stay on-line for a long time, paying only for the capacity used. GPRS offer bit rates from 14.4 kbit/s to over 100 kbit/s. This means that the response times are reasonable even if the amount of data is moderate.

GPRS requires modifications in GSM phones and allows new types of services which need to be developed. Heavy investments will also be needed in new network components, which might slow down the adoption of GPRS.

The role of GPRS is to connect GSM services to the Internet, while HSCSD is the solution when a GSM terminal should be connected to PSTN modems, ISDN terminals or other circuit-switched services, especially when the application is time-critical.

2.3 Universal Mobile Telecommunication Service, UMTS

UMTS (Universal Mobile Telecommunication Service) is the future platform for mobile communications. According to plans made by the UMTS Forum, ETSI (European Telecommunication Standards Institute) has reached an agreement on the technology concept for UMTS. If the implementation schedule for UMTS is met, the first services based on UMTS should be in commercial use in the year 2002. The full band of UMTS should be available in 2005 and an extended band in 2008-2010. The frequency allocated to UMTS is 2 GHz. The current GSM network work in two bands: 900 and 1800 MHz. UMTS terminal devices will be designed to work both on terrestrial and satellite networks and to be compliant with GSM phones. After NMT and GSM, UMTS will be the third generation of mobile phones.

The EU has obliged its member states to introduce the licensing rules for UMTS by the year 2000. The governments of EU member states should also release frequencies for UMTS

technology. Furthermore, governments should ensure that users can roam, which means that UMTS terminals can be used anywhere in Europe, as can now be done with GSM phones. The EU expects the UMTS concept to be as successful as GSM (based on TDMA technology), which in most areas has won the competition over the technology developed in the US (based on CDMA technology). However, the global coverage of UMTS may be hard to achieve, since the US government has already allocated the 2 GHz frequency for other purposes. At the moment UMTS is supported by Alcatel, Bosch, Ericsson, Italtel, Motorola, Nokia, Nortel, Siemens and Sony.

From a physical point of view, UMTS provides a new air interface and new radio components. The aim is to combine these with the current GSM systems. UMTS is based on two technologies: Wide-band Code Division Multiple Access (W-CDMA) and Time Division CDMA (TD-CDMA). They are based on the CDMA air interface used in the North American Personal Communications Services (PCS) system. It has some technical benefits over the TDMA (Time Division Multiple Access) system used in GSM, but the choice is regarded as more of a political than a technical one.

UMTS technology will provide wideband wireless multimedia capabilities over mobile telephone networks, allowing the introduction of high-speed data services. The specification includes access to fixed network. UMTS supports both circuit-switched and packet-switched data services. UMTS promises a transmission speed of 144 kbit/s and bandwidth on-demand up to 2 Mbit/s. However, the maximum speed only works if the user is stationary or moving slowly. Also, when we are speaking of high frequencies, e.g. gigahertz, there may be limitations due to rain, i.e. drops of water in the air may stop the radio waves.

2.4 Wireless Application Protocol , WAP

WAP (Wireless Application Protocol) brings Internet content and advanced interactive services to various terminals, including mobile phones and PDA terminals. In the future most of the mobile phone services will be based on Internet technologies, and WAP will offer the means to generate these services. This means that WAP will be the basis of the future data services of the GSM network. But WAP is not limited to GSM; it can also be applied in other wireless networks. WAP is developed by a consortium called the WAP Forum, which administers the specification process. The WAP Forum was founded by a group of large vendors: Ericsson, Motorola, Nokia and Unwired Planet. Today the WAP Forum has over 60 members (September 1998).

WAP defines a stack of protocols for transport, security and session layers (Fig. 2). Applications using WAP are scaleable across a variety of transport options and device types. Terminal devices can be GSM phones, smart phones or different kinds of PDAs. WAP applications can run across carrier networks which use different bandwidths. WAP services are also able to utilise the GPRS. For Internet content and service providers, WAP means that they can write applications for one global wireless Internet.

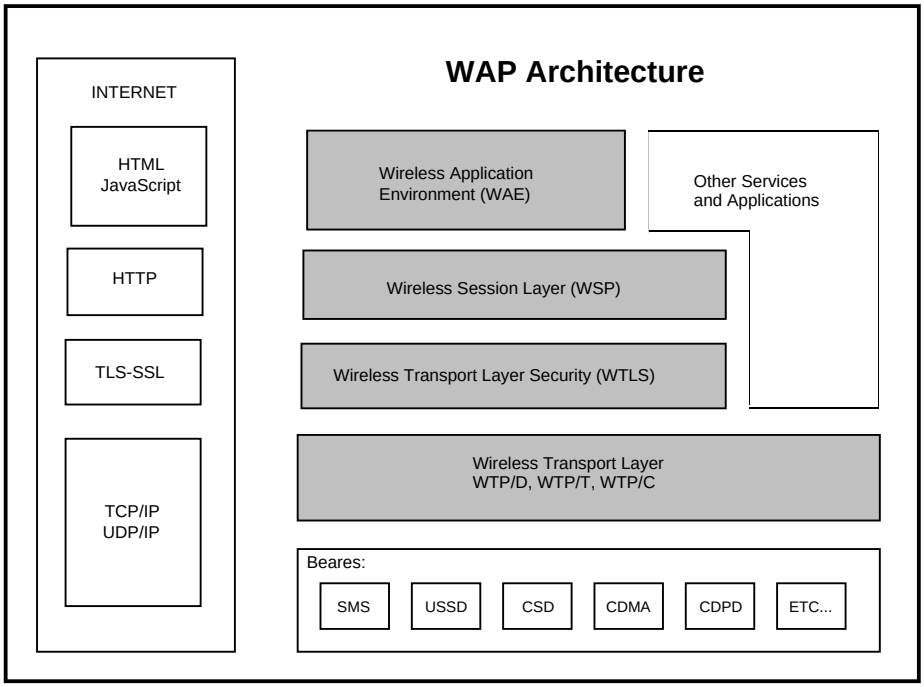

Fig. 2. WAP architecture compared with the current Internet architecture. WML, part of WAE, is the mobile equivalent of HTML and WMLScript is the mobile equivalent of JavaScript. In WAP architecture the common data exchange mechanism is controlled by the session layer. The security layer is responsible for access to data and applications. The lowest layer is the transport layer. The session and transport layers can also be accessed directly from other applications. The underlying network can be GSM or some other mobile network. WAP allows the use of the current Short Message Service (SMS) through gateways.

The applications are similar to the current Internet applications, but there are differences. Above the WAP protocol stack there is the Wireless Application Environment (WAE). The main components of WAE are the Wireless Markup Language (WML) and the Wireless Markup Scripting language (WMLScript), WAE applications and WAE supported content formats. WML is a lightweight tag-based document language and is specified as an XML document type. In comparison with HTML, WML is more optimised for use in hand-held mobile terminals, and WML takes account of the constraints of small narrowband devices, such as small display, narrowband network, and limited computational resources and user input facilities. The other component, WMLScript, is used in generating pages suitable for terminal devices. It is designed to reduce the network traffic and make optimum use of the GSM air interface. The technology enables the use of applets transmitted to the terminal device. WMLScript is loosely based on the JavaScript scripting language. WMLScript provides hooks for integrating future services and in-device applications.

From the user's point of view WAP services may be based on a personal WWW page, which reflects the interests of the user. The user interface is adapted according the capabilities of the terminal device. From the service provider's and operator's point of view, programming

for WAP is like programming for the web. WAP allows all content to be hosted on Web servers. The common standard means that the same services can be used in various WAP-compatible terminal devices, regardless of the vendor.

With WAP it is possible to strip out all graphics from a web page, making it more suitable for mobile networks. Nokia's view is that the task of the filtering and reformatting information is suited to the operator or Internet Service Provider (ISP). One reason for this is that the content provider doesn't have to worry about the document tagging. Another reason is, again according to Nokia, that the content providers – unlike operators and service providers – lack the knowledge that comes with direct access to the people whom they are trying to reach.

Adding WAP functionality to terminal devices doesn't require much special technology, so the price of the phones and other WAP-compatible terminal devices should not rise significantly. However, in order to utilise the future WAP services, users will have to buy new mobile phones.

The WAP specification 1.0 is ready, but so far we don't have any WAP-based terminal devices or servers. Also, the technology for interfacing WAP and mobile phones' SIM cards has not yet been defined. It has been optimistically estimated that the first WAP-based mobile terminals will enter the market at the beginning of 1999. The first WAP servers will be introduced towards the end of 1998. WAP will be first introduced for GSM phones, but it will also be possible to use WAP in other mobile networks. It is likely that the service development will be boosted when the WAP servers and terminal devices become available. It has been estimated that WAP services will be in widespread use within two to three years.

Java may be a competitor of WAP, because it is possible to run Windows CE and other operating systems used in mobile terminals, e.g. EPOC32 or JavaOS, together with GSM data. This means that WWW pages and their Java-based services can be displayed without WAP. This would simplify applications development, because the same application could be run on both mobile terminal and other terminal devices. An advantage of Java in comparison with WAP is that it is already well established. However WAP also has its advantages. One is that the resources needed to develop WAP-compatible mobile phones are reasonable, which means that the prices of WAP-compatible phones will about the same as current mobile phones. Also for the operators it is relatively easy to update their systems to be WAP compatible, because WAP is optimised for narrow band carriers, e.g. for GSM.

2.5 Broadcast

Broadcast transmission can be used to deliver information to mobile terminals. Possible carriers are analogue FM radio, analogue TV, digital audio broadcast (DAB) and digital video broadcast (DVB). In broadcast transmission, the same information goes to all receivers (one-to-many). The receiving terminal selects its own part of the total information. Text-TV is the best-known technology that works on this principle. More generally, the term "datacast"

is used to depict the broadcasting of data. For instance, alphanumeric pager devices (see 3.4) use datacasts.

In datacast, the data is either intermixed with the visual information or it uses its own frequency band, like pagers do. In analogue transmission, intermixing is done by using the invisible lines of the TV broadcast, while in digital transmission (DAB, DVB) data is multiplexed with the other information. For newspapers, DAB is especially interesting. For instance, news could be transferred to DAB receivers in cars and then presented as synthesised voice.

Broadcast delivery can be combined with cellular phone technology for the supply of return information. If the user wants more information about a broadcast topic, an wireless connection is opened, e.g. through the GSM network, by clicking on an outgoing link.

2.6 Other technologies contributing to the use of mobile terminals

A California-based start-up called SiRF Technology, Inc. is developing **global positioning systems** (GPS) among other applications for mobile phones and PDAs. SiRF Technology is notable because it has signed an agreement with Ericsson and Nokia to develop a GPS technology for mobile terminals. The price of a GPS chip is expected to be less than 10 U.S. dollars in the near future. This will make it possible to use them in mobile phones. It has been estimated that in the year 2001 GPS will be integrated into two-thirds of all mobile phones. A contributing factor is that the US government is pushing a project to pinpoint mobile phones which have dialled an emergency number.

GSM network also provides certain information about the location of the user by identifying the cell in which the mobile terminal is situated. This technology is called **cell-broadcasting**.

"Bluetooth" (a code name) is a small radio module or chip allowing a connection of approximately ten metres. It has the ability to handle both voice and data. The transfer rate is one megabit per second. With Bluetooth it will be possible to transfer data and messages from a portable terminal via a mobile phone without a cable connection. It will be possible to receive e-mail and access the Internet directly on a computer via the mobile phone. Bluetooth is being developed as a collaborative venture involving Ericsson, IBM, Intel, Nokia, and Toshiba. Bluetooth products are expected to enter the market in 1999.

3. Mobile terminals

Chapter 3 examines the characteristics of current mobile terminals. In this survey the portable terminals are divided into mobile phones, smart phones, like the Nokia Communicator, personal digital assistants (PDAs) and pagers. There are two types of PDAs, i.e. those with and those without a keyboard. The devices in the latter group are equipped with a pen. Most PDAs have a touch sensitive screen. Keyboard-based PDAs and the smallest laptops are converging in terms of functionality. The main difference is the operating system. PDAs are based on Windows CE or some other similar operating systems. Laptops, on the other hand, are based on Windows 95 or 98.

The differences between the various types of mobile terminals are getting smaller. PDAs are getting features enabling mobile communication, while mobile phones are being equipped with features familiar from PDA devices. And GSM phones are getting smarter. Mobile terminals are becoming increasingly popular. The popularity of not only GSM phones but also PDAs is growing rapidly.

Behind the scenes, there is an ongoing battle between the operating systems. The market will eventually decide whether Microsoft is to rule also in this area with its Windows CE, or whether some other operating system, EPOC32, GEOS or Palm OS, is to gain the upper hand.

3.1 PDAs

PDAs have been around for some time, but so far they have not been able to emulate the huge success of the PC or mobile phone. Their screens have been too difficult to read, their keyboards too small, and their range of useful applications too limited. However, today's PDAs are much better than the early devices, and PDAs are at last becoming the next technology boom.

There are many terms that are used in referring to PDA devices. At least following terms exist:

- Communicator
- PDA
- Palmtop computer
- Palmtop PC
- Palm PC
- Palm-size PC
- Pen computer
- Pocket PC
- Hand-held device
- Hand-held computer
- Hand-held PC

Fig. 3. The keyboard of a hand-held PC is quite small. The screens are touch-sensitive with 16 or 256 colours. A pen can be used like the mouse, or it can be used for writing, if the device has handwriting recognition. Shortcut buttons are applied in hand-held PCs. They may be located in the upper part of the keyboard or sometimes on the screen.

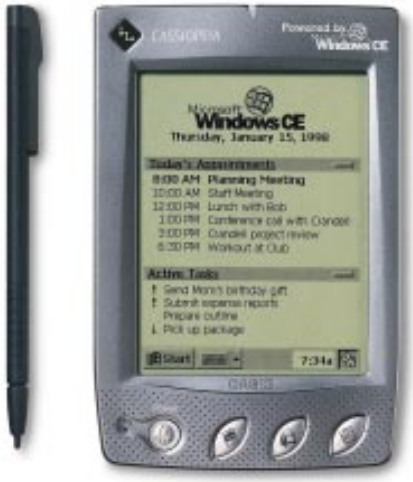

Fig. 4. A pen is important in using a Palm-PC. It is used for data input either through handwriting recognition or a virtual keyboard. Buttons are used to switch between applications.

At the high end of the product spectrum, PDAs approach laptop computers. However, there is a difference. Laptops or notebooks are based on Windows 95/98, and PDAs on Windows CE or some other comparable operating system. Most of these devices have a keyboard and touch-sensitive screen. High-end PDAs are often called hand-held PCs.

Low-end PDAs are often called palm PCs or palm-size PCs. Today's low-end PDAs have, instead of a keyboard, a pen and a touch-sensitive screen. Pen-based devices are smaller and lighter and have a smaller screen than those with a keyboard. A pen-based device may have handwriting recognition along with a touch sensitive screen. Depending on the size, the devices weigh between 200 - 500 grams. The market leader in Palm PCs is 3Com with its Palm III (previously a product of U.S. Robotics, which was acquired by 3Com).

PDAs typically store their operating system and applications in ROM. ROMs used in PDAs are typically 1 MB. RAM is needed for working space and data storage. The size of the RAM usually varies between 1-16 MB. Because of the limited amount of RAM, applications cannot be very RAM-hungry and the user has watch the number of files he wants to save. For this reason, Microsoft, for example, has developed slimmed-down versions of its Office applications, including Word and Excel. Some PDAs even have user-upgradable ROM and RAM.

Most of the PDA devices have a touch-sensitive LCD screen. The resolution varies from 160 x 160 (e.g. Palm III) to 640 x 240 pixels (e.g. Psion Series 5). Most of the current PDAs come with monochrome grayscale displays. Color screens are not widely available, because of the larger power consumption. Battery life varies widely among hand-held devices, from a few hours to many days. The battery times quoted by vendors are based on optimal conditions, which seldom exist. Modems and other optional hardware use the batteries and shorten their service time. Some PDAs come with rechargeable batteries. In interfacing PDAs with PC workstations there are three possibilities: serial interface, IrDA and docking port.

A modem is available at least as an option. The fastest modems are currently (1998) 33.6 - 56 kbit/s. The speed is substantially better than the speed of GSM (9.6 kbit/s). An built-in modem is needed for e-mail communication and connection to the Internet. The functionality of the PDAs vary from one device to another. The functionality may be as follows:

- calendar
- alarms
- calculator
- phone book
- search of names
- organiser
- word processor
- spreadsheet
- e-mail
- Internet

Today, the processing performance of PDAs is at best comparable to a 33 MHz 468 processor. It has been estimated that in 2005 the performance PDAs will be approximately 5 times the capacity of the Pentium Pro. By then, PDAs will also include a reliable speech and handwriting recognition. Speech recognition will eventually make the keyboard obsolete. This trend will also prevail in mobile phones. The most likely mass memory technology will be flash memory, because of its efficient energy consumption. The market leaders in PDAs are Casio, Compaq, HP, Psion and 3Com.

The pen-based Toshiba Cuaderia is based on the Toshiba Libretto, which is a small laptop computer running Windows 95. The operating system of Cuaderia is also Windows 95, not

Windows CE, which is usually the case with PDAs (see chapter: Operating systems for terminal devices). Besides the pen, Cuaderia has a numeric keypad for easy input of numbers into applications like Excel. A full-size touch-typable keyboard or mouse can be attached to the Cuaderia. Cuaderia doesn't have a built-in modem. The battery life of Quaderia's Lithium ion rechargeable battery is short, only 2-3 hours.

Table 1. Examples of PDAs and their technical characteristics.

Name of the device	**Casio Cassiopeia A-20 E**	**Ericsson MC 16**	**Nokia9110 Communicator**
Vendor	Casio Electronics	Ericsson Mobile Phones	Nokia Mobile Phones
WWW-page	www.casio.com	www.ericsson.se	www.nokia.com
Processor	SH-3/80 MHz	SH-3/75 MHz	Embedded AMD 486
Operating system	Windows CE 2.0	Windows CE 2.0	GEOS 3.0
RAM	8 MB	16 MB	4 MB
ROM	8 MB	10 MB	4 MB
Size, mm	185 x 94 x 25 mm	183 x 94 x 29 mm	158 x 56 x 27 mm
Weight	430 g	442 g	253 g
Screen size	156 x 60 mm	156 x 60 mm	n/a
Screen resolution	620 x 240	640 x 240	n/a
Data input	keyboard	keyboard	keyboard
Battery	2 x AA, Li-ion as an option	NiMH or 2 xAA	n/a
Battery life	25 h (Li-ion 15 h)	15 h	talk time 3-6 hours, stand-by phone on 60-170 hours, stand-by phone off up to 400 hours
E-mail	yes	yes	yes
Internet browser	yes	yes	yes
Handwriting recognition	no	no	no
Price (FIM)	approx. 5000	approx. 5300	approx. 6000
Note		IR-connection with Ericsson GSM phones	Includes a mobile phone
Name of the device	**Palm III**	**Psion Series 5**	**Toshiba Cuaderia**
Vendor	3Com	Psion Computers	Toshiba
WWW-page	www.3com.com	www.psion.com	www.toshiba.com
Processor	Motorola 68238	ARM7100/18 MHz	DX4-75 MHz
Operating system	PalmOS/3	EPOC32	Windows 95
RAM	2 MB	8 MB	16 MB
ROM	2MB	6 MB	810 MB hard disk
Size, mm	120 x 84 x 18 mm	170 x 90 x 23 mm	210 x 148 x 28 mm
Weight	160 g	354 g	875 g
Screen size	60 x 60 mm	133 x 50 mm	n/a
Screen resolution	160 x 160	640 x 240	n/a
Data input	pen	keyboard	pen
Battery	2 x AAA	2 x AA	Li-ion
Battery life	8-12 weeks	35 h	2-3 h
E-mail	option		n/a
Internet browser	option	option	n/a
Handwriting recognition	yes	no	n/a
Price (FIM)	approx. 3000	approx. 5000	n/a
Note			

3.2 GSM phones

Rather than terminal devices, mobile phones have been used to connect laptop computers fitted with a GSM modem to a fixed data network. Because of the limitations imposed by their screens, GSM phones have not been ideal as terminal devices. However, the usability of GSM phones is getting better. One reason is the active matrix screens that have replaced the alphanumeric LCD displays.

A major problem from the point of view of applications development is the small screen of the mobile phone. Typically, the screens can display 4-10 lines of data, with 12-20 characters per line. The phones have only numeric keys augmented by some menu keys, which makes data input rather difficult, but allows navigation on the screen. Usually, mobile phones don't have any local memory, making them totally dependent on the network connection.

New GSM phones are coming onto the market frequently. It is not unusual for a GSM phone model to be sold for less than a year. The trend has been towards smaller and smaller devices. New GSM phones now weigh less than 200 grams. Battery lives are getting longer. Also the new lithium-ion batteries can be replenished whatever their state of charge without any fear of ruining them.

Most GSM phones have built-in facilities for data transmission. This means that GSM phones have an adapter with a modem device – typically a PCMCIA card which is interfaced with a laptop computer. For example, Ericsson's new GSM phones have a built-in infrared modem.

PCMCIA cards enabling data transmission services are not very popular. Only about 5 per cent of new GSM phones are sold with such a card. The most popular data service of the GSM network is SMS. Actually, it is practically the only data transmission service yet to gain favour with users. Among other services, news content is delivered to GSM phones in the form of SMS. SMS enables users to receive messages up to 160 characters in length. SMS also allows users to receive and send e-mail, but the limitation is that the messages may not be longer than 160 characters.

In the near future GSM phones will get some of the properties of the next generation of mobile phones (see UMTS). Internet-enabled GSM phones are expected to reach the market next year (see WAP). High-speed circuit-switched data (see HSCSD) phones will reach the market during 1998 and packet-switched data transmission should be available in the year 2000 (see GPRS).

3.3 Smart phones and communicators

Smart phones combine the features of GSM phones and PDAs. A smart phone is a mobile phone combined with calendar, phone book, notebook and other similar functions. This development makes it more and more difficult to distinguish smart phones from PDA devices.

Maybe the best-known smart phone at the moment is the Nokia 9000i Communicator. Ericsson's solution is to combine a GSM phone with a PDA device. Other vendors of smart phones include Phillips and Sharp.

The **Nokia 9000i Communicator** is a combination of a GSM phone and PDA. The strengths of the device are in communications. Using e-mail and browsing web pages is easy with the Communicator. It also includes the sending and receiving of fax messages, and it is possible to use the Communicator as a terminal device (using the Telnet protocol). The Nokia 9000i Communicator supports SMS and Smart Messaging.

The PDA functionality of the Communicator includes notebook, calendar and calculator plus a currency and measurement converter. Besides the basic English user interface, the Nokia 9000i Communicator includes language versions for the Danish, Finnish, Norwegian, Spanish and Swedish markets.

The latest **Nokia 9110 Communicator** has been introduced. It is lighter than the previous 9000 Communicator model, weighing in at 253 grams. It includes voice, Internet and e-mail access, fax and SMS. It has a software package that enables communication with Windows 98/NT. The Nokia 9110 Communicator also offers Digital Camera Connectivity, which lets you transmit a picture from a digital camera to the Communicator and then forward the image using e-mail or fax. Additional memory for the device is provided by an optional Memory Card, which is available in sizes up to 4 MB. The Nokia 9110 Communicator will support GSM data speeds up to 14.4 kbit/s when it becomes available. The Nokia 9110 Communicator will be introduced to the market during 1998.

The **Ericsson MC 16** – the mobile companion, as Ericsson calls it – is a mobile phone and Windows CE based PDA connected by an infrared modem (Fig. 5). No cables are needed. The MC 16 is compatible with the Ericsson 600, 700 and 800 series mobile phones. The Ericsson MC 16 is manufactured by Hewlett Packard. The MP 16 comes with a 2 MB CompactFlash memory card, which has Ericsson's software, including a fax program. Pressens Tidning (number 15/98) has tested the MC 16 and found that at the moment it is not well suited to newspapers, because it does not accept the type 3 PC card used in most digital cameras.

Fig. 5. Ericsson´s MC 16 is a combination of a mobile phone and a PDA.

3.4 Pagers

Pagers are wireless message receiving devices displaying small amounts of numeric or alphanumeric information (Fig. 6). The numerical pager typically tells the phone number and calling time of the caller, whereas the alphanumeric pager displays more information like sports, news, stock market and weather information. The alphanumeric pagers display a few lines and store a few messages, and the number of characters is limited to a few hundred - in this respect they resemble current mobile phones. Prices are in the $ 100 - 200 range and monthly rates are $ 20 - 30. Pagers, especially the alphanumeric type, are mainly used in the Western hemisphere, i.e. the USA, Canada, Latin America and the Caribbean. In the USA, for instance, SkyTel serves over 100,000 pager owners. The pager has only a radio receiver and no transmitter, which enables it to be smaller and have longer battery durations (even over one month) than ordinary cellular phones. The messages are transmitted from satellites (e.g. Iridium) or from terrestrial stations.

Fig. 6. A pager (left). A PDA device can be turned into a pager using a special plug-in pager card (right).

3.5 Operating systems for mobile terminals

Because of the small size and restricted memory, PDA devices cannot use the operating systems of laptop computers or workstations. In PDAs the operating system is typically stored in ROM memory and the availability of RAM for applications is limited. Also, it is important that the energy consumption is low in PDAs. The idea is to optimise the performance of the CPU in relation to energy consumption.

Microsoft's **Windows CE 2.0** is gaining ground in PDA devices. The Windows CE operating system will be used in larger devices (larger screen and keyboard) competing with the smallest Windows 95 laptops, like Toshiba's Libretto (Windows 95). One strength of Windows CE is compatibility with MS Office applications, making it rather simple to exchange files with the workstation.

Microsoft has already demonstrated a prototype of a new keyboardless Windows CE. The functionality of this CE version offers a calendar, contact and task management and e-mail. Moreover, the keyboardless CE operating system will support the recording of voice notes and the storage of hand-written notes. This CE version doesn't have the pocket versions of Microsoft Office. PDA devices, for example, from Casio, Compaq and Phillips are based on Windows CE. In addition, many device and software vendors have announced their support for Windows CE, which is becoming a de facto standard. Besides PDAs, Windows CE is also targeted at Web-TV.

A serious challenge for Microsoft is **Symbian**, which is a joint initiative of Nokia, Ericsson, Motorola and Psion. Symbian intends to develop software for the mobile device of the future (Fig. 7) and to licence this technology to third parties. The basis of Symbian technology is the **EPOC** operating system. Many experts regard it as the most advanced operating system for PDAs, mainly because it offers multitasking and advanced memory functions. EPOC supports technologies like WAP, Java and Bluetooth. EPOC is being developed by Psion Software Plc.

Another operating system is **GEOS**, which can be applied in PDAs, smart phones and set-top boxes for interactive cable TVs. GEOS is a product from Geoworks. The GEOS operating system is used in the Nokia Communicator, among other devices. **Palm OS** is the operating system of Palm III, originally developed by U.S. Robotics. At the moment it has the largest market share, i.e. 40-50 per cent, but Microsoft's keyboardless Windows CE is targeted to challenge the position of Palm OS.

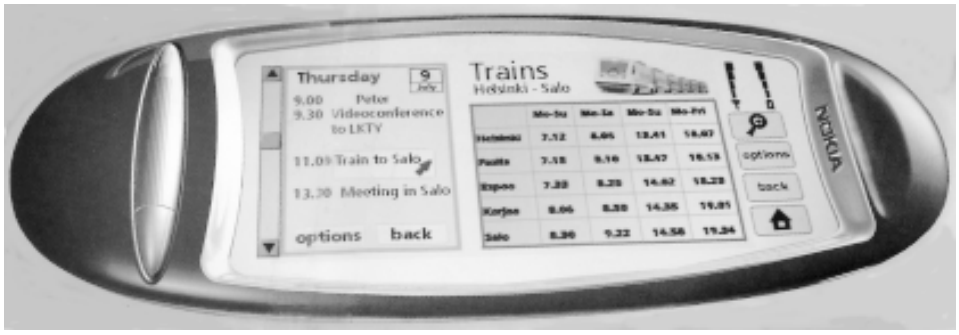

Fig. 7. The next generation of mobile phone as envisioned by Nokia. Such mobile phones can be compared with the PC world, where new applications can be added on top of the operating system. These kinds of devices reflect the shift from voice transmission to data transmission. One example of the new services is the synchronisation of the databases in the network. Down-loading of information can take place in the background through GPRS. Possible applications include a calendar, e-mail, and push- or pull-based information services.

4. Production technology for delivery to mobile users

In this section methods of producing news content for mobile terminal users are described. Newspaper publishers have already some experience of producing online newspapers in the WWW. However, these papers are usually best viewed using wired desktops with high-resolution displays. The information presented in online newspapers has to be customised for the displays of mobile terminals.

There are currently two different approaches to the delivery of information to the mobile terminals: text messaging and WWW publishing. Text messages have become one of the basic features of mobile phones and they are rather popular. With text messages one can send a short message of up to 160 characters in length to another mobile phone. Smart messaging is Nokia's concept to widen the capability of text messages. Smart message specification offers, for example, a mechanism to create embedded menus and hypertext-like information cards.

WWW publishing has become a very popular and rapidly growing publishing medium in the last few years. The reason for this is that it is relatively simple to publish hypertext documents that are accessible all around the world. The documents are created using HTML (Hypertext Markup Language). In a HTML document the logical parts of the document, e.g. titles and paragraphs, are marked using special tags. WWW browsers understand these tags and present the content of the document accordingly.

The drawback of HTML is that it is suitable only for presentation. An HTML document is difficult to process automatically. For example, if a newspaper article is presented as an HTML document, it is hard to extract automatically the ingress of the article for delivery to mobile users. For this reason, W3C, the WWW consortium that organises the development of WWW, has announced a new recommendation for document presentation. This standard is XML (Extensible Markup Language). The Wireless Markup Language (WML) designed for mobile data is based on XML. It is probable that most of the mobile news delivery services will rely on this standard.

4.1 Text messaging

Text messages, or short messages, are widely supported by current mobile phones and are very popular among mobile phone users. They are based on SMS specified in the GSM network standard. The SMS service is provided by the user's network operator. To be able to use text messages, users have to subscribe to the service.

When using short messages there is no need to establish a direct connection between the sender and the receiver of the message. After the GSM network has accepted the sent message, it is stored in an SMS service centre and delivered to the receiver. If the phone of the receiver is switched off, the message is delivered once the receiver has switched on his or her phone.

The maximum length of a text message is 160 characters. The messages do not need to be text information only, they can also be sent as eight bit binary data. With eight bit data the maximum message length is 140 bytes. To increase the capacity of short messages, data compression can be used. There are plans that in the future the capacity of a short message could be increased by concatenating many messages. The maximum number of messages has been specified as 255. The actual number depends on the memory size in the receiver.

To expand the functionality of short messages, Nokia has introduced its smart message specification. Smart messaging enables mobile phone users to access Internet services without an Internet connection. It also allows a mechanism for service providers to provide dynamic updates of menu items that are embedded in the user's mobile phone menu structure. Dynamic menu updates are currently supported only in the latest models of Nokia's mobile phones. As users become more familiar with the concept of dynamic menus, this capability is expected to be introduced in all handsets.

When a menu item is selected, it may cause a number of different actions to take place. For example, a phone call can be initiated, a short message can be sent or a TTML (Tagged Text Markup Language) based service can be contacted. TTML is a language that provides a means to create hypertext-like documents, "information cards" that can be browsed using the handset's menu control key. User interactions include:

– entering text into fields of the card,
– making a selection from different kinds of menus, and
– following the links of the card.

The following example TTML code describes one information card.

```
++HA-MENU
Select one of the Mobile Daily
+<services:
>>*Headlines
>>*Local News
>>*World News
>>*Business
>>*Sports
or select the service page of
+<your operator
<>*GSM-999
Have a good day!
```

This information would be presented to the user as a selection list with 6 options:

Select one of the Mobile Daily services:
- Headlines
- Local News
- World News

- Business
- Sports
or select the service page of your operator
- GSM-999
Have a good day!

To be able to use a TTML-based service, there must be a TTML gateway between the mobile phone and Internet service provider. This gateway filters and reformats the data transferred between the user and Internet service.

4.1.1 WWW publishing

Since its invention in the early 1990s, the World Wide Web has become a popular and rapidly growing publishing medium all over the world. The reason for the popularity of WWW is its scalability and simplicity. WWW is based on the client-server architecture. The WWW servers and WWW clients are connected to the Internet using the TCP/IP telecommunication protocol (see Fig. 2). The documents reside on the server. The client and the server communicate with each other using a simple request-respond communication protocol called HTTP. Thus, if the client wants to have a certain document, it makes an HTTP request "GET" containing the identifier of the document. This identifier, URL (Unified Resource Locator), is unique globally and identifies the document from all other WWW documents in the world. The server responds by sending the document to the client.

The documents published in the WWW are typically HTML documents. HTML is one application of SGML (Standard Generalized Markup Language). With SGML one can define all kinds of document types, markup languages. A markup language is actually a set of rules that describes the elements of the document, the order of the elements and the hierarchy of the elements. This set of rules is called a Document Type Definition (DTD).

This example illustrates one of the profound ideas of SGML: the content is separated from the layout. By marking up only the logical content of the document, it is portable, and platform and software independent. Any SGML supportable software can understand it, and the document can be used for many purposes other than just presentation. An SGML document is presented using style sheets that describe how the elements are presented on the screen or on the paper.

XML (Extensible Markup Language) is a subset of SGML developed especially for WWW publishing. It constitutes a family of standards for the presentation of documents and interchangeable data. Like SGML, XML is a metalanguage that defines a mechanism to create its own markup languages. Unlike an SGML application, an XML document does not need to validated, even if this improves the interchangeability between different systems. This leads to the concept of a well-formed document.The XML specification defines a mechanism to store data as a structured, well-formed document. XSL (Extensible Style Language) defines a standardised way to write style sheet rules. XLink and XPointer are

used to create sophisticated hypertext links.

XML is very young. W3C announced it to be its recommendation on February, 1998. Still, there is much enthusiasm for XML. Even Microsoft strongly supports the development of XML, which is reflected in their Internet Explorer 5 browser. There are many XML-based markup languages available, and a lot of applications based on XML technology are being implemented.

The weakness of XML is its youth. At the moment, there are only a few genuine XML tools available. For example, no pure XML editor has yet been introduced. One can, of course, use SGML tools to create and store XML documents. However, this is not a very tempting idea, because of the complexity of SGML. Also, SGML tools are rather expensive.

HTML was originally chosen for portability issues. It was designed to be a simple markup language so that it would be easy to write browsers that could understand and present it. Figure 8 illustrates how a newspaper article could be marked up using either HTML or XML.

```
<HTML>
  <HEAD>
    <TITLE>Microsoft demands authors' notes about rival
          Netscape</TITLE>
  </HEAD>
  <BODY>
    <H1>Microsoft demands authors' notes about rival
        Netscape</H1>
    <H2> Laywers working hard<H2>
    <P><B>Less than three weeks before its antitrust trial in
          Washington  Microsoft Corp.  scrambling to
          uncover evidence that it believes
          could help defend itself against the
government.
        </B>
    <P>Microsoft is eager to find evidence that may show
       Netscape's own business blunders -- not its allegedly
        illegal conduct -- caused Netscape's Internet
        browser software to flounder while Microsoft's
grew
        in popularity.
    <H3>The fight is not yet over </H3>
    <P>But the fight over the recorded Netscape interviews
       remains, one of the authors said Tuesday.
    <P>Microsoft said it was willing to work with the
       authors, but called the information "relevant to...
    <IMG SOURCE=lawyers.gif>
    <H6>Microsoft's lawyers entering the court</H6>
  </BODY>
</HTML>
```

```
<ARTICLE>

  <TITLE>Microsoft demands authors' notes about rival
        Netscape</TITLE>
  <TITLE2>Laywers working hard</TITLE2>
  <INGRES>Less than three weeks before its antitrust trial
in
        Washington Microsoft Corp.  scrambling to
        uncover evidence that it believes could help
        defend itself against the government.
  </INGRES>
  <PARA>Microsoft is eager to find evidence that may show
        Netscape's own business blunders -- not its
        allegedly illegal conduct -- caused Netscape's
        Internet browser software to flounder while
        Microsoft's grew in popularity. </PARA>
  <SUBTITLE>The fight is not yet over </SUBTITLE>
  <PARA>But the fight over the recorded Netscape
        interviews remains, one of the authors...</PARA>
  <PARA>Microsoft said it was willing to work with the
        authors, but called the information "rel.. >PARA>
  <FIGURE IMG=lawyers.gif>
  <FIGURETITLE>Microsoft's lawyers...</FIGURETITLE>

</ARTICLE>
```

Fig 8. A newspaper article presented as HTML (on the left) and XML (on the right). In the HTML article, tags that describe the presentation are used. In the XML article, tags that describe content rather than presentation are used. This substantially simplifies the automatic processing of the article.

W3C is organising the development of HTML. Currently, there are basically three versions of HTML available: HTML 2.0, HTML 3.2, and HTML 4.0. Version 3.2 is most popular, and it is supported by the two major WWW browsers, Microsoft's Internet Explorer and Netscape's Navigator. Version 4.0 was published late 1997, and it is also rather well supported.

Although the original intention of designing HTML was to separate the content from the layout, browser vendors have introduced their own layout-specific tags and attributes. This is because publishers of WWW pages wanted to create more visually striking pages. For example, a FONT tag can be included in a page code to indicate a change of font, as the following example illustrates

<H1 ALIGN=center><FONT COLOR=red>Newspaper article title</FONT></H1>

This causes difficulties in maintaining the WWW pages. If one wants to change the visual appearance of all the pages in a WWW site, one has to make changes to all the layout elements and attributes on every HTML-page.

To overcome this problem, W3C has introduced a concept of Cascading Style Sheets (CSS). Cascading style sheets define a method to describe presentation rules for HTML elements in a separate style sheet file. When attached to the HTML file the browser can present the file as if the layout-specific tags were used. Using style sheets the example heading in the HTML file would be written as follow

<H1>Newspaper article title</H1>

The style sheet would contain content like

H1{text-align: center; color: red}

The benefit of the style sheets is that when one wants to change the visual appearance of many pages, only the style sheet has to be changed. There can also be several style sheets attached to one HTML file. For example, the user can have his or her own style sheet that meets her personal preference for HTML file presentation. However, there could be certain conflicts when the different party style sheets are cascaded together. Two versions of CSS are available: CSS1 and CSS2. Unfortunately, the cascading style sheets are rather poorly supported even by the latest versions of WWW browsers.

From HTML's original design perspective, HTML is in crisis. Browser vendors define their own implementations of HTML, so it is not always possible to publish an HTML page that both Internet Explorer and Netscape Navigator would present correctly. Indeed, one cannot say that HTML is platform and software independent. The loose structure and omission of the end tags cause problems when trying to automatically import an HTML file into another system. Also, people tend to markup their documents based on the presentation of the tag. For example, if they want to emphasise some information they use heading tags even if the information is not a heading. This causes problems, for example, for search engines that try

to index document content intelligently. To solve these problems, W3C has introduced its recommendation for XML.

It should be noted that XML only offers a mechanism for representing documents on the web. In addition, the user societies must define relevant XML tags in the forms of DTDs. This standardisation work is on its way in the newspaper community. The Newspaper Association of America - NAA - together with IPTC (The International Press Telecommunication Council) has determined a DTD for news called News Industry Text Format (NITF).

4.2 Personalisation

When the information services are digitalised, it is easy to offer customers a vast amount of information. However, no single individual has the time or interest to handle all the information that can be offered to him or her. This is especially true for mobile terminals with limited screens and transmission speeds. The user needs a mechanism that filters off information that is uninteresting or irrelevant for his or her purposes. The filter should offer an information product which contains the information the user is most interested in and whose "look-and-feel" is appealing. This process is *personalisation* - or *information filtering,* if we are concerned only with the mechanism of selecting information relevant to the user.

On the other hand, when producing news content for heterogeneous customers, personalisation is also needed. Newspaper publishers increasingly have to take into account the needs of people reading their news not only from ordinary hard copy but also from the digital version of the newspaper using all kinds of terminals. These terminals vary from high-speed reliably connected workstations with high-resolution displays to GSM-linked mobile phones or PDAs.

Current web newspapers have usually been designed to be viewed only on workstations with high resolution displays and wired Internet connections. This is not the case when the terminal is a mobile phone or a PDA. The display of the terminal is small and the resolution is rather poor. Also, the bandwidth and reliability of the GSM network is poor compared with wired connections. This means that the amount of information sent to the mobile terminal must be less than the amount sent to a wired workstation. So the information content offered by news server has to be somehow personalised - or *compressed* - according to the terminal type.

The next three sections explain the methods of information filtering and information compression and technology.

4.2.1 Information filtering

When the user is offered a personalised information product, the selection of the material is based on a so-called *user model* or *user profile*. The user model contains information about the user: for example, his or her age, profession, hobbies and personal interests. On the basis of this information the user is offered published material. For example, if the user model says that the user is interested in home decoration and President Clinton the user is offered material on home decoration and the latest news about President Clinton. What information is recorded in the user model depends on the service provider.

There are basically two ways to construct the user model: either the user explicitly enters the desired information into the system using, for example, an inquiry form or the system tries to learn the personal interests of the user by following the user's behaviour when he or she is using the system.

Both technologies have their benefits and drawbacks. When the creation of the user model is based on a user-filled questionnaire form, it might be that the questions of the form are formulated in such a way that user finds it difficult to answer them. In the worst case this might cause some material of interest to the user being excluded. On the other hand, when the personalisation information is collected by asking the user to enter the information, the user can control which kind of information the system has on him or her.

When the system follows the behaviour of the user, the probability that user gets the information he or she is really interested in increases, at least in theory. This is because if the user is asked beforehand whether he or she is interested in a certain subject, the question might be difficult to answer or the personal interests of the user might change over time. When the system registers the reaction of the user to the different subjects (i.e. does the user read the article or not, or how long his or her visit to certain site lasts) it can learn what the user's interests really are. The drawback of using this learning approach is that it is rather laborious to implement. This is because for a reasonably good profile we need to code a vast amount of inference rules. Also, machine learning methods - such as neural or bayesian networks - can be employed, but the problem of these methods is that they are rather slow for interactive applications.

One interesting method of information filtering is so-called *social filtering*. Social filtering has different forms, but basically in the system's users rate documents according to certain criteria. These can be, for example, interest in the document content or the overall quality of the document. Thus, the documents with high rating are prioritised when delivering documents to the users.

Social filtering can also be implemented without people rating documents, and it can be employed in conjunction with other personalisation functions of the system. For example, the system can suggest to the user an article that is most read in the system or an article that is read by other users with similar user profiles.

4.2.2 Ways to implement personalisation for mobile environment

When designing a newspaper publishing system supporting personalisation one must find the balance between the quality of the personalised information product of an individual customer and the extra effort needed in newspaper production workflow to provide such an extra service. For example, Nokia recommends that the needs of Nokia 9000i Communicator users are fulfilled by maintaining double WWW pages of the information service: those that are designed for wired workstation browsers and those that are customised for the Communicator's browser (see Chapter 5.2). This demands, of course, twice as much work.

Ideally, the publishing system should be a single continuously updated information pool from which the different publications - from printed newspaper to digital news service for the mobile user, personalised according to the demands of both the user and the terminal - are automatically extracted. In practice, implementing this kind of system might cause dramatic changes in the current newspaper production process.

There are several view points to be considered when choosing the technology enabling personalisation in newspaper publishing. First, where is the personalisation done? Is the selection of the material performed on the server side or is it done by a user agent in the client? Secondly, do we need a database or is a file-based system enough? And, if so, what kind of database, a relational database or a text database? Thirdly, in what form should the information be stored? What kind of files should be produced by the text processing system, HTML files or XML files?

Since an online newspaper server can have tens of thousands of clients, it would be a tempting idea to distribute the personalisation to the clients. If the server does all the selection of the material, it might cause a significant performance problem. However, the lack of memory and processor capacity of mobile terminals means that personalisation on the client side would be too slow. Also, because of the narrow bandwidth, it is essential to minimise to amount of information sent to the mobile terminal. To find a balance between the extremes, it might be a good solution if the server does the personalisation for the mobile terminals. If the client workstation is wired with good cables, the server could send the raw material to the client, which would then personalise it according to the user profile using, for example, style sheets.

The amount of information concerned in a newspaper publishing system is so huge that it would be rather tedious to manage if it were stored in a file system. Thus a database would most probably be needed. Before selecting a database, one must consider the requirements carefully. Relational databases have proved to be appropriate technology for many business applications. They are widely accepted and reliable even in thousands of user environments. But they do not efficiently support the storage of text and multimedia information. For example, the amount of text stored in one field is usually limited to 256 characters. And relational databases seldom have any full text search engines.

4.3 User requirements

The nature of the mobile environment imposes restrictions on the applications for mobile devices. The narrow bandwidth of the GSM network means that client-server communication is slower than in a wired environment. From the user's point of view, this means waiting, which is usually very frustrating. Also, the small size of the display is a challenge to user interface design. It is hard to fit all the required information in the display so that the user would understand it. Information has to be divided into separate screenfuls and organised so that navigation is easy.

Usability issues of applications used in the mobile environment have not yet been widely studied. However, some general design principles can be drawn. These principles are based on the results of user tests in an EU project. Although the tests focused on users using WWW services with palmtops, the results can be generalised for all kinds of mobile applications. The aim of the design principles is to minimise usability problems caused by the narrow bandwidth of wireless networks and the small display size:

- The maximum file size of a single image should be 10 kB.
- Do not use progressive JPEG compression on images.
- Do not use links that point to multimedia data types.
- Provide a global search routine for your service. Users find it more convenient to make a search to determine whether certain information is available than to browse and look for the information. This is especially important when the connection is slow.
- Place frequently needed information so that it is more accessible than other information.
- Provide a short description of the site that the user can read before accessing it. This reduces the number of unsatisfying visits.
- Gather similar information in one place. Users have difficulties when similar information is scattered in many places.
- Do not use more than three major levels of hierarchy.
- Group links to enable selection without scrolling.

In general, users expect to be able to access all kinds of services and data via their mobile terminals. No distinction between clients should be made.

4.4 Electronic payment for partial material

Electronic commerce on the Internet has become popular and its volume is estimated to explode during the next couple years. There are several incompatible vendor-dependent protocols available, which makes the penetration of electronic commerce difficult. The US government has strongly supported the development of electronic commerce on the Internet. CommerceNet, which comprises research institutes and commercial enterprises, is trying to develop software and a platform-independent architecture for commerce on the Internet.

There are many commercial WWW-based e-commerce systems available. These systems includes tools for searching the catalogue, tailoring the choices for different kinds of customers, pricing the products depending on the customer, as well as support for different kinds of payment mechanisms. The best-known e-commerce systems are: IBM's CommercePoint, Microsoft's Internet Commerce Framework, Netscape's ONE (Open Network Environment), Oracle's NCA (Network Computing Architecture), and Sun's JECF (Java Electronic Commerce Framework).

The above systems apply various kinds of protocols and standards developed for e-commerce on WWW. The protocols include mechanisms for selecting the method of payment, for transferring data to the Internet, and for identification, encryption and protection. The best-known protocols are Secure Electronic Transaction (SET), Open Trading Protocol (OTP) and Open Buying on The Internet (OBI).

These protocols are very complex. This means that they are not very suitable for commerce involving small information products. The transaction costs would be greater than the value of the product. Micro Payment Transfer Protocol (MPTP) has been developed in order to solve these problems. MPTP defines the mechanism for the transfer of payments. There are three parts: the customer, the seller, and the broker. The broker is responsible for the customer's account . MPTP minimises the need for ultimate security, since the price of the product is rather small. Systems supporting MPTP include ClickShare, Millicent, Mini-Pay, SubScrip, and NetBill.

An interesting concept has been developed by a Finnish company called Money-Penny Payment Systems Ltd. For the Internet service provider, Money-Penny doesn't cost anything, but he needs Money-Penny software installed in his Internet service. Money-Penny can be used by persons or companies who open an account with Money-Penny Payment Systems. When the user wants to pay within an Internet service, a form appears on the desktop and he has to give his Money-Penny user ID and password. Also the references for purchased items are shown for the user. Money-Penny Payment Systems then sends an invoice to the user once a month and clears the money to the seller. The identity of the buyer is not revealed to the seller.

4.5 Synergies

The relationships between paper, web and mobile news can be seen as a evolutionary process (see Fig. 9). The starting point is, of course, the paper version, which is still - and will remain for the foreseeable future - the major product. Historically, the web edition developed as a way to electronically deliver content that already existed in electronic form in the pre-press systems. The mobile edition is in turn based upon the web edition - being a special case with its own clear limits. The different media versions will, of course, coexist and develop in parallel. However, there is a lot of synergy between the different media.

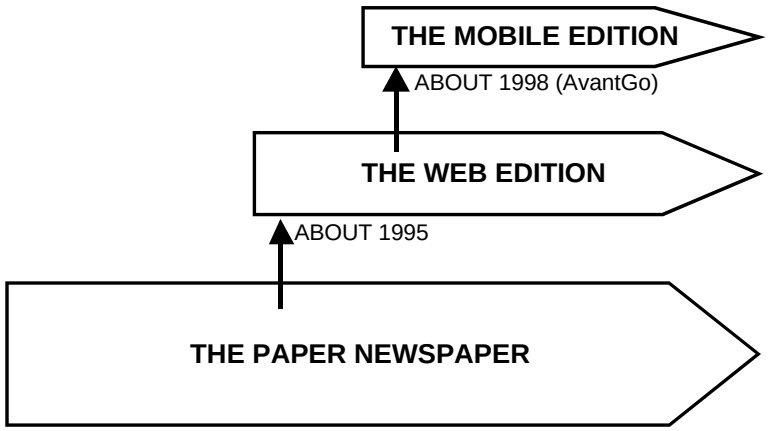

Fig. 9. The historical development of web and mobile news. The mobile edition covers only a part of the web edition, which in turn is typically a subsection of the paper version.

Web newspapers are typically produced by a web team, consisting of journalists, graphic designers, system specialists and marketing people. The content is to a large extent drawn from the paper newspaper - in this sense the Internet version is for the most part a subsection of the paper edition. The technical synergy between the paper and net versions depends largely on the editorial system used in the newspaper. With some heavily dedicated editorial systems, only the article texts can be utilised directly, whereas in other systems the web newspaper is more –or less automatically generated from the editorial database. A typical practice lies somewhere in between - the editor selects with the mouse the parts of the paginated page that he want to include in the web version.

Currently, very few newspapers deliver content to mobile terminals. In most of these cases, a very restricted number of news offerings are transmitted. The synergy between web and paper is small, because of limited content - only top stories expressed as headlines and a few content lines.

With more rapid wireless connections (say HSCSD with 42 kbit/s) and by using channel-based push technology, which only transfers content changes, the delivery can be regarded as a special case of the web newspaper. This increases the synergy compared with the current situation. The main difference is then the smaller display size of the mobile terminal compared with the desktop, where the web newspaper is normally viewed. This sets limits on the synergy - the articles may need different kinds of headlines and ingresses and they are much shorter.

In order to increase the synergies, the news process should be changed. Instead of producing content only for the paper version, the journalist should produce different media versions of their article. In this scenario, the news editor executes “media editing” for the different media. Technically, this process should be supported by a hybrid database possessing both relational

and full-text properties. A hybrid architecture would enable media and personal versions as well as information retrieval capabilities.

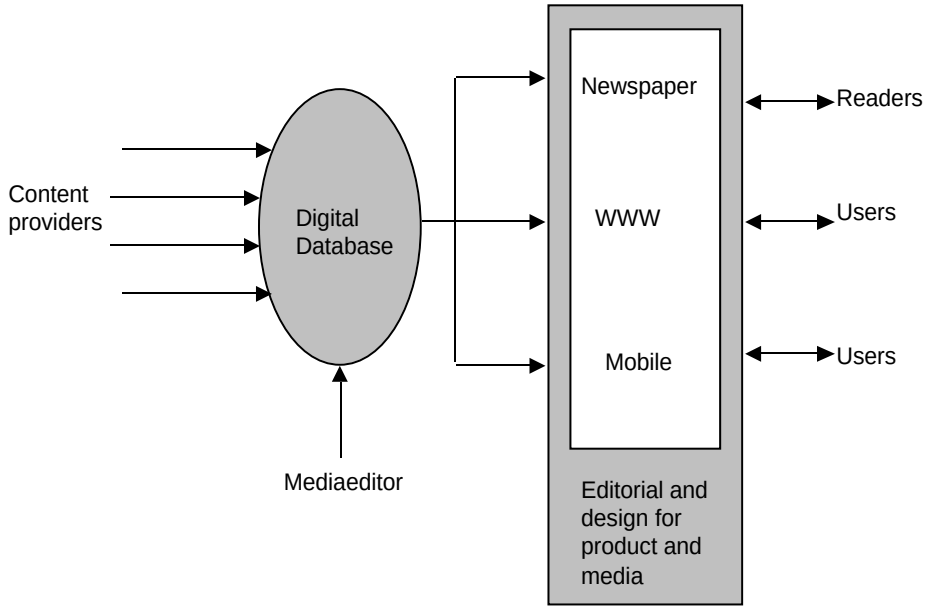

Fig. 10. Editorial work is shifting in a direction where content is saved in a common digital database. The media-dependent editorial and design work is done later.

5. Experiences

This chapter describes experiences of delivering news content to mobile terminals. One of the pioneers is Alexpress (part of Alma Media), whose editorial office edits - among other media -news for GSM mobile phones. In the case of mobile phones the idea is to cover the top news of the day within the subject area. So far the nature of the activity has been experimental. Also in Finland, Radiolinja has established a service called AskIt. AskIt offers many services, e.g. schedules, information on movies, restaurants and hotels, but news is also available. In both services , AskIt and Alexpress GSM news, the content is delivered as short messages. In the US, for example, The New York Times and The Wall Street Journal are available through AvantGo channels. In order to read the channels, users need a special AvantGo client software for their PDA devices.

5.1 Alexpress

Alexpress Oy is a new media research and development company within Alma Media. Among other things Alexpress produces news on various subjects for all electronic media, including GSM phones and Nokia Communicator. GSM news is one part of Alexpress's total news offering. In addition to news for GSM phones, the same editorial staff prepares news for various Internet services, fax, text-TV and cable-TV, and radio. Actually, GSM news accounts for a small proportion of the total number of news offerings. The news production of Alexpress covers domestic, foreign and financial news, as well as entertainment, weather, lottery and pools results. Every day a few news items are written also in English.

The main sources of information are the services of the Finnish News Agency (FNA) and Reuters as well as other media, especially TV in the case of sports news. When a news topic is chosen, an article of 500 characters is written and saved in the database, from where it is automatically send and transmitted to various media, such as:

- -Internet, various services offered by Alexpress
- -Internet services of Alma Media's newspapers, including Kauppalehti, Iltalehti and Aamulehti
- -Text news for text-TV and cable-TV
- -Fax news for local radio stations
- -Fax news for hotels and travellers
- -Nokia Communicator
- -Voice news for GSM phones
- -Voice news for local radio stations

Every article is given a priority coding, according to which the article is published in the media. In certain media only the top priority news are published, while others publish more news. For example, fax news transmitted to radio stations includes almost the whole news coverage.

GSM news is selected from the top news items. Before a GSM news item can be published, the previously written article of 500 characters is condensed, because the length of the SMS message is restricted to 160 characters. Also the news headlines are rewritten so that they are suitable for GSM phones. Depending on the subject, some news (and voice files prepared for the radio) may be read aloud and saved in a voice file, which can be listened to through the GSM phone. When reading the editor rephrases the text, making it more suitable for radios and phone news. The subscriber can listen to the voice files by dialling the number which is mentioned in the GSM news.

All news articles are coded and saved in the database, from where they are transmitted to the publishing medium. In case of the GSM service, the news transmitted to operators to a given an IP address. The system takes care of coding the text in two ways, one way for Sonera and the other for Radiolinja, which are the two major GSM operators in Finland. Of course, it would be easier if both operators would accept the text coded in the same way. Information on the distribution list to be used in sending the news item is attached to the news article.

The working hours at the Alexpress editorial office are from 5 a.m. to 10 p.m. During the night the Finnish News Agency takes care of writing and sending the GSM news in case there is important news.

The number of news offerings per day varies from one to four, depending on the GSM service (Table 2). The reason for the low number of news offerings is the policy of covering only the top news. The idea is that the nature of these news services is complementary rather than comprehensive in the chosen areas.

The subscribers to the GSM news receive their news in the order of the distribution list. The transmission of GSM news to the subscribers takes in series rather than as a broadcast, where the news would be transmitted simultaneously to all receivers. So, the first person of the distribution list receives his news in his GSM phone slightly earlier than the last person in the list. Today, the significance of the delay is very small, because the number of subscribers is small. The case would be different with a large subscriber base.

The subscription to the service is done through the operator, either Sonera or Radiolinja, depending on which operator the subscriber uses. The operator takes care of the invoicing along with the normal phone invoice.

The editorial system of Alexpress is a server-based system operating under Windows NT. Two clients are available: a web client which has a window for writing text and a user interface on Lotus Notes. The system has been developed in-house, mainly because of the special needs of the news transmission.

The profile of Alexpress's GSM news has been low. Despite the high mobile phone penetration in Finland, the investments in marketing have been low. When marketing a niche service like GSM news, the real challenge is to get the timing right. However, the service is not totally unknown to the general public. During the World Ice-hockey Championships in 1997 there

was a Sports News offering free of charge for the first 3,000 subscribers. These subscriptions

Table 2. The selection of GSM news services and other SMS services produced by Alexpress Oy.

Name of the service	Main characteristics	Number of news offerings per day	Monthly subscription fee
FNA-Alex News Headlines (STT-Alex-uutissalamat)	Day's top news delivered immediately in 160 characters	when needed	FIM 68
Morning News (Aamu-uutiset)	Most important news every morning	1 per day	FIM 50
Financial News (Talousuutiset)	Covers the news of economy	1-4 per day	FIM 34
Sports News (Urheilu-uutiset)	Covers the most significant sports news	1-4 per day	FIM 50
Exchange and Interest Rates (RahanTasalla)	Covers the main currencies and interest rates		FIM 250

came in very quickly. Today, the total subscriber base of Alexpress numbers thousands of users. However, the Exchange and Interest Rates service has not attracted much interest.

At the moment there is very little co-operation with the group's own major newspapers, namely Iltalehti, Kauppalehti and Aamulehti. The only form of co-operation is that the online editorial offices of the above-mentioned newspapers use the news articles prepared by Alexpress in their online Internet services. One reason for the low level of co-operation is that the news has to be written on the terms of the media. Traditional paper-based articles differ from the articles written for the online Internet and GSM phone services.

5.2 Nokia Forum

Nokia Forum (http://www.forum.nokia.com/communicator/) is the home page of the Communicator device. The web site includes links to a set of web pages optimised for the Communicator. One group of these pages contains current news, edited by Alexpress (see 5.1). The news is exclusively text items - about twenty news items a day covering domestic, foreign and economic news as well as sport and entertainment. Another notable service is the Mobile English-Finnish-English dictionary.

Nokia Forum illustrates the problems of web pages optimised for a certain terminal. There are relatively few services offered and the scope of the services does not seem to grow. This is in clear contrast to the general explosive development of the web. A solution whereby the mobile terminal accesses general non-optimised web pages, possibly through some kind of filtering proxy server, seems to be more viable.

5.3 US experiment: AvantGo

The New York Times has started to provide selected current articles in a format designed for viewing on Windows computers and PDAs equipped with AvantGo software. The user's desktop computer uses AvantGo to download the articles, which are then automatically transferred to the hand-held computer when the user connects it to the desktop machine. Besides synchronisation of the user's desktop and hand-held computer, the articles can be transmitted directly to mobile terminals using wireless modems. In addition, dial-up modems can be used, for example, to connect to the home computer. The user can view the articles in a Web browser interface with all terminal devices, including wireless terminals.

The New York Times calls its content "The New York Times on the Web To Go". It includes front-page items, up-dated once a day. The "Mercury Center To Go" consists of daily business news and two high technology stories, plus computing and investing columns.

Earlier, The Wall Street Journal Interactive Edition became available through AvantGo. Earlier The Wall Street Journal Interactive Edition became available through the AvantGo. The Wall Street Journal Interactive Edition is a paid-subscription web-site which has started to offer news summaries free of charge to users which have bought the AvantGo software. Later, The Wall Street Journal plans to offer a subscriber-only channel that includes additional news and information, such as full articles, a portfolio and personalised selections from a list of categories. The idea is to serve readers who are mobile and keen on adopting new mobile technologies.

The Wall Street Journal Interactive Edition is pre-configured for the AvantGo Desktop (Windows 95 and NT) and AvantGo Client software (PalmOS, Windows CE). By clicking the HotSync button the channel is automatically up-dated, in other words, the content of the web pages are compared to the server side and the latest content is reloaded as necessary. Of course, there has to be a direct network connection or a dial-up or wireless connection through an Internet access provider. Users can install AvantGo on multiple computers, both at work and at home.

Other established channels include web publishers e.g. Wired News, InfoWorld, CNET's News.com, Excite and The Industry Standard, which is the weekly magazine on Internet Economy. AvantGo, Inc. is developing a version of its software for Windows CE. The channel refers to a specific web site and its pages.

AvantGo, Inc. is a Californian company offering AvantGo software 2.0. AvantGo 2.0 consists

of

- AvantGoServer, enabling remote access and delivery of mobile transactions between PDA devices and the newspaper's or other content repository,
- AvantGo Connect for synchronisation of the desktop and PDA
- AvantGo Client, a web browser for navigating data on PDAs that offers a direct connection to AvantGo Server.

AvantGo Client can be used on terminal devices supporting Palm OS or Windows CE. AvantGo Client
supports HTML (version 3.2 including forms). AvantGo Server communicates over existing mobile and fixed networks. Direct mobile connections use wireless modems. AvantGo Connect provides the network conduit that enables AvantGo Client to synchronise with AvantGo Server at the same time that the hand-held synchronises with the desktop.

5.4 Radiolinja AskIt and Europolitan EuroText

Radiolinja Group, which is one of the two major GSM operators in Finland, opened a short message service called AskIt in September 1998. Through AskIt the users can – at the moment – access over 100 information services. The service is available to the customers of Radiolinja.

In order to access the service the user dials the number 1515 and inputs the index word of the AskIt directory. For example, if you input the word "sports", the service shows all the subjects under that area, e.g. ice hockey or Formula 1 results. At this stage you select the subject, and the information content is delivered to your mobile phone in about one minute. The weakest part of the service is that you have to use the keys of the mobile phone to input the characters of the index word. Also, you have to know the correct index word. Radiolinja charges FIM 1.85 (approx. ECU 0.30) per search. However, there is no charge for receiving the requested information.

At the moment AskIt has 20 content providers. Through AskIt users can receive information on timetables and flight schedules, weather forecasts, the stock market, exchange rates, movies, opera, TV programmes, restaurants and hotels. News services are provided by Kauppalehti Online (Kauppalehti is the financial newspaper of Alma Media, see Alexpress) and the Finnish Broadcasting Company, YLE.

The AskIt service is based on Nokia's Netgate system. Netgate is part of the Nokia Artus Messaging Platform. The communication between the mobile phone and the NetGate is based on the TTML (see Chapter 4.1) . The Netgate system retrieves the information requested by the user from the content provider's WWW site and routes the information in the form of SMS messages to the user's GSM phone. In Sweden, the EuroText Service of Europolitan (Swedish operator) is also based on the same technology. EuroText includes weather forecasts, exchange rates, stock market, domestic, foreign and financial news.

6. Conclusions

The rapid expansion of mobile phones and terminals makes news delivery to these devices an important service. Already today, the penetration of these devices approaches 50% in several industrial countries. Currently, the slow data transmission speed severely limits the deliverable content to a few top stories per day. However, the next few years will bring huge increases in transmission speeds through the HSCSD, GPRS and UMTS technologies. Combined with wireless application protocols, faster speeds will make it possible for the mobile user to browse the web in much the same way as the desktop user does today. It will be possible to offer wirelessly significantly wider news coverage than at present and even the transmission of multimedia clips will be feasible. However, it should be borne in mind that the lack of bandwidth and the limited physical screen size will keep the technical performance of wireless devices inferior to the wired desktops.

Mobile media possess several unique features. They allows any two points to be connected: the location of the user is known through GPS or cell-broadcasting and the user and terminal device can be identified. These features enable new applications, where local information is offered to the user according to the place he is at. As local newspapers are central gatherers of local advertisements, local news and information about regional events, they will surely play an important role as local information providers.

To be able to offer mobile news, the newspapers will have to develop their production processes. Currently, mobile news are either text messages or optimised web pages. In the future, mobile news will increasingly be in the web format, applying wireless Internet protocols. The mobile newspaper will then be a special case of the desktop web edition of the newspaper. Special features of the mobile version will be a more compact content, and, probably, a certain degree of personalisation. Both being web products, the desktop and the mobile editions will be produced with very much the same technology. The key elements are databases and machine-readable mark-up languages, like XML, which enable automatic tailoring of the news to suit different terminals and users. Compatibility with older terminal devices has to be maintained - even if this requires text messaging.

In spite of the automatic conversions, journalists, photographers, editors and other creative personnel will have to consider the various uses of their material from the very outset. This means that a certain amount of metadata - classifications, indexes, weights, abstracts - has to be assigned to the articles before the publishing. Because this alters the work tasks, it will take time to introduce new practices. However, it is important to start this work as soon as possible.

Even if the newspaper does not plan mobile delivery in the near future, it is important for the management and systems personnel to keep themselves informed about the development of wireless technology. This means testing and evaluating new mobile services and devices, even if they do not directly relate to news. Cooperation with teleoperators is important in developing mobile news delivery services.

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Abbreviations

CDMA	Code Division Multiple Access
CSS	Cascading Style Sheet
DAB	Digital Audio Broadcast
DCS	Digital Cellular System
DTD	Document Type Definition
DVB	Digital Video Broadcast
ETSI	European Telecommunication Standardisation Institute
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile communication
HSCSD	High Speed Circuit Switched Data
HTML	HyperText Mark-up Language
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
ITU	International Telecommunication Union
LAN	Local Area Network
LCD	Liquid Cristal Display
NITF	News Industry Text Format
NMT	Nordic Mobile Telephone
OBI	Open Buying on The Internet
OTP	Open Trading Protocol
PCMCIA	Personal Computer Memory Card Interface Association
PDA	Personal Digital assistant
PSTN	Public Switched Telephone Network
SET	Secure Electronic Transaction
SGML	Standard Generalized Markup Language
SIM	Subscribers Identity Module
SMS	Short Message Service
TDMA	Time Division Multiple Access
TTML	Tagged Text Markup Language
UMTS	Universal Mobile Telecommunication Services
URL	Unified Resource Locator
WAN	Wide Area Network
WAP	Wireless Application Protocol
WWW	World Wide Web
W-CDMA	Wide-band Code Division Multiple Access
WML	Wireless Markup Language
XML	Extensible Markup Language
XSL	Extensible Style Language